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BODY SIZE INDICATORS AND THE EXAMINATION OF STRESS FROM A GROWTH AND DEVELOMENT PERSPECTIVE: A NEW METHOD OF BIOARCHAEOLOGICAL ASSESSMENT

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BODY SIZE INDICATORS AND THE EXAMINATION OF STRESS FROM A GROWTH AND DEVELOMENT PERSPECTIVE: A NEW METHOD OF BIOARCHAEOLOGICAL ASSESSMENT

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ABSTRACT

The purpose of this thesis research is to introduce a new method to examine childhood stress episodes from adult skeletal remains. Through the use of indicators of adult body size and regression analysis, stress patterns were analyzed in two climatically different populations, the Sadlermiut Inuit of Southampton Island and the Sacred Heart Cemetery population from southwestern Ontario. By comparing body size indicators to one another in sequential order, it was possible to assess at what time during growth and development that certain individuals deviated from their normal growth patterns and experienced stress. As expected, the Sadlermiut and Sacred Heart samples demonstrated different stress patterns that can be linked to the different environmental contexts in which they lived. This research demonstrated the potential utility of this new methodology and the use of growth and development patterns to assess stress, especially when considered in conjunction with other methods.

KEYWORDS:

growth and development, skeletal stress, body size, body size indicators, bioarchaeological methods, skeletal lesions, Sadlermiut Inuit, Sacred Heart Cemetery, regression analysis, environmental stress, cold climate adaptations

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CHAPTER 1: INTRODUCTION

1.1 Purpose and Significance

Growth and development studies from a bioarchaeological perspective are linked to an ever-growing interest in population health. By analyzing the human skeleton and its relatively predictable patterns of growth and development, bioarchaeologists are able to evaluate individual health through a variety of means. The primary purpose of this research is to develop a new method of examining patterns of stress throughout the entire period of growth and development and to assess two different populations adapted to two different environmental regions: the Sadlermiut Inuit (Nunavut) from an Arctic climate and the Sacred Heart Cemetery population (southwestern Ontario) from a temperate climate.

In bioarchaeology, stress is generally assessed through multiple methods of analysis to provide the most complete picture of individual and/or population health. While many of the methods employed by bioarchaeologists focus on skeletal lesions as a means of evaluating stress, this study will focus specifically on patterns of growth and development. During the timeline of growth and development (approximately birth to 20 years of age) many different stress events can drastically affect how the adult skeleton will mature (Rosenfield 1996; Hoppa and FitzGerald 1999). To better understand these stress events and their potential causes, bioarchaeologists must focus upon methods of stress analysis that can be used to examine stress at any age during growth and development.

While the more commonly used lesion-based methodologies of bioarchaeology (enamel hypoplastic lesions, Harris lines, porotic hyperostosis and cribra orbitalia) can provide relevant information regarding sub-adult stress episodes, they cannot provide information regarding all stages of growth and development. By examining the patterns of growth and development in the skeleton to evaluate stress, this research will attempt to compensate for the problems associated with lesion-based methods of analysis, by providing a means to examine stress at any age during childhood.

Body size (overall stature and/or overall weight) is predominately used in clinical and archaeological research as a means of assessing health (Eveleth and Tanner 1976; Hoppa and FitzGerald 1999; King and Ulijaszek 1999; Bogin 2001; Ruff 2002, 2007). Empirical studies have shown that osteological indicators of body size exist throughout the human skeleton, and can be used to examine overall body stature and overall body weight. While many studies have focused on overall body size as a means to evaluate health, this research project will establish the use of many individual indicators of body size to explore patterns of growth disruption within the human skeleton that may be attributable to stress.

Because reduced body size is generally regarded as an indicator of poor health, as it indicates a disruption of the regular pattern of growth and development, it follows that a reduction in the individual indicators of body size also indicates poor health. Although individuals within a population sample may reach normal overall body size, certain indicators of body size may be smaller or larger than expected if their growth was affected during critical periods of maturation.

The significance of this research is that it will provide another methodology to be used and manipulated by bioarchaeologists to further understand the health of past populations. By better establishing the patterns of stress manifestation within the human skeleton through new methodologies, bioarchaeologists will be better able to discuss the impact of stress on overall population health. This research will also attempt to correct for the inherent problems encountered when assessing childhood health by attempting to examine stress episodes through the entire span of growth and development. The ultimate goal of establishing this growth and development method is to create a more holistic means of examining past population stress and at what age(s) that stress occurs.

1.2 Research Methodology

The Sadlermiut Inuit from northern Canada were chosen to represent a cold-adapted population who lived under harsh environmental conditions and would have been host to multiple stress factors affecting their overall health. The Sacred Heart Cemetery population from southwestern Ontario was chosen as a comparative population to the Sadlermiut, as they occupied a warmer, temperate climate region. Because of the environmentally distinct regions that these populations occupied, it can be assumed that they experienced different patterns of stress and this research will provide information about these two cultures and their overall health.

In order to evaluate this disruption of growth and development patterns, multiple skeletal measurements referred to as body size indicators (BSIs), will be collected and analyzed. As discussed, a reduction in overall body size can indicate stress during the years of sub-adult growth; therefore, it is presumed that a similar pattern of skeletal size reduction will also appear in the individual indicators of body size. In order to assess these stress events affecting the overall size of each BSI, specific focus will be placed upon the maturation sequence of each skeletal variable. Well-established within the bioarchaeological literature (Anderson *et al.* 1977; McHenry 1992; Aiello and Wood

1994; Porter 1999; Ruff 2002; Spocter and Manger 2007), each of these indictors matures at various times during growth and development and can be ordered into an age at maturation sequence through the use of clinical growth data and sample specific sub-adult data. Once this maturation sequence is established for both the Sadlermiut and Sacred Heart population samples, correlation analysis will be used to examine the relationships between each BSI. This correlation analysis will demonstrate that real relationships do exist among these skeletal variables ("the smooth" data). Following this initial correlation analysis, linear regression analysis will then be used as the comparative tool to determine if stress was present and at what age during growth and development that stress occurred, as determined from individual departures from the underlying trends of growth and development ("the rough" data). Stress episodes will be evaluated based upon the statistical analysis of each individual, and how they fluctuate above or below the predicted trajectory of the regression line confidence interval for age-successive pairs of BSIs. The age at which that stress occurred will be determined by assessing the duration of when an individual deviates from the normal growth trajectory. Once completed, specific emphasis on population stress patterning will be examined to compare and contrast the stress endured by the Sadlermiut and Sacred Heart population samples.

1.3 Objectives

This research project aims to further enhance the bioarchaeological understanding of the patterns of growth and development, and the maturation sequencing of the human skeleton. Current models suggest that the human skeleton, controlled by the endocrine system, matures in a predictable pattern with slight deviations between populations (Rosenfield 1996; Humphrey 1998; Van der meulen and Prendergast 2000). It is the goal of this research to test this model of consistent sequencing patterns, and also to demonstrate that deviations will occur between populations due to various stress factors such as climate. Once established, this research aims to use these stress patterns in conjunction with other stress analysis methods to further explore the numerous causes of stress. Through the establishment of better methods of stress analysis, patterning may emerge that can help to unravel the potential causes of stress within a specific population so that bioarchaeologists can better assess overall health in past populations.

1.4 Research Questions

For this project some primary research questions are:

- Are there significant correlations between the various body size indicators within the body that can help to predict the timing of specific stress episodes?
- Do individuals show a predictable pattern of stress manifestation that can be tracked and explained through regression analysis and the established growth and development literature?
- Are there distinct differences between the Sadlermiut and Sacred Heart population samples that can be understood in terms of climatic differences?
- Do skeletal indicators of body size provide an accurate reflection of stress episodes sustained during the years of growth and development?
- What is the overall impact of this growth and development method for bioarchaeological stress analysis?

The exploration of these questions will play an integral part of this research project and the understanding of stress and its affect on skeletal growth and development. While Chapter 1 has provided a broad overview of this project, Chapter 2 will focus on the current literature discussing the patterns of growth and development, stress analysis, body size and the environmental impact on body size. Chapter 2 will also introduce some of the considerations and limitations of this research project. Chapter 3 will provide the context of this project with regards to the methodologies and techniques employed to examine stress. Chapter 4 focuses on the results of this research, while Chapter 5 is a discussion of the trends observed in both the Sadlermiut and Sacred Heart samples and how these trends may help to explain the stress endured by these two population samples. Chapter 6 presents the conclusions of this project and future research possibilities.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to provide the background information required for this research project. This chapter will discuss the historical background of both the Sadlermiut and Sacred Heart populations, followed by an outline of the skeletal remains that were examined. Stress analysis, growth and development and body size are also discussed in this chapter with specific attention paid to how stress can affect what is considered normal growth and development. Following this section is a discussion of the potential considerations and limitations for this project, specifically the osteological paradox and longitudinal versus cross-sectional growth and development data collection.

2.2 Archaeological Samples

SADLERMIUT

2.2.1 Sadlermiut Inuit History

The Sadlermiut Inuit, once regarded as a mysterious and unique people, occupied the Southampton and Coats Islands at the northwestern perimeter of Hudson Bay, as shown below in Figure 2.1 (Manning 1942; Maxwell 1985). The Sadlermiut were both geographically and culturally isolated from the surrounding Inuit groups on the neighbouring mainland which delayed European contact up until 1824 (Merbs 1983). After initial contact with the Sadlermiut culture, European visits remained infrequent and minimal until the establishment of a whaling station at the Cape Low site on July 13, 1899 (Ross 1977). This whaling station was established by the Scottish firm Robert Kinnes and Sons and employed three European men along with over 150 non-Sadlermiut Inuit from the mainland (Ross 1977). Despite this encroachment into the Sadlermiut territory, these elusive people remained on the periphery of the whaling, fur and material trade economy (Ross 1977).

Figure 2.1
Southampton Island, Nunavut, Canada

(after: http://upload.wikimedia.org/wikipedia/commons/4/44/Canada_provinces_blank.png)

The success of the Cape Low whaling establishment inevitably led to an increase in European contact with the employed mainland Inuit, as well as the Sadlermiut, whose land was being more frequently visited by whalers (Ross 1977). During the summer season of 1902, the *Active* whaling ship made its usual stops in and around Southampton Island between the three main docking ports: Cape Low, Lake Harbour and Repulse Bay (Ross 1977). It was during this voyage that European disease spread into the Inuit populations and moved across the island as the various Inuit groups began their migratory movements for the coming winter months (Ross 1977). Although various diagnoses have been suggested, severe dysentery or gastric fever have been the most widely accepted causes for this epidemic (Ross 1977).

It has been estimated that during the course of the fall and winter months of 1902 and 1903, European disease spread as far as 500 miles north and south of the original outbreak point and eventually subsided at the Native Point site on the southern Bell Peninsula of Southampton Island (Ross 1977). While this outbreak affected multiple Inuit groups, the Sadlermiut were the most affected by symptoms of severe diarrhea which eventually wiped out almost the entire population on both Southampton and Coats Islands during the winter of 1902/1903 (Manning 1942; Ross 1977; Merbs 1983). Despite the suggestion that the Sadlermiut were completely eradicated by this disease, there were five survivors, one adult woman and four children. Upon their discovery by the European whalers during the summer of 1903, they were taken to Repulse Bay and assimilated into the Aivilingmiut culture. However, none of these survivors had any progeny, thereby ending the Sadlermiut lineage (Ross 1977; Merbs 1983; Rowley 1994).

Sadlermiut Culture

The cultural title of Sadlermiut (Sagdlirmiut) was originally coined by surrounding Hudson Bay Inuit groups, to denote "the people of the *Sadleg*" which was the Inuit name for Southampton Island (Boaz 1888; Manning 1942). The Sadlermiut were primarily located on the island in an area referred to as *Tunirmiut,* also known as Native Point (Merbs 1983). This Inuit group was characterized as mysterious, unique and described by other neighbouring groups as unusual (Merbs 1983). Much of the information gathered about the Sadlermiut people and their culture was obtained by Therkel Mathiassen from Inuit informants during his early exploration and documentation of Arctic peoples in 1927. Through this establishment of friendship with other Inuit populations, particularly the Aivilik, Mathiassen was able to document the mystery surrounding the Sadlermiut (Mathiassen 1927). From his early research, Mathiassen discovered that the Sadlermiut were considered to be self-isolating people who refused to marry into other Inuit groups and were characterized by their peculiar dialect which was different from all other surrounding cultures (Mathiassen 1927). Despite their geographic and cultural isolation, the Sadlermiut were regarded by surrounding Inuit groups as very strong and skillful flint knappers, a tradition long-forgotten by many other Arctic groups (Maxwell 1985). For the Sadlermiut, trade with the Europeans and other Inuit cultures was largely avoided, as this culture preferred to exploit and use the raw materials from their own geographic region (Maxwell 1985).

Not only did the Sadlermiut avoid trade relations but they also demonstrated various lifeways that were regarded as odd and simplistic by other neighbouring groups. The architecture of the Sadlermiut was regarded as crude and sloppy as their snow houses were poorly constructed and more permanent houses known as *qarmats* were made from stones, sod and whale bones. These *qarmats* were primarily insulated with whale blubber that constantly dripped into the living areas of these homes and covered the inhabitants with grease (Rowley 1994; Hayes *et al.* 2005). The fabrication of tools by the Sadlermiut was also criticized as being simplistic in comparison to other Inuit groups, as the main materials exploited by the Sadlermiut were flint and chert rather than metal that was easily acquired from European traders (Hayes *et al.* 2005). Perhaps the biggest criticism of the Sadlermiut was their appearance and their use of polar bear skin to make pants, which when completed, required the wearer to rub whale blubber on their legs to keep the hide from chafing their skin (Manning 1942; Rowley 1994; Hayes *et al.* 2005). The Sadlermiut also were accused of being constantly unclean, not only because of their constant use of whale blubber, but because of the build-up of soot inside their homes which inevitably transferred onto their clothes and skin (Hayes *et al.* 2005).

It is important to recognize that some of these early characterizations of the Sadlermiut were based upon the testimonies of mainland Inuit groups who had the tendency to speak poorly about other cultures that practiced lifeways different from their own (Hayes *et al.* 2005). It has been argued by scholars that these differences observed between the Sadlermiut and other Inuit groups were merely adaptations to their isolated geographic position and their ties to the archaeological Dorset Tradition (Rowley 1994).

The Dorset Tradition (eastern Arctic) of the paleo-Inuit was characterized by an unspecialized tool kit that allowed for the exploitation of marine resources and large terrestrial land animals. This Tradition was also characterized by snow houses, more commonly referred to as *igloos* (Maxwell 1985; Hayes *et al.* 2005) and other adaptive techniques which allowed Inuit peoples to withstand the cold temperatures of the Arctic through the exploitation of the environment for subsistence and shelter (Hayes *et al.* 2005). During the Dorset period, many Inuit groups in the east were isolated from the Alaskan Inuit culture (Norton Tradition) which evolved into the Thule Tradition that eventually spread eastward around AD 1000 (Hayes *et al.* 2005). With the widespread dispersion of the Thule Tradition, the Dorset culture began to disappear as Thule tools were more refined and resulted in the better procurement of subsistence and shelter.

However, it has been argued that isolated groups in the east, such as the Sadlermiut, were not as affected by the incoming Thule Tradition and were "survivors of the Dorset culture" (McGhee 1996:233). Because the Sadlermiut differed so greatly from their surrounding mainland neighbours, many scholars have debated the origins of these unique people, attributing their unusual lifeways to the Dorset Tradition (Collins 1956). Archaeological investigations suggest that the dwelling structures and tool making techniques of the Sadlermiut were more closely related to the Dorset Tradition than the Thule Tradition (Maxwell 1985). Genetic testing has also been carried out on Sadlermiut remains to examine familial relationships and these tests have demonstrated that this culture was genetically influenced in some capacity by the early Dorset people (Hayes *et al.* 2005). Although evidence has been found to demonstrate the Dorset affinities of the Sadlermiut people, some scholars also argue that the surrounding environment and geographic isolation of these people contributed to their unique lifeways.

The geographic landscape of Southampton Island is primarily characterized by its limestone foundation with intermittent marshlands throughout the Bell Peninsula region. This dominant limestone presence explains the Sadlermiut use of limestone rocks to help stabilize and form their semi-permanent dwellings and construct their graves (Manning 1942; Rowley 1994). Wildlife on the island is limited; however, there is a high concentration of polar bears, which were mainly exploited by the Sadlermiut as a clothing and food source (Manning 1942; Rowley 1994). Chert and flint raw material sources are abundant on the island; by having continual access to chert and flint sources, the Sadlermiut were able to make the tools needed to survive without travelling great distances to procure other construction materials (Rowley 1994).

The climate of Southampton Island at the beginning of the twentieth century was relatively similar to other Arctic regions of Canada with an average summer temperature 7.2° to 10° Celsius and an average winter temperature of -15° to -12.2° Celsius (Natural Resources of Canada 2003). The cool climate of Southampton Island also affected the annual average ground temperature which was recorded between -18° and - 23° Celsius with an average snow depth of 30 to 49 centimeters (Natural Resources of Canada 2003). Rainfall within this region had an annual mean of 201 to 400 millimeters while sunlight hours between the winter and summer months were drastically different. On June 21st (summer solstice) the average amount of sunlight per day was 22.03 hours and on December 22nd (winter solstice) the average amount of sunlight per day was only 3.34 hours (Natural Resources of Canada 2003). By examining these environmental conditions and the access to raw materials, it becomes clear why some scholars argue that the Sadlermiut were affected the most by their isolated and climactic circumstances, rather than being remnants of the Dorset Tradition. While their unique lifeways may have appeared more akin to the Dorset Tradition, perhaps these survival techniques were merely an adaptation to their harsh environment and continued social isolation rather than a cultural choice to follow a specific Arctic Tradition.

Overall, regardless of their origins, the Sadlermiut can be characterized as being a strong people, accomplished whale hunters and skillful flint knappers. The Sadlermiut mainly subsisted upon marine resources such as small fish and whale but supplemented their diet with large terrestrial animals such as bears (Boaz 1888; Rowley 1994). Although their use of *kayaks* and *umiaks* (both water transportation vessels) is unknown, they did have access to many other tool-types to aid in their survival on Southampton and Coats Islands (Merbs 1983). Archaeological evidence of harpoons, lance heads, bows, sleds, needles, knives and arrows suggest the extensive tool kit of these Arctic people (Merbs 1983). The responsibilities for survival among this group were divided between the sexes, with males and females being responsible for different aspects of daily life.

The Sadlermiut males were responsible for the procurement of food, while the Sadlermiut females were characterized, like many other Inuit women, as being responsible for the preparation of animal hides to make clothing and other implements used in daily life (Merbs 1983).

The Sadlermiut Inuit were a distinct people of the Canadian Arctic and because of their unique nature, different types of stress would have affected the growth and development of their skeletons. Up until European contact in 1824, the Sadlermiut had a long genetic endogamous lineage that was kept closed to outside populations (Merbs 1983). This would suggest that these people were genetically well adapted to their circumstances as specific genes were kept within the gene pool to aid in cold climate survival, as has been argued in Neanderthal studies of skeletal adaptations to cold temperatures (Blumenfeld 2001; Nelson and Thompson 2002). However, it is important to recognize that the Sadlermiut did possess cultural buffers that aided them in their cold climate survival such as their bear skin pants. The isolated geographic position of the Sadlermiut would have also affected subsistence strategies, as only certain food resources would have been available and only during certain times of the year. This lack of reliable food resources could have drastically affected the nutritional content of the Sadlermiut diet. The small group size of the Sadlermiut may have also affected the social roles of males and females. Although males and females had specific roles within the Sadlermiut community, small population numbers may have required an overlap in the social roles of men and women in order to survive. Because of these distinct lifeways the Sadlermiut are assumed to have been exposed to different types of stress not only related to their cold climate environment, but also to genetics, nutrition, sex and social systems.

2.2.2 Sadlermiut Skeletal Collection

The Sadlermiut skeletal collection was originally excavated by Henry Collins in 1954 - 1955 through the National Museum of Natural History, with subsequent excavations throughout 1959 by William Laughlin (Merbs 1983). The original examination of the skeletal remains was carried out by two major institutions, the Smithsonian Institute in Washington D.C. and the University of Wisconsin at Madison (Merbs 1983). The Sadlermiut skeletal remains used in this study were recovered from the Native Point site on the western perimeter of the Bell Peninsula and boast excellent preservation (Merbs 1983). The limestone topography of the Southampton Island provided an excellent preservative as most graves were built into the high alkalinity limestone which protected the remains from the elements and from scavengers (Manning 1942; Merbs 1983). These graves were simple in their construction with a circle of rocks outlining the body and were usually situated overlooking the sea. They also lacked grave goods (Manning 1942; Rowley 1994). Estimates suggest that the skeletal remains recovered from the Native Point region may date back as far as 500 years. It appears however, that many of these individuals were interred around the time of the 1902-1903 epidemic (Merbs 1983).

<u>**SACRED HEART**</u>

2.2.3 Sacred Heart Cemetery History

In contrast to the cold climate region occupied by the Sadlermiut, The Sacred Heart Cemetery population was chosen to represent a temperate climate population for this research project, as shown below in Figure 2.2.

Figure 2.2
Ingersoll, Ontario, Canada

(after: http://upload.wikimedia.org/wikipedia/commons/4/44/Canada_provinces_blank.png)

Ingersoll, Ontario was originally founded by Thomas Horner in 1792, but was not truly established until 1795 when Thomas Ingersoll brought 40 families northward from Salem, Massachusetts to settle in the area (Whitwell 1977). At this time the county of Oxford in southwestern Ontario was partially formed and gained full county status in 1798 (Whitwell 1977). Thomas Ingersoll was a well regarded individual in the Niagara region, and had a reputation of devoting his entire wealth and life to the establishment of the Town of Ingersoll. Within a year of his settlement, Thomas Ingersoll had commissioned the construction of roadways and further explored the land surrounding the town with the help of the Six Nations Group (Whitwell 1977). It has been well documented that the Ingersoll pioneers had a good relationship with the Six Nations Group, especially with their chief Joseph Brant (Whitwell 1977). Between 1851 and

1852, the Town of Ingersoll was officially recognized and incorporated as a village and boasted two general stores, a school house, two saw mills and a distillery (Whitwell 1977). The literature discussing the settlement of Ingersoll suggests that despite the difficulties in the early years of town formation during this time period, many people living in Ingersoll were well-off.

The Sacred Heart Cemetery was originally situated behind the Sacred Heart Church built in 1847 (Whitwell 1977; D.R. Poulton and Associates 2008). Bought by John Carnegie in March of 1833, this small area of land on the west side of Ingersoll was initially divided into residential lots in the 1840s (D.R. Poulton and Associates 2008). These lots were designated as Carnegie Town which later became amalgamated with the town of Ingersoll (D.R. Poulton and Associates 2008). A small portion of the land was donated by Carnegie to the Toronto Diocese of the Roman Catholic Church and the Sacred Heart Church was erected in 1848 (D.R. Poulton and Associates 2008). Unfortunately, no records have survived to document the opening of the associated Sacred Heart Cemetery but it has been assumed that the cemetery was established in 1847 or shortly after the construction of the church in 1848 (D.R. Poulton and Associates 2008).

In 1879, a new Sacred Heart Church was constructed north of Ingersoll and it is believed that the human remains from the original Scared Heart Cemetery were transferred to the new burial ground around this time (Ingersoll Tribune 1967; Whitwell 1977; Town of Ingersoll 1977). There is some evidence that the new Sacred Heart Cemetery north of the town was in use by 1870, as parish records from the original Sacred Heart Cemetery do not show any funerals occurring after 1869, which suggests that the original cemetery was full by this time (Walker 1994). Despite the lack of official records as to when the cemetery first opened and when it was officially closed, it is believed that the original Sacred Heart Cemetery was in use between 1847 and 1869 (D.R. Poulton and Associates 2008).

In contrast to the climate of Southampton Island, nineteenth century Ingersoll enjoyed a relatively temperate climate with an average summer temperature between 18° to 21° Celsius and an average winter temperature between 6° to 7° Celsius (Natural Resources of Canada 2003). Annual rainfall in southwestern Ontario at this time was generally between 801 to 1200 millimeters, with an average snow depth in the winter of less than 30 centimeters (Natural Resources of Canada 2003). Also in contrast to the Southampton Island climate, Ingersoll had fewer hours of sunlight during the summer months but significantly more exposure to sunlight during the winter months. On average Ingersoll received 15.13 hours of sunlight on the longest summer day (June 21st), while receiving 9.04 hours of sunlight on the shortest winter day (December 22nd) (Natural Resources of Canada 2003).

Despite the success of the town of Ingersoll and the well-being of many of its inhabitants, this early pioneer village would have been exposed to particular types of stress aside from the environment, related specifically to diet, social roles and modes of production. Known for its cheese production, the town of Ingersoll was an industrial and agricultural hub in southwestern Ontario (Whitwell 1977). Once settled, the town would have been exposed to various factors of stress related to an agricultural way of life, such as zoonotic diseases spread via domesticated livestock, water-borne diseases from industrial and farm land waste and even a reduction in nutrition, as certain food types may not have been agriculturally viable in this new region. Along with dietary stress, the people of Ingersoll would have also been exposed to stress based upon their social roles. During this time, road construction and industry were priorities for the town and many young men were recruited to help construct these roadways and establish industry outside of traditional farming at the homestead (Whitwell 1977). Depending on the type of work conducted by the men, biomechanical stress may have increased over time. While the men were busy constructing these roadways and developing industry in Ingersoll, the women were required to tend the farm and the household which would have also increased their own biomechanical stress (Whitwell 1977).

2.2.4 Sacred Heart Skeletal Collection

Characteristic of nineteenth century Christian burial practices, the individuals from the original Sacred Heart Cemetery were mainly oriented east-west and buried in plain wood coffins (D.R. Poulton and Associates 2008). Before the establishment of sawmills in the region, coffins in the early 1800s were generally made by the family from a pine tree that was hollowed out and individuals were interred on family land (Whitwell 1977). The opening of sawmills in the region slightly changed burial practices, as coffins were then constructed from pine or oak planks and a cost was associated with funerals that took place on land owned by religious institutions (Whitwell 1977). It was not until the 1820s that religious organizations began to recognize official meeting places. Once these meeting places were decided upon, cemeteries were then designated as being associated with each of the different religious groups (Whitwell 1977). The skeletal collection excavated from the original Sacred Heart Cemetery site contained male and female adult and sub-adult remains. Further investigation into family plots and associations has yet to be conducted; however, preliminary studies show that there is variability within this population in regards to overall health. Because the original Sacred Heart Cemetery was the first Catholic cemetery in Ingersoll, these skeletal remains may provide important information about the first pioneers in southwestern Ontario and the types of stress endured at that time (Whitwell 1977).

2.3 Stress and Growth

The main focus of this project is to examine stress in both a cold climate population and a temperate climate population to observe the skeletal changes that took place during growth and development as a result of this stress. For the purpose of this study, stress will be defined as any measurable disturbance that has negative consequences such as disrupted or delayed skeletal growth, usually regarded as an overall reduction in body size or an alteration in the growth of skeletal elements (Goodman and Martin 2002). Some potential causes of stress are: poor nutrition, socio-economic status, psychosocial problems, climate, disease and being a particular sex (Johnston *et al.* 1982; Hoppa and FitzGerald 1999; Bogin 2001; Ruff 2002). Despite the plasticity of the human body and its ability to adapt, the human skeleton grows in a patterned sequence with certain skeletal elements reaching maturation landmarks at predictable stages of growth (Humphrey 1998; Prokopec 2001). Because these general trends of growth and development are known, and known to be affected by different variables, any deviations from these predictable patterns allow for more insight into the potential vulnerability of the human skeleton during the sub-adult years of life (approximately birth to 20 years of age) (Larsen 1997; Bogin 2001). Deviations from these normal patterns of growth and development are generally associated with stress or stress events that occurred during the maturation of the adult skeleton. Larsen (1997) argues that three main factors can contribute to stress: the environment, cultural systems, and the resistance of the host to the stress event. Therefore, through the analysis of stress in past populations, information regarding culture, behaviour and health can be explored (Larsen 1997). Unfortunately because stress is generally non-specific in nature and can be the result of many influencing factors, it is often difficult to dissect out the primary cause of stress. Within bioarchaeology stress analysis is beneficial in that it allows for the examination of societal health, at both the individual level and population level, to gain a better understanding of the hardships endured by past peoples. In order to understand past population health trends, stress analysis is best explored through the integration of multiple lines of evidence (Buikstra and Cook 1980; Huss-Ashmore *et al.* 1982; Goodman and Armelagos 1989).

2.3.1 Lesion-based Approaches of Stress Analysis

Stress is generally examined in archaeological populations following a lesion-based approach. Currently, there are three dominant lesion-based methods that help bioarchaeologists to understand stress in past populations: enamel hypoplastic lesions, Harris lines and porotic hyperostosis and cribra orbitalia.

Enamel hypoplastic lesions (EHL) are generally identified as lines or pits along the tooth, most commonly found on the anterior teeth (Lewis and Roberts 1997). As the tooth enamel forms, it does so in a predictable pattern as ameloblasts (enamel forming cells) lay down new enamel which will eventually mineralize into fully mature enamel (Larsen 1997). During this process, however, disruptions to the homeostasis of the body caused by stress can affect the process of enamel formation. As a result of stress, the enamel on the teeth does not fully form and is generally thinned, leaving lines or pits as evidence of a stress event (Goodman and Rose 1990). EHL, created in response to growth disruption, are generally the result of metabolic changes within the body, particularly nutritional deficiencies (Goodman and Armelagos 1988). A primary benefit of this method is the predictability of enamel formation patterns which allows for bioarchaeologists to estimate the age at which the stress event occurred (Blakey and Armelagos 1985; Hutchinson and Larsen 1988). Another benefit of EHL is that they do not remodel over time and remain a permanent indicator of stress (Goodman and Song 1999). However, a primary limitation with this method is that once the permanent teeth have formed and erupted this method can no longer indicate stress, as enamel does not remodel over time; therefore, this method can only provide an assessment of early childhood stress.

Harris lines are another line of evidence used by bioarchaeologists when examining stress in past populations that can provide a chronological age of when stress occurred. Harris lines can manifest on all bones of the body but are best visualized on the distal tibia and distal femur (Larsen 1997). These lines are visible only through x-ray analysis and appear as lines of increased density indicating the resumption of growth after a stress event has passed (Garn *et al.* 1968; Hunt and Hatch 1981; Maat 1984; Byers 1991; Mays 1995). Although Harris lines were originally documented as indicators of rickets, they are now associated with nutritional stress, diseases and traumatic stress (Larsen 1997). Studies show that Harris lines appear most commonly after the initial six months of life and usually plateau around five to six years of age (Clarke and Gindhart 1981). However, despite the benefit of Harris line analysis, a major limitation with this method is the potential for the disappearance of these lines over time as bone remodels. Another confounding issue is the lack of standardized methods in how bioarchaeologists score and count these lines, making their comparison across populations difficult (Mays 1995; Larsen 1997; Lewis and Roberts 1997).

The third lesion-based method of stress analysis is the examination of porotic hyperostosis and cribra orbitalia. The term porotic hyperostosis was first introduced by Angel in 1966, and can be described as lesions of the cranium located on the parietal bones or the superior surface of the eye orbits, known as cribra orbitalia (Larsen 1997; Roberts and Manchester 2005). Porotic hyperostosis and cribra orbitalia are generally believed to be linked to iron-deficiencies caused by inadequate nutrition, individuals born with a low birth weight or blood loss (Stuart-Macadam 1989). Although the analysis of porotic hyperostosis and cribra orbitalia provides relevant information about stress sustained during the years of growth and development, there has yet to be a method of analysis to accurately date the time at which that stress occurred (Larsen 1997; Roberts and Manchester 2005). As a result, the use of porotic hyperostosis and cribra orbitalia as stress analysis tools can only be used to gain general information concerning the health of a population in relation to anemias. Because this project focuses on the chronological identification of stress events during childhood, the examination of cribra orbitalia and porotic hyperostosis will be omitted.

As outlined above, lesion-based methods of stress analysis are highly regarded by bioarchaeologists in the understanding of health in past populations. The goal of this study is not to discount the use of these lesion-based methods, but rather to enhance and build upon alternative lines of evidence to explore stress and its impact on growth and development; specifically, to examine how deviations in the patterns of growth and development may provide a more holistic understanding of sub-adult stress.

2.3.2 Growth and Development Approaches to Stress Analysis

From an archaeological perspective, stress can be examined from both skeleton lesions and in patterns of growth and development. While lesion-based methods are more abundant and more commonly used, it is the goal of this study to expand the framework of growth and development stress analysis through the use of body size indicators.

While fluctuating asymmetry is currently the only existing method of stress analysis that is used to examine stress episodes from a growth and development perspective, there has been some recent study into the relationship between lesions and skeletal development and how this may be used to better understand stress (Lukacs 2009). Fluctuating asymmetry is defined as the deviation of skeletal formation from symmetrical development, with asymmetry becoming more pronounced as the result of prolonged stress (Palmer and Strobeck 1986; Leung *et al.* 2000). The reason that stress affects growth is due to a reduction of energy within the body that helps to maintain proper skeletal development during critical periods of skeletal maturation (Sommer 1996). In the archaeological record, higher instances of fluctuating asymmetry in a sample population are generally regarded as evidence of greater levels of "developmental instability" (Albert and Greene 1999; DeLeon 2007:520). The stress agents that have been associated with fluctuating asymmetry are environmental instability (excessive heat or cold), nutritional deficiencies, excessive noise, prenatal chemicals and diabetic fetal environments (Albert and Greene 1999; DeLeon 2007). All of these potential stress agents, which are similar to the factors cited above as possible causes for the appearance of stress lesions, can provide insight into the type of stress events that may have affected the Sadlermiut and Sacred Heart population samples.

Because this research is dependent on establishing consistency between indicators of stress, both lesion-based approaches (EHL and Harris lines) and a growth and development approach (fluctuating asymmetry) are important considerations for how bioarchaeologists identify and accurately age stress episodes during childhood growth and development.

2.3.3 Bone Structure and the Effects of Stress

To understand the mechanisms of stress and the effect of stress on skeletal growth and development, an overview of bone structure is necessary. Bone is a dynamic element of the human body, providing the necessary structure and support to the various systems within the body (Rosenfield 1996). For this discussion it is important to focus on the mechanisms of skeletal formation, specifically how bone is created and maintained within the body and also how the human skeleton grows and develops over time.

Human bone is comprised of both organic and inorganic materials. Collagen is the primary component of human bone and comprises 90% of the bone matrix, while the inorganic component of bone, hydroxyapatite, comprises less than 10% of the bone matrix (White and Folkens 2005). This bone matrix of organic and inorganic materials houses three types of bone cells (osteoblasts, osteocytes and osteoclasts) that contribute to the creation, maintenance and destruction of bone (White and Folkens 2005). Osteoblastic cells are responsible for the formation of bone and are located directly under the periosteal sheath that protects bone. Once these cells become surrounded within the bony matrix, they become osteocyte cells that are responsible for the maintenance of the newly created bone (White and Folkens 2005). Osteoclastic cells, in contrast, are responsible for the destruction or remodeling of bone, most important during the growth and development period of early life (White and Folkens 2005).

Bone growth and development is possible due to the interaction between all three types of bone cells. It is this interaction that allows the bony matrix to remodel through a change in shape and size (White and Folkens 2005). Bone maturation can occur either through intramembranous ossification or through endochondral ossification. Membranous ossification generally occurs in the cranial vault while the majority of bones in the appendicular skeleton begin primarily as a cartilage model (White and Folkens 2005). It is the growth plates, found between the metaphyses and epiphyses of all long bones that allow for growth in bone length as this cartilage model is eventually turned over into bone (Van Der Eerden *et al.* 2003). While bone length is obtained through cell proliferation in the growth plates, bone mass is increased through the interaction of osteoblastic and osteoclastic cells during appositional growth (White and Folkens 2005). These differing processes of skeletal ossification ultimately allow for the maturation of specific skeletal and tissue elements in a particular sequence, so that maximum growth can be attained as these models are turned over into the bony matrix of the adult skeleton (Humphrey 1998; Scheuer and Black 2000).

It is during this period of bone growth and development that disruptions can occur, ultimately affecting the overall size and shape of the adult bone. As discussed above, many different stress variables can affect the skeleton and its maturation; however, the process by which the skeletal system responds to stress is through the release of glucocorticoids into the body. Glucocorticoids are endogenous steroids found within the human body and are associated with the hypothalamo-pituitary-adrencortical axis (Herman and Cullinan 1997). It is through the release of these steroids that stress becomes manifested within the body bringing about physiological change, particularly in the skeleton (Miller *et al.* 2007). Times of stress, whether environmental, nutritional or social, trigger the release of glucocorticoids into the body as a means to alert the body that stress is occurring while also attempting to maintain homeostasis (Herman and Cullinan 1997). However, long term or chronic stress may saturate the body with high levels of glucocorticoids which can lead to hard tissue damage (Burckhardt 1984; Herman and Cullinan 1997; Manelli and Giustina 2000; Klein 2004; Miller *et al.* 2007).

Glucocorticoids are documented in the clinical literature as having profound effects on bone metabolism by increasing bone resorption and decreasing bone formation through three main processes: the reduction of osteoblastic replication, a decline in the regeneration of osteoblastic cells, and an increase in the death of osteoblastic cells (Manelli and Giustina 2000). All three of these metabolic processes have the negative effect of decreasing bone mass within the body, potentially leading to the biomechanical weakening of the skeleton or a reduction in skeletal size (Klein 2004). Growth plates can also be affected by glucocorticoids as the chondrocyte cells within these plates have a glucocorticoid receptor, whereby allowing these steroids to have direct influence over their localized growth (Van Der Eerden *et al.* 2003). As discussed above, bones have the ability to increase in length and increase in mass; because these two processes are controlled by different mechanisms it can be assumed that glucocorticoids would also affect these processes differently. This suggests that some skeletal elements may be more susceptible to an over saturation of glucocorticoids causing these elements to be reduced in size. The mechanism of glucocorticoid release, via the hypothalamo-pituitary-adrencortical axis and its effect on bone remodeling, provides an important model for the impact of stress on the growth of skeletal elements. Ultimately, the constant release of glucocorticoids into the body of a chronically stressed individual will affect skeletal mass and may alter their growth outcome if there is a decrease in osteoblastic activity during critical periods of skeletal maturation. It is through this process that stress manifests within the human skeleton and can produce patterns of stress in the Sadlermiut and Sacred Heart samples.

2.3.4 Catch-up Growth

Although it may appear that the process of glucocorticoid release into the body during times of stress produces irreversible changes to the human skeleton there is still the potential for growth after a stress episode has passed. Known as catch-up growth, this phenomenon has the potential to return an individual to their normal growth rate if the stress has not been prolonged and if skeletal elements have not surpassed their capacity to grow any further (Boersma and Maarten Wit 1997; Bogin 2001). Catch-up growth is generally regarded as a rapid increase in growth affecting all skeletal elements in a proportional manner (Tanner 1962). However, recent research has suggested that catch-up growth may also occur under the control of localized mechanisms within individual growth plates, suggesting that catch-up growth has the potential to differently affect various indicators of body size (Baron *et al.* 1994). This increase in growth velocity will continue in an individual until they have reached the point of growth (usually described as stature) they would have achieved had stress not delayed or halted their growth progress. When this maturation point is reached, the body re-regulates this process and returns the growth rate to a normal pace (Bogin 2001). How the body knows when to stop the process of catch-up growth has yet to be determined (Prader *et al.* 1963). While the underlying mechanism of catch-up growth is not fully understood, it is well documented to occur after periods of stress (Tanner 1962; Prader *et al.* 1963; Boersma and Maarten Wit 1997) and can presumably be detected through the analysis of patterns of growth and development.

2.3.5 Patterns of Growth and Development

From this understanding of how stress can affect the growth and development of the human skeleton, it is important to outline and be aware of how the human skeleton should normally mature. The study of normal patterns of growth and development has become an important avenue of research for bioarchaeologists studying the health of past populations. Growth generally refers to "a quantitative increase in size or mass" while development refers to "a progression of changes, either quantitative or qualitative that lead from an undifferentiated or immature state to a highly organized or specialized mature state" (Bogin 2001:283-284).

En route to adult maturity, the modern human skeleton passes through five stages of growth and development: infancy, childhood, juvenile, adolescent and adult (Bogin 2001). Each stage is characterized by different growth and development landmarks when certain skeletal and tissue elements reach their final adult size. Infancy is the first stage of postnatal life and lasts for approximately three years; it is characterized by having faster velocity in growth than any other phase, particularly rapid brain growth (Bogin 2001). The childhood stage encompasses the years of three to seven and is the stage where permanent teeth begin to replace deciduous teeth and the brain reaches its final adult weight (Bogin 2001). From the age of seven to approximately 13 years is the juvenile stage of growth and development which can be characterized by a slowing of skeletal and tissue growth. However, during the juvenile stage an individual may experience a mid-growth spurt and also during this stage the brain reaches its final adult size (Bogin 2001). The adolescent stage of growth and development does not begin at the same skeletal age for males and females and although this process is highly regulated by genetics, it can be delayed due to various factors such as malnutrition or socio-economic status (Golub 2000; Bogin 2001). Females generally reach adolescence around 12 years while males reach adolescence around 14 years. During this stage, individuals reach sexual maturity and also experience a rapid growth spurt followed by the cessation of growth as the bones of the body fuse with their epiphyses (Bogin 2001). The adult stage, and final stage of growth, begins once an individual has completed their skeletal growth at approximately 20 years of age and continues for the rest of their life until death (Bogin 2001). For this research project, and with regards to the bioarchaeological literature, the term "sub-adult" will refer collectively to all of the stages of growth and development that precede the adult stage (birth to approximately 20 years of age), where an individual still has the capacity to grow. The term "adult" will refer to any individual who has matured beyond the adolescent stage and where all long bone, pelvic, hand, foot and vertebral epiphyses are fused.

From this knowledge of human skeletal patterns of growth and development and the examination of human skeletal remains, bioarchaeologists are able to infer relevant information about skeletal variability in both the individual and the overall population (Larsen 1997). Growth rate within each growth and development stage, although highly regulated within the body, can be affected by different stress factors such as sex, disease and cultural systems; however, it has been argued that the environment and nutritional status have the most influence on the achieved adult size of an individual (Eveleth and Tanner 1976; Larsen 1997; Bogin 2001). As outlined by Eveleth and Tanner (1976), the final size and shape that an individual attains in adulthood is a direct reflection of the continued interaction between different influences during the period of maturation, more specifically during the five outlined stages of growth and development.

2.3.6 Environment and Body Size/Proportions

As discussed above, stress during the years of growth and development will ultimately affect the growth outcome of an individual. Of particular interest for these two population samples is the interaction between the human body and the environment as a primary stress agent. Morphological adaptation to different climates is governed by the principles of thermoregulation in mammals, including humans, and is described by the rules proposed by Bergmann (1847) and Allen (1877). Bergmann's Rule states that in colder climates mammals grow to a larger body mass to reduce their surface area to volume ratio; Allen's Rule suggests that in colder climates appendages are smaller in relation to overall body size also to reduce the surface area to volume ratio (Eveleth and Tanner 1976; Vrba 1996; Jurmain *et al.* 2004). Explored by multiple authors (Eveleth and Tanner 1976; Y'Edynak 1978; Johnston *et al.* 1982; Blumenfeld 2001; Nelson and Thompson 2002) cold climate adapted human populations are shown to have larger body mass (Bergmann's Rule), and also demonstrate shorter appendages and shorter overall stature (Allen's Rule), relative to warm adapted populations. As outlined by Eveleth and Tanner (1976), bigger does not always mean better, as a smaller body size or smaller body limb proportions may be adaptive in specific environmental circumstances. The goal of this study is to distinguish between these environmental adaptations and other stress influences that may have affected the growth and development of these population samples. It is through this examination of body size and body size indicators that the effects of stress on the underlying adaptations of the Sadlermiut and Sacred Heart people will be studied.

2.3.7 Body Size

Skeletal growth and development normally works in a coordinated manner so that a well-proportioned adult skeleton is the end result of a normal growth and development sequence. Body size can be defined as overall body stature or overall body weight while body size indicators (BSIs) are defined as the various measurements taken throughout the skeleton that have been empirically demonstrated to be correlated to overall body stature or body weight. Because a well-proportioned adult skeleton is dependent on demonstrating a consistent relationship between body size indicators, an individual affected by stress during growth and development should deviate from this relationship among BSIs. Therefore, the examination of body size and its indicators is important to growth and development studies because of the established correlation between body size and stress, as discussed in section 2.3.5. Because different BSIs attain maturity at different ages, it should be possible to link an interruption in the expected pattern of correlation among BSIs to a stress event that occurred during particular years of growth and development and might otherwise be undetectable (cf. Eveleth and Tanner 1976; Hoppa and FitzGerald 1999; King and Ulijaszek 1999; Bogin 2001; Ruff 2002).

The use of body size within a bioarchaeological framework has thus far been mainly focused on studies of overall body size (stature or mass) estimation in fossil hominids. Because no accurate reference population exists to examine body size in fossil hominids, specific cranial and infra-cranial elements have been examined in an attempt to reconstruct the early hominid physique (Anderson *et al.* 1977; McHenry 1992; Aiello and Wood 1994; Porter 1999; Ruff 2002; Spocter and Manger 2007). As discussed by Ruff (2002), studies of hominid body size provide relevant information about past populations, particularly social organization, ecology, health and nutrition and therefore, have value to archaeological studies also assessing body size.

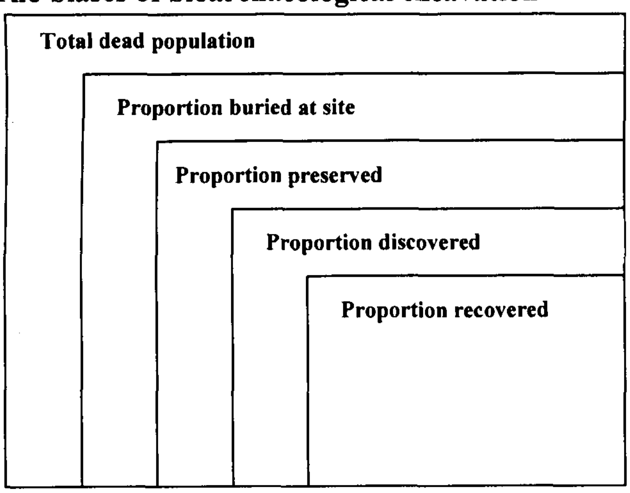
Many scholars recognize the fact that human body proportions can vary considerably between populations and therefore, certain skeletal elements will ultimately be better predictors of body size that others (Ruff 2002). The majority of scholars regard infra-cranial skeletal elements as the best predictors of body size, specifically long bone measurements (Steudel 1980; Jungers 1985; McHenry 1992; Ruff *et al.* 1997; Ruff 2002). There is a clear functional relationship between body size and load bearing capacity; therefore, the most reliable features on the long bones appear to be the articular surfaces which are less affected by activity and provide relatively accurate body size predictions (McHenry 1992; Trinkaus *et al.* 1994; Ruff 2002). This close association of limb bone measurements and body size is believed to be the result of the tight constraints on the limb bones due to the transmission of weight through those bones, as opposed to the cranial or dental features of the skeleton that do not bear weight (Aiello and Wood 1994). However, some scholars do argue that cranial and dental elements also provide accurate measurements to make body size predictions, although the exact mechanism underlying this association has not yet been explored (Anderson *et al.* 1977; Aiello and Wood 1994; Kappelman 1996; Spocter and Manger 2007). Aiello and Wood (1994), argue that some cranial elements are better indicators of body size and produce higher correlations than other indicators, but that these same biases exist when considering infra-cranial elements as well. Because of these limitations of cranial and infra-cranial BSIs, both are needed to provide accurate body size estimates as all of these predictors from the human skeleton have some degree of error (Aiello and Wood 1997). It is through the exploration of these error rates in both cranial and infra-cranial measurements that this study will seek the best possible measurements to indicate body size and any deviations from expectations which could indicate the presence of stress. While past studies focused upon the actual prediction of overall body size, this research concentrates on establishing the patterns and relationships between each indicator of body size.

2.4 Considerations and Limitations

2.4.1 The Osteological Paradox

Despite the importance of growth and development studies in understanding the health of past populations there are particular limitations that bioarchaeologists must consider. In 1992, Wood and colleagues examined bioarchaeological research from a different perspective in "The Osteological Paradox: Problems of Inferring Prehistoric Health from Skeletal Samples" which focused on the straightforward relationships assumed between the skeletal remains studied by scholars and the health conclusions proposed. Wood *et al.* argued that pathological research based on past populations is reliant on the assumption that skeletal lesions are a direct reflection of health, which they felt needed to be re-examined in light of three issues: demographic non-stationarity, selective mortality and hidden heterogeneity in risks (Wood *et al.* 1992). Particularly important for this study, and the assessment of Sadlermiut and Sacred Heart health, are the issues of selective mortality and hidden heterogeneity in risks. Selective mortality refers to the concept that bioarchaeologists will never have access to the entire population at risk, and therefore, all information collected will come from a selective and presumably unrepresentative sample of the original population (Wood *et al.* 1992), as shown in Figure 2.3 below.

Figure 2.3
The biases of bioarchaeological excavation



(Waldron 1994:13)

The caution for bioarchaeologists is to recognize these biases within the skeletal sample being studied so that the most accurate assessment of population health can be made, as no sample will entirely represent the original population due to multiple factors. For this research, it is recognized that the individuals studied only represent a proportion of the once living Sadlermiut and Sacred Heart populations, and cannot be assumed to represent these populations in their entirety. This research also avoids any demographic conclusions about these sample groups and thus avoids the issue of non-stationarity.

The hidden heterogeneity in risks is also an important consideration for this study as different individuals will inevitably respond differently to sources of stress over their lifetime (Wood *et al.* 1992). Although general population assessments are made by bioarchaeologists, it is important to recognize that each individual has a specific level of vulnerability when it comes to various stress events or the risk of death, which may affect the overall health profile of a population. These variances between individuals can be attributed to environmental causes, genetics, social roles and a variety of other influences (Wood *et al.* 1992). Therefore, assumptions made with regard to population health must consider these various factors at the individual level so as to not categorize the entire population under the risks demonstrated by a few individuals.

Another consideration discussed by Wood *et al.* (1992) is how bioarchaeologists approach the presence of lesions on the skeleton. Lesions are generally the primary focus of health and disease analysis, where multiple lesions are generally associated with worse health. However, this assumption has been challenged by Wood *et al.* who argue that "better health makes for worse skeletons" (1992:356). Because the manifestation of lesions into the hard tissue of bone takes time, the individuals who survived long enough to show skeletal lesions are perhaps more healthy than individuals who succumbed to disease or stress immediately and did not have time to produce skeletal lesions (Wood *et al.* 1992). However, this viewpoint has been challenged by Goodman (1993) who argued that Wood *et al.* (1992) devoted too much attention to lesions as a singular line of evidence to examine health and stress. Goodman suggested "the importance of the use of multiple indicators of stress," such as models that contextualize the skeletal indicators of stress and the development of multiple lines of evidence to examine the cultural contexts of lesions found on the skeleton (Goodman 1993:283,285). In regards to this argument, this study seeks to examine stress from a growth and development perspective as well as a lesion-based perspective, providing an opportunity to assess multiple lines of evidence and to avoid the limitations outlined above.

2.4.2 Longitudinal versus Cross-sectional Studies

In growth and development studies, there are two main methods of data collection: longitudinal and cross-sectional. Discussed in detail by Eveleth and Tanner (1976), longitudinal data represent multiple data points for each individual sampled over an extended period, while cross-sectional data are single data points collected for each individual representing one particular point in time; in an archaeological context this would be the time of death. Longitudinal data collection is the methodology used primarily in living populations over the course of many years to gather specific data on how each individual grows and develops (Eveleth and Tanner 1976). However, a major limitation of this method is the time commitment needed by both the researcher and subject and also the resulting small sample sizes as it is difficult to follow many individuals over multiple years of study; furthermore, it is simply impossible with archaeological data (Eveleth and Tanner 1976).

Cross-sectional data collection is the method used primarily by bioarchaeologists who are working with deceased individuals that can only be observed at one particular point in their lifetime. A benefit of the cross-sectional approach is that the growth curve created represents not just one individual but rather multiple individuals from the deceased population (Hoppa and FitzGerald 1999). This population growth curve can be a benefit when conducting cross-population studies where it is more important to recognize overall population patterns rather than the growth patterns of specific individuals (Eveleth and Tanner 1976; Hoppa and FitzGerald 1999). Despite the benefits of the cross-sectional approach there are limitations, particularly the loss of individual variability as one individual can only provide data for the age at which they died and cannot provide any growth velocity data (Eveleth and Tanner 1976). Because the primary focus of this project is on adult measurements to assess growth disruption during the sub-adult years of life, the limitations discussed here should not hinder the analysis of sub-adult stress.

2.5 Conclusions

The purpose of this chapter was to review the Sadlermiut and Sacred Heart population samples, as well as to provide an overview of bioarchaeological inquiry into growth and development studies. Growth and development studies have provided important information regarding individual, as well as population health. In contrast to the predictable patterns of human growth, it is evident that human adaptability and plasticity can affect how the skeleton fully matures. It is through the examination of deviations from those predictable patterns that bioarchaeologists can study stress in past populations and examine the potential causes for skeletal change such as climate, nutrition or social systems. Multiple methods of stress examination have been employed by bioarchaeologists, although most have been lesion-based approaches. Through the use of body size indicators and their correlation to stress events, this study strives to understand how various skeletal interactions can demonstrate the stress endured by both the Sadlermiut Inuit from the Canadian Arctic and the Sacred Heart Cemetery population from southwestern Ontario.

CHAPTER 3: MATERIALS AND METHODS

3.1 Introduction

Two populations were used for this study: the Sadlermiut Inuit of Southampton Island, Nunavut and the Sacred Heart Cemetery population from Ingersoll, Ontario. The data gathered from the Sadlermiut and Sacred Heart samples were collected based upon similar osteological data collection methods described below in section 3.1.1. Important to note here is the terminology that will be used throughout the remainder of this thesis when referring to the Sadlermiut and Sacred Heart individuals. "Sample" will be used when referring to the entire adult population sample of either group including both males and females. "Sub-sample" will be used when referring to one of the four specific adult sub-groupings: Sadlermiut females, Sadlermiut males, Sacred Heart females or Sacred Heart males.

3.1.1 Osteological Data Collection Methods

The individuals from the Sadlermiut and Sacred Heart collections were chosen using three main criteria: skeletal preservation, age and sex. Satisfactory skeletal preservation (> 50% complete) was the specific criteria for the cranium, the vertebral column and the long bones. Because this study focuses on the manifestation of stress in the adult skeleton, the criteria of age was fulfilled by selecting as many well preserved adult individuals as possible. Attempts were made to collect as many BSI measurements from both young and old adults when possible. Sub-adult samples were also used as tools to calibrate published growth models; therefore, data from the various sub-adult stages of growth and development were collected to provide a sample of the Sadlermiut and Sacred Heart sub-adult populations. Sex was also an important selection criteria in creating a representative sample of the Sadlermiut and Sacred Heart, by sampling an equal number of males and females. Due to the difficulty of sub-adult sex determination, no attempts were made to equally sample sub-adult males or females; individuals were assessed in this case on preservation and age only. However, attempts were made to determine sex for older adolescent individuals if possible.

3.1.2 The Sadlermiut Population Sample

The Sadlermiut skeletal collection is housed at the Canadian Museum of Civilization in Gatineau, Quebec, and is a relatively large skeletal collection that was excavated between 1954 and 1955 by Henry Collins and further in 1959 by William Laughlin (Merbs 1983). The Sadlermiut people represented a distinct Inuit culture that was well-established in the Canadian north pre-contact, yet succumbed to disease during the early part of the twentieth century (Manning 1942; Ross 1977; Merbs 1983). This entire skeletal collection is comprised of approximately 110 individuals, 48 of which were used for this study as shown in Appendix A, Table A-1. Tables 3.1 and 3.2 below illustrate the sex and age distributions of the Sadlermiut sample.

Table 3.1
Sex distribution of the Sadlermiut sample

Age	Male	Female	Unknown	Total
Adult	16	17	0	33
Sub-adult	2	0	13	15
Total	18	17	13	48

Table 3.2
Age distribution of the Sadlermiut sample

Age	Male	Female	Unknown	Total
0-10 yrs	0	0	8	8
11-20 yrs	2	0	5	7
21-30 yrs	4	2	0	6
31-40 yrs	3	3	0	6
41-50 yrs	7	5	0	12
50+ yrs	2	7	0	9
Total	18	17	13	48

3.1.3 The Sacred Heart Population Sample

The Sacred Heart population is currently housed at The University of Western Ontario under the supervision of Dr. Michael Spence and Dr. Andrew Nelson. This mid-nineteenth century Roman Catholic cemetery was excavated during the spring of 2008 under the direction of archaeological consultants D.R. Poulton and Associates Inc. (Poulton 2008). Currently there are no surviving records as to when the original Sacred Heart Cemetery was officially opened for interment or when it was officially closed, although estimates suggest that the cemetery could have been open as early as 1847 and was potentially in use until 1870 (Poulton 2008). This skeletal collection is comprised of 112 individuals, 30 of whom were used in this study: 20 adult and 10 sub-adult individuals as shown in Appendix A, Table A-2. Tables 3.3 and 3.4 below illustrate the sex and age distributions of the Sacred Heart sample.

Table 3.3
Sex distribution of the Sacred Heart sample

Age	Male	Female	Unknown	Total
Adult	10	10	0	20
Sub-adult	2	1	7	10
Total	12	11	7	30

Table 3.4
Age distribution of the Sacred Heart sample

Age	Male	Female	Unknown	Total
0-10 yrs	0	0	7	7
11-20 yrs	2	1	0	3
21-30 yrs	0	2	0	2
31-40 yrs	3	2	0	5
41-50 yrs	4	2	0	6
50+ yrs	3	4	0	7
Total	12	11	7	30

3.2 Data Collection

Since the primary purpose of this study was to examine episodes of stress through the disruption of growth, a series of measurements empirically shown to indicate adult body size (BSIs) that mature at different ages were collected as shown in Appendix B, Table B-1. The BSI measurements examined in this study were collected from various literature sources that discuss the role of metric observations to make assessments about body size in past populations (Anderson *et al.* 1977; McHenry 1992; Aiello and Wood 1994; Porter 1999; Ruff 2002; Spocter and Manger 2007). Each measurement was chosen based on its position within the body, as well as the age at which the skeletal element reached maturity. The main goal was to include as many skeletal elements as possible which matured at various ages between birth and 20 years of age. The BSIs chosen for this study were measured following the standards established by Buikstra and Ubelaker in *Standards for Data Collection from Human Skeletal Remains* (1994). Although body size measurements are not specifically discussed by Buikstra and Ubelaker, metric measurements outlined by Moore-Jansen *et al.* (1994) were used that establish specific skeletal landmarks in the body that increase the consistency of metric observations. This primary reference material was used for the majority of the measurements taken on the long bones as well as the cranium with more specific BSI measurement criteria taken from other sources of reference. Each measurement, the associated skeletal element, what it indicates and the reference from where the information was attained is listed in Appendix B, Table B-2. In order to permit the assessment of fluctuating asymmetry, both left and right side measurements were taken for all of the long bones as well as the tarsals and metatarsals. Measurements for the crania however, were limited to the left side only as many of the Sadlermiut crania were damaged due to taphonomic processes and excavation damage. In order to remain consistent in measuring techniques, the Sacred Heart cranial material was also assessed on the left side only. All skeletal measurement data were collected on a standard osteological inventory form as shown in Appendix C, Tables C-1 and C-2. All raw data pertaining to the BSI measurements collected for the Sadlermiut and Sacred Heart samples can be found in Appendix D, Tables D-1, D-2, D-3 and D-4.

3.3 Metric Observations

For this study, measurements were taken consistently with one of four types of measuring instruments: osteometric board, fiber-glass coated measuring tape, digital calipers and spreading calipers. Listed below in Table 3.5 is the osteological instrument used to measure each type of skeletal element.

Table 3.5
Osteological measurement instruments

Skeletal Element	Measurement Instrument
Cranium	digital calipers, spreading calipers
Vertebrae	digital calipers
Long Bones	osteometric board, digital calipers, fiber-glass coated measuring tape
Tarsals/Metatarsals	digital calipers

All osteological instruments were used in the same way between the Sadlermiut and Sacred Heart population samples and measurements were taken following standard osteological practices.

3.3.1 Sex Determination

Adult sex assignment for this study was based upon both pelvic and cranial characteristics. The pelvic characteristics used to determine sex were the three traits of Phenice (1969): ventral arc, sub-pubic concavity and the ischiopubic ramus ridge. The greater sciatic notch and the preauricular sulcus were also used as traits to determine sex, as outlined by Buikstra and Ubelaker (1994). Supplementary data from five cranial traits were also used to determine sex: the nuchal crest, the mastoid processes, the supra-orbital margins, the glabella and the mental eminence (Acsadi and Nemeskeri 1970). Each individual was given a score for each trait and determined to be either male or female; however, if sex could not be determined, the individual was regarded as an unknown and omitted from the adult sample of this study.

Sub-adult sex determination was only completed when all three pelvic bones (ilium, ischium and pubis) were fully fused and assessed as being past puberty when pelvic differences become more pronounced between the sexes. This fusion is evident at approximately 15 years for females and 17 years for males (Bogin 2001).

3.3.2 Age Estimation

Age estimation for all adults in this study was based primarily on the analysis of the pubic symphyses. The Todd (1921) and Suchey-Brooks (1990) methods were both used to estimate age based on the morphological changes of the symphseal faces. Both of these aging methods were used in this study in an attempt to avoid the limitations imposed by each method, specifically the lack of sex differentiation with the Todd method and the large age ranges provided by the Suchey-Brooks method. By using the data collected from both aging methods the best possible age estimation was attained. The auricular surface was also assessed to determine age based on the Lovejoy *et al.* (1985) method. This method was used primarily when individuals could not be assessed using either the Todd or Suchey-Brooks methods. If an instance arose where these three aging techniques of the pelvis did not agree, age estimation was based upon the method where the most criteria were fulfilled as outlined in *Standards for Data Collection from Human Skeletal Remains* (1994).

Cranial observations were also used to help determine age at death, specifically cranial suture closure, a method developed by multiple researchers (Buikstra and Ubelaker 1994). The use of cranial suture closure to determine age at death is not as accurate or reliable as pubic aging techniques due to the variation of when the sutures actually fuse (Masset 1989); therefore, this method only supplemented the pelvic methods discussed above.

Sub-adult age at death estimates for these two population samples were based on dental eruption and epiphyseal fusion in the long bones. Dental eruption examination was completed using the dental sequencing diagram developed by Ubelaker (1989) for American Aboriginal populations. Although this dental sequencing diagram is based on American Aboriginal populations, it is still regarded as an accurate assessment of the dental eruption sequence for other archaeological populations (Ubelaker 1989; Smith 2005). Long bone epiphyseal closure was scored based on the idealized timeframe of growth and development established by Scheuer and Black (2000), and through the scoring system established in *Standards for Data Collection from Human Skeletal Remains* (1994). These two aging techniques were used together whenever possible to determine an accurate age at death estimate for all sub-adults. However, if these two aging techniques did not agree with one another, the dental eruption age estimate was used, as it has been argued that dental eruption is less affected by external stress than bones within the body and can be assumed to show a more accurate reflection of age at death (Hoppa and FitzGerald 1999).

3.3.3 Asymmetry Data

Asymmetry data were collected on all of the long bones, tarsals and metatarsals to help assess fluctuating asymmetry as another indicator of stress. These data were collected by measuring both the left and right sides of each BSI located in the arms, legs, tarsals and metacarpals. The measurements taken from the left and right sides were combined in the following equation to provide the percentage of how the left side of the body compared to the right side

$$= \frac{R - L}{R} \times 100$$

R = right side measurement
L = left side measurement

This percentage for each measurement was then inserted into SPSS 16.0 to calculate means and Z-scores. If certain variables fell outside of the acceptable Z-score range of 1.0, it was considered to demonstrate that the asymmetry present between the left and right sides differed significantly from the mean and was of interest for this study.

3.3.4 Lesion Analysis

Data regarding skeletal lesions that indicate stress were also collected from the two population samples with specific emphasis on enamel hypoplastic lesions (EHL), and Harris lines. These lesion data were collected as supplementary data to aid in the final analysis of childhood stress.

EHL were scored based upon the methods discussed by Goodman *et al.* (1984, 1990) with analysis of all permanent teeth, except the third molars. EHL were only recorded if the lesion bands or pits were visible through the use of a magnifying glass and a desk lamp. If dental wear, damage or calculus obstructed the view of the teeth, EHL were not recorded. If EHL were identified on any teeth (mandibular or maxillary), measurements from the lesion to the cemento-enamel junction were taken and recorded in accordance to the method proposed by Swardstedt (1966) to determine the EHL age at formation. The measurements taken were then compared to the age at formation growth chart designed by Swardstedt (1966), as seen in Appendix E, Table E-1, to determine an approximate age of when each EHL was formed on the tooth.

Harris lines were assessed through x-ray analysis on all adult tibiae from both the Sadlermiut and Sacred Heart samples. Left and right complete adult tibiae were used and were x-rayed on an anterior posterior and medial lateral planes to increase the visibility of any possible Harris lines. All Sadlermiut x-rays were taken at the Ottawa Civic Hospital with a Siemens MX DR unit with a source to image distance of 100.0cm. Technical factors used on each image were a kVp value of 50, 3.2 mAs and a 0.6 mm focal spot size. These images were produced by a digital imaging software system, Siemens Diamond view #11, which was specifically formatted for the tibia and fibula using the image algorithm that was a combined high contrast extremity algorithm. All Sacred Heart x-rays were taken at The University of Western Ontario on Kodak X-Sight G/RA high contrast diagnostic film with a Faxitron cabinet x-ray system with a source to film distance of 61.0cm. All x-ray settings remained consistent between each individual with a kVp value of 60, 0.2 mAs, a focal spot of 0.5mm and an exposure time of three seconds. The Harris line x-ray films from the Sacred Heart sample were then scanned into a personal computer and analyzed and measured in Adobe Photoshop using the invert and ruler tool functions. Harris lines were only counted if they fulfilled the two criteria outlined by Maat (1984) and Mays (1995): 1) the lesion must cross over the half-way mark on the tibial shaft and 2) the lesion must be visible in both the anterior posterior x-ray and the medial lateral x-ray. Any Harris lines identified were then measured from the lesion to the distal end of the tibia (see Appendix E, Tables E-2 and E-3) and inserted into the formula below.

$$1.15\,(T-2.33D) \times 100/T$$

T = total length of the mature tibia (including the styloid process)
D = the measurement from the Harris line to the distal end of the tibia
(Byers 1991)

Once calculated, this formula provided a percentage for each Harris line recorded which was then compared to an age at formation chart for males and females as shown in Appendix E, Table E-4 taken from Byers (1991). Because the source to distance measurements were not consistent between samples this caused different magnification of the bone in each sample (Faxitron = 104.3 magnification and Siemens = 102.6 magnification). To compensate for this problem, all Sacred Heart measurements were reduced by 1.7% to equalize the magnification.

3.3.5 Stature Estimates

Stature estimates were calculated for both the Sadlermiut and Sacred Heart samples to be compared to the final BSI analysis of this project. Because stature estimates are often used in bioarchaeology to assess the health of past populations (Haviland 1967; Nickens 1976; Danforth 1994) these estimates will provide another line of evidence to assess stress impact on both population samples. Following the calculation established by Feldesman *et al.* (1990) maximum femur length was inserted into the formula below for each adult individual providing a stature estimate. This formula was used as it has been shown by Feldesman *et al.* (1990) that this ratio can be applied to multiple populations regardless of ethnicity.

Stature (cm) = femur length (cm) x 100 / 26.74

26.74 = mean ratio of femur length to stature across populations
(Feldesman *et al.* 1990)

3.4 Data Analysis

For this research project, two initial analyses were performed: a correlation analysis of cranial measurements from the Howells dataset, and a technical error of measurement (TEM) analysis on the Sadlermiut and Sacred Heart skeletal samples. The Howells dataset and the TEM calculations were primarily used to help validate the goals of this project as well as to verify the accuracy of the metric observations that were collected.

3.4.1 The Howells Dataset

The Howells dataset (1973) is made up of various cranial measurements from different geographic regions, and was investigated in the early stages of this project as a proof of concept that correlations do exist between indicators of body size within the cranium. By using these empirical data to examine these correlations within the body, this project continued forward in an attempt to further establish correlations in the infra-cranial skeleton. However, because the final BSIs examined in this project did not include multiple cranial measurements (see sections 4.3 and 5.3) , the Howells data used in this initial proof of concept study can be found as a separate case study in Appendix F.

3.4.2 Technical Error of Measurement (TEM)

Technical error of measurement (TEM) is a re-check method which is an "accuracy index" to examine the quality of measurements taken by one observer (Knapp 1992; Perini *et al.* 2005). This examination is completed by taking re-check measurements of approximately 20 variables and calculating the relative TEM values for each individual, whereby determining whether or not the relative TEM value falls within an acceptable range of intra-observer error (< 1.5%) (Perini *et al.* 2005). Both relative and absolute TEM values must be calculated in order to assess the intra-observer error. Illustrated in Table 3.6 below are the equations used to calculate absolute TEM and relative TEM.

Table 3.6
Test of error measurement (TEM) calculations

Calculation	Equation
Absolute TEM	$\sqrt{\frac{\sum di^2}{2n}}$
Relative TEM	$\frac{TEM}{VAV} \times 100$

$\sum d^2$ = summations of deviations raised to the second power
n = total number of variables
i = the number of deviations
TEM = technical error of measurement expressed in %
VAV = variable average value
(Perini *et al.* 2005)

For this project, TEM calculations were completed for 10 random adult individuals (five males and five females) and five random sub-adults individuals from both the Sadlermiut and Scared Heart samples. Below in Tables 3.7 and 3.8 are the results of the TEM calculations for both groups.

Table 3.7
Sadlermiut TEM calculations

Skeleton #	Sex	Adult/Sub-adult	Absolute TEM	Relative TEM (%)	Acceptable?	Comments
XIV-C:112	F	Adult	0.87	1.21	YES	
XIV-C:149	F	Adult	0.71	1.12	YES	
XIV-C:192	F	Adult	0.70	1.05	YES	
XIV-C:219	F	Adult	0.61	0.89	YES	
XIV-C:104	F	Adult	2.72	4.11	NO	
XIV-C:126	M	Adult	0.92	1.37	YES	
XIV-C:156	M	Adult	2.52	3.52	NO	
XIV-C:157	M	Adult	0.59	0.86	YES	
XIV-C:216	M	Adult	0.93	1.29	YES	
XIV-C:117	M	Adult	1.11	1.56	NO	
XIV-C:158	?M	Sub-adult	0.64	1.01	YES	

Table 3.7 continued

XIV-C:146	M	Sub-adult	0.99	1.47	YES	
XIV-C:193	M	Sub-adult	1.83	2.67	NO	
XIV-C:220	?	Sub-adult	0.66	1.14	YES	N=16
XIV-C:76	?	Sub-adult	1.09	1.73	NO	N=10

Range of acceptability for Relative TEM < 1.5 %
(XIV-C:220 and 76 have a reduced N-value due to missing skeletal elements)

Table 3.8
Sacred Heart TEM calculations

Skeleton #	Sex	Adult/Sub-adult	Absolute TEM	Relative TEM (%)	Acceptable?	Comments
120	F	Adult	0.75	1.05	YES	N=19
5	F	Adult	0.92	1.54	NO	N=19
124B	F	Adult	0.58	1.03	YES	N=19
71	F	Adult	0.66	0.97	YES	
24	F	Adult	0.62	0.97	YES	N=19
33	M	Adult	0.55	0.75	YES	N=19
145	M	Adult	0.69	0.99	YES	
30	M	Adult	0.43	0.56	YES	
64	M	Adult	0.92	1.24	YES	
83	M	Adult	0.68	0.94	YES	
63	M	Sub-adult	0.39	0.69	YES	N=19
90	F	Sub-adult	0.65	1.01	YES	
66A	?	Sub-adult	0.72	1.76	NO	N=6
12	?	Sub-adult	0.54	0.87	YES	N=17
67	?	Sub-adult	0.43	0.92	YES	N=13

Range of acceptability for Relative TEM < 1.5%
(Skeleton #s 120, 5, 124B, 24, 33, 63, 66A, 12 and 67 have reduced N-values due to missing skeletal elements)

As shown above, the majority of these TEM calculations demonstrated that measurements taken for this study fell within the acceptable range. However, in the cases where this acceptability was not achieved, possible sources of error may include: difficulty in identifying specific skeletal landmarks where measurements were taken, the time of day the measurements were taken, or post-mortem damage to the remains. Rather than reduce the total number of individuals analyzed and therefore, the number of possible comparisons in this study, no individuals were omitted; however, results using the individuals who did not meet the TEM standards will be examined carefully with regard to these particular measurements.

3.4.3 Correlation of Sadlermiut and Sacred Heart BSI Measurements

Statistical correlation is defined as a measure of the linear relationship between two variables which either demonstrates a strong relationship or a loosely associated relationship depending upon how the variables interact with one another (Banning 2000). The purpose of determining correlation among BSIs for this project was to identify specific, highly correlated measurements that would provide the best possible suite of BSIs to examine childhood stress episodes. Also, because this project hopes to address stress differences between females and males, sex specific correlation matrices were calculated for both the Sadlermiut and Sacred Heart samples to determine if similar BSIs were correlated within the male and female sub-samples. BSI measurements were first divided into skeletal element and compared to one another (cranial, vertebral, arms, legs and tarsals/metacarpals). In order to determine which BSIs were the most highly correlated within each skeletal element grouping, only BSIs that were correlated at the 0.05 or 0.01 level of significance to at least two other BSI measurements were considered for the final BSI list.

After this preliminary correlation analysis, the BSIs that were selected from each skeletal element grouping were compared by sex and population to determine the best overall BSIs (that is, showed strong correlation to most other BSIs) that equally represented both population samples. When possible, redundant BSI measurements were removed from the study (i.e. midshaft circumference vs. minimum midshaft circumference). In instances such as this, to decide which BSI should be removed, results from the preliminary skeletal element correlation analysis were used and the BSI showing the best correlation to other measurements was kept in this study while the other, less strongly correlated measurement was omitted. To reduce the BSI measurement list further, anterior posterior and medial lateral measurements of limb bones were used to calculate the cross-sectional area of the bone. Because many of these skeletal elements were not rectangular in nature, the area of an ellipsis was calculated using the following formula:

$$A = \Pi/4(L \times W)$$

A = area of ellipsis
Π = 3.14
L = length
W = width
(Nelson 1995)

Once the final BSI list was compiled for both males and females, a final correlation analysis was done to ensure that all BSI measurements chosen were correlated to one another, and also that the measurements chosen matured at various times during the growth and development period.

3.4.4 r-values and Significant Association

After correlation analysis was complete and the most highly correlated BSIs were established, each BSI was then put into a chronological pairing based upon the maturation timing of each BSI (V1:V2, V1:V3, V1:V4...). After this chronological variable pairing, r-values were then calculated to determine the significant association between each BSI measurement in a pairing and how much of the variability in the sample could be explained through the line of best fit (Sokal and Rohlf 1981). The r-value was an important tool for this project as it explained the probability of these correlations happening by chance alone through a measure of interdependence. The r-squared value, also known as the coefficient of determination, determined the variation of Y explained by X and whether X could significantly explain the pattern of Y (Sokal and

Rohlf 1981). The underlying assumption here was that if these individual BSIs are highly correlated to body size, then they should also be highly correlated with each other.

To determine the r-values, each sample was divided by sex and tested separately through the SPSS 16.0 regression function. r-values and r-squared values were both recorded, as well as the t-test significance value to determine if the slope of the linear relationship was significantly different from zero. If the t-test significance value fell below 0.05, then the null hypothesis (H_0 = no relationship exists between BSI X and BSI Y) was rejected suggesting that there was a true relationship between the two BSIs being tested. However, if the significance value was above 0.050, then the null hypothesis was accepted demonstrating that no true relationship existed between the two BSIs. All tests of correlation between variable pairs in which the null hypothesis was rejected were then used in the final regression analysis of this project to determine episodes of stress and the timing of that specific stress.

3.4.5 Examination of Individual Departures from Underlying Trends

The examination of individual departures from underlying trends was undertaken using regression analysis. Much like correlation, regression analysis examines the relationship between variables; however, while correlation establishes the strength of a relationship, regression analysis determines the nature of that relationship (Shennan 1997). The nature of the BSIs and how they interact with one another becomes an important consideration for this study in the establishment of a new methodology, and can be used to identify individuals who depart from the expected relationships among different BSIs. In order for a new methodology to be developed using BSIs, the interconnected nature of the skeleton must be well-established to help better understand the effects of stress. As discussed by Shennan (1997), the use of statistics in archaeology allows researchers to empirically observe patterns in past populations rather than just assuming that these patterns exist (Shennan 1997), which is paramount for this research project.

For this analysis, regression analysis was completed for each adult sample further divided by sex, as it is well documented that males and females grow and develop at different rates (Frayer and Wolpoff 1985; Bogin 2001). Though the use of SPSS 16.0, BSI measurements were examined in successive chronological pairs with the younger maturing BSI always positioned on the X-axis and the later maturing BSI positioned on the Y-axis. 95% confidence intervals were also calculated during regression analysis to demonstrate the pattern of dispersal for the majority of individuals to use as a landmark for the determination of departures from the underlying trend. By examining the BSIs in successive chronological pairs it was possible to determine when individuals initially fell outside the confidence intervals and when they returned to the predicted trajectory of their sub-sample. By manipulating the regression output calculated by SPSS, the data for each individual were then arranged into a regression summary to identify the specific periods when individuals had negative residuals (below the confidence interval) and positive residuals (above the confidence interval) and the severity of these fluctuations. It was expected that this summary would illustrate a clear timeline of growth disruption or acceleration that could be used to examine periods of stress; unfortunately, this clarity was not achieved. In an attempt to compensate for this lack of clarity these regression summaries were again re-arranged into growth fluctuation pattern maps for each individual.

3.4.6 Growth Fluctuation Pattern Maps and Expectations

In order to assess the patterns of growth disruption and growth acceleration pattern maps were used to pinpoint significant growth fluctuations. These patterns maps provided a visual representation of the growth fluctuation occurring in each individual and the timeline of when these growth fluctuations began and finished. To calculate the age ranges of these growth fluctuations, specific focus was placed upon the Y variable. The Y variable in all BSI pairings was the later maturing variable; therefore, while the Y variable still had the capacity to fluctuate above or below the confidence intervals, the X variable would have already achieved its final adult outcome and no longer had the capacity to grow. Therefore, the X variable provided the lower limit of the age range while the Y variable provided the upper limit of this age range. Because growth fluctuation may occur naturally within the skeleton as an individual grows and develops, the identification of significant fluctuations was achieved through an examination of the overlapping age ranges of negative and positive residuals in each individual. This examination of overlapping fluctuation patterns demonstrated significant periods of disruption and acceleration. Therefore, by examining the patterns of when the age ranges from multiple BSIs pairs overlapped, the timeframe of when growth disruption and acceleration most commonly occurred in each individual was narrowed down.

With regards to normal growth fluctuations it was assumed that isolated growth disruption or acceleration periods departing from the sub-sample trends were mere "noise" and did not directly contribute to the establishment of an accurate timeline of disruption or acceleration. Because the age ranges between each BSI pair could be quite large depending on when the Y variable reached maturation, this fluctuation "noise" was inevitably created. However, once these age ranges of disruption and acceleration were narrowed down by analyzing the overlapping age ranges of BSI pairs this "noise" was diminished and presumably did not affect the overall growth fluctuation patterns of this study.

3.4.7 Skeletal Sequencing and Growth Curves

It is well established in bioarchaeology that no two populations grow and develop in exactly the same manner (Eveleth and Tanner 1976; Hoppa and FitzGerald 1999; Bogin 2001). These differences in growth and development can be attributed to many different factors such as sex, genetics, nutrition, climate and status; therefore, the creation of a universal growth curve for all skeletal elements is virtually impossible (Eveleth and Tanner 1976; Hoppa and FitzGerald 1999; Bogin 2001). Because populations can be stressed by various factors, the age at which adult maturation occurs for specific skeletal elements will change between populations; however, the sequencing of when these elements reach maturation should remain the same (Humphrey 1998). The reason behind this universal sequencing pattern is the mechanism of how bones initially form. It has been suggested that the bones of the human body form in response to the overlying soft tissues, and because certain soft tissues must mature before others, it can be assumed that the underlying skeletal structure should also mature in a predictable way (Rosenfield 1996; Humphrey 1998; Scheuer and Black 2000).

For this study, skeletal sequencing becomes an important consideration for the establishment of idealized growth curves, as the timing of this sequencing within cold climate populations and temperate climate populations will allow for the refinement of the age range of when stress occurred. To create these idealized growth curves, a standard timeframe of skeletal growth maturation was compiled using Scheuer and Black (2000). This standard, as seen in Appendix J, Table J-3, is an idealized prediction of how all humankind should grow and develop. The sub-adult data collected from both the Sadlermiut and Sacred Heart samples were tested against this idealized prediction of growth and development to demonstrate how these specific populations grew in comparison to the ideal. By plotting the various sub-adult BSI measurement data, a proportional growth curve of each sample emerged demonstrating when each BSI reached adult maturity. To establish this proportionate scale, a sample-specific average was calculated from all adult measurements of each BSI to determine the 100% mark to which all other measurements would be compared (cf. Thompson and Nelson 2000). All sub-adult measurements were then converted into a percentage and compared to the adult average to determine the age of maturation for each BSI in both population samples. This population specific growth curve could then be compared back to the idealized patterns outlined by Scheuer and Black (2000) to determine the differences in the age at maturation of each BSI measurement. The importance of this sample calibration was to provide an accurate age estimation of when stress affected the skeleton; by incorporating both sample specific and idealized data.

The argument can be made that these idealized growth curves are created based upon healthy standards, and therefore using deceased sub-adults as calibration tools would not reflect the patterns of healthy children, even in ancient populations. With regards to the Sadlermiut and Sacred Heart samples, all steps were taken to examine sub-adult remains that lacked any outward signs of pathological lesions in an attempt to create the best possible sample specific growth curve. However, it is recognized that these children may have been exposed to stress that did not have adequate time to manifest within the skeleton before the time of death, as discussed in Chapter 2, section 2.4.1.

CHAPTER 4: RESULTS

4.1 Introduction

The purpose of this chapter is to outline the results of this project, with specific emphasis on the similarities and differences between the Sadlermiut and Sacred Heart population samples. Beginning with an overview of the correlation and regression analyses, followed by a discussion of the supplementary lesion and growth and development data, this chapter will provide the information needed to further discuss and explore stress within these two population samples.

4.2 Proof of Concept: The Howells Dataset

Correlation analysis was used for this study after the initial establishment of correlation and proof of concept among BSIs within the cranium using the Howells dataset. As discussed in Appendix F, Tables F-1, F-2 and F-3, the examination of the Buriat Siberian sample, the Inugsuk Greenland sample and the Early Arikara South Dakota sample all demonstrated significant correlations between the six cranial BSIs chosen from the body size literature (maximum cranial length, upper facial height, maximum orbital height, maximum orbital breadth, biorbital breadth and foramen magnum length). These significant correlations were important to establish first, that relationships between BSIs existed and second, that they were consistent between populations. From this initial analysis it was evident that significant correlations did exist between specific BSIs; however, the BSIs that did show correlation did not seem to be consistent across these samples. While most of the cranial variables in these three sample groups were correlated in a similar way, there was some variability in the correlation results. All three population samples were however, analyzed with both sexes combined which may explain why some correlations were not as strong between certain BSIs. Overall the use of the Howells dataset provided the necessary data to establish that correlation patterns among BSIs within the cranium do exist so that further investigation into the infra-cranial skeleton could be undertaken.

4.3 Sadlermiut and Sacred Heart Correlations

From this initial proof of concept, the Sadlermiut and Sacred Heart adult BSI measurements were then inserted into correlation matrices that were divided first by population sample and then by sex, in an attempt to create cohesive sub-samples for analysis. These sub-samples were then divided by skeletal element as shown in Appendix G, Tables G-1 to G-20. Through these complete matrices, certain BSIs were shown to have significant correlations while others did not; therefore, the significantly correlated BSIs that were correlated to at least two other BSIs were chosen from each skeletal grouping and were analyzed in a final correlation matrix seen in Appendix G, Tables G-21 and G-22. The final list of these BSIs measurements is shown below in Table 4.1.

Table 4.1
Sadlermiut and Sacred Heart adult BSI measurements chosen after final correlation filtering

FEMALES	MALES
3. Upper facial breadth	3. Upper facial breadth
4. Biorbital breadth	20/21. C7 superior surface area
11. Maximum cranial height	22/23. T12 superior surface area
12/13. Foramen magnum area	24/25. L1 superior surface area
14. Interorbital breadth	26/27. L5 superior surface area
17. Maximum breadth of the mandible	28. Sacrum anteroposterior diameter of superior surface
24/25. L1 superior surface area	32. Bi-iliac breadth
26/27. L5 superior surface area	34. Midshaft circumference
28/29. Sacrum superior surface area	37. Distal joint breadth
33. Maximum humerus length	39. Capitual height
34. Midshaft circumference	40. Maximum ulna length
37. Distal joint breadth	42. Transverse diameter of radius head

Table 4.1 continued

38. Anteroposterior diameter of head	44. Maximum superior/inferior diameter of head
39. Capitual height	45. Femur head breadth
40. Maximum ulna length	48. Biepicondylar diameter of distal femur
41. Maximum radius length	50. Maximum femur length
44. Maximum superior/inferior diameter of head	52. Midshaft width
45. Femur head breadth	53. Maximum tibia length
48. Biepicondylar diameter of distal femur	55. Proximal tibia breadth
50. Maximum femur length	56/57. Talar facet area
51. Midshaft circumference	58. Anteroposterior diameter of proximal tibia
53. Maximum tibia length	59. Tibia midshaft width
57. Transverse diameter of talar facet	60. Maximum fibula length
59. Tibia midshaft width	62. Patella maximum breadth
60. Maximum fibula length	64. Maximum length of calcaneus
64. Maximum length of calcaneus	65. Posterior length of calcaneus
66. Maximum length of talus	68. Articulated height of calcaneus/talus
TOTAL BSIs = 27	**TOTAL BSIs = 27**

It becomes clear from this final BSI list, that males and females demonstrated different patterns of significant correlations among these BSI measurements. Females showed far more correlation among cranial variables, while males demonstrated more correlation within the vertebral column. Males also demonstrated higher BSI correlations within the foot bones. It is important to note that these trends in sex differences appeared to be consistent across both population samples.

4.4 r-values and Significant Association

Once the final set of 27 BSIs was culled from the original dataset, these variables were re-numbered into their chronological maturation order (Appendix H, Tables H-1 and H-2) facilitating further exploration into variable correlation via r and r-squared values shown in Appendix H, Tables H-3, H-4, H-5 and H-6. By calculating the r and r-squared values for each of the BSI pairs, the null hypothesis (H_0 = no relationship exists between BSI X and BSI Y) was either accepted or rejected. Below Table 4.2 illustrates the percentage of variable pairs for each population that demonstrated significant association. These variable pairs from each sub-sample were then further manipulated through regression analysis.

Table 4.2
Sadlermiut and Sacred Heart variable pairs demonstrating significant association (%)

	Females	Males
Sadlermiut	47	40
Sacred Heart	38	39

The Sadlermiut sub-sample, in general, showed a larger number of variable pairs that demonstrated significant association, with the Sadlermiut females demonstrating more significantly associated variable pairs than the males. While the preliminary correlation matrices demonstrated that females and males do not necessarily show the same correlation patterns in all skeletal elements, the final variables pairs in each sub-sample demonstrating significant association diminished these differences allowing for similar BSIs to be compared in both sexes.

4.5 Growth Curve Data

The importance of establishing a population specific growth curve was to aid in the overall designation of the age at which a stress event would have occurred by examining whether the sample specific growth curves were similar to the idealized Scheuer and Black model. To create these sample specific growth curves, data were collected on sub-adults from each sample to calibrate the idealized growth curve as show below in Tables 4.3 and 4.4.

Table 4.3
Sadlermiut and Sacred Heart female sub-adult calibration summary

	Age at Maturation (years)		
Body Size Indicators	**Scheuer and Black**	**Sadlermiut Calibration**	**Sacred Heart Calibration**
3. Upper facial breadth	3.0	8.0	19.0
4. Biorbital breadth	3.0	8.0	19.0
66. Maximum length of talus	9.0	10.5	19.0

Table 4.3 continued

28/29. Sacrum superior surface area	10.0	17.5	19.0
37. Humerus distal joint breadth	11.0	17.5	19.0
39. Humerus capitual height	11.0	17.5	19.0
33. Maximum humerus length	11.5	17.5	19.0
34. Humerus midshaft circumference	12.0	17.5	19.0
59. Tibia midshaft width	12.0	10.0	19.0
51. Femur midshaft circumference	12.0	10.0	19.0
11. Maximum cranial height	13.0	8.0	9.0
14. Interorbital breadth	13.0	10.0	9.0
17. Maximum breath of the mandible	13.0	10.5	19.0
12/13. Foramen magnum area	13.5	10.5	9.0
44. Femur max. superior/inferior diameter of head	14.0	10.5	19.0
45. Femur head breadth	14.0	10.5	19.0
50. Maximum femur length	14.0	10.5	19.0
60. Maximum fibula length	14.0	17.5	19.0
38. Humerus anteroposterior diameter of head	15.0	17.5	19.0
53. Maximum tibia length	15.0	10.5	19.0
57. Tibia transverse diameter of talar facet	15.0	10.5	9.0
41. Maximum radius length	15.0	17.5	19.0
64. Maximum length of calcaneus	15.5	17.5	9.0
40. Maximum ulna length	16.0	17.5	9.0
48. Biepicondylar diameter of distal femur	16.0	10.0	19.0
24/25. L1 superior surface area	20.0	17.5	19.0
26/27. L5 superior surface area	20.0	17.5	9.0

Table 4.4
Sadlermiut and Sacred Heart males sub-adult calibration summary

	Age at Maturation (years)		
Body Size Indicators	**Scheuer and Black**	**Sadlermiut Calibration**	**Sacred Heart Calibration**
3. Upper facial breadth	3.0	19.5	19.0
20/21. C7 superior surface area	4.5	18.5	15.5
28. Sacrum anterior height of first segment	10.0	19.5	15.5
34. Humerus midshaft circumference	12.0	18.5	15.5
52. Femur midshaft width	12.0	19.5	15.5
59. Tibia midshaft width	12.0	18.5	15.5
37. Humerus distal joint breadth	13.5	19.5	15.5
39. Humerus capitual height	13.5	18.5	19.0
62. Patella maximum breadth	16.0	19.5	19.0
42. Transverse diameter of radius head	16.5	18.5	15.5
56/57. Talar facet area	16.5	18.5	19.0
60. Maximum fibula length	17.0	18.5	19.0
44. Femur max. superior/inferior diameter of head	17.5	18.5	19.0
45. Femur head breadth	17.5	19.5	15.5
48. Biepicondylar diameter of distal femur	17.5	18.5	15.5

Table 4.4 continued

50. Maximum femur length	17.5	18.5	19.0
53. Maximum tibia length	18.4	19.5	19.0
55. Proximal tibia breadth	18.4	18.5	15.5
58. Anteroposterior diameter of proximal tibia	18.4	18.5	15.5
40. Maximum ulna length	18.5	19.5	15.5
64. Maximum length of calcaneus	19.0	19.5	19.0
65. Posterior length of calcaneus	19.0	19.5	19.0
68. Articulated height of calcaneus/talus	19.0	18.5	15.5
22/23. T12 superior surface area	20.0	19.5	19.0
24/25. L1 superior surface area	20.0	19.5	19.0
26/27. L5 superior surface area	20.0	18.5	19.0
32. Bi-iliac breadth	21.5	17.5	no data

* *no data refers to when no sub-adult data was available for that BSI*

Because many of the sub-adult individuals did not reach the 100% mark of adult size, the highest percentage of adult growth attained was accepted as the best possible representation of adult size. The age at which this highest percentage of adult size was achieved was then recorded as the age of adult maturation as shown in Appendix J, Tables J-4, J-5, J-6 and J-7. From the data collected, the Sadlermiut female BSIs consistently matured earlier than the Sacred Heart female BSIs but in the male sub-samples both groups showed similar BSI maturation ages. Unfortunately, due to missing data and the small sample size of sub-adult individuals, there were many gaps within these population growth curves, particularly the Sacred Heart females. Without an equal representation of individuals at all stages of growth and development the creation of these growth curves were limited to data pertaining only to older sub-adult individuals. Therefore, it appeared that all BSIs matured at a later age than predicted in the idealized growth curve, as there were not enough data from younger individuals to accurately assess the age of adult maturation. Also, because sub-adult individuals cannot be sexed accurately this may also have biased the results in terms of defining the age of maturation, as females consistently mature earlier than males. Although consistencies between the idealized growth curve and the sample specific growth curves did exist, there were too many gaps to avoid the use of the idealized growth curve. Therefore, the idealized growth curve was accepted as the best possible representation of normal growth sequencing in these two samples and the sample specific data was largely avoided due to significant gaps in the dataset.

4.6 Examination of Individual Departures from Underlying Trends

Regression analysis was used for this study to assess stress in each population sample as well as in each individual to examine the departures from the underlying trends. By analyzing the specific timing of when individuals fell outside the confidence intervals of the rest of their sub-group, the age range in which a stress event occurred was determined. Through a further examination of the BSIs affected by stress within each of these sub-sample groups, further insight into the potential causes of stress was gained. In order to manipulate each of these variables through regression analysis as simply as possible, each BSI was assigned a number according to its chronological maturation and paired in sequential order to all other BSIs (V1:V2, V1:V3, V1:V4...). Appendix I, Figures I-1, I-2, I-3 and I-4 illustrate the original regression analyses of all variable pairs in each sub-sample. Appendix K, Tables K-1, K-2, K-3 and K-4 provide the regression summary data of these analyses by documenting the individuals who fell above (+) or below (-) the confidence intervals in each variable pairing. Through the combination of these two data sources described, a final growth fluctuation pattern map was created for each individual to illustrate the specific age ranges of growth disruption and growth acceleration, as shown in Appendix K, Tables K-5, K-6, K-7 and K-8. These growth fluctuations are briefly summarized for each individual in Appendix K (K-9). Below is an example of how these growth fluctuations were interpreted, with specific emphasis on the patterns of growth disruption and growth acceleration.

4.6.1 Growth Fluctuation Pattern Map Interpretation

This section will focus on how the growth fluctuation pattern maps were interpreted for each adult individual to determine periods of growth disruption, growth acceleration and periods of normal fluctuation (noise), as outlined previously in Chapter 3, section 3.4.6. Individual XIV-C:155 (see Table 4.5) will be used as an example from the Sadlermiut female sub-sample to describe the interpretation of these growth fluctuation pattern maps.

XIV-C:155

XIV-C:155 showed growth acceleration during the early years of childhood, with the Y variable of these first four pairings maturing at various ages. Three of these four maturation ages were over 10 years of age, establishing a large age range of growth acceleration. As discussed in section 3.4.6, although the Y variable, compared to the earlier maturing X variable, may produce a large age range of acceleration this needs to be further narrowed by examining the overlapping patterns of different variable pairings to one another. From the data collected on these first four variable pairings, acceleration appeared to have occurred between three and 20 years of age. However, this age range was too broad to accurately identify the specific period of acceleration; therefore, further investigation was required to narrow down this timeframe of acceleration. Following this period of early growth acceleration was a more clearly defined period of growth disruption between the ages of 11 and 15 years. This age range of growth disruption was established by examining when the disruption patterns of each variable pair most frequently overlapped. Although some of the variable pairs showed disruption beginning before 11 years (established from the X BSI) and continued after 15 years (established from the Y BSI), the most common period for all of these pairings to overlap was between 11 and 15 years. The main variables that were affected by this disruption were the maximum femur length, fibula length and the humeral head. During this period of growth disruption, there was also evidence of growth acceleration in V8, V9, V11, V16, V18 and V23 (humerus midshaft circumference, tibia midshaft width, maximum cranial height, femur head breadth, maximum fibula length and maximum calcaneus length) between the ages of 12 and 15 years. The determination of whether growth disruption or acceleration was significant and not merely extra "noise" was made if: 1) multiple variable pairings demonstrated a similar age range of confidence interval deviation, or 2) the same Y variable showed similar fluctuations in multiple variable pairings. Interestingly, XIV-C:155 showed both types of significant deviation. During her growth acceleration period between 12 and 15 years multiple variable pairs showed a similar time frame of stress with the different Y variables reaching maturity at a similar time, while her final acceleration period that occurred between 15 and 20 years was characterized by the same two Y variables (V26 and V27) being affected in multiple pairings. Overall, it became clear that XIV-C:155 had multiple growth fluctuations during her growth and development period. Although she did experience early childhood acceleration before 10 years of age, when comparing that early data with the acceleration data between 12 and 15 years, it was clear that this early childhood fluctuation was merely "noise." This early period of acceleration did not have significant overlap in the early years of growth but did fall into the overlapping pattern of the second acceleration period between 12 and 15 years. Therefore, this individual exhibited, early childhood "noise" followed by a period of disruption between 11 and 15 years with corresponding acceleration between 12 and 15 years concluding with a final period of acceleration between 15 and 20 years. It was possible to distinguish these two separate periods of acceleration in this individual as the Y variables of these overlapping pairings showed two distinct stop periods at 15 and 20 years of age. XIV-C:155 was an individual who demonstrated considerable fluctuation above and below the 95% confidence interval for the Sadlermiut female sub-sample. As a result of this continuous fluctuation during the years of growth and development, it was not surprising that her overall stature was short when compared to the rest of the Sadlermiut female sub-sample. While the average stature estimate for the Sadlermiut females was 151.86cm, the stature estimate for XIV-C:155 was 150.00cm, suggesting that perhaps continual growth disturbance and acceleration during her maturation may have affected her overall achieved stature.

Table 4.5
XIV-C:155 growth fluctuation pattern map

Age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V2	+																	
V1:V4	+	+	+	+	+	+	+	+										
V1:V11	+	+	+	+	+	+	+	+	+	+	+							
V2:V26	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V3:V7							-	-	-									
V3:V8							+	+	+	+								
V3:V15							-	-	-	-	-	-						
V3:V17							-	-	-	-	-	-						
V3:V18							-	-	-	-	-	-						
V3:V19							-	-	-	-	-	-	-					
V3:V20							-	-	-	-	-	-	-					
V3:V22							-	-	-	-	-	-	-					
V3:V24							-	-	-	-	-	-	-	-				
V4:V6								+	+									
V4:V7								-	-									
V4:V8								+	+	+								
V4:V9								+	+	+								
V4:V11								+	+	+	+							

Age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V4:V19								-	-	-	-	-	-					
V4:V22								-	-	-	-	-	-					
V4:V26								+	+	+	+	+	+	+	+	+	+	+
V5:V6									+									
V5:V8									+	+								
V5:V22									-	-	-	-	-					
V5:V24									-	-	-	-	-	-				
V5:V27									+	+	+	+	+	+	+	+	+	+
V6:V7									-									
V6:V8									+	+								
V6:V17									-	-	-	-						
V6:V18									-	-	-	-						
V6:V19									-	-	-	-	-					
V6:V20									-	-	-	-	-					
V6:V22									-	-	-	-	-					
V6:V24									-	-	-	-	-	-				
V7:V8									+	+								
V7:V9									+	+								
V7:V15									-	-	-	-						
V7:V16									+	+	+	+						
V7:V18									+	+	+	+						
V7:V23									+	+	+	+	+					
V7:V26									+	+	+	+	+	+	+	+	+	+
V7:V27									+	+	+	+	+	+	+	+	+	+
V8:V15										-	-	-						
V8:V19										-	-	-	-					
V8:V20										-	-	-	-					
V8:V22										-	-	-	-					
V8:V24										-	-	-	-	-				
V9:V10										-								
V9:V20										-	-	-	-					
V9:V22										-	-	-	-					
V10:V15										-	-	-						
V10:V16										+	+	+						
V10:V22										-	-	-	-					
V10:V24										-	-	-	-	-				
V15:V16												+						
V15:V23												+	+					
V16:V17												-						
V16:V18												-						
V16:V19												-	-					
V16:V20												-	-					
V16:V21												-	-					
V16:V22												-	-					
V16:V24												-	-	-				
V17:V22												-	-					
V17:V23												+	+					

Age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V17:V24												-	-	-				
V17:V26												+	+	+	+	+	+	+
V18:V20												-	-					
V18:V22												-	-					
V18:V24												-	-	-				
V19:V23													+					
V20:V23													+					
V20:V26													+	+	+	+	+	+
V21:V23													+					
V21:V26													+	+	+	+	+	+
V22:V23													+					
V22:V26													+	+	+	+	+	+
V22:V27													+	+	+	+	+	+
V23:V24													-	-				

By describing in detail the fluctuation patterns of XIV-C:155, it is possible to understand the underlying mechanics of how these individual growth fluctuation pattern maps help to clarify and identify the disruption and acceleration patterns seen in these population samples which contributes to the osteobiography of each individual (Saul and Saul 1989). Below is a growth fluctuation summary describing the general trends of disruption and acceleration that were observed in the Sadlermiut and Sacred Heart sub-samples.

4.6.2 Growth Fluctuation Summary

Although there were subtle differences between each of the four sub-samples in regards to growth disruption and acceleration, particular patterns did emerge between the males and females as shown below in Tables 4.6 and 4.7.

Table 4.6
Sadlermiut and Sacred Heart female average age of growth disruption and acceleration

	Disruption (-)	Acceleration (+)
Sadlermiut	11.0-15.0	15.0-20.0
Sacred Heart	9.0-16.0	9.0-15.0

Table 4.7
Sadlermiut and Sacred Heart male average age of growth disruption and acceleration

	Disruption (-)	Acceleration (+)
Sadlermiut	12.0-17.0	12.0-17.0
Sacred Heart	12.0-17.0	12.0-17.0

As shown here, the Sadlermiut and Sacred Heart males both had similar patterns of combined growth disruption and acceleration occurring between 12 and 17 years of age. The females of these samples however, showed far less consistent fluctuation patterns; the Sadlermiut females experienced growth disruption beginning at 11 years of age, while the Sacred Heart females experienced disruption at nine years of age. The Sadlermiut females also showed later growth acceleration than the Sacred Heart females beginning at 15 years of age. Also important to note when comparing these four different sub-samples, is the average number of variables pairs that either fell above or below the confidence intervals established for each sub-sample. As mentioned above, of the variable pairings in each sub-group, only a certain percentage of these pairs fluctuated either above or below the confidence intervals. Below in Table 4.8 is a summary of each of the four sub-samples used in this study.

Table 4.8
Sadlermiut and Sacred Heart male and female average number of variable pairs demonstrating disruption or acceleration (%)

	Females	Males
Sadlermiut	31	27
Sacred Heart	22	24

As illustrated here, the Sadlermiut female sub-sample showed the highest frequency of fluctuation among variable pairs per individual, followed by the Sadlermiut males, the Sacred Heart males, and finally the Sacred Heart females.

4.7 Supplementary Data Analysis

The primary purpose of collecting supplementary data (EHL, Harris lines, asymmetry data and stature estimates) from both population samples was to examine stress from a broad perspective, using both lesion-based and growth and development-based methods of stress analysis.

4.7.1 Enamel Hypoplastic Lesions

As discussed, EHL are important indicators of early childhood stress, and data were collected on all available adult teeth for each individual. The EHL age at formation data for the Sadlermiut and Sacred Heart samples is seen below in Tables 4.9 and 4.10 with a graphic representation illustrated in Figures 4.1 and 4.2.

Table 4.9
Sadlermiut EHL age at formation

Skeleton #	Sex	# of Lesions	EHL Age at Formation (yrs)
XIV-C:246	M	3	3.3, 3.5, 5.0
XIV-C:243	M	4	3.5, 3.7, 4.7, 5.0
XIV-C:182	M	7	2.7, 3.3, 3.5, 3.7, 4.0, 4.3, 4.5
XIV-C:181	M	4	2.7, 4.0, 4.3, 5.0
XIV-C:155	F	1	4.0
XIV-C:117	M	6	2.0, 2.5, 3.3, 3.5, 4.0, 4.5
XIV-C:111	M	2	2.7, 3.1

(following Goodman *et al.* 1980, modified from Swardstedt 1966)

Table 4.10
Sacred Heart EHL age at formation

Skeleton #	Sex	# of Lesions	EHL Age at Formation (yrs)
33	M	1	2.0
71	F	1	3.5
139	M	5	2.0, 3.0, 3.5, 4.0, 4.5

(following Goodman *et al.* 1980, modified from Swardstedt 1966)

Figure 4.1

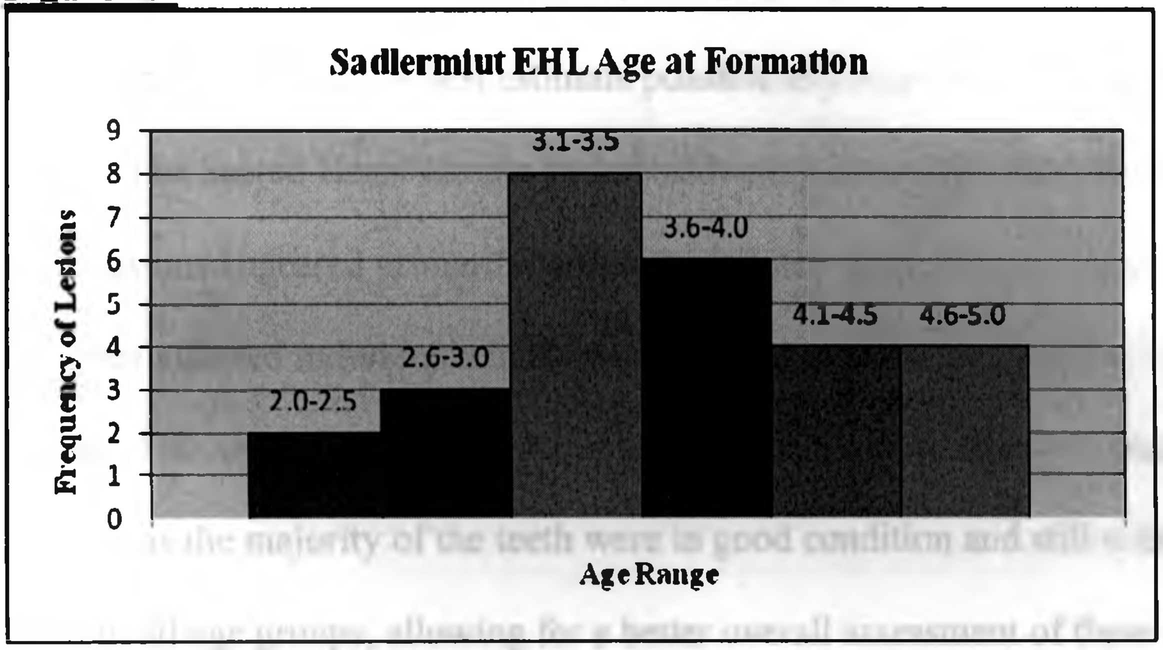
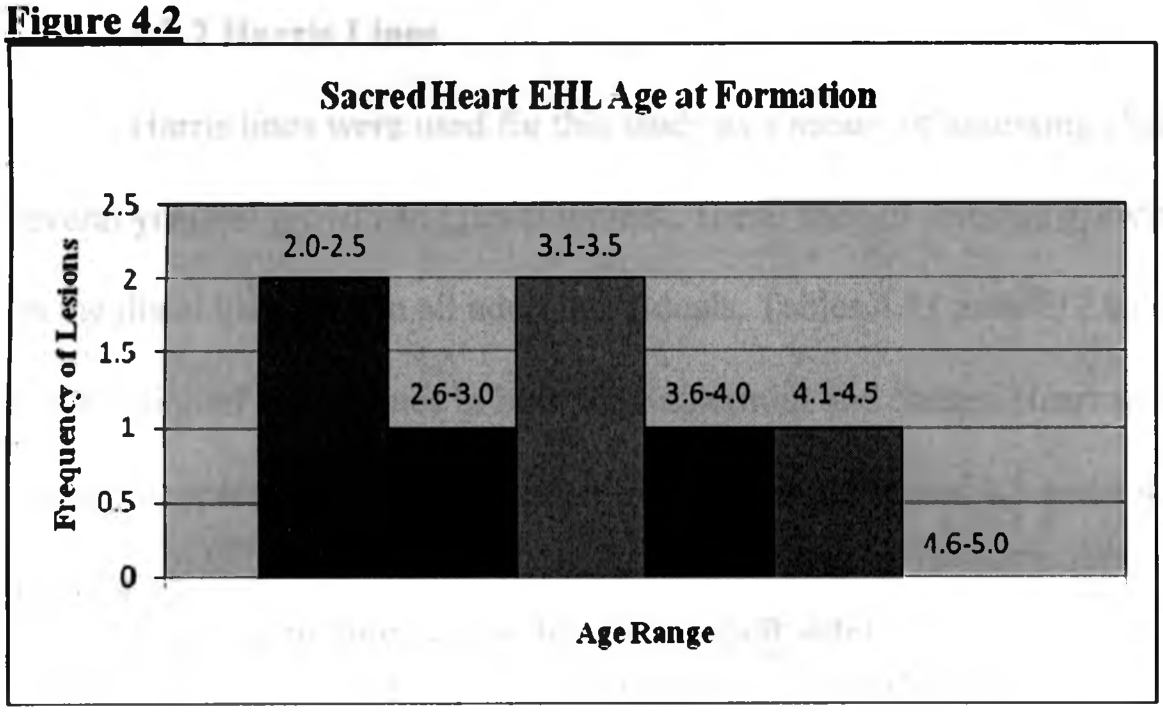


Figure 4.2



The Sadlermiut sample, in comparison to the Sacred Heart sample, demonstrated a higher frequency of EHL with all of these stress events occurring under the age of five years between the infancy and childhood stages of growth and development. Seven individuals from the Sadlermiut sample were shown to have EHL, six were male and one was female (XIV-C:155). Interestingly, she was the only individual to have only one EHL present. However, it is important to consider that within the Sadlermiut sample, many older adult individuals did not have any teeth present during data collection. As a result, this sample cannot be considered to represent the entire EHL frequency within the once living population, but rather the best estimate possible as a representative sample.

The Sacred Heart sample had considerably fewer EHL than the Sadlermiut, and these lesions appeared primarily within the infancy stage of growth and development. Of the three affected individuals in the Sacred Heart sample, two were male and one was female. The Sacred Heart EHL summary is arguably more complete than the Sadlermiut sample, as the majority of the teeth were in good condition and still within the alveolar bone in all age groups, allowing for a better overall assessment of these lesions.

4.7.2 Harris Lines

Harris lines were used for this study as a means of assessing childhood stress over several years of growth and development. These lines of arrested growth were examined on the distal tibia only in all adult individuals. Tables 4.11 and 4.12 below outline the age at formation of Harris lines in both the Sadlermiut and Sacred Heart samples followed by a graphic representation of the lesion frequencies in Figures 4.3 and 4.4.

Table 4.11
Sadlermiut Harris lines age at formation (left side)

Skeleton #	Sex	# of Lesions	Harris Line Age at Formation (yrs)
XIV-C:111	M	3	<1.0, 4.0-5.0, 8.0-9.0
XIV-C:98	F	5	7.0-12.0
XIV-C:112	F	3	<1.0, 9.0-10.0
XIV-C:126	M	0	/
XIV-C:99	M	3	<1.0, 11.0-13.0
XIV-C:100	F	2	<1.0, 9.0-10.0
XIV-C:230	M	0*	/
XIV-C:219	F	3	1.0-2.0, 10.0-11.0
XIV-C:104	F	1	<1.0
XIV-C:216	M	1	<1.0
XIV-C:221	F	1	<1.0
XIV-C:246	M	1	<1.0
XIV-C:217	M	2	<1.0
XIV-C:181	M	3	<1.0, 10.0-11.0, 12.0-13.0
XIV-C:183	F	2	<1.0, 8.0-9.0
XIV-C:101	M	3	<1.0, 1.0-2.0, 12.0-13.0

Table 4.11 continued

XIV-C:175	F	3	<1.0, 2.0-3.0, 8.0-9.0
XIV-C:149	F	6	<1.0, 1.0-5.0
XIV-C:105	F	2	1.0-2.0, 3.0-4.0
XIV-C:103	F	2	<1.0
XIV-C:156	M	1	<1.0
XIV-C:157	M	0	/
XIV-C:155	F	6	<1.0, 1.0-2.0, 4.0-5.0, 9.0-10.0
XIV-C:145	F	1	<1.0
XIV-C:153	F	3	<1.0, 9.0-11.0
XIV-C:74	M	1	<1.0
XIV-C:182	M	1	<1.0
XIV-C:148	F	0	/
XIV-C:179	M	0	/
XIV-C:243	M	4	<1.0, 9.0-10.0, 13.0-15.0

* tibia missing
(Byers 1991)

Table 4.12
Sacred Heart Harris lines age at formation (left side)

Skeleton #	Sex	# of Lesions	Harris Line Age at Formation (yrs)
5	F	3	5.0-6.0, 7.0-9.0
9	F	1	5.0-6.0
55	M	1	7.0-8.0
64	M	4	4.0-5.0, 8.0-9.0, 10.0-11.0, 13.0-14.0
83	M	1	3.0-4.0
97	F	2	6.0-7.0, 9.0-10.0
122	F	1	7.0-8.0
139	M	3	9.0-12.0

(Byers 1991)

Figure 4.3

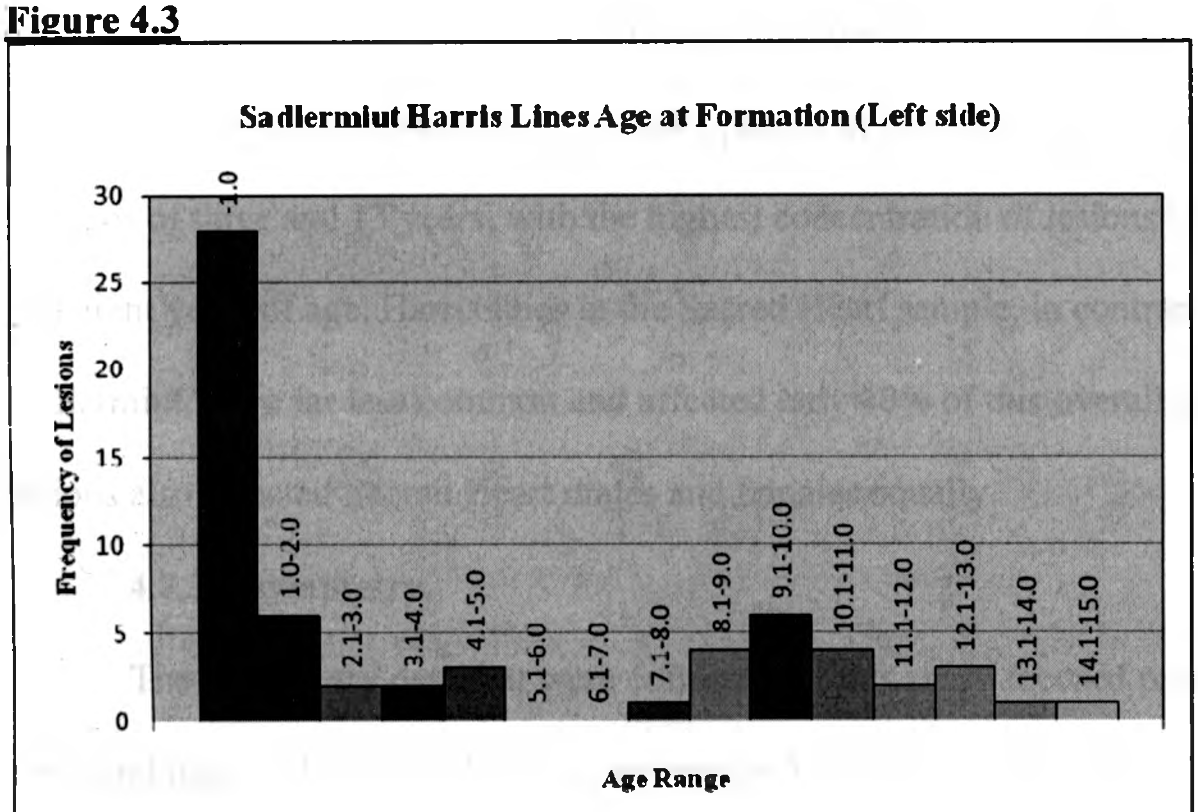
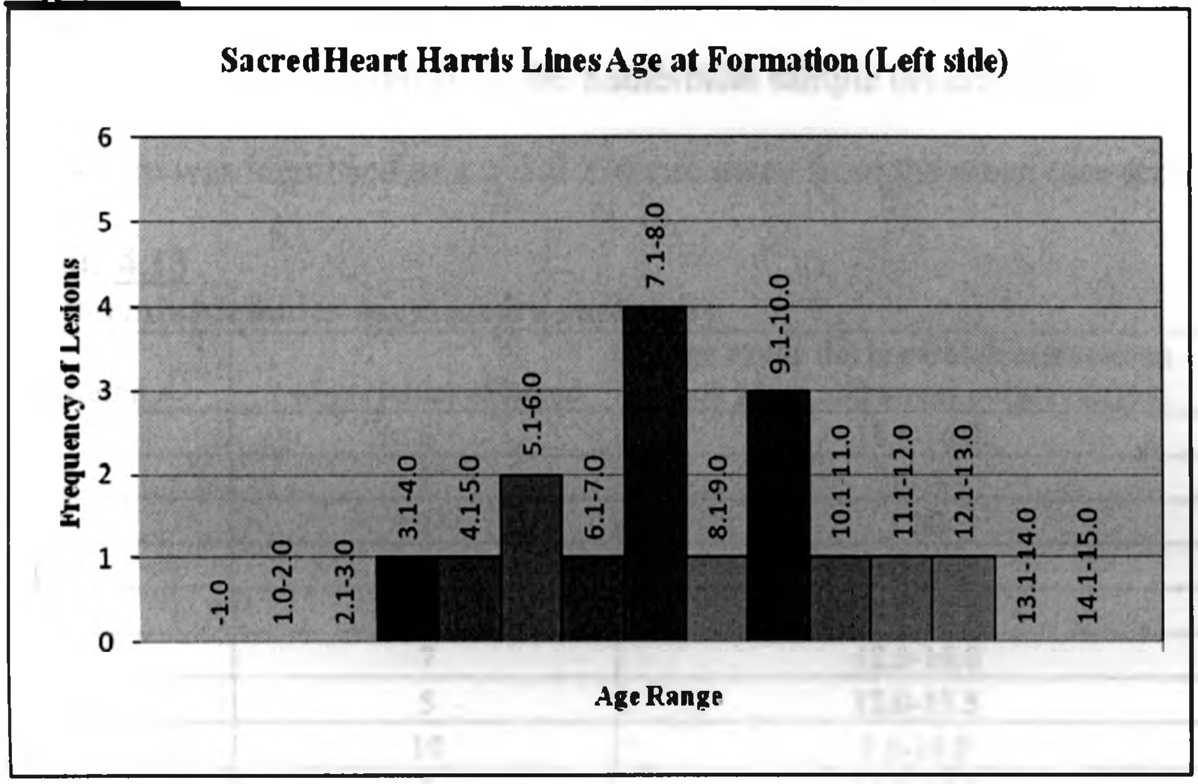


Figure 4.4



Within the Sadlermiut sample, there was a general tendency for Harris lines to appear first before the age of one year, after which these lines were most common during the childhood and juvenile stages of growth and development. The Sadlermiut also showed an equal distribution of Harris lines between males and females with these lesions affecting 91% of this overall sample.

The age at formation of Harris lines within the Scared Heart sample occurred primarily during the childhood and juvenile phases of growth and development, between the ages of three and 13 years, with the highest concentration of lesions between seven and eight years of age. Harris lines in the Sacred Heart sample, in contrast to the Sadlermiut, were far less common and affected only 40% of this overall sample. These lesions also affected Sacred Heart males and females equally.

4.7.3 Asymmetry

The asymmetry data that were collected for this study focused primarily on the arms and legs of all adult individuals as seen in Appendix E, Tables E-5, E-6, E-7 and E-

8. Tables 4.13 and 4.14 and Figure 4.5 below show a summary of the significant asymmetry data collected from the Sadlermiut sample divided by sex. Significant departure was identified as x > 1.0 Z-score away from the mean (see section 3.3.3).

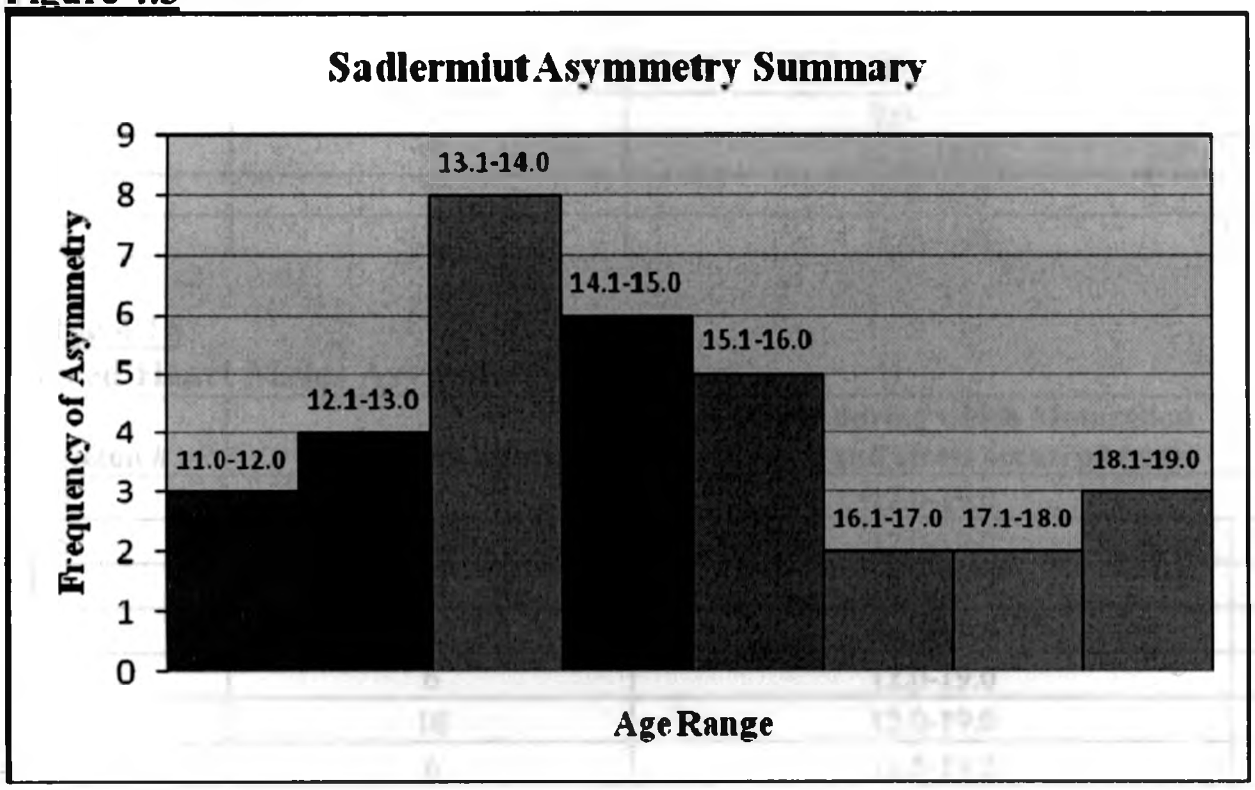
Table 4.13
Sadlermiut females asymmetry summary

Skeleton #	# of variables affected	Age range during which maturation took place and stress occurred (yrs)	Midpoint (yrs)
96	5	11.5-16.0	13.75
112	1	11.5	11.5
175	1	15.0	15.0
105	4	11.5-14.0	12.75
145	3	12.0-15.0	13.5
149	7	12.0-16.0	14.0
153	5	12.0-15.5	13.75
103	10	9.0-16.0	12.5
104	3	11.5-14.0	12.75
98	5	12.0-15.5	13.75
155	5	9.0-14.0	11.5
219	5	12.0-15.0	13.5
183	7	11.0-16.0	13.5
148	1	15.0	15.0
100	2	11.0-15.0	13.0
192	5	11.5-16.0	13.75
221	2	14.0-15.0	14.5

Table 4.14
Sadlermiut males asymmetry summary

Skeleton #	# of variables affected	Age range during which maturation took place and stress occurred (yrs)	Midpoint (yrs)
230	2	12.0	12.0
74	3	12.0-18.4	15.2
117	9	12.0-18.5	15.25
126	3	17.5-19.0	18.25
246	5	17.0-19.0	18.0
111	5	12.0-18.5	15.25
243	2	13.5-17.5	15.5
216	2	17.0	17.0
217	5	12.0-17.5	14.75
179	5	12.0-19.0	15.5
182	3	13.5-16.5	15.0
157	5	16.5-18.4	17.45
181	8	17.5-19.0	18.25
101	4	17.5-19.0	18.25
156	3	12.0-17.5	14.75
99	5	13.5-19.0	16.25

Figure 4.5



While males and females from the Sadlermiut sample demonstrated a similar frequency in variables affected by significant asymmetry, the females did show more asymmetry in their arms than did the males. Females also demonstrated their asymmetry in earlier maturing BSIs, whereas the asymmetry among males was more common in later maturing BSIs. Within this population sample the most common variable showing asymmetry in females was BSI #59 (tibia midshaft width) and in males, BSI #56/57 (talar facet area) and #59 (tibia midshaft width) were the most common. Overall, the Sadlermiut sample generally showed asymmetry during the early adolescent stage of growth between 13 and 16 years. Below in Tables 4.15, 4.16 and Figure 4.6 are the results of the Sacred Heart asymmetry analysis.

Table 4.15
Sacred Heart females asymmetry summary

Skeleton #	# of variables affected	Age Range during which Maturation took place and stress occurred (yrs)	Midpoint (yrs)
88	6	9.0-15.0	12.0
24	7	11.5-16.0	13.75
9	4	11.0-15.0	13.0
120	6	12.0-15.0	13.5

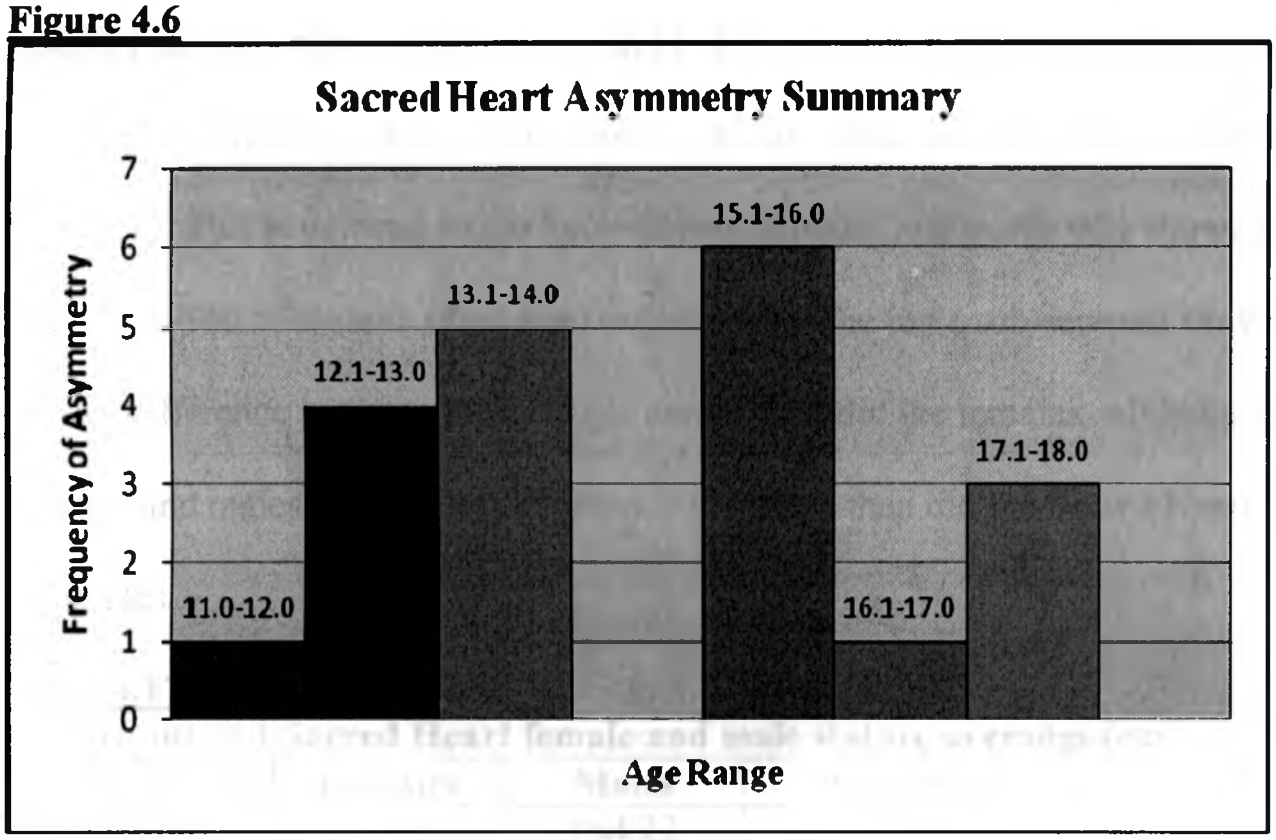
Table 4.15 continued

124B	2	11.0-15.5	13.25
97	3	11.0-15.0	13.0
71	8	9.0-15.5	12.25
5	9	11.0-16.0	13.5
114	7	11.0-16.0	13.5
122	3	11.0-15.0	13.0

Table 4.16
Sacred Heart Males Asymmetry Summary

Skeleton #	# of variables affected	Age Range during which Maturation took place and stress occurred (yrs)	Midpoint (yrs)
139	3	12.0-19.0	15.5
115	2	17.0-19.0	18.0
145	6	12.0-18.4	15.2
30	5	16.5-19.0	17.75
72	6	12.0-19.0	15.5
33	10	12.0-19.0	15.5
73	6	16.5-19.0	17.75
64	8	12.0-19.0	15.5
83	9	12.0-19.0	15.5
55	5	13.5-19.0	16.25

Figure 4.6



Comparable to the Sadlermiut sample, the Sacred Heart individuals also showed a relatively equal distribution of significant asymmetry between males and females. However, in contrast to the Sadlermiut males, the Sacred Heart males showed significant asymmetry in their arms. In this population, the females demonstrated asymmetry more frequently during the juvenile stage of growth and development, while the males generally experienced asymmetry during the adolescent stage. The most commonly affected variable in females was BSI #37 (humerus distal joint breadth) while the most commonly affected variable in males was BSI #50 (maximum femoral length). Overall the Sacred Heart sample showed a spike in asymmetry later than the Sadlermiut sample occurring between 15 and 16 years of age with no asymmetry present between 14 and 15 years.

4.7.4 Stature Estimates

The stature estimates calculated for both populations demonstrated that the Sadlermiut females and males were, on average, shorter in stature than the Sacred Heart sample (see Appendix E, Tables E-9 and E-10). As shown below in Table 4.17, the Sadlermiut female average stature was 151.86cm, while the male stature average was 164.22cm. This is contrast to the Sacred Heart females and males who showed average statures of 160.55cm and 176.44cm, respectively. The male sub-samples showed a greater difference between their stature means than did the females, while the Sadlermiut females and males showed less difference in stature than did the Sacred Heart females and males.

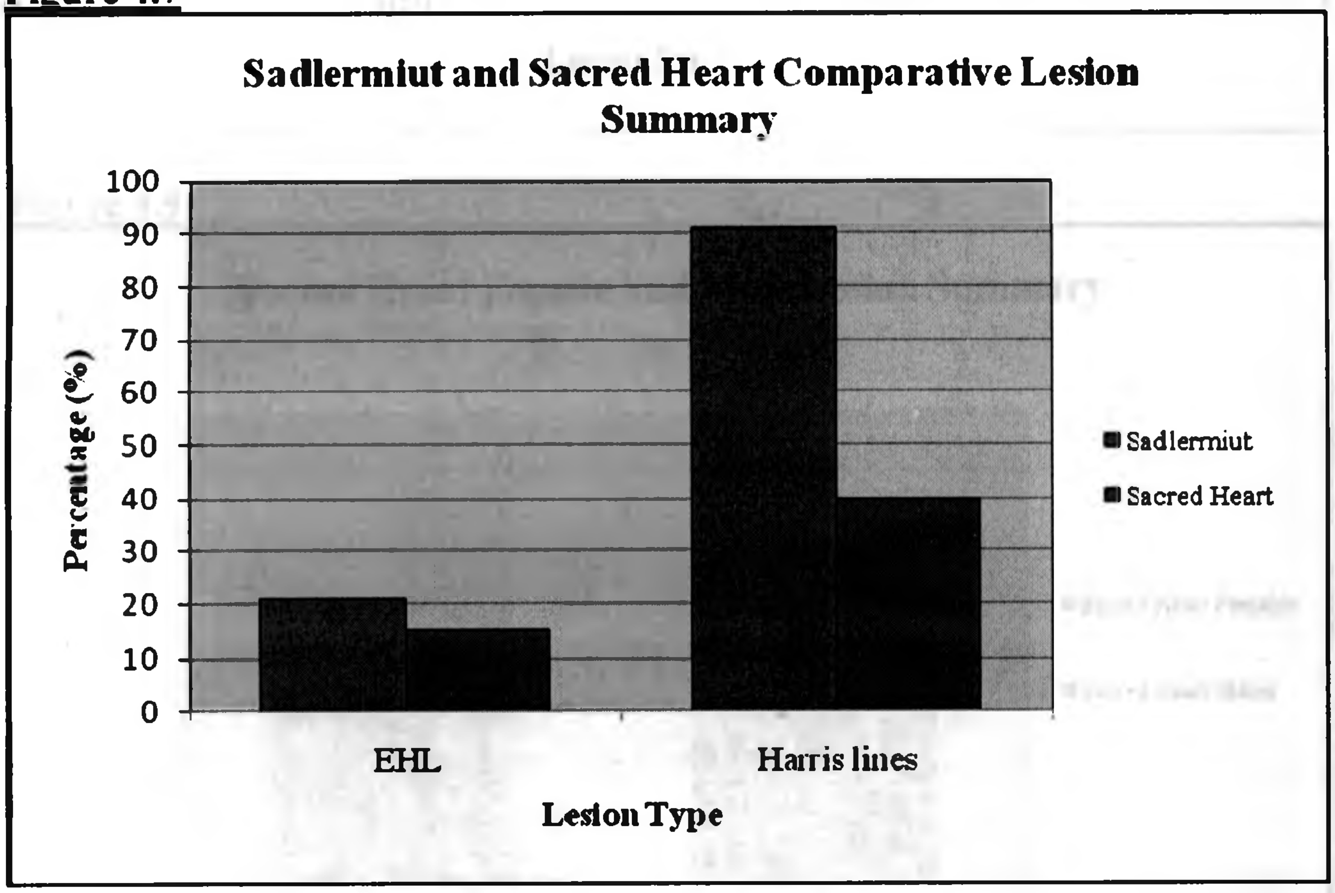
Table 4.17
Sadlermiut and Sacred Heart female and male stature averages (cm)

	Females	Males	Difference
Sadlermiut	151.86	164.22	12.36
Sacred Heart	160.55	176.44	15.89
Difference	8.69	12.20	

4.8 Stress Summary

As shown in the lesion summaries below, the Sadlermiut sample was far more affected by stress lesions than the Sacred Heart sample. As a general trend, Harris lines were more frequent than EHL in the both samples. While EHL lesions showed a similar frequency between the Sadlermiut and Sacred Heart samples, Harris lines were much more prevalent in the Sadlermiut sample. Figure 4.6 below represents the percentage of these lesion frequencies within each sample.

Figure 4.7



Below in Figures 4.8 and 4.9 is a similar lesion summary for both populations based upon sex.

Figure 4.8

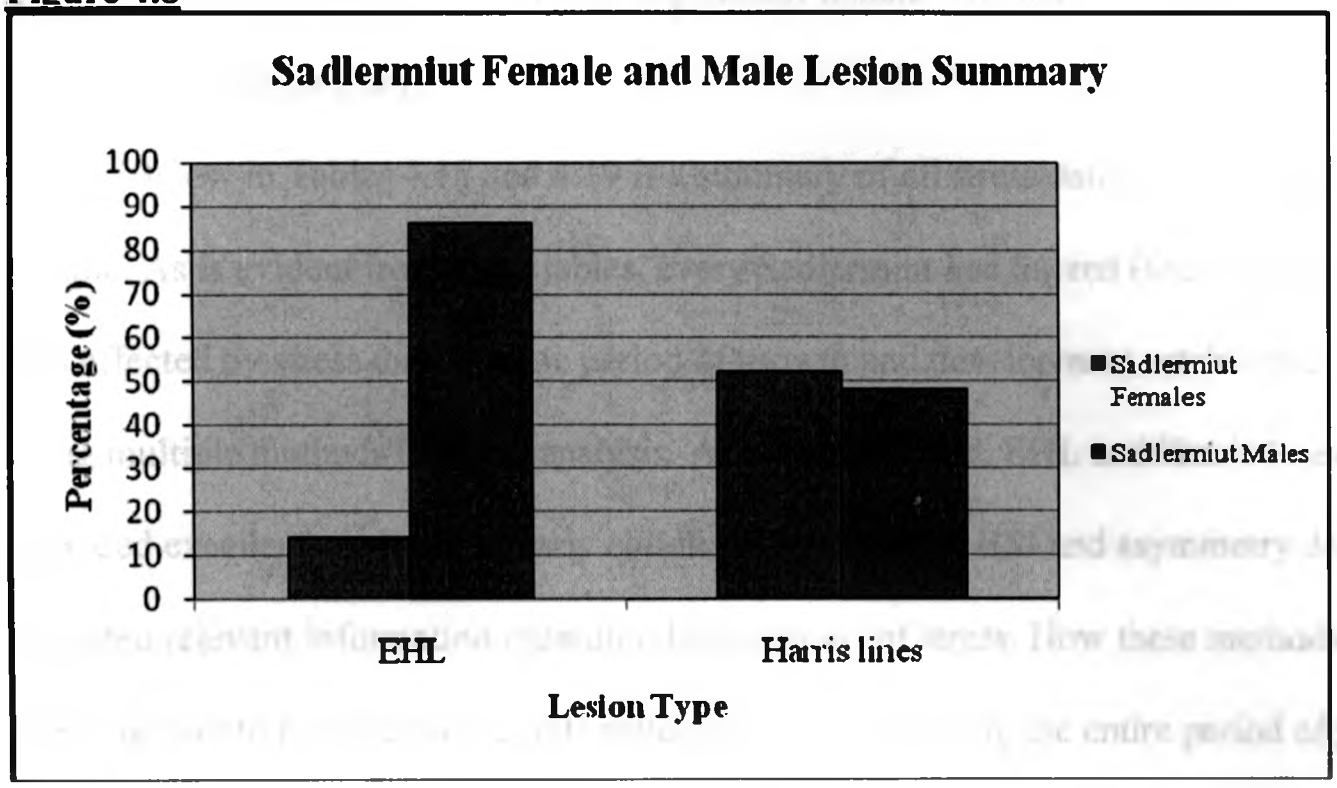
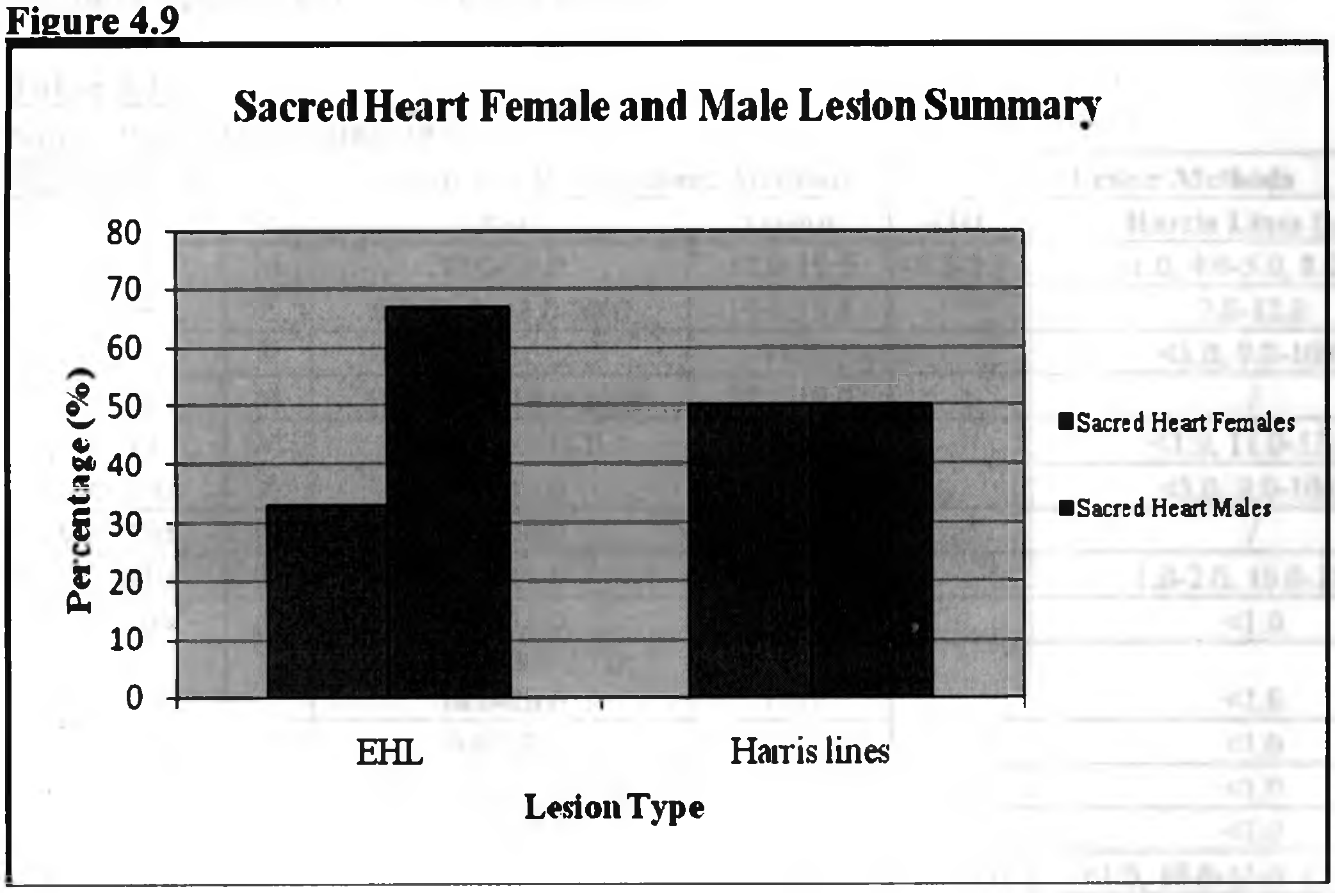


Figure 4.9



From this summary it was evident that males were generally more affected by stress lesions than females within both populations; however, there were exceptions to this. In the Sadlermiut population the females appeared to show slightly higher frequencies of

Harris lines, while in the Sacred Heart population females and males showed an equal frequency of Harris lines.

Below in Tables 4.18 and 4.19 is a summary of all stress data for each population sample. As is evident from these tables, every Sadlermiut and Sacred Heart individual was affected by stress during some period of growth and development established by using multiple methods of stress analysis. As a general trend, EHL and Harris lines provided excellent coverage of early childhood stress while BSI and asymmetry data provided relevant information regarding later periods of stress. How these methods were used together to provide an accurate reflection of stress during the entire period of growth and development will be further explored in Chapter 5.

Table 4.18
Sadlermiut stress summary

	Growth and Development Methods			Lesion Methods	
Skeleton #	**Sex**	**BSI**	**Asymm**	**EHL**	**Harris Lines (left)**
XIV-C:111	M	10.0-16.0	12.0-18.5	2.7-3.1	<1.0, 4.0-5.0, 8.0-9.0
XIV-C:98	F	9.0-14.0, 15.0-20.0	12.0-15.5		7.0-12.0
XIV-C:112	F		11.5		<1.0, 9.0-10.0
XIV-C:126	M	10.0-17.0, 18.0-20.0	17.5-19.0		/
XIV-C:99	M	12.0, 13.0-17.0	13.5-19.0		<1.0, 11.0-13.0
XIV-C:100	F	11.0-15.0	11.0-15.0		<1.0, 9.0-10.0
XIV-C:230	M	12.0-20.0	12.0		/
XIV-C:219	F	11.0-15.0	12.0-15.0		1.0-2.0, 10.0-11.0
XIV-C:104	F	11.0-14.0	11.5-14.0		<1.0
XIV-C:216	M	4.0-10.0, 13.0-17.0, 18.0-20.0	17.0		<1.0
XIV-C:221	F	9.0-12.0	14.0-15.0		<1.0
XIV-C:246	M	4.0-10.0, 13.0-17.0	17.0-19.0	3.3-5.0	<1.0
XIV-C:217	M	13.0-17.0	12.0-17.5		<1.0
XIV-C:181	M		17.5-19.0	2.7-5.0	<1.0, 10.0-11.0, 12.0-13.0
XIV-C:183	F	11.0-15.0	11.0-16.0		<1.0, 8.0-9.0
XIV-C:101	M	13.0-17.0	17.5-19.0		<1.0, 1.0-2.0, 12.0-13.0
XIV-C:175	F	3.0-15.0, 11.0-15.0	15.0		<1.0, 2.0-3.0, 8.0-9.0
XIV-C:149	F	3.0-10.0, 9.0-14.0, 16.0-20.0	12.0-16.0		<1.0, 1.0-5.0
XIV-C:105	F	12.0-15.0	11.5-14.0		1.0-2.0, 3.0-4.0
XIV-C:103	F	12.0-16.0	9.0-16.0		<1.0
XIV-C:156	M	16.0-20.0	12.0-17.5		<1.0
XIV-C:157	M	10.0-17.0	16.5-18.4		/

Table 4.18 continued

XIV-C:155	F	11.0-15.0	9.0-14.0	4.0	<1.0, 1.0-2.0, 4.0-5.0, 9.0-10.0
XIV-C:145	F	15.0-16.0	12.0-15.0		<1.0
XIV-C:153	F	11.0-14.0	12.0-15.5		<1.0, 9.0-11.0
XIV-C:74	M	13.0-18.0	12.0-18.4		<1.0
XIV-C:182	M	10.0-17.0	13.5-16.5	2.7-4.5	<1.0
XIV-C:148	F	9.0, 12.0-15.0	15.0		/
XIV-C:179	M	13.0-16.0, 17.0-19.0	12.0-19.0		/
XIV-C:243	M	12.0-17.0	13.5-17.5	3.5-5.0	<1.0, 9.0-10.0, 13.0-15.0
XIV-C:117	M	10.0-20.0	12.0-18.5	2.0-4.5	
XIV-C:192	F	3.0-10.0, 9.0-12.0	11.5-16.0		
XIV-C:96	F	11.0-15.0, 15.0-20.0	11.5-16.0		

Table 4.19
Sacred Heart stress summary

	Growth and Development Methods			Lesion Methods	
Skeleton #	**Sex**	**BSI**	**Asymm**	**EHL**	**Harris Lines (left)**
5	F	12.0-14.0	11.0-16.0		5.0-6.0, 7.0-9.0
9	F	3.0-11.0, 11.0-14.0	11.0-15.0		5.0-6.0
55	M	13.0-16.0	13.5-19.0		7.0-8.0
64	M	10.0-20.0, 13.0-18.0	12.0-19.0		4.0-5.0, 8.0-9.0, 10.0-11.0, 13.0-14.0
83	M	4.0-20.0, 12.0-18.0	12.0-19.0		3.0-4.0
97	F		11.0-15.0		6.0-7.0, 9.0-10.0
122	F		11.0-15.0		7.0-8.0
139	M	13.0-20.0	12.0-19.0	2.0-4.5	9.0-12.0
33	M	16.0-18.0, 19.0-20.0	12.0-19.0	2.0	
71	F	12.0-15.0	9.0-15.5	3.5	
30	M		16.5-19.0		
115	M	12.0-17.0, 20.0	17.0-19.0		
124B	F	3.0-10.0, 12.0-14.0, 20.0	11.0-15.5		
88	F	9.0-12.0	9.0-15.0		
24	F	9.0-13.0, 14.0-16.0	11.5-16.0		
120	F	<10.0	12.0-15.0		
114	F	13.0-15.0	11.0-16.0		
145	M	10.0-17.0	12.0-18.4		
72	M	16.0-18.0	12.0-19.0		
73	M	12.0-17.0, 18.0-20.0	16.5-19.0		

CHAPTER 5: DISCUSSION

5.1 Introduction

The main goal of this project was to establish a new method of stress analysis to minimize the inherent problems associated with the more commonly used lesion-based methods of analysis. From a growth and development perspective, this project assessed various BSIs throughout the skeleton to determine whether stress was present and the timeframe in which that stress occurred. Through the use of correlation and regression analyses, the underlying patterns of stress for each population sample were revealed and further allowed for the investigation of the timing of stress that may have affected the Sadlermiut and Sacred Heart population samples.

Although the Sadlermiut and Scared Heart population samples showed variability within and between each sub-sample, they did show some evident trends in their growth and development patterns, particularly between the sexes. However, despite these trends in growth patterns, specific fluctuation patterns were still not easily defined in these samples. Although the methods with which these growth disruption and acceleration periods were assessed provided relevant information, further investigation into the BSIs affected and where they fell along the regression line must be undertaken. This further investigation can provide the data needed to better understand the disruption and acceleration events that occurred, and how the Sadlermiut and Sacred Heart responded to these periods of growth fluctuation.

5.2 Correlation Analysis

Correlation analysis was used for this project as the primary method to establish that real relationships were present between the different BSIs selected from the bioarchaeological literature, in order to establish the baseline against which each individual was compared. Although over half (43) of the original 70 BSI measurements collected from each population sample were omitted in the final selection of all BSIs, there was still a generous age range between the BSIs to be further used for regression analysis (Appendix J, J-1 and J-2). Seeing as the primary goal of this research was to establish the best possible suite of BSI measurements, it was expected that this original list of 70 measurements would be significantly minimized to fulfill two criteria: 1) that the most highly correlated BSIs were represented and 2) that a significant age range was covered in regards to the sub-adult years of growth and development.

It is important to recognize, however, that these correlation outcomes may very likely change when studying different populations as was evident in the Howells dataset study. The three population samples chosen from Howells showed similar correlations between the six cranial BSIs; however, these correlation results were not identical in all three groups suggesting some variability in these correlations. This change in correlation outcomes may make it difficult to maintain the two criteria outlined above in other populations, and requires this method to be retuned for every sample studied. As discussed briefly in Chapter 4, another limitation of the correlation analysis conducted on the Sadlermiut and Sacred Heart samples was the complete omission of some skeletal elements, specifically the cranium. Although 16 cranial measurements were originally recorded for each individual, many of these measurements did not correlate well with other infra-cranial measurements as shown below in Table 5.1.

Table 5.1
Sadlermiut and Sacred Heart cranial measurements and final correlation results

Original Cranial BSI Measurements	Males	Females
Maximum Cranial Breadth		
Maximum Cranial Length		
Upper Facial Breadth	*	*
Biorbital Breadth		*
Maximum Orbital Height		
Maximum Orbital Breadth		
Postorbital Breadth		
Biporionic Breadth		
Occipital Condyle Length		
Occipital Condyle breadth		
Maximum Cranial Height		*
Foramen Magnum Area		*
Interorbital Breadth		*
Chin Depth		
Maximum Breadth of the Mandible		*
Palate Length		

* = BSIs that were correlated to variables in the infra-cranial skeleton

As a result of these measurements being omitted, particularly among the Sadlermiut and Sacred Heart males, the final list of BSIs representing the very early years of life was greatly reduced as many of these cranial BSIs mature in the childhood and juvenile stages of growth (Aiello and Wood 1994; Raxter *et al.* 2006; Spocter and Manger 2007).

Although the goal of this research was to collect data from BSIs covering the entire age range of growth and development, future research focused on early childhood stress episodes may benefit from the examination of cranial BSIs only, as they provide coverage of the childhood and juvenile stages of growth and development. By using the cranial BSIs already well established within the bioarchaeological literature (Aiello and Wood 1994; Kappelman 1996; Raxter *et al.* 2006; Spocter and Manger 2007) and the correlation results from the Howells dataset study, presumably these cranial measurements may still be used within this methodological framework to provide relevant stress information on the early formative years of growth and development, with the caveat that infra-cranial skeletal elements are better proxies to calculate overall body stature or body weight (McHenry 1992; Ruff 2002).

5.3 r-values and Significant Association

The r-values and the t-test of significant association calculated for each variable pair, derived from the final BSI list of 27 measurements, were important for this research to establish the probability of these correlations happening by chance and also to explore whether the size of individual variables was actually being explained by ultimate adult body size. Through this analysis of association, it became clear that the original BSI list would need to be further narrowed as certain BSIs did not necessarily correlate well with all other 26 BSIs. As outlined in Table 4.2, not one of the four sub-samples showed significant association over 50% in the variables pairs analyzed. This would suggest that although the final 27 BSIs were correlated to one another, only certain pairings of these variables showed significant association. Although a sufficient age range was covered in the original 27 BSIs (see Appendix J, Tables J-1 and J-2), the process of determining significant association further omitted certain measurements. As a general trend, many of the BSIs used for this study matured during the adolescent stage of growth and development with multiple indicators between the years of 10 and 20. The majority of earlier maturing BSIs ended up being omitted in both the male and female sub-samples, as they did not satisfy the selective criteria, leaving a spotty coverage between three and 10 years. Thus while the full range of coverage for this method was approximately three to 20 years, the best coverage period was between 10 to 20 years.

However, with the further omission of the earlier maturing BSIs for both sample groups the differences between males and females and their 27 correlated BSIs were minimized. As discussed, the females originally showed more correlation among their cranial variables and the males had higher correlations among their vertebral BSIs. As a result of testing for significance of association among variables, the differences between males and females were equalized, revealing similar trends in the final BSIs that showed significant association with each other.

5.4 Growth Curve Data

The main purpose in compiling growth curve data from both clinical and population specific data was to define the age ranges of adult maturation for each BSI in each sample. As discussed, Scheuer and Black (2000) was used to create the idealized model in which the human skeleton is expected to grow. It was the goal of this project to then supplement this idealized growth curve with more specific data from each sample to calibrate the idealized model. As shown in Appendix J, Tables J-4, J-5, J-6 and J-7, the data collected from both the Sadlermiut and Sacred Heart sub-adults did not provide sufficient data to substantiate this type of model or alter the idealized maturation ages. While each sample did provide some information regarding the maturation timing of each BSI, inevitable gaps in the data were present. Therefore, this idealized model was accepted as the best possible growth curve to determine skeletal sequencing and the age of adult maturation for each BSI.

Because the recovery of sub-adult skeletal material is fraught with preservation issues due to a less dense skeletal structure and a higher organic composition (Currey and Butler 1975; Specker *et al.* 1987; Gordon and Buikstra 1981), many of the younger sub-adult remains were damaged or incomplete, affecting which BSIs could be measured. It was the older sub-adult individuals within these samples that were the most complete, thereby creating a bias in the data being collected for growth curve calibration. If a BSI is predicted to reach adult maturation in the juvenile stage of growth but there is no sub-adult individual that represents that age range, then the presence of adult-sized BSIs in adolescent individuals make it appear that the BSI reaches maturity later than it should. As a result of this sampling issue, many of the BSIs for both the Sadlermiut and Sacred Heart samples appeared to have a far later maturation period than predicted from the idealized growth trajectory.

Despite the inherent biases in this method of growth curve calibration, there are important data to be recovered in the assessment of BSI maturation. If it was possible to work with a larger sub-adult sample with the majority of BSIs recovered, then there would be great potential for this method of analysis. The major drawbacks in using these two samples were a lack of sub-adult individuals, specifically within the juvenile stage of growth, and missing or damaged skeletal elements for individuals of all ages. Because there are fewer BSIs that reach adult maturity during the juvenile stage of growth, it was imperative to collect sufficient data from individuals whose age at death is within this timeframe. Although it is recognized that the growth curve created from the Scheuer and Black (2000) reference is idealized, it was accepted as the best possible means to assess the age of maturation for each BSI. Because it is known that the sequence when certain BSIs reach maturation is consistent across populations (Humphrey 1998), this growth curve does provide accurate sequencing information regarding both sample populations. However, it must be cautioned that the age ranges produced through regression analysis are a best estimate only from the data collected in this study. If provided with adequate data to satisfactorily calibrate the idealized growth curve, the resulting age ranges of growth acceleration and disruption for the Sadlermiut and Sacred Heart samples may very well have shifted up or down in age.

5.5 Growth Fluctuation Pattern Maps: A Discussion of Growth Disruption and Growth Acceleration

This method of data arrangement proved to be quite successful for determining the lower-most and upper most-limits of growth disruption and growth acceleration among the BSIs used for this study. The creation of these pattern maps allowed for the regression analysis results to be arranged by individual to track the overlapping patterns of growth disruption and growth acceleration. Seeing where these variable pair age ranges overlapped helped to narrow down the timeframe of when growth disruption and acceleration was occurring. By compiling the data in this way, it was possible to assess these patterns of growth fluctuation to determine if these periods of instability were the result of stress, natural growth spurts or catch-up growth. If these periods of growth fluctuation were merely random "noise," then the distinct patterns of growth disruption and fluctuation would not be present as shown in Figure 5.1 (pg. 100). Although there is some evidence of "noise" in specific individuals, the growth patterns of each sub-sample reveal that true patterns of fluctuation do exist.

For this analysis, growth disruption was interpreted as stress caused by external factors, as stress is generally defined as a fluctuation of growth that may result in decreased body size and presumably the indicators of body size (Larsen 1997; Goodman and Martin 2002) which was evident in individuals who continually fell below the confidence interval over a given period. However, in contrast to the patterns of growth disruption, growth acceleration was not as easily defined and needs to be discussed in further detail.

While growth disruption periods could be confidently equated only to periods of stress that negatively affected BSI size, growth acceleration periods were far more difficult to categorize due to the normal acceleration periods that are expected to occur during maturation. These normal periods of growth acceleration occur during the juvenile and adolescent stages of growth and are known as growth spurts (Bogin 2001). Because these growth spurts occur naturally across populations (Golub 2000), it becomes difficult to distinguish between normal growth acceleration and acceleration occurring as the result of catch-up growth following the cessation of stress. For the purposes of this project it was assumed that if a natural growth spurt was occurring then acceleration would be present at seven years of age (the juvenile spurt) and between 11-13 years of age (the adolescent spurt) (Bogin 2001). It was also assumed that if a natural growth spurt was occurring then it was possible to still see growth disruption in other BSIs. While stress events may have been affecting certain BSIs during these periods of natural acceleration, all other BSIs not being affected by disruption were assumed to begin the natural growth spurt, thereby potentially showing growth disruption and acceleration during a similar time period but in different BSIs.

In contrast to the pattern of natural growth spurts, it is also important to outline the expectations of stress-induced growth acceleration, also referred to as catch-up growth. While natural growth acceleration is regulated to a specific time period within the juvenile and adolescent stages of growth, acceleration caused by stress may appear during any time period of growth. However, stress-induced acceleration was predicted to only occur after a stress event had passed as per the expectations of catch-up growth discussed in Chapter 2, section 2.3.4. Therefore, while natural growth acceleration can occur during the same time period as growth disruption in different BSIs, catch-up growth should only be visible after a stress event has completely passed.

It is important to recognize that not all acceleration periods visible in the four sub-samples conformed to natural growth spurts or catch-up growth periods discussed above. As mentioned in Chapter 4, section 4.6.2 the growth fluctuations visible in each of the four sub-samples provided relevant information on developmental stability. It has been argued that if the human skeleton is exposed to prolonged stress then multiple deviations from the norm should be visible in multiple skeletal elements as the body struggles to maintain homeostasis (Albert and Greene 1997; Cardoso 2007). Through the analysis of these growth fluctuation patterns in each sub-sample it was assumed that individuals who showed high levels of fluctuation among their variable pairs were likely more stressed than individuals showing less fluctuation. Therefore, growth acceleration periods that did not fall within the parameters of normal growth spurts or catch-up growth were assumed to represent this instability fluctuation. Overall, it is important to recognize that individuals who showed growth acceleration outside the defined periods of natural acceleration and catch-up growth may appear to have been less stressed, as certain BSIs were larger in size than the rest of the sub-sample. However, these individuals may in fact have been more stressed due to developmental instability as they constantly fluctuated above and below the confidence intervals of their sub-sample.

To summarize the preceding section, when examining the growth disruption and growth acceleration patterns in each of the four sub-samples, it was assumed that growth disruption only indicates periods of stress. In contrast, growth acceleration may be explained by three different processes: 1) natural growth acceleration during the growth spurt time periods, 2) catch-up growth occurring after a stress event has passed or 3) acceleration that does not fall within the parameters of normal acceleration or catch-up growth and is most likely growth fluctuation that may be contributing to developmental instability in an individual.

Other explanations regarding the growth disruption and growth acceleration patterns of these sub-samples are possible and will be discussed here. For instance, when examining growth disruption and acceleration the argument can be made that these fluctuations above or below the confidence intervals may be congenital anomalies affecting certain individuals of the sub-sample and not necessarily the product of stress, normal growth spurts or catch-up growth events.

The Sadlermiut were a distinctly endogamous society due to their social and geographic isolation on Southampton Island and the Sacred Heart population may have also practiced a loose type of endogamy as they established their community in the wilderness of southwestern Ontario, with only 40 family groups and a lack of neighbouring European settlers in this region (Whitwell 1977). Based upon this information, it can be argued that congenital anomalies may have very likely affected multiple individuals of the community because of a reduced gene pool, which would allow for similar patterns of growth disruption or acceleration to be noted in various individuals. However, as discussed by Roberts and Manchester (2005), individuals plagued with congenital anomalies are less likely to reproduce and pass along their condition to a future generation. Also, while congenital anomalies are known to have the potential to affect all regions of the skeleton (cranium, spine, pelvis, hands and feet) (Roberts and Manchester 2005), the individuals from this study showed a consistency among the skeletal elements being affected, specifically the arm and leg bones. Congenital anomalies also tend to have very clear skeletal stigmata (Roberts and Manchester 2005) which would be evident in a general pathological examination of skeletal remains, none of which were evident in the Sadlermiut or Sacred Heart samples. While congenital anomalies may have been present in some individuals examined, the above evidence suggests that the overall patterns of growth fluctuation in these four sub-samples were most likely the result of an external source of stress.

Another potential cause of these growth fluctuations, specifically growth disruption, is the possibility of genetically smaller individuals within a population. It has been well documented in hominid, archaeological and modern literature that populations in northern Arctic environments generally have different body proportions than individuals living within a warmer, temperate climate (Eveleth and Tanner 1976; Y'Edynak 1978; Johnston *et al.* 1982; Nelson and Thompson 2002). Therefore, it can be argued that an individual with small stature is not necessarily indicative of past stress in that individual, but could simply represent the low end of normal population variability. However, as long as a small person's BSIs maintain the proportional relationship seen in the rest of the sub-sample, no growth disruption will be detected. The benefit of this method is that the trajectory calculated is specific to each population sub-sample and the average relationship between variable pairs. Therefore, while small (or large) individuals will simply slide up or down the regression lines the individuals deviating away from this trajectory truly represent the outliers of the group, regardless of their overall body size.

Although there are multiple explanations for the patterns of growth disruption and growth acceleration seen in these sub-samples it is assumed that the parameters outlined above provide the most accurate interpretation for this analysis.

As discussed in Chapter 4, section 4.6.2 the Sadlermiut and Sacred Heart sub-samples showed distinct periods of growth disruption and growth acceleration occurring generally in the late juvenile stage and throughout the adolescent stage of growth and development. Below is a discussion of each sub-sample and the general trends of growth fluctuation through BSI analysis, as well as the incorporation of all supplementary data.

5.6 Sub-sample Growth Disruption and Acceleration Summaries

5.6.1 Sadlermiut Females

While the Sadlermiut females showed evidence of early childhood growth disruption through the analysis of EHL (two years to five years) and Harris lines (> one year to 12 years), BSI analysis was only able to identify growth disruption between the ages of 11 and 15 years, as shown below in Figure 5.1. The asymmetry data collected for this sub-sample, similar to the BSI data, also demonstrated a stress period between 11 and 16 years. This period of disruption was then followed by growth acceleration between 15 and 20 years of age. In line with the argument made above, the acceleration pattern noted in this sub-sample is most likely catch-up growth, suggesting that the level of stress endured by the Sadlermiut females was extreme enough to preclude any acceleration until the stress had passed. There was no evidence of natural growth spurts occurring within this sub-sample, reiterating the magnitude of stress endured by these females. Of the four sub-samples the Sadlermiut females showed the greatest frequency of fluctuation per individual, suggesting that these females were continually exposed to developmental instability during the period of growth and development. With regards to stature estimates, the Sadlermiut females were, on average, the shortest sub-sample. Although these stature estimates did not provide direct evidence to suggest stress, they did provide a good indication of overall growth fluctuation patterns and potentially of interference with a normal growth spurt. Individuals mainly falling below the sub-sample confidence interval were generally shorter, while individual consistently falling above the confidence interval were generally taller than the rest of the sub-sample.

5.6.2 Sacred Heart Females

Similar to the Sadlermiut female sub-sample, the Sacred Heart females showed evidence of early childhood stress through the examination of EHL (3.5 years). Harris line data, although mainly present during the childhood stage of growth (five years to 10 years with a peak at seven years) did show some overlap with BSI and asymmetry data between nine and 10 years of age. In this Sacred Heart female sub-sample, growth disruption illustrated in the BSI and asymmetry data, was generally present between nine and 16 years of age as shown below in Figure 5.1. During this same time period growth acceleration was also present between nine and 15 years of age, which does not fall within the timeframe of natural growth spurts. Because this acceleration period did not begin during one of the natural growth spurt periods or after a stress event had passed (catch-up growth), it can be assumed that this acceleration is part of a pattern of growth fluctuation affecting the developmental stability of this sub-sample. Similar to the Sadlermiut females, the average stature estimate for this sub-sample did not provide direct evidence of stress; however, as discussed above, the individual estimates of stature were good indicators of the individual patterns of growth fluctuation.

5.6.3 Sadlermiut Males

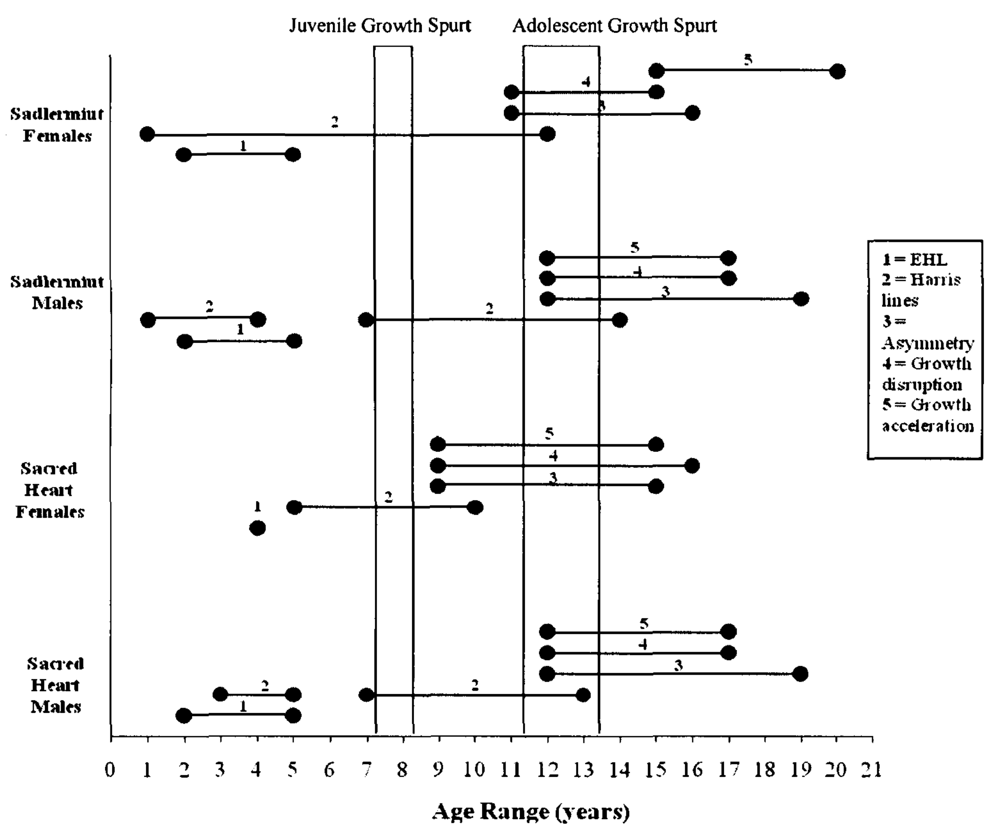
The Sadlermiut males showed an early period of stress through the analysis of EHL (two years to five years) and Harris lines (one year to four years and seven years to 14 years). However, the Harris line data also overlapped with the growth disruption period evident in both BSI and asymmetry analyses, as shown below in Figure 5.1. Growth disruption in this sub-sample generally began at 12 years of age with growth acceleration also beginning at 12 years of age. Because the adolescent growth spurt is known to begin in males and females between approximately 11-13 years of age, it can be assumed that the growth acceleration period experienced by the Sadlermiut males is representative of the normal adolescent growth spurt. Therefore, while some BSIs were being affected by stress, other BSIs were accelerating in growth during this growth spurt period. Similar to the female sub-samples, all stature estimates calculated for the Sadlermiut males were more indicative of individual fluctuation patterns rather than indicative of chronic stress.

5.6.4 Sacred Heart Males

Similar to the Sadlermiut male sub-sample, the Sacred Heart males also showed early childhood stress through the examination of EHL (two years to five years). While the Sadlermiut male sub-sample showed Harris line stress between one and four years and seven and 14 years with peaks at one year and nine years, the Sacred Heart males showed Harris line stress between three and five years and seven and 14 years with a peak at 11 years. The BSI and asymmetry data collected for the Sacred Heart male sub-sample mainly showed disruption occurring between 12 and 17 years and acceleration occurring during the same time period. Because the beginning of this acceleration fell within the adolescent growth spurt period, it was assumed that the acceleration exhibited in this sub-sample represented the normal growth spurt pattern of adolescence. The average stature estimate of the Sacred Heart male sub-sample was by far the tallest of all four sub-groups. Similar to the other three sub-samples, these data were better suited to examine individual fluctuation patterns rather than specific patterns of stress.

By establishing the general trends of growth disruption and the varying causes of growth acceleration in these sub-samples along with the patterns of different stress indicators, it becomes easier to address the potential causes of these fluctuations and how this may have affected the overall health of the Sadlermiut and Sacred Heart samples.

Figure 5.1
Sadlermiut and Sacred Heart methods summary (males and females)



5.7 Non-specificity of Stress Indicators

As discussed earlier, skeletal stress can be caused by multiple factors and can produce skeletal changes as a result of disrupted or delayed growth and development (Goodman and Martin 2002). Some potential stress variables are: poor nutrition, socio-economic status, migration, sex, genetics and climate (Johnston *et al.* 1975; Delemarre-van de Waal 1993; Hoppa and FitzGerald 1999; Bogin 2001; Ruff 2002). Because the presence of the skeletal stress markers (EHL, Harris lines, fluctuating asymmetry and BSI analysis) can be caused by a variety of different variables, bioarchaeologists are not able to succinctly link specific stress processes to specific skeletal changes. While there is evidence that some stress variables may contribute to some specific skeletal changes within the human body, these stressors and their skeletal impact still remain largely non-specific (Goodman *et al.* 1984). Although this inherent non-specificity of stress indicators is a constant consideration for bioarchaeological research, certain patterns can emerge with regards to stress timelines and the use of multiple indicators to examine stress periods during growth and development (Goodman *et al.* 1984). Although there may be multiple variables causing skeletal stress to become manifest, the timeline of when that stress specifically occurred may help bioarchaeologists to more conclusively explore the type of stress present and why it is occurring during a specific time period of growth and development. A well established example of this would be the examination of EHL and how the timing of these lesions has been linked to periods of weaning within different cultures (Goodman and Rose 1990).

5.8 Adolescence and Skeletal Stress

It has been well documented that during the adolescent stage of growth and development, both males and females experience a rapid acceleration of growth with regards to body mass and body stature (Bogin 2001), which can be a potential source of physiological stress. This acceleration within the body pertains to nearly all tissues in the body, including the skeletal system which is highly correlated to puberty and can manifest the many stresses of adolescence (Delemarre-van de Waal 1993). At the onset of puberty in the human body, both males and females experience a variety of different changes requiring far more energy in order to grow and develop these systems properly (Bogin 2001). Although heredity provides the basis of all growth potential within the body, multiple factors can affect whether or not an individual will reach their genetic growth potential (Delemarre-van de Waal 1993). During the adolescent stage of growth and development it has been documented that individuals can be exposed to potential stress factors as they require more calories, proper nutrients, develop sex-dependent immune systems responses, experience psychosocial stress and can be exposed to specific diseases that do not openly manifest within the body until puberty is reached and the growth spurt is completed (Delemarre-van de Waal 1993; Golub 2000). Although the mortality rate during adolescence in archaeological and modern populations is generally regarded as low (Golub 2000), it is clear that this time period of growth and development is fraught with many potential stress variables to be considered for both the Sadlermiut and Sacred Heart samples.

5.9 Adolescence and the Sadlermiut and Sacred Heart Sub-samples

5.9.1 Sadlermiut and Sacred Heart Females

As discussed above, the Sadlermiut females displayed a distinctive pattern of growth disruption and acceleration beginning at the onset of adolescence. The goal now is to explain why stress was visible in this population during this time period. Although the movement into the adolescent stage of growth may be slightly different in different cultures, one key element experienced by all females during this time period is the onset of menarche. The onset of menarche for females generally signifies the beginning of adolescence but has been found to be highly variable between populations (Bogin 2001; Thomas *et al.* 2001; Gluckman and Hanson 2006). It has been argued that variation in the timing of menarche is tied to body fat distribution (Lassek and Gaulin 2007), skeletal development (Elizondo 1992), genetics (Campbell and Udry 1995), nutrition (Cole 2000), the environment (Golub 2000), broken households (Campbell and Udry 1995) and ethnic affiliations (Freedman *et al.* 2002). Regardless of the primary initiator of menarche, this process can be identified as a potential stress to the skeletal system of females. Generally menarche begins after the maximum velocity growth rates are reached in body stature and body weight (Tanner 1962; Frisch and Revelle 1970). Due to the very nature of menarche and the continual loss of iron during each monthly cycle, many young women lacking the proper nutritional intake may well have suffered stress during these early years of menarche while their body still continued to grow and develop. Discussed by Condon (1987) and Kozlov and Vershubsky (2003), the average onset of menarche in Arctic populations generally ranges between 13 and 15 years of age, while the average onset of menarche in historical American and European populations is approximately 13 to 14 years of age (Laslett 1971). This later onset of menarche in Arctic populations is most likely tied to environmental conditions, such as inadequate nutrition (Cole 2000), that may restrain the proper development of these young women and delay their maturation. It is assumed that the onset of menarche in addition to other adolescent stresses contributed to the growth disruption experienced by the Sadlermiut females.

In contrast to the Sadlermiut females, however, are the Sacred Heart females, who did not experience a similar pattern of growth disruption during their onset of menarche. This difference between the female sub-samples may be due to other external sources of stress that may have affected the female response to menarche and the beginning of adolescence. While the Sadlermiut females may have been plagued with more external stress such as nutritional deficiencies contributing to their adolescent stress period, the Sacred Heart females may have had a smoother transition into the adolescent stage of growth with less contributing factors exacerbating the already known stresses of adolescence. While the Sacred Heart females may appear to be less affected by stress overall, it is important to recognize that these individuals were not stress free. These females were affected by a distinct period of growth disruption in the late juvenile stage of growth, perhaps the result of nineteenth century cultural factors not yet understood. However, because this period of growth disruption coincided with growth acceleration suggests that this fluctuation may have also been the result of developmental instability during this time period where these females were both fluctuating above and below the confidence intervals of their sub-sample. The fluctuation experienced by the Sacred Heart females was far less than the other three sub-samples, suggesting that while these females experienced some sort of stress it was not as easily defined or long term when compared to the Sadlermiut females or male sub-samples.

5.9.2 Sadlermiut and Sacred Heart Males

In contrast to the females of this study, the males from both the Sadlermiut and Sacred Heart sub-samples experienced similar periods of growth disruption and acceleration. Both male samples, on average experienced these growth fluctuations between 12 and 17 years of age. Akin to the Sadlermiut female sub-sample, this time period of growth fluctuation is consistent with the time frame of adolescence (Bogin 2001). Although males do not experience the stress of menarche, they are still faced with similar stresses during this period of growth and development. A primary obstacle faced by the growing skeletal system is the acquisition of proper nutrients and calories (Delemarre-van de Waal 1993). During this time period of growth males and females begin to differ significantly in body size, both in stature and in weight, and develop secondary sexual characteristics. The product of this physical differentiation is known as sexual dimorphism (Grey and Wolfe 1982). Therefore, when males enter the adolescent stage of growth, their bodies can be physiologically stressed by the constraints of growing a large body size in a short period of time, especially if the proper nutrients are not available within their surrounding environment. The psychosocial stress of early adolescence may also play a role in the skeletal development noted in these males. An example of this may be the psychological stress associated with being socially recognized as a man in different societies. As discussed by Condon (1987), in many Arctic groups females demonstrate their maturity through the onset of menarche; however, males must prove their maturity by demonstrating their strength through their hunting abilities. While both males and females are exposed to the psychosocial stress of adolescence perhaps the cultural expectations put onto males to physically display their maturity makes this transition much more stressful.

As briefly mentioned above, another potential cause of stress during the adolescent stage of growth is the maturation of the immune system. During this stage of growth the immune system undergoes changes that are sex-dependent and it has been documented that during this sex-differentiation the male immune system is not as responsive as the female immune system (Golub 2000). Although this difference between male and female susceptibility to stress has a genetic basis referred to as sexual buffering, the changes to the immune system during adolescence may further increase the male susceptibility to external stressors. Despite the evident stress affecting both male sub-samples, it appears that this early adolescent stress was present but did not affect the normal progress of the adolescent growth spurt for these sub-samples which appeared as growth acceleration at the same time as growth disruption.

5.10 Sexual Buffering: The Resistance to Stress in Females and Males

Sexual buffering is generally regarded as a process by which females appear to be genetically programmed to be resistant to certain types of stress (Stinson 1985). Males appear to be more sensitive to environmental or cultural stressors during critical growth periods that will affect their overall stature in adulthood (Stinson 1985). Theoretically, sexual buffering is based on the concept that females must remain hearty in order to successfully reproduce while the male is the expendable sex, as only one male is needed to seed a population (Stinson 1985). This concept of sexual buffering can be examined both empirically and theoretically. Empirical evidence of sexual buffering is generally observed by examining the maturation rates of males and females as well as their overall body size and responses to stress.

From the moment of conception male embryos are more fragile than female embryos (Catalano and Brunckner 2006). Empirical data for ratios of male to female embryos reveal that males are actually more readily conceived than females, but are confronted with far more in-utero complications such as brain damage, congenital abnormalities, and cerebral palsy (Kraemer 2000). Male embryos also suffer a higher rate of spontaneous abortion in the womb (Catalano and Brunckner 2006). It is important to recognize here that this fragility in the womb continues through life for the male embryos that do survive, as they are more vulnerable to environmental and cultural stress (Catalano and Brunckner 2006). Patterns of growth and development in early life also reflect this dichotomy between male and female buffering, as females generally develop faster than males, specifically in tooth eruption, sexual maturation, and skeletal development (Flory 1935).

From a theoretical perspective, females are assumed to be buffered against stress more than males for reproductive and nurturing purposes. Even at a microscopic level, male and female sex cell production exhibits this buffering. When faced with stress, female sex cell production continues within the gonads while males, exposed to a similar stress, show a reduction in sex cell production in the gonads (Hunt and Hassold 2002). This suggests that during times of stress the female reproductive system allows sex cell production to continue in order to promote reproduction while the male sex cells recognize the stress and diminish in number. Although sexual buffering appears to be anchored in genetics, this buffering can be affected by cultural processes that favour one sex over the other.

5.10.1 Cultural Influence on Sexual Buffering

As argued in this thesis, when an individual is confronted with stress during the period of growth and development their skeleton can be affected as a result. If sexual buffering is acting naturally on a population, bioarchaeologists would expect that males would be more affected by stress than females (Stinson 1985). However, the intrusion of cultural preferences or practices onto this natural process can change the expression of sexual buffering in skeletal remains and needs to be considered (Stinson 1985). Once the cultural practices of a population infringe on sexual buffering, not only does sex need to be considered when examining stress but also the social roles that males and females are expected to play within their community, which may be invisible archaeologically (Armelagos 1998). However, as explored by Storey (1998) in her study of the Maya, the archaeological examination of dietary patterns, textiles, iconography, etc. may make some of these social and gender roles become more evident, providing insight into the processes of sexual buffering in past populations. These social roles often affect the access males and females have to certain privileges in society and those privileges can drastically affect their growth and development (Armelagos 1998). The importance in examining social roles for bioarchaeologists is how the social roles of males and females ultimately affect their health, specifically their overall body size and development of individual skeletal elements (Storey 1998). Generally males are more preferred than females in society and this has been documented in both past and present populations (Storey 1998). This preference can usually be linked to economic value and social prestige of males over females who are limited to domestic and reproductive value (Storey 1998). However, it is important to note that specific social roles are not always easy to define; this is the case among the Sadlermiut and Sacred Heart population samples.

5.10.2 Sexual Buffering among the Sadlermiut and Sacred Heart

It was expected that if sexual buffering was occurring naturally in the Sadlermiut and Sacred Heart samples, then the females would show less evidence of stress than the males. However, if the Sadlermiut or Sacred Heart females demonstrated more stress than the males it was assumed that cultural influences were affecting the natural occurrence of sexual buffering.

Based on the sexual buffering literature and the growth and development trends noted for each population sample, it became clear that the sexual buffering patterns expected to emerge were not clearly evident within these four sub-samples. In general, the Sadlermiut females demonstrated more stress than the Sadlermiut males. Although both sub-samples had distinct periods of stress, the acceleration periods following these stress events suggest that the stress endured by the Sadlermiut females was more severe. While the normal adolescent growth spurt was evident in the male sub-sample, the females only experienced catch-up growth acceleration in late adolescence after the stress event had passed, suggesting a more chronic and long term type of stress. The Sadlermiut females also endured the longest period of continual Harris line stress with overlapping periods of EHL stress and asymmetry stress. While the Sadlermiut males also showed considerable stress when examining Harris lines and EHL, these periods of stress were not continuous periods of disruption. The tremendous growth fluctuations experienced by the Sadlermiut females also suggested higher levels of stress as their bodies were constantly trying to regulate their skeletal system in response to both episodes of disruption and acceleration.

The data collected from the Sacred Heart females suggested that this sub-sample was the least stressed in comparison to the other three sub-samples. As discussed above, the Sacred Heart females showed the least amount of growth fluctuation and continual stress when examining EHL and Harris lines, and showed the least amount of skeletal lesions. In comparison to the female sub-sample, the Sacred Heart males had longer periods of continual stress, particularly when examining Harris lines, and had an overall higher frequency of skeletal lesions. The Sacred Heart male sub-sample also showed more growth fluctuation than the female sub-sample, suggesting more developmental instability in the males.

As discussed above, it was assumed that if sexual buffering was occurring normally then females would appear less stressed than males, but if sexual buffering was being hindered by cultural stresses then the differences between males and females and their response to stress would be less apparent. Within these four sub-samples it was clear that the Sadlermiut females were more stressed than the Sadlermiut males when examining all lines of evidence. However, in the Sacred Heart sample the females appeared to be less stressed than the males when examining all lines of evidence. From these results a general conclusion can be made that sexual buffering was acting naturally on the Sacred Heart sample with females showing less stress than males; however, in the Sadlermiut sample it was assumed that some type of cultural stress was affecting the expected pattern of sexual buffering as the Sadlermiut females were considerably more stressed than the males. A very probable explanation of this apparent difference is the distinct environmental regions in which these individuals lived which would have encroached on all aspects of daily life and how these individuals were affected by stress.

5.11 Stress and the Environment

As discussed above, the specific causes of stress are difficult to identify in bioarchaeological research. Further investigation into these mechanisms and how they function in response to external influences will ultimately aid bioarchaeologists in their understanding of how stress directly affects the human skeleton. From this examination of the Sadlermiut and Sacred Heart samples it became clear that many of the potential stressors affecting their skeletons, either through the creation of lesions or the alteration of the patterns of growth and development, are all linked to the environmental regions in which these individuals lived. As discussed, the physical environment can have a significant effect on the genetically determined body proportions of a population; however, it is important to recognize that many of the other external stress factors are also created as a consequence of the physical environment.

Within a cold Arctic environment the Sadlermiut would have constantly struggled to attain enough food high in nutritional content that they needed to survive, ultimately affecting their patterns of growth and development. This population would likely have also been exposed to psychosocial stress as a result of their social isolation from other surrounding Inuit groups. Also reduced sunlight hours during the winter months (see section 2.2.1) may have increased the prevalence of Arctic hysteria, a well documented psychosocial stress brought on by a reduced photoperiod during the winter season (So 1980). Because this population was endogamous, the Sadlermiut may also have been exposed to various congenital conditions within their own community group, fostering specific types of physiological stress. Depending on the social structure of the Sadlermiut, access to resources may have been divided between the sexes, creating a type of social stress which may have contributed to the higher levels of growth disruption evident among the Sadlermiut females. Although these stress factors are not directly linked with a cold environment, it is clear that this type of environment will ultimately foster specific types of stress due to the very nature of survival within this region. While long term natural selection may have selected for adaptations to the cold temperature such as thermoregulatory adaptation of limb proportions, it is important to recognize the many other stress factors within this cold region that would have affected Sadlermiut health.

When examining the Sacred Heart sample it also became clear that the stress experienced by these individuals was related to the environment in which they occupied. In general, the Sacred Heart males and females showed far less stress than the Sadlermiut in regards to the supplementary stress data. This low frequency of stress makes sense in the context of the environment in which these people lived, as their access to food would have been more consistent because of the availability of agricultural products. Psychosocial stress may have been diminished, as these Sacred Heart individuals were regarded as social people interacting in a positive manner with surrounding First Nation groups. Disease threat would have also been diminished among these individuals as they had emigrated from Europe and mostly likely had a strong resistance to the common pathogens in the region. Despite the Sacred Heart individuals demonstrating less susceptibility to stress in their temperate environment, it is important to recognize that while these individuals did experience stress, it appeared minimized when compared to the harsher environmental conditions of the Sadlermiut. Living conditions for archaeological populations are generally regarded as poor in comparison to modern Western standards (Steckel and Rose 2002); individuals lived short lives filled with many hardships only to be further challenged by their surrounding physical environmental.

CHAPTER 6: CONCLUSIONS AND FUTURE RESEARCH

6.1 Conclusions

The primary goal of this research project was to develop a new method to examine stress from a growth and development perspective. While the primary methods of stress analysis within the bioarchaeological discipline generally examine skeletal lesions to assess stress, this research focused more on what the patterns of growth and development could reveal about the manifestation of stress. The established body size literature (Anderson *et al.* 1977; McHenry 1992; Aiello and Wood 1994; Porter 1999; Ruff 2002; Spocter and Manger 2007) was used as the basis to select individual indicators of body size that were used to examine how stress manifests within the skeleton. Although it has been documented that stress can be caused by multiple factors (Johnston *et al.* 1975; Delemarre-van de Waal 1993; Hoppa and FitzGerald 1999; Bogin 2001; Ruff 2002), environmental stress was examined as a primary stress factor affecting these two populations. In order to analyze the stress response to environmental factors two climatically distinct populations were examined, the Sadlermiut Inuit and Sacred Heart Cemetery, who occupied a cold climate in the Canadian Arctic and a temperate climate in southwestern Ontario, respectively.

In order to assess the effects of stress in the skeleton using BSIs, the relationship between these variables needed to be established through the use of correlation analysis followed by t-tests of significant association. All BSIs shown to be highly correlated and significantly associated were interpreted as being correlated via a common control mechanism tuned to the final adult body size. The BSIs were then ordered into a chronological sequence denoting the age of maturation for each variable. Once this sequence was established, regression analysis was then used to examine individuals who deviated from the normal growth trajectory of the group. Individuals falling above the confidence interval were interpreted as demonstrating growth acceleration, while individuals falling below the confidence interval were thought to indicate growth disruption. Through an analysis of these disruption and acceleration patterns a growth fluctuation pattern map was created for each of the sample populations divided by sex to track the overall patterns of disruption and acceleration of these groups.

One of the primary goals of this project was to assess the utility of body size indicators to assess stress within the human skeleton and whether or not these indicators showed significant correlations to one another. As is evident from the general growth fluctuations in both sample populations, the use of BSIs to assess stress has great potential in bioarchaeological research. Because the correlations between these indicators do exist and provide a sufficient age range of maturation, their use is viable to determine stress at any age during the years of growth and development.

With regards to the predictable patterns of growth disruption and acceleration demonstrated in each sub-sample, this method does provide relevant information to examine population sample patterns. The assessment of regression analysis data through the growth fluctuation pattern maps made specific trends of growth disruption and acceleration clear, allowing for the further investigation of stress within these sub-samples. Through this analysis of growth fluctuations, along with supplementary stress lesion data from both samples, it became clear that the Sadlermiut and Sacred Heart population samples both experienced stress during a similar time period of growth;

however, the magnitude of that stress was dependent upon the environment in which they occupied.

By using multiple lines of evidence to examine the stress patterns of these two population samples it became evident that each method was an important contributor to the overall outcome of this research. While EHL and Harris lines were excellent indicators of early childhood and juvenile stress events, BSI and asymmetry data were better suited to define the adolescence periods of stress. Through the integration of these multiple methods a more complete analysis of the Sadlermiut and Sacred Heart samples was possible, demonstrating the benefit and importance of using multiple lines of evidence in bioarchaeological research.

The Sadlermiut population sample was clearly more affected by stress than the Sacred Heart sample. As was evident from both supplementary data and from the BSI method explored in this research, the Sadlermiut individuals were continually plagued by stress from the very beginning of childhood into the adolescent stages of growth. The Sadlermiut females, in contrast to the expected patterns of sexual buffering, were more stressed than the Sadlermiut males suggesting additional cultural stresses affecting females in this population. While the males of this population appeared to have overcome their stress before the adolescent growth spurt, the stress experienced by the females continued through this period, followed by a period of catch-up growth in late adolescence. The significant stress experience by the males and females of this sample was partially due to the biological changes of adolescence but also due to the harsh environment that they occupied. Scarce food resources, social isolation, and disease were all potential causes of the stress that manifested within the Sadlermiut skeletal remains, ultimately compounding the biological stress of adolescent maturation.

In contrast to the Sadlermiut, the Sacred Heart population sample was far less affected by stress during their period of growth and development. This sample showed stress mainly occurring during the late juvenile stage and early adolescent stage of maturation. The supplementary data showed that the Sacred Heart females were far less affected by stress than the males and that stress was most likely short-term and not severe. While the Sadlermiut demonstrated stress during the early childhood stage of growth, the Sacred Heart males and females generally tended to show stress later on. The Sacred Heart males appeared to have been stressed by the biological changes of adolescence but then quickly began the adolescent growth spurt, while the females demonstrated stress through growth fluctuations above and below the confidence intervals. Although these individuals were stressed during growth and development their temperate climate provided more shelter from environmental stressors. Because this population relied on agriculture, food sources were readily available, social isolation was not as extreme as the Sadlermiut and disease manifestation may have been minimal due to population resistance to European diseases. Overall, the Sacred Heart individuals were stressed but in comparison to the hardships suffered by the Sadlermiut their temperate environment acted as a buffer to potential sources of stress.

6.2 Future Research

Although this research project established the utility of using BSIs to examine stress episodes in archaeological populations, future research into how growth and development patterns can indicate stress must be undertaken with regards to bone biology. While patterns of growth and development and skeletal lesions may indicate stress, it is important to further investigate the thresholds by which these indicators of stress manifest within the skeleton, specifically why some indicators of stress may be more prevalent than others (cf. Dolphin 2000). By understanding these thresholds as well as the underlying biological processes, bioarchaeologists will be better equipped to discern the type of stress occurring, the time period of when that stress affected the body and finally the magnitude of stress. Another important consideration is how these differences in threshold may be linked to the underlying biological processes of bone formation and how these mechanisms respond to stress. While the different mechanisms of bone growth (length vs. mass) may help to explain why some BSIs are more readily affected by stress, further investigation into these processes and their affect on bone development is needed to fully understand how stress manifests within the skeleton.

Further investigation into patterns of variability among BSIs is also important to examine the possibility of selecting earlier maturing BSIs that may fill in some of the inevitable gaps in the age range of BSI maturation. A larger list of BSIs may also open up the possibility of further correlations among certain indicators that will also help to create a more complete BSI age range for examination.

The skeletal mechanism of growth acceleration is also an important area of study that could aid in this method of stress analysis. By better understanding the adolescent growth spurt, catch-up growth and growth fluctuation it is possible that these acceleration processes may be more clearly differentiated in future research, providing further insight into how the skeletal system responds to stress via growth acceleration.

Finally, it is important to recognize that future research into the methods of stress analysis is needed. As discussed, stress is considered non-specific and the sources of stress are difficult to clearly define. However, through the integration of multiple methods of analysis from different perspectives, this non-specificity of stress may be addressed through supplementary comparative data, timeline information and skeletal threshold data. By developing further methods of stress analysis from multiple perspectives, skeletal stress will eventually become less of an enigma to the bioarchaeologists who seek to uncover the health patterns of past populations.

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APPENDIX A: SKELETAL SAMPLES

A-1 Sadlermiut skeletal sample

Skeleton #	Adult/Sub-Adult	Age	Sex
XIV-C:96	adult	25.0-40.0	F
XIV-C:112	adult	25.0-35.0	F
XIV-C:175	adult	30.0-40.0	F
XIV-C:105	adult	30.0-45.0	F
XIV-C:145	adult	35.0-45.0	F
XIV-C:149	adult	40.0-50.0	F
XIV-C:153	adult	40.0-60.0	F
XIV-C:103	adult	45.0-55.0	F
XIV-C:104	adult	45.0-55.0	F
XIV-C:98	adult	45.0-60.0	F
XIV-C:155	adult	50.0+	F
XIV-C:219	adult	55.0-60.0	F
XIV-C:183	adult	55.0+	?F
XIV-C:148	adult	55.0+	F
XIV-C:100	adult	60.0+	F
XIV-C:192	adult	60.0+	F
XIV-C:221	adult	60.0+	F
XIV-C:230	adult	25.0-30.0	M
XIV-C:74	adult	25.0-35.0	M
XIV-C:117	adult	25.0-35.0	M
XIV-C:126	adult	25.0-35.0	M
XIV-C:246	adult	30.0-40.0	M
XIV-C:111	adult	30.0-60.0	M
XIV-C:243	adult	35.0-45.0	M
XIV-C:216	adult	40.0-45.0	M
XIV-C:217	adult	40.0-45.0	M
XIV-C:179	adult	40.0-50.0	M
XIV-C:182	adult	45.0-50.0	M
XIV-C:157	adult	45.0-55.0	M
XIV-C:181	adult	45.0-55.0	M
XIV-C:101	adult	45.0-60.0	M
XIV-C:156	adult	50.0+	M
XIV-C:99	adult	50.0-60.0	M
XIV-C:122	sub-adult	B-2.0 mons.	?
XIV-C:107	sub-adult	3.0-9.0 mons.	?
XIV-C:120	sub-adult	8.0 mons.-1.4	?
XIV-C:77	sub-adult	1.0-2.0	?
XIV-C:79	sub-adult	1.0-2.0	?
XIV-C:78	sub-adult	4.0-8.0	?
XIV-C:118	sub-adult	5.0-8.0	?
XIV-C:76	sub-adult	6.0-10.0	?
XIV-C:124	sub-adult	8.0-12.0	?
XIV-C:220	sub-adult	9.0-12.0	?

XIV-C:75	sub-adult	9.0-14.0	?
XIV-C:158	sub-adult	13.0-16.0	?M
XIV-C:73	sub-adult	15.0-20.0	?
XIV-C:146	sub-adult	17.0-20.0	M
XIV-C:193	sub-adult	18.0-21.0	M

Legend:
mons. = months
M = male
F = female
? = unknown/questionable

A-2 Sacred Heart skeletal sample

Skeleton #	Adult/Sub-Adult	Age	Sex
88	Adult	20.0-24.0	F
24	Adult	22.0-29.0	F
9	Adult	35.0-39.0	F
120	Adult	35.0-39.0	F
124B	Adult	40.0-45.0	F
97	Adult	40.0-50.0	F
71	Adult	45.0-60.0	F
5	Adult	50.0-59.0	F
114	Adult	50.0+	F
122	Adult	50.0+	F
139	Adult	30.0-35.0	M
115	Adult	35.0-39.0	M
145	Adult	35.0-45.0	M
30	Adult	40.0-45.0	M
72	Adult	40.0-45.0	M
33	Adult	40.0-49.0	M
73	Adult	40.0-50.0	M
64	Adult	45.0-60.0	M
83	Adult	50.0-60.0	M
55	Adult	60.0+	M
56	Sub-adult	3.0mons-6.0mons	?
44	Sub-adult	6.0mons-1.0	?
66A	Sub-adult	2.5-3.5	?
25	Sub-adult	3.0-4.0	?
36	Sub-adult	4.0-6.0	?
67	Sub-adult	5.0-7.0	?
12	Sub-adult	8.0-10.0	?
141	Sub-adult	14.0-17.0	M
63	Sub-adult	18.0-20.0	M
90	Sub-adult	18.0-20.0	F

Legend
mons. = months
M = male
F = female
? = unknown/questionable

APPENDIX B: BODY SIZE INDICATOR (BSI) MEASUREMENTS

B-1 BSI measurements

Cranium
1. Maximum Cranial Breadth
2. Maximum Cranial Length
3. Upper Facial Breadth
4. Biorbital Breadth
5. Maximum Orbital Height
6. Maximum Orbital Breadth
7. Postorbital Breadth
8. Biporionic Breadth
9. Occipital Condyle Length
10. Occipital Condyle breadth
11. Maximum Cranial Height
12. Foramen Magnum Length
13. Foramen Magnum Breadth
14. Interorbital Breadth
15. lateral incisors/canines mesiodistal width
16. Chin Depth
17. Maximum Breadth of the Mandible
18. maxilla intercanine breadth
19. Palate Length

Vertebrae
20. C7 anteroposterior diameter of superior surface
21. C7 transverse diameter of superior surface
22. T12 anteroposterior diameter of superior surface
23. T12 transverse diameter of superior surface
24. L1 anteroposterior diameter of superior surface
25. L1 transverse diameter of superior surface
26. L5 anteroposterior diameter of superior surface
27. L5 transverse diameter of superior surface
28. Sacrum anteroposterior diameter of superior surface
29. Sacrum transverse diameter of superior surface
30. Sacrum anterior height of first segment
31. Maximum height of C2-L5
32. Bi-iliac breadth

Humerus
33. Maximum humerus length
34. Midshaft circumference
35. Minimum midshaft circumference
36. Distal epiphysis breadth
37. Distal joint breadth
38. Anteroposterior diameter of head
39. Capitual height

Ulna/Radius
40. Maximum ulna length
41. Maximum radius length
42. Transverse diameter of radius head
43. Total arm length humerus/radius

Femur
44. Maximum superior/inferior diameter of head
45. Femur head breadth
46. Anteroposterior diameter of shaft inferior of lesser trochanter
47. Transverse diameter of shaft inferior of lesser trochanter
48. Biepicondylar diameter of distal femur
49. Anteroposterior diameter of distal shaft
50. Maximum femur length
51. Midshaft circumference
52. Midshaft width

Tibia/Fibula
53. Maximum tibia length
54. Tibia midshaft circumference
55. Proximal tibia breadth
56. Anteroposterior diameter of talar facet
57. Transverse diameter of talar facet
58. Anteroposterior diameter of proximal tibia
59. Tibia midshaft width
60. Maximum fibula length
61. Total leg length femur/fibula
62. Patella maximum breadth
63. Ankle width tibia/fibula/talus/ calcaneus

Calcaneus/Talus
64. Maximum length of calcaneus
65. Posterior length of calcaneus
66. Maximum length of talus
67. Transverse diameter of tibial facet
68. Articulated height of calcaneus/talus

Metacarpals
69. Second metacarpal length
70. Second metacarpal breadth

B-2 BSI references

Bone	Measurement	Reference	Indicates
ankle	maximum width with tibia, fibula, calcaneus and talus articulated	Porter 1999	body weight/stature
C7	anteroposterior diameter of the superior aspect on the vertebral body	McHenry 1992	body weight
C7	transverse diameters of the superior aspect on the vertebral body	McHenry 1992	body weight
calcaneus	maximum length of the calcaneus as taken parallel to the long axis	Holland 1995	body stature
calcaneus	posterior length of the calcaneus	Holland 1995	body stature
cranium	maximum cranial breadth	Porter 1999	body weight
cranium	maximum cranial length	Spocter and Manger 2007	body weight
cranium	upper facial breadth	Spocter and Manger 2007	body weight
cranium	biorbital breadth	Spocter and Manger 2007	body weight
cranium	maximum orbital height	Spocter and Manger 2007	body weight
cranium	maximum orbital breadth	Spocter and Manger 2007	body weight
cranium	orbital area	Spocter and Manger 2007	body weight
cranium	interorbital breadth	Aiello and Wood 1994	body weight
cranium	postorbital breadth	Aiello and Wood 1994	body weight
cranium	biporionic breadth	Aiello and Wood 1994	body weight
cranium	occipital condyle length	Aiello and Wood 1994	body weight
cranium	occipital condyle breadth	Aiello and Wood 1994	body weight
cranium	occipital condyle area	Aiello and Wood 1994	body weight
cranium	basion-bregma height	Raxter *et al* 2006	body stature
femur	maximum superoinferior diameter of the femoral head	McHenry 1992	body weight
femur	anteroposterior diameter of femoral shaft inferior to the lesser trochanter	McHenry 1992	body weight

femur	transverse diameter of the femoral shaft inferior to the lesser trochanter	McHenry 1992	body weight
femur	biepicondylar diameter of the distal femur	McHenry 1992	body weight
femur	shaft anteroposterior diameter of the distal femur	McHenry 1992	body weight
femur	femoral head breadth	Ruff 2002	body weight
femur	maximum femur length	Trotter and Gleser 1958	body stature
femur	midshaft circumference	Aiello and Wood 1994	body weight
femur	midshaft width	Porter 1999	body weight/stature
femur/fibula	total leg length	Porter 1999	body stature
fibula	maximum fibula length	Trotter and Gleser 1958	body stature
foramen magnum	maximum length (anterior to posterior)	Spocter and Manger 2007	body weight
foramen magnum	maximum breadth	Spocter and Manger 2007	body weight
foramen magnum	total area	Spocter and Manger 2007	body weight
humerus	maximum humerus length	Trotter and Gleser 1958	body stature
humerus	midshaft circumference	Aiello and Wood 1994	body weight
humerus	minimum shaft circumference	Aiello and Wood 1994	body weight
humerus	distal epiphyseal breadth	Aiello and Wood 1994	body weight
humerus	distal joint breadth	Aiello and Wood 1994	body weight
humerus	maximum anterior posterior diameter of humerus head	McHenry 1992	body weight
humerus	capitual height	McHenry 1992	body weight
humerus/radius	total arm length	Porter 1999	body stature
L1	anteroposterior diameter of superior surface	Porter 1999	body weight/stature
L1	transverse diameter of superior surface	Porter 1999	body weight/stature
L5	anteroposterior diameter of superior surface	McHenry 1992	body weight
L5	transverse diameter of superior surface	McHenry 1992	body weight
mandible	lateral incisors and canines mesiodistal widths	Anderson *et al* 1977	body weight
mandible	chin depth (males)	Anderson *et al* 1977	body stature
mandible	maximum width	Porter 1999	body weight

maxilla	intercanine breadth	Aiello and Wood 1994	body weight
maxilla	palate length	Aiello and Wood 1994	body weight
metacarpal	second metacarpal length	Anderson *et al* 1977	body weight/stature
metacarpal	second metacarpal width	Anderson *et al* 1977	body weight/stature
patella	maximum width	Porter 1999	body weight/stature
pelvis	bi-iliac breadth	Porter 1999	body stature
radius	mediolateral diameter of the radial head	McHenry 1992	body weight
radius	maximum radius length	Trotter and Gleser 1958	body stature
sacrum	anteroposterior diameter of superior surface	McHenry 1992	body weight
sacrum	transverse diameter of superior surface	McHenry 1992	body weight
sacrum	anterior height of first segment	Raxter et al 2006	body stature
T12	anteroposterior diameter of superior surface	McHenry 1992	body weight
T12	transverse diameter of superior surface	McHenry 1992	body weight
talus	mediolateral diameter of the tibial facet	McHenry 1992	body weight
talus	maximum length of the talus	Holland 1995	body stature
talus/calcaneus	articulated height	Raxter et al 2006	body stature
tibia	anteroposterior diameters of the talar facet on the distal tibia	McHenry 1992	body weight
tibia	transverse diameter of the talar facet on the distal tibia	McHenry 1992	body weight
tibia	anteroposterior diameter of proximal tibia	McHenry 1992	body weight
tibia	maximum tibia length	Trotter and Gleser 1958	body stature
tibia	midshaft circumference	Aiello and Wood 1994	body weight
tibia	proximal breadth	Aiello and Wood 1994	body weight
tibia	midshaft width	Porter 1999	body weight/stature
ulna	maximum ulna length	Trotter and Gleser 1958	body stature
vertebrae	maximum height of C2-L5	Raxter et al 2006	body stature

APPENDIX C: SKELETAL RECORDING FORMS

C-1 Adult skeletal recording form

Burial/Skeleton Number:

Site Location:

Housed At:

Recorded By:

Date Recorded:

Skeletal Inventory

√ = present
/ = missing

Cranial Bones and Joint Surfaces

	LEFT	RIGHT
Frontal		
Parietal		
Occipital		
Temporal		
Sphenoid		
Zygomatic		
Maxilla		
Palatine		
Mandible		

Post-Cranial Bones and Joint Surfaces

	LEFT	RIGHT
Patella		
Sacrum		
Ilium		
Ischium		
Pubis		

Vertebrae (individual)

	Centrum	Neural Arch
C7		
T12		
L1		
L5		

Vertebrae (grouped)

	Centrum	Neural Arch
C1-6		
T1-T11		
L2-4		

Hand Bones

	LEFT	RIGHT
2^{nd} Metacarpal		

Tarsals

	LEFT	RIGHT
Talus		
Calcaneus		

Long Bones

	Prox. Epip	Prox. Third	Middle Third	Distal Third	Distal Epip
Left Humerus					
Right Humerus					
Left Radius					
Right Radius					
Left Ulna					
Right Ulna					
Left Femur					
Right Femur					
Left Tibia					
Right Tibia					
Left Fibula					
Right Fibula					

Comments:

Sexing

1 = female (< 3)
2 = ambiguous (3)
3 = male (> 3)

Pelvis	LEFT	RIGHT
Ventral Arc (1-3)		
Subpubic Concavity (1-3)		
Ischiopubic Ramus Ridge (1-3)		
Greater Sciatic Notch (1-5)		
Preauricular Sulcus (1-4)		

Estimated Sex, Pelvis: _____

Cranium	LEFT	CENTER	RIGHT
Nuchal Crest (1-5)	/		/
Mastoid Process (1-5)		/	
Supraorbital Margin (1-5)		/	
Glabella (1-5)	/		/
Mental Eminence (1-5)	/		/

Estimated Sex, Cranium: _____

Sex Determination:
_____ Probable Female
_____ Female
_____ Ambiguous
_____ Probable Male
_____ Male

Comments:

Aging

Pelvis	LEFT	RIGHT
Pubic Symphysis (Todd 1-10)		
Pubic Symphysis (Suchey-Brooks 1-6)		
Auricular Surface (1-8)		

Todd: _____ =

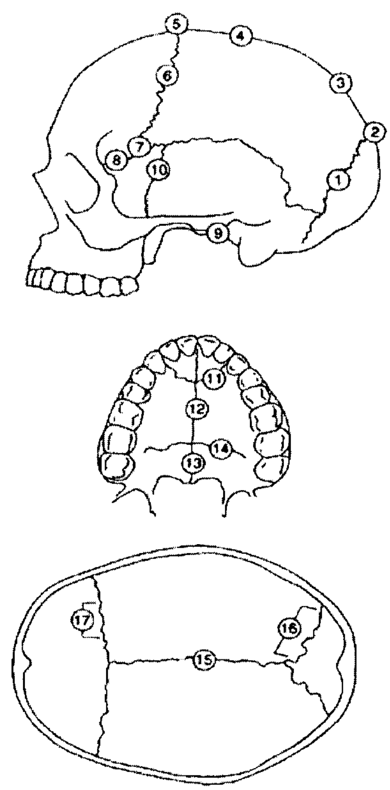
Suchey-Brooks: _____ =

Auricular Surface: _____ =

Comments:

Cranial Suture Closure
/ = unobservable/missing
1 = minimal closure
2 = significant closure
3 = complete obliteration

External Cranial Vault	
1) Midlambdoid	
2) Lambda	
3) Obelion	
4) Anterior Sagittal	
5) Bregma	
6) Midcoronal	
7) Pterion	
8) Sphenofrontal	
9) Inferior Sphenotemporal	
10) Superior Sphenotemporal	



Palate	
11) Incisive	
12) Anterior Median Palatine	
13) Posterior Median Palatine	
14) Transverse Palatine	

Internal Cranial Vault	
15) Sagittal	
16) Left Lambdoid	
17) Left Coronal	

Vault Composite Score: _____ =

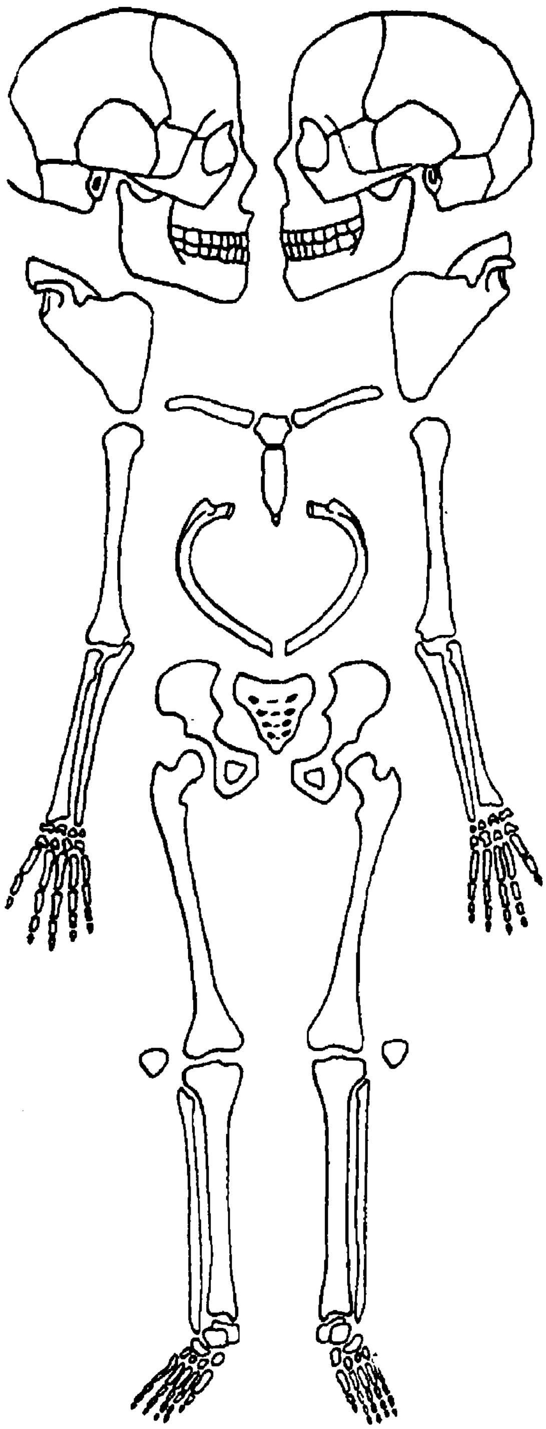
Lateral-Anterior Composite Score: _____ =

Estimated Age:

_____ yrs. - _____ yrs.

Comments:

Pathology (general)



Comments:

Stress Indicators

Enamel Hypoplasic Lesions

Teeth involved:

Lesion description (Pits or Lines):

Distance from cemento-enamel junction:

Comments:

Porotic Hyperostosis/Cribra Orbitalia:

Location(s):

Healed/Unhealed:

Severity (light, moderate, severe):

Comments:

Harris Lines:

Location:

Number of lines:

% of diaphysis crossed:

____

____

Comments:

____

____

____

____

BSI Measurements

* All measurements are in millimeters (mm) and to one decimal place

Cranium

	Measurement
max. cranial breadth	
max. cranial length	
upper facial breadth	
biorbital breadth	
max. orbital height	
max. orbital breadth	
postorbital breadth	
biporionic breadth	
occipital condyle length	
occipital condyle breadth	
basion-bregma height	
foramen mag. length	
foramen mag. breadth	
interorbital breadth	

Mandible/Maxilla

	Measurement
lateral incisors/canines mesiodistal width	
chin depth (males)	
max. breadth of mandible	
maxilla intercanine breadth	
palate length	

Vertebrae

	Measurement
C7 anteroposterior diameter of sup. surface	
C7 transverse diameter of sup. surface	
T12 anteroposterior diameter of sup. surface	
T12 transverse diameter of sup. surface	
L1 anteroposterior diameter of sup. surface	
L1 transverse diameter of sup. surface	

L5 anteroposterior diameter of sup. surface	
L5 transverse diameter of sup. surface	
sacrum anteroposterior diameter of sup. surface	
sacrum transverse diameter of sup. surface	
sacrum anterior height of first segment	
maximum height of C2-L5	
bi-iliac breadth	

Humerus

	LEFT	RIGHT
max. humerus length		
midshaft circumference		
min. midshaft circumference		
distal epiphysis breadth		
distal joint breadth		
anteroposterior diameter of head		
capitual height		

Ulna/Radius

	LEFT	RIGHT
max. ulna length		
max. radius length		
transverse diameter of radius head		
total arm length humerus/radius		

Femur

	LEFT	RIGHT
max. sup/infer. diameter of head		
femur head breadth		
anteroposterior diameter of shaft inferior of lesser trochanter		
transverse diameter of shaft inferior of lesser trochanter		
biepicondylar diameter of distal femur		
anteroposterior diameter of distal shaft		
max. femur length		
midshaft circumference		
midshaft width		

Tibia/Fibula

	LEFT	RIGHT
max. tibia length		
tibia midshaft circumference		
proximal tibia breadth		
anteroposterior diameter of talar facet		
transverse diameter of talar facet		
anteroposterior diameter of proximal tibia		

tibia midshaft width		
max. fibula length		
total leg length femur/fibula		
patella max. breadth		
ankle width tibia/fibula/talus/calcaneus		

Calcaneus/Talus

	LEFT	RIGHT
max. length of calcaneus		
posterior length of calcaneus		
max. length of talus		
transverse diameter of tibial facet		
articulated height of calcaneus/talus		

Metacarpals

	LEFT	RIGHT
second metacarpal length		
second metacarpal breadth		

Comments:

C-2 Sub-adult skeletal recording form

Burial/Skeleton Number:

Site Location:

Housed At:

Recorded By:

Date Recorded:

Skeletal Inventory

√ = present
/ = missing

Cranial Bones and Joint Surfaces

	LEFT	RIGHT
Frontal		
Parietal		
Occipital		
Temporal		
Sphenoid		
Zygomatic		
Maxilla		
Palatine		
Mandible		

Post-Cranial Bones and Joint Surfaces

	LEFT	RIGHT
Patella		
Sacrum		
Ilium		
Ischium		
Pubis		

Vertebrae (individual)

	Centrum	Neural Arch
C7		
T12		
L1		
L5		

Vertebrae (grouped)

	Centrum	Neural Arch
C1-6		
T1-T11		
L2-4		

Hand Bones

	LEFT	RIGHT
2nd Metacarpal		

Tarsals

	LEFT	RIGHT
Talus		
Calcaneus		

Long Bones

	Prox. Epip	Prox. Third	Middle Third	Distal Third	Distal Epip
Left Humerus					
Right Humerus					
Left Radius					
Right Radius					
Left Ulna					
Right Ulna					
Left Femur					
Right Femur					
Left Tibia					
Right Tibia					
Left Fibula					
Right Fibula					

Comments:

Aging

/ = unobservable/missing
0 = open
1 = partial union
2 = complete union

Epiphyseal Fusion

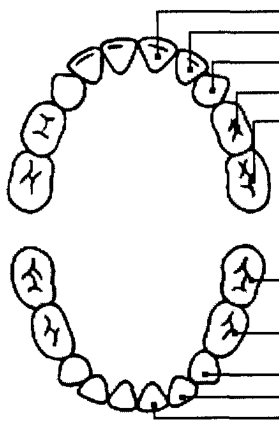
Bone	Epiphysis	Stage of Union
Cervical vertebrae	superior	
	inferior	
Thoracic Vertebrae	superior	
	inferior	
Lumbar Vertebrae	superior	
	inferior	
Radius	proximal	
	distal	
Ulna	proximal	
	distal	
Pelvis	illiac crest	
	ischial tuberosity	
Femur	head	
	greater trochanter	
	lesser trochanter	
	distal	
Tibia	proximal	
	distal	
Fibula	proximal	
	distal	

Age estimate based on epiphyseal union:
Fetal _____
b- 5 years _____
5-10 years _____
10-15 years _____
15-20 years _____
20+ years _____

Comments:

Dental Maturation

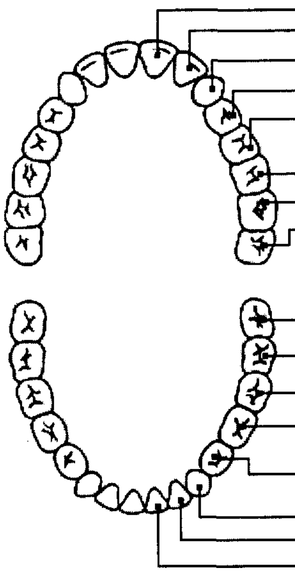
Primary Teeth



Upper Teeth	Erupt
Central Incisor	8-12 Months
Lateral Incisor	9-13 Months
Canine (Cuspid)	16-22 Months
First Molar	13-19 Months
Second Molar	25-33 Months

Lower Teeth	Erupt
Second Molar	23-31 Months
First Molar	14-18 Months
Canine (Cuspid)	17-23 Months
Lateral Incisor	10-16 Months
Central Incisor	6-10 Months

Secondary Teeth



Upper Teeth	Erupt
Central Incisor	7-8 Years
Lateral Incisor	8-9 Years
Canine (Cuspid)	11-12 Years
First Premolar (first bicuspid)	10-11 Years
Second Premolar (second bicuspid)	10-12 Years
First Molar	6-7 Years
Second Molar	12-13 Years
Third Molar (wisdom tooth)	17-21 Years

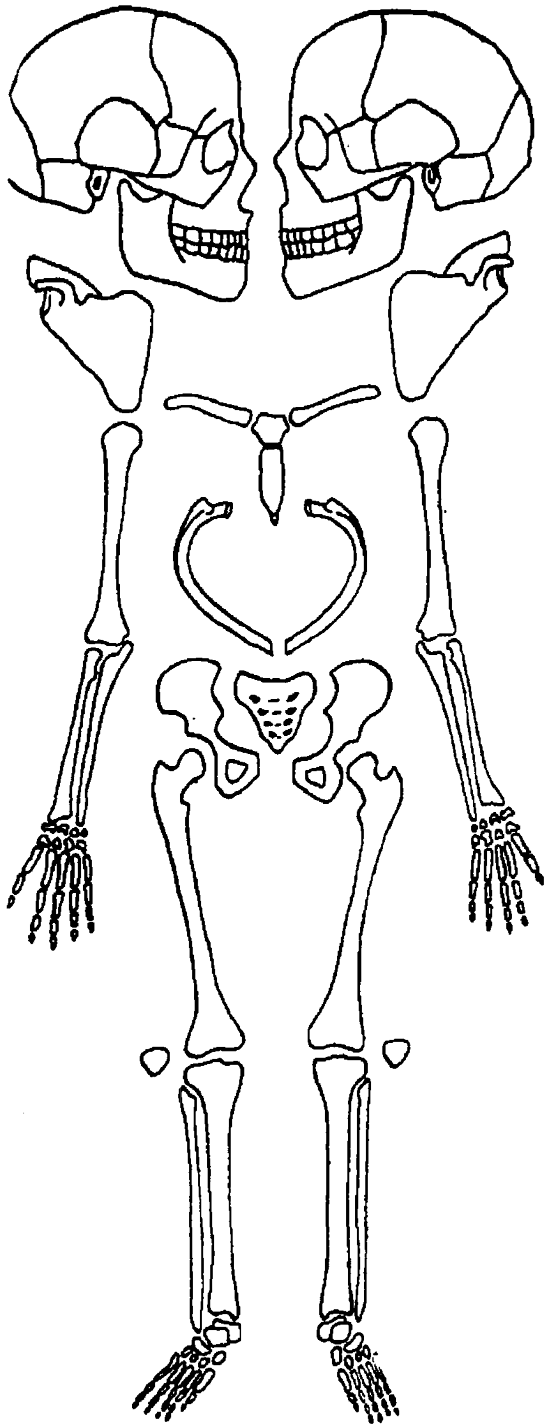
Lower Teeth	Erupt
Third Molar (wisdom tooth)	17-21 Years
Second Molar	11-13 Years
First Molar	6-7 Years
Second Premolar (second bicuspid)	11-12 Years
First Premolar (first bicuspid)	10-12 Years
Canine (Cuspid)	9-10 Years
Lateral Incisor	7-8 Years
Central Incisor	6-7 Years

Age Estimate based on dental eruption: _____

Estimated Age:
_____ yrs. - _____ yrs.

Comments:

Pathology (general)



Comments:

Stress Indicators

Enamel Hypoplasic Lesions

Teeth involved:

____

____

Lesion description (Pits or Lines):

____

____

Distance from cemento-enamel junction:

____

____

Comments:

____

____

____

____

Porotic Hyperostosis/Cribra Orbitalia:

Location(s):

____

____

Healed/Unhealed:

____

____

Severity (light, moderate, severe):

____

____

Comments:

____

____

____

____

Harris Lines:

Location:

____

____

Number of lines:

____

____

% of diaphysis crossed:

Comments:

BSI Measurements

* All measurements are in millimeters (mm) and to one decimal place

Cranium

	Measurement
max. cranial breadth	
max. cranial length	
upper facial breadth	
biorbital breadth	
max. orbital height	
max. orbital breadth	
postorbital breadth	
biporionic breadth	
occipital condyle length	
occipital condyle breadth	
basion-bregma height	
foramen mag. length	
foramen mag. breadth	
interorbital breadth	

Mandible/Maxilla

	Measurement
lateral incisors/canines mesiodistal width	
chin depth (males)	
max. breadth of mandible	
maxilla intercanine breadth	
palate length	

Vertebrae

	Measurement
C7 anteroposterior diameter of sup. surface	
C7 transverse diameter of sup. surface	
T12 anteroposterior diameter of sup. surface	
T12 transverse diameter of sup. surface	
L1 anteroposterior diameter of sup. surface	
L1 transverse diameter of sup. surface	

L5 anteroposterior diameter of sup. surface	
L5 transverse diameter of sup. surface	
sacrum anteroposterior diameter of sup. surface	
sacrum transverse diameter of sup. surface	
sacrum anterior height of first segment	
maximum height of C2-L5	
bi-iliac breadth	

Humerus

	LEFT	RIGHT
max. humerus length		
midshaft circumference		
min. midshaft circumference		
distal epiphysis breadth		
distal joint breadth		
anteroposterior diameter of head		
capitual height		

Ulna/Radius

	LEFT	RIGHT
max. ulna length		
max. radius length		
transverse diameter of radius head		
total arm length humerus/radius		

Femur

	LEFT	RIGHT
max. sup/infer. diameter of head		
femur head breadth		
anteroposterior diameter of shaft inferior of lesser trochanter		
transverse diameter of shaft inferior of lesser trochanter		
biepicondylar diameter of distal femur		
anteroposterior diameter of distal shaft		
max. femur length		
midshaft circumference		
midshaft width		

Tibia/Fibula

	LEFT	RIGHT
max. tibia length		
tibia midshaft circumference		
proximal tibia breadth		
anteroposterior diameter of talar facet		
transverse diameter of talar facet		
anteroposterior diameter of proximal tibia		

tibia midshaft width		
max. fibula length		
total leg length femur/fibula		
patella max. breadth		
ankle width tibia/fibula/talus/calcaneus		

Calcaneus/Talus

	LEFT	RIGHT
max. length of calcaneus		
posterior length of calcaneus		
max. length of talus		
transverse diameter of tibial facet		
articulated height of calcaneus/talus		

Metacarpals

	LEFT	RIGHT
second metacarpal length		
second metacarpal breadth		

Comments:

APPENDIX D: RAW DATA

D-1 Sadlermiut adult BSI measurements (mm)

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	Age	Sex	1	2	3	4	5	6	7	8	9	10	11	12	13	14
XIV-C:96	25.0-40.0	F	125.0	189.0												22.7
XIV-C:112	25.0-35.0	F	131.0	180.0	108.0	98.3	37.8	42.9	89.7	109.0	26.0	10.3	138.0	34.9	29.1	20.8
XIV-C:175	30.0-40.0	F		173.0	102.0	94.4	34.6	36.7	92.9		22.8	12.8		35.5	29.3	20.4
XIV-C:105	30.0-45.0	F	120.0	176.0	101.0	90.6	33.3	39.5	96.1	106.5	23.7	12.2	127.0	35.2	27.9	16.8
XIV-C:145	35.0-45.0	F	128.0	174.0												20.6
XIV-C:149	40.0-50.0	F	126.0	169.0	101.0	94.8	36.9	40.6	92.4	107.6	21.8	11.4	124.0	36.5	31.1	20.8
XIV-C:153	40.0-60.0	F	132.0	181.0	104.0	97.4	35.3	41.5	94.9	105.1			133.0			20.2
XIV-C:103	45.0-55.0	F	131.0	182.0	107.0	97.3	39.2	42.3	98.2	112.8	28.5	11.4	136.0	38.2	29.5	19.8
XIV-C:104	45.0-55.0	F	126.0	178.0	108.0	102.2	37.1	43.1	94.5	107.1	25.0	11.5	132.0	39.9	30.9	20.7
XIV-C:98	45.0-60.0	F	110.0	180.0	103.0	93.3	33.7	39.9	86.4	99.0	21.3	10.6	128.0	38.8	30.5	18.3
XIV-C:155	50.0+	F	129.0	174.0	101.0	96.5	37.0	38.4	92.6	108.9	23.8	12.8	138.0	35.4	33.1	21.2
XIV-C:219	55.0-60.0	F	129.0	183.0	108.0	97.6	38.2	39.7	94.4	107.5	24.1	14.4	136.0	36.2	30.0	22.1
XIV-C:183	55.0+	?F	131.0	175.0	101.0	96.0	40.5	41.0	93.0	104.9	25.7	14.9	129	36	26.9	17.0
XIV-C:148	55.0+	F	127.0	168.0	97.0	93.1	33.9	39.6	87.3	99.1	22.9	11.6	131.0	33.5	29.6	20.5
XIV-C:100	60.0+	F			104.9	96.3			90.2		21.5	14.4		39.6	30.6	21.4
XIV-C:192	60.0+	F	139.0	185.0	109.0	96.8	37.8	39.3	102.3	105.9	19.5	11.8	139.0		31.7	23.6
XIV-C:221	60.0+	F	130.0	180.0	105.0	97.2	35.9	39.5	92.9	104.5	25.2	12.3	139.0	38.2	31.5	19.7
XIV-C:230	25.0-30.0	M	133.0	187.0	113.0	101.4	36.8	40.1	102.2	114.1	22.8	13.8	131.0	40.2	35.5	22.3
XIV-C:74	25.0-35.0	M														
XIV-C:117	25.0-35.0	M	135.0	185.0	112.0	101.6	36.5	41.8	99.7	119.5	23.5	13.5	141.0	39.2	30.2	22.7
XIV-C:126	25.0-35.0	M	134.0	182.0	110.0	101.8	35.6	42.4	95.0	111.3	27.2	14.3	135.0	36.6	30.8	
XIV-C:246	30.0-40.0	M	131.0	181.0	106.0	97.2	39.4	41.5	95.4	110.3	25.6		134.0	34.1	33.5	20.0
XIV-C:111	30.0-60.0	M	133.0	185.0	110.0	102.2	37.6	43.1	99.5	113.6	27.7	12.0	139.0	39.6	30.9	22.5
XIV-C:243	35.0-45.0	M	139.0	174.0	106.0	96.4	38.5	39.6	97.3	115.8	25.3	14.7	140.0	38.0	30.5	18.5
XIV-C:216	40.0-45.0	M	136.0	176.0	103.0	95.7	37.3	37.7	93.9	110.2	26.1	13.9	140.0	38.9	33.6	21.5
XIV-C:217	40.0-45.0	M	133.0	191.0	111.0	99.0	36.6	41.2	96.2	116.9	23.7	14.5	139.0	41.3	30.5	18.5
XIV-C:179	40.0-50.0	M	132.0	181.0	111.0	101.6	39.4	40.4	101.4	110.3	26.8	13.9	145.0	39.7	30.5	21.0
XIV-C:182	45.0-50.0	M	136.0	186.0	112.0	102.9	40.5	43.3	95.4	118	23.4	13.5	136	33.8	32.2	15.8
XIV-C:157	45.0-55.0	M	138.0	180.0	111.0	101.8	36.1	41.5	101.7	111.5	22.2	13.3	135.0	35.2	31.4	22.9
XIV-C:181	45.0-55.0	M	134.0	187.0	109.0	101.8	38.9	41.5	96.9							24.2
XIV-C:101	45.0-60.0	M														
XIV-C:156	50.0+	M	131.0	181.0	104.0	96.3	40.1	41.9	92.3	110.9	25.7	11.5	140.0	39.9	34.2	18.8
XIV-C:99	50.0-60.0	M														

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
				53.9	18.2	26.6	29.7	38.2			31.9	46.6					
	33.4	107.0	25.3	55.6	18.9	23.6	32.6	38.2	33.5	43.3	43.8	56.9	36.5	57.3	31.0		
7.6			23.2	51.4	15.6	21.2	26.2	36.5	27.3	39.1	31.4	47.2	29.5	44.9	27.0		
	37.8	97.0		49.4													
					16.7	26.8	31.1	44.6	32.7	43.6	39.0	59.8	33.2	61.7	28.1		253.0
	31.1	101.4	22.9	49.0	15		29.7	40.1	28.1	39.8	26.1	49.0	24.0	50.2	30.6		257.0
	36.0	97.7		52.9													
	30.1	114.9	23.6	55.9	18.1	24.3	28.5	39.5	28.8	42.1		56.8	31.4	57.6	26.5		
	32.5	103.2	24.7	54.7	16.1				32.8				31.2	59.3	27.5		274.0
	26.0	92.4	24.3	53.4			28.6	37.2	29.2	39.8	32.7	46.8	29.5	50.3	26.2		
7.9		103.2		51.1	16.8	25.4	32.7	40.3	32.1	43.1	35.4	56.8	30.8	57.8	32.8		280.0
7.1		110.9	24	49.7	16.0	20.0	28.2	39.4	29.5	41.7	35.9	52.9	38.6	57.4	28.4		280.0
		86.2	21.1	49.1	17.9	24.5	32.0	39.6	32.8	40.4		50.2	32.2	51.4	23.8		272.0
	26.8	97.4		44.5													
	25.7	117.1	21.8	54.1			17.5	26.1	32.6	41.9		52.6	33.1	52.9	27.7		285.0
		104.2	25.9	54.1	16.2	23.4	33.5	39.9	34.3	41.6		53.4	32.1	53.4	29.4		
		99.9		49.5	16.4	24.4	29.5	41.2	31.0	42.5	36.9	52.7	32.8	53.6	28.0		280.0
8.5			26.8	55.7	16.2	22.9	27.6	35.6	31.6	42.1	35.2	53.3	34.1	52.6	27.8		276.0
							29.0	44.7	31.0	45.9	35.6	57.9	26.2	44.1	25.7		
	37.0	113.2	24.1	55.3	17.4	29.4	35.3	43.4	36.2	44.8	38.0	54.7	36.7	58.8	25.6		264.0
	36.2	115.6	26.0	55.9	19.7	28.0	31.8	44.8	31.1	45.6	37.3	59.2	34.7	60.5	29.9		257.0
	38.6	104.4	24.4	53.7	18.5	28.2	31.1	45.4	32.7	46.4	36.5	56.7	31.6	48.2	29.8		260.0
	34.4	115.1	26.4	53.5	18.3	25.2					36.5	56.9	32.7	56.9	26.9		
	33.9	112.5	25.9	52.0	17.5	23.8			31.8	44.2	34.8	55.8	34.4	56.4	27.7		
	32.3	120.7		50.5	16.3	24.8	32.4	46.7	34	46.9	35.8		28.4	57.7	27.1		258.0
	36.1	118.3	24.3	57.0	19.0	28.0	32.7	44.1	33.7	47.8			33.9	56.4	25.9		270.0
	36.6	117.7	19.4	52.7	19.0	33.6	33.3	46.6	35.3	46.9	41.3	59.5	38.5	62.3	28.5		284.0
	36.1	121.7	27.3	51.1	18.3	25.2	34.9	46.5	38.0	49.1	34.8	55.6	32.7	49	29.1		278.0
8.1	37.2	111.9	24.3	52.6	15.9	25.8	34.3	42.2	34.4	44.3	37.2	54.3	30.8	53.0	29.9		259.0
	37.1	110.4		55.1	23.3	30.8	40.0	52.2	40.7	54.1	41.5	66.3	39.0		35.4		294.0
							29.7	44.2	32.2	41.4	34.9	50.9	24.9	54.2	22.7		260.0
5.4	37.0	109.4		46.6	17.3	26.4	33.8	41.2	35.7	47.1	34.6	60.8	34.3	54.2	29.3		286.0

LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
282.0	63.0	58.0	52.9	39.6	37.8	17.9	222.0	202.0	18.6	484.0	41.4	43.9	29.0	29.3	77.8	28.0	422.0
319.0	65.0	61.0	54.9	40.8	42.8	19.4	253.0	233.0	20.5	552.0	46.4	46.3	27.7	28.5	75.9	30.6	452.0
241.0	54.0	50.0	49.1	38.6	35.2	16.6	198.0	175.0	17.6	416.0	37.8	38.8	23.9	24.3	68.0	23.9	358.0
276.0	62.0	55.0	54.5	38.8	40.6	17.8	220.0	200.0	20.3	476.0	43.6	41.8	24.9	27.2		26.5	390.0
307.0	66.0	62.0	59.0	42.3	44.2	18.8	232.0	214.0	21.3	521.0							
279.0	55.0	48.0	51.8	38.2	36.8	17.7	223.0	198.0	18.7	477.0	41.2	41.5	24.5	27.4	73.6	30.8	410.0
280.0	64.0	54.0	51.1	40.2	39.2	18.4	215.0	198.0	20.3	478.0	43.1	42.7	23.9	27.9		26.7	398.0
278.0	62.0	55.0	56.9	40.8	40.2	18.5	231.0	210.0	18.6	488.0	42.9	42.8	24.7	32.3	69.0	25.0	404.0
287.0	57.0	52.0	51.9	38.3	37.9	17.5	216.0	198.0	18.1	485.0	42.2	42.9	26.2	28.3	76.0	25.1	401.0
276.0	61.0	55.0	54.6	39.1	43.6	16.5	220.0	202.0	19.5	478.0	44.0	44.2	24.9	28.0	77.5	27.8	412.0
271.0	65.0	55.0	52.5	39.1	38.2	18.7	210.0	191.0	20.4	462.0	40.5	44.5	27.9	30.8	75.3	29.0	401.0
291.0	60.0	57.0	52.9	39.1	41.0	18.5	221.0	198.0	16.6	489.0	42.8	44.0	25.9	28.7	74.9	27.5	414.0
281.0	57.0	55.0	54.6	41.3	40.1	17.7	210.0	191.0	19.9	472.0	41.6	42.6	25.9	27.2	76.1	26.1	416.0
250.0	56.0	48.0	47.0	36.1	35.2	16.1	196.0	175.0	16.9	425.0	41.0	41.2	24.2	27.8	72.8	27.9	370.0
296.0	64.0	57.0	55.0	40.1	41.8	18.2		208.0	21.1	504.0							
283.0	57.0	53.0	54.5	39.0	38.1	16.8	230.0	207.0	17.4	490.0	42.4	43.4	25.1	24.8	72.5	23.8	413.0
287.0	59.0	52.0	54.0	40.5	40.3	19.5	221.0	204.0	19.3	491.0	43.4	44.9	24.5	27.6	76.2	25.4	430.0
325.0	68.0	62.0	59.9	45.1	45.7	18.7	254.0	229.0	21.0	554.0	44.9	48.2	29.9	30.0	82.0	31.8	473.0
301.0	67.0	63.0	57.0	42.0	40.0	20.8	241.0	223.0	21.7	524.0							
304.0	67.0	67.0	62.3	44.6	44.2	20.2	227.0	205.0	20.4	509.0	50.7	50.3	25.0	33.5	84.0	29.8	429.0
293.0	71.0	66.0	60.1	45.4	43.4	20.9	231.0	215.0	20.9	508.0	47.7	47.3	26.9	35.2	83.9	33.8	435.0
295.0	71.0	64.0	57.8	46.9	46.4	20.5	233.0	211.0	20.2	506.0	48.9	49.8	28.1	30.5	83.4	34.1	432.0
312.0	65.0	62.0	59.3	42.2	40.5	19.5	247.0	225.0	19.4	537.0	47.9	47.3	27.6	34.2	83.2	30.3	418.0
309.0	69.0	66.0	57.8	42.1	44.1	18.7	244.0	227.0	19.5	536.0	44.9	46.5	29.6	28.2	79.0	30.4	454.0
306.0	73.0	66.0	60.5	49.3	45.3	20.0	239.0	215.0	23.8	521.0	47.2		28.6	29.3	86.5	30.2	441.0
313.0	66.0	63.0	63.3	45.6	47.3	20.7	238.0	221.0	21.0	551.0	44.0	47.7	30.9	27.5	82.1	31.5	443.0
287.0	74.0	67.0	60.4	47.1	49.8	20.5			20.8		48.1	51.0	28.7	27.0			436.0
293.0	77.0	71.0	64.6	45.5	43.9	20.9	239.0	216.0	20.3	509.0	45.5	47.4	29.3	30.3	84.6	33.4	421.0
305.0	63.0	60.0	55.7	43.8	43.6	18.5	237.0	214.0	20.1	519.0	40.2	44.7	25.6	25.6	75.6	27.1	439.0
294.0	74.0	68.0	61.8	48.4	49.3	21.5	232.0	213.0		507.0	48.7	51.7	31.4	36.0	89.6	37.2	455.0
286.0	65.0	60.0	55.7	41.4	42.8	18.0	230.0	210.0	19.6	496.0	43.8	40.7	25.2	29.5	79.2	27.5	409.0
315.0	72.0	65.0	60.3	46.4	48.0	21.2	226.0	207.0	22.0	522.0	47.9	50.8	30.4	35.6	89.6	36.4	452.0
295.0	77.0	64.0	64.2	45.5	43.8	21.2	238.0	218.0	23.1	513.0	49.2	47.8	28.3	34.5	84.3	30.2	450.0

LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**
93.0	28.1	333.0	83.0	70.7	24.6	32.3	40.2	22.2					68.9	50.9			
94.0	27.5	371.0	79.0	68.4	27.1	31.7	48.1	20.3	363.0	815.0	42.6	64.7	74.8	52.3	57.0	30.2	67.0
71.0	22.0	289.0	73.0	63.4	27.5	26.2	46.5	16.1					63.2	44.0	46.7	25.5	67.0
82.0	25.1	316.0	72.0		24.3	32.0	48.7	18.0	307.0	697.0		60.9	74.0	53.0	53.1	30.3	63.3
		355.0	81.0	72.2	29.4	32.9	49.3	22.6	346.0		45.1	65.9	76.7	53.8	57.0	28.7	78.0
81.0	25.6	337.0	70.0	68.9	25.1	27.6	46.0	17.6	327.0	737.0		60.6	70.0	46.0	54.4	26.9	74.0
79.0	25.4	314.0	71.0					19.9	305.0	703.0			69.1	47.0			
82.0	26.0	335.0	74.0	64.4	26.3	29.7	45.6	18.9	320.0	724.0	44.1	58.9			54.1	27.8	
85.0	26.5	318.0	74.0	68.1	26.9	31.8	44.0	19.5	307.0	708.0	42.6	60.8	70.3	48.8		29.9	
85.0	25.2	323.0	75.0	72.8	23.6	29.3	47.7	18.5	315.0	727.0	43.7	61.9	69.5	49.8	55.5	26.6	61.1
83.0	26.3	315.0	72.0	67.0	28.6	29.7	48.7	20.1	311.0	712.0	42.1		72.5	52.4	55.3	25.9	73.0
84.0	25.4	318.0	75.0	66.7	31.1	29.8	46.5	18.8	312.0	726.0	41.8		70.3	51.5			
84.0	25.1	327.0	72.0	67.8	29.3	32.0	49.4	16.5	316.0	732.0	42.1		68.2	48.3	53.1	28.5	73.0
79.0	25.7	289.0	69.0	65.2	24.8	28.9	46.3	18.2	276.0	646.0		62.3			51.9	26.4	
		338.0	78.0	66.4	23.8	28.5	49.3	20.6	330.0			59.5	68.8	51.5			
82.0	24.5	328.0	71.0	65.3	30.4	31.9	45.6	18.3	314.0	727.0	41.2				54.1	30.0	
77.0	24.1	331.0	69.0		28.8	31.1		17.5	321.0	751.0	43.1		71.5	51.2	55.9	29.7	76.0
93.0	28.8		86.0	75.6				22.2	364.0	837.0							
		353.0	80.0	76.2	24.0	32.3	44.1	20.9	353.0			67.2	70.8	44.4	56.0	28.7	59.2
91.0	28.9	348.0	80.0	77.9	32.7	36.9	51.6	18.8	338.0	767.0	46.3	69.9	76.6	51.3	61.8	30.2	67.4
93.0	28.0	349.0	82.0	76.8	27.5	35.0	52.7	23.4	346.0	781.0	48.2	70.3	77.0	55.7	60.4	31.9	75.0
90.0	26.8	338.0	74.0	73.7	34.2	35.8	53.6	21.5	321.0	753.0	46.2		74.5	55.1	57.9	32.0	79.0
110.0	34.8	362.0	85.0	73.6	26.0	33.2	49.9	23.8	351.0	769.0	43.4	71.1	83.9	59.4	58.5	31.5	
93.0	25.2	353.0	84.0	72.5	34.3	31.9	52.7	22.3	353.0	807.0			73.5	52.5	57.1	29.9	76.0
95.0	29.2	351.0	82.0	76.5		41.3	56.9	22.1	325.0	766.0	45.8		77.7	54.6	62.0	31.6	79.0
92.0	26.5	340.0	85.0		29.8	32.8		20.3	335.0	778.0			75.5	56.5	56.7	30.6	
92.0	28.8	332.0	87.0	78.9	39.4	32.4	57.5	23.1	329.0	765.0			77.0	55.9	58.0	29.3	79.0
96.0	30.2	335.0	83.0	78.3	29.7	36.9	53.4	22.9	336.0	757.0	48.5		75.3	54.6	58.2	32.4	78.0
85.0	25.8	340.0	74.0	70.5	30.8	34.7	52.3	20.6	336.0	775.0	42.0				59.4	30.6	
105.0	31.9	346.0	88.0	81.8	32.0	35.1	62.3	25.2	340.0	795.0	51.2		89.2	66.1	65.2	32.2	88.0
83.0	25.6	324.0	78.0	70.8	25.9	31.3	47.9	20.1			42.3		70.6	48.7	56.8	28.4	62.6
96.0	31.4	349.0	87.0	80.2	34.8	32.0	55.1	23.3	346.0	798.0	47.6		86.1	59.7	61.2	30.9	87.0
96.0	30.4	359.0	87.0	77.4	26.0	31.7	53.3	21.5	351.0	801.0	49.9	72.4	80.8	57.6			

LEFT	LEFT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT
69	70	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
		292.0	66.0	63.0	54.3	41.5	40.7	19.3	230.0	206.0	19.0	498.0					
	6.9	329.0	68.0	63.0	54.5	42.3	42.0	19.3	254.0	234.0	20.4	563.0	46.9	47.2	27.6	31.4	77.5
		244.0	56.0	54.0	50.4	38.4	36.5	16.9	198.0	177.0	17.5	421.0	37.4	39.3	23.0	23.6	
		286.0	62.0	57.0	54.9	42.2	40.4	17.5	222.0	205.0	21.3	491.0		43.2	24.7	28.6	76.8
	7.2	312.0	71.0	62.0	59.3	42.7	41.4	18.6	234.0	217.0	21.4	529.0					
	6.6	285.0	59.0	52.0	53.4	38.3	37.2	18.1	225.0	200.0	19.2	485.0	41.7	41.6	26.4	29.8	67.9
		288.0	63.0	56.0	51.9	39.7	36.4	19.1	214.0	200.0	20.0	488.0	42.8	43.8	23.0	27.8	73.0
	6.2	283.0	62.0	55.0	56.4	41.0	40.5	18.0					41.5	42.7	24.8	30.6	74.1
	6.3	288.0	61.0	55.0	54.8	39.6	37.0	17.2					42.0	42.7	26.2	30.5	
		282.0	66.0	58.0	56.5	40.9	45.1	17.1	219.0	201.0	19.2	483.0	44.1	44.5	25.3	30.6	79.1
	7.0	278.0	69.0	58.0	53.1	39.3	38.1	17.5	213.0	195.0	18.9	473.0	40.9	43.7	27.1	31.2	76.1
		298.0	63.0	60.0	53.9	41.6	40.7	19.2	223.0	200.0	19.0	498.0	42.9	43.3	26.4	30.2	76.2
		287.0	60.0	57.0	55.2	18.0	40.4	17.9	216.0	198.0	20.6	485.0	41.2	41.8	25.5	29.3	76.8
	6.7	257.0	60.0	51.0	48.4	37.2	36.1	15.9	200.0	179.0	18.1	436.0	41.4	41.2	24.3	28.5	74.2
		300.0	66.0	57.0	54.0	40.7	41.5	19.3	225.0	201.0	22.0	501.0					
		286.0	59.0	53.0	55.8	41.1	38.0	16.8	226.0	204.0	18.1	490.0	42.6	44.0	23.4	27.6	73.7
	6.4	291.0	61.0	54.0	54.8	42.1	40.9	19.8	221.0	206.0	19.7	497.0	43.4	45.4	24.9	28.8	76.1
	8.0	330.0	68.0	63.0	59.4	45.1	45.2	18.5	254.0				44.3	48.0	30.9	28.8	81.5
	7.2	307.0	72.0	65.0	58.9	43.3	41.6	21.0	243.0		20.1						
	6.9	311.0	70.0	68.0	63.0	46.2	43.6	20.4	233.0				50.2	49.3	26.0	30.5	85.4
	8.1	298.0	75.0	67.0	61.2	45.0	43.7	20.9	234.0				47.7	47.4	27.7	34.3	85.3
	7.8	302.0	73.0	63.0	58.4	47.1	47.1	20.3	229.0				50.6	51.9	29.1	33.9	84.0
	7.9	314.0	69.0	67.0	61.7	44.7	41.9	18.9	253.0				47.7	48.3	26.8	33.6	82.7
		312.0	72.0	69.0	58.7	44.0	46.0	18.0	246.0				42.5	46.8	28.0	29.8	79.9
	7.1	315.0	74.0	69.0	63.3	49.0	46.9	19.5	240.0				47.3	49.2	26.6	30.7	86.6
	8.1	321.0	75.0	68.0	62.5	48.6	48.0	20.4	241.0				44.5	48.9	28.8	29.5	83.5
		299.0	73.0	70.0	61.9	47.4	48.9	20.4	241.0				47.5	51.7	28.5	32.1	
	7.4	297.0	82.0	73.0	64.9	47.1	45.0	21.7	243.0				45.4	49.2	29.4	30.7	84.6
		304.0	65.0	63.0	57.7	44.1	43.7	18.7	239.0	218.0	20.6	522.0	43.6	45.8	25.4	27.8	74.3
	7.3	304.0	79.0	69.0	60.9	49.8	49.9	21.4	230.0				45.9	51.1	31.7	34.5	91.2
													43.0	44.3	25.2	30.5	
	9.5	316.0	74.0	68.0	61.6	47.8	46.9	22.0	230.0				44.9	51.3	29.7	35.1	89.1
	7.6	301.0	80.0	69.0	64.5	42.7	43.2	20.6	243.0				48.7	48.8	27.7	35.0	85.2

RIGHT 49	RIGHT 50	RIGHT 51	RIGHT 52	RIGHT 53	RIGHT 54	RIGHT 55	RIGHT 56	RIGHT 57	RIGHT 58	RIGHT 59	RIGHT 60	RIGHT 61	RIGHT 62	RIGHT 63	RIGHT 64	RIGHT 65	RIGHT 66
				336.0	83.0	70.2	26.2	33.3	41.0	22.9	320.0			66.1	71.5	49.9	54.5
30.5	453.0	94.0	27.2	373.0	80.0	70.0	26.4	32.3	47.2	21.3	366.0	819.0	42.7	66.7	74.6	52.0	56.6
25.5	361.0	72.0	21.9	292.0	69.0	64.6	25.9	25.8	45.4	16.5							
27.3	393.0	83.0	25.5	317.0	75.0	65.7	25.2	32.5	48.4	17.8	308.0	701.0		63.2	74.1	51.3	52.2
				359.0	81.0	71.5	31.2	31.8	49.2	22.8	348.0			66.3	78.0	53.7	
28.0	406.0	81.0	26.0	335.0	73.0	70.0	25.2	29.4	45.3	18.8	324.0	730.0	41.4	60.8	69.4	48.4	
25.4	396.0	77.0	25.1	314.0	70.0	63.4			45.9	19.3	304.0	700.0	40.0		66.9	46.6	
24.2	409.0	80.0	26.6	335.0	75.0	66.9	26.4	28.6	45.4	18.4	323.0	732.0	42.6	58.4	71.3	51.6	53.0
25.7	407.0	85.0	26.1	321.0	77.0	69.8	26.7	32.2	44.4	20.7	309.0	716.0	42.7	61.1	71.8	49.4	
27.4	414.0	83.0	25.6	328.0	76.0	73.4	24.5	31.3	50.2	19.0	316.0	730.0	45.1	62.9	71.7	51.7	55.2
30.1	403.0	87.0	27.4	319.0	74.0	69.2	33.6	29.1	49.4	21.4	310.0	713.0	41.8		71.6	51.8	56.6
25.3	411.0	88.0	26.0	324.0	77.0	69.0	30.2	30.7	47.9	18.6	314.0	725.0			71.4	52.2	
25.0	411.0	85.0	25.9	328.0	73.0	68.9	27.8	33.0	48.7	17.5	313.0	724.0	41.7		68.9	49.8	53.3
28.6	373.0	80.0	26.2	288.0	68.0	66.7	25.6	28.7	45.4	18.5	277.0	650.0		58.6	69.0	49.9	51.1
					80.0	66.7			49.5	21.3							50.5
23.5	413.0	82.0	24.7	326.0	70.0	66.6		31.4		19.2	317.0	730.0					53.3
25.5	428.0	79.0	24.4	331.0	69.0	66.7	27.9	32.6	52.9	17.4	317.0	745.0	42.5		71.2	51.1	55.9
30.8	476.0	101.0	30.3	373.0	85.0	74.6	36.9	32.4	55.9	21.8	363.0	839.0	46.6				62.5
				353.0	82.0	69.3	24.1	32.2	46.9	20.2					67.6	45.0	55.9
30.4	435.0	91.0	22.1	347.0	80.0	77.8	28.9	37.6	53.6	20.6	334.0	769.0	47.3	71.8	75.3	51.1	60.8
33.6	434.0	92.0	28.5	347.0	83.0	79.3	30.0	36.5	52.9	23.7			47.0		79.5	57.5	60.2
34.3	429.0	95.0	26.8	346.0	79.0		36.8	36.5	53.4	22.7	326	755	45.6		76.6	55.3	58.3
31.4	445.0	89.0	28.1	368.0	90.0	73.8	27.0	35.0	51.2	24.6	352.0	797.0	43.3	73.1	83.1	59.1	59.1
28.7	451.0	93.0	26.8	357.0	86.0	74.1	33.8	32.0		22.3	351.0	802.0			75.4	54.2	56.7
31.7	444.0	94.0	29.3	350.0	89.0	76.2	31.7	35.2	55.5	22.7	338.0	782.0			79.5	54.5	59.9
32.7	447.0	98.0	26.9	339.0	86.0	72.9	35.9	33.5	55.6	21.2	327.0	774.0	49.3		76.7	58.4	57.1
34.7	437.0	95.0	29.2	334.0	87.0	80.7	35.5	31.6	58.0	22.6	330.0	767.0			77.0	55.1	58.6
30.6	429.0	92.0	27.9	337.0	83.0	78.9	34.3	40.1	52.2	22.8	338.0	767.0	46.4		75.4	54.9	58.0
26.9	432.0	86.0	26.9	341.0	78.0	71.6	29.3	33.7	50.2	20.8	333.0	765.0	42.0		79.8	53.6	59.0
36.2	452.0	105.0	31.8	338.0	89.0	81.8	34.3	34.7	58.7	24.8	331.0	783.0	51.5		89.6	64.8	64.0
				324.0	80.0	66.4	27.5	33.1	46.9	21.4					72.6	52.0	55.7
35.0	454.0	100.0	30.5	350.0	87.0	80.9	30.2	32.9	56.0	25.1	341.0	795.0			84.5	59.9	61.9
32.2	444.0	95.0	30.0	365.0	91.0	74.8	25.8	34.4	53.8	24.0	353.0	797.0	50.7	75.8	79.7	61.2	65.5

RIGHT	RIGHT	RIGHT	RIGHT
67	**68**	**69**	**70**
28.8	76.0	*61.3*	8.4
29.9	65.2		7.7
27.9	61.0		7.4
			6.6
27.6	59.2		
26.7	63.6		7.7
25.8			
			6.5
28.5	73.0		
25.9	70.0		6.8
26.6	56.2		
30.0			
29.1	75.0		
31.0			8.7
28.9	66.3		7.4
31.6	69.1		7.2
33.2	74.0		7.9
32.6	79.0		8.5
31.3	72.1		8.2
30.8	79.0		8.1
32.9	76.0		7.5
30.0	78.0		
28.9	76.0		
31.9	79.0		8.0
30.8	82.0		7.3
30.8	87.0		8.2
28.0	61.1		
31.1	88.0		8.5
32.4	67.0		7.6

D-2 Sadlermiut sub-adult BSI measurements (mm)

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	Age	Sex	1	2	3	4	5	6	7	8	9	10	11	12	13	14
XIV-C:122	B-2.0 mons.	?			55.0	52.5			50.1		9.3	6.1				10.9
XIV-C:107	3.0-9.0 mons.	?									10.9	6.5				
XIV-C:120	8.0 mons.-1.4	?	103.4		62.9	58.2		23.3	60.9		13.1	8.0				14.0
XIV-C:77	1.0-2.0	?	110.0		67.8	61.4		26.4	64.0		15.4	7.9		36.1	23.3	15.1
XIV-C:79	1.0-2.0	?	106.0		71.5	66.0		25.4	70.6							16.9
XIV-C:78	4.0-8.0	?														
XIV-C:118	5.0-8.0	?					30.5	35.1								18.4
XIV-C:76	6.0-10.0	?	135.0	172.0	98.0	88.0	34.8	39.3	103.7	100.3	24.4	10.0	133.0	35.9	27.4	17.6
XIV-C:124	8.0-12.0	?			96.2	88.5	36.1	34.9	94.0							19.0
XIV-C:220	9.0-12.0	?	129.0	165.0	91.0	85.4	33.5	35.0	84.7	93.1	21.7	12.1	126.0	36.8	29.8	18.9
XIV-C:75	9.0-14.0	?														
XIV-C:158	13.0-16.0	?M	132.0	180.0	102.0	93.0	38.1	37.1	91.9	102.7	23.8	12.5	129.0	38.5	29.1	18.2
XIV-C:73	15.0-20.0	?														
XIV-C:146	17.0-20.0	M	137.0	174.0	102.0	92.4	34.2	37.5	97.7	102.0	25.1	12.0	136.0	37.0	29.9	20.8
XIV-C:193	18.0-21.0	M	133.0	180.0	109.0	98.5	36.2	39.4	95.8	113.4	26.2	13.2	127.0	37.7	30.4	23.1

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	11.7	48.3															
	14.4	58.8															
	15.9	55.9															
	18.3	65.8	19.3	30.6													
	17.3	61.4															
	23.3	80.9															
	24.1	75.2		28.5													
	28.9	87.3	24.6	43.9	13.3	20.9	20.4	28.9	22.8	30.0	23.0	38.2	20.6	39.0	18.9		182.0
	28.0	86.5	22.6	45.3			19.7	27.1	19.8	30.3	23.3	40.0	21.7		16.5		
	29.5	88.0	21.6	39.3	13.5	22.8	22.7	30.4	21.9	31.3				22.8			
					14.1	22.7			23.3*	30.9	25.7	39.1	23.3	38.8	19.6		203.0
8.1	31.2	108.3	23.3	52.5	15.1	24.5	28.2	35.9	29.7	37.9	32.8	52.3	28.4	53.9	26.6		244.0
							26.7	38.5*	29.0	41.4	29.8	48.2	28.7	51.7	27.2		253.0
	31.6	101.9	20.9	46.5	16.9	24.4	29.3	37.9	32.9	36.4	36.3	54.5	27.9	59.9	27.1		
	35.5	109.1	25.5	49.5	15.1		31.0	42.7	32.0	43.7	32.4	55.3	30.9	61.2	27.8		250.0

LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
63.0	17.0	17.0					58.0	50.0		113.0			7.4	7.6		9.1	72.0
							69.0	61.0									
89.0	25.0	25.0					76.0						10.3	13.7		11.5	110.0
94.0	33.0	30.0					81.0	69.0		163.0			12.0	13.0		11.3	122.0
87.0	32.0	31.0						67.0		154.0							
								106.0									
146.0	39.0	38.0						103.0		249.0			14.7	18.4		16.5	195.0
					25.5			131.0									
168.0	41.0	38.0					137.0	122.0		290.0	29.3	29.0	17.1	23.8	56.2	21.3	236.0
203.0	40.0	40.0					157.0	143.0		346.0	34.5	35.5	17.2	21.3		23.6	276.0
								144.0									
263.0	52.0	49.0	49.2	37.2	34.6	17.5	212.0	188.0		451.0	42.2	42.7	23.4	29.6	71.8	26.7	385.0
262.0	60.0	55.0	51.0	37.1	31.1	17.9	208.0	185.0	17.3	447.0							
294.0	62.0	57.0	53.9	40.5	39.6	18.3	218.0	193.0	20.0	487.0	44.1	42.4	25.7	29.6	79.7	31.9	433.0
			57.5	42.2	43.7	18.2	238.0	218.0	18.9		42.6	45.3	24.8	26.8	77.2	30.1	434.0

LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**
21.0	6.0	62.0	20.0	14.1			11.8	5.5	58.0	130.0							
		77.0	25.0	16.3			12.0	6.4									
29.0	7.6	88.0	29.0	22.1			14.5	7.5	88.0	198.0							
36.0	11.1	97.0	34.0	26.0			15.9	8.8	94.0	216.0							
		90.0	32.0	21.3			14.4	8.9									
46.0	14.4	146.0	42.0	36.6			22.0	11.2	150.0	345.0			36.2	20.6			
				48													
54.0	17.4	180.0	49.0	40.4			28.4	14.3							38.4	22.6	
53.0	17.2	217.0	50.0	56.6	22.4	25.2	40.3	12.5	213.0	489.0	30.4		54.9	35.2	44.3	22.4	44.8
80.0	25.7	320.0	68.0	65.4	27.1	29.8	44.8	17.5	308.0	693.0	35.4		66.6	43.2	53.0	27.2	69.0
									308.0		40.6		68.9	51.0			
80.0	25.3	335.0	72.0	75.3	30.3	32.5	52.0	21.6	337.0	770.0	43.8	71.6	73.7	51.6	58.6	28.1	75.0
87.0	26.4	346.0	75.0	69.8	28.8	32.7	51.1	19.7	334.0	768.0	45.6		77.3	55.2			

LEFT	LEFT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT
69	**70**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
		63.0	17.0	17.0					58.0	50.0		113.0			7.6	7.8	
									69.0	59.0					8.8	8.9	
									76.0*	67.0					10.0	13.6	
		96.0	32.0	30.0					80.0	70.0		166.0			12.3	13.4	
		88.0	33.0	28.0					78.0						11.6	14.6	
										107.0							
		148.0	39.0	38.0					121.0	103.0		251.0			14.8	17.8	
							26.5			133.0							
		168.0	43.0	38.0					138.0	123.0		291.0	29.2	29.3	16.7	23.1	52.8
		205.0	40.0	40.0	39.1	31.8	30.9	13.5	158.0	141.0		346.0			16.8	24.1	
										143.0							
52.4	6.2	270.0	55.0	52.0	52.1	39.0	36.3	16.7	214.0	189.0	16.8	459.0					
	6.6	267.0	60.0	55.0	53.6	37.9	30.8	20.2	209.0	188.0	18.2	455.0					
	6.9	300.0	62.0	56.0	56.2	41.4	43.5	18.1	216.0	195.0	19.0	495.0	45.1	45.8	24.4	29.4	82.1
	6.4	297.0	63.0	59.0	57.2	42.2	42.4	17.6	238.0	219.0	19.1	516.0	42.1	44.9	23.9	29.3	78.0

RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT
49	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
9.2	73.0	20.0	6.1	62.0	21.0	14.6			12.0	5.7	60.0	133.0					
8.9	95.0	34.0	6.8	78.0	25.0	16.5			11.2	6.3							
9.9	110.0	30.0	8.3	88.0	29.0	21.5			14.5	7.5	88.0	198.0					
11.5	121.0	36.0	11.5	97.0	33.0	26.1			15.3	9.1	95.0	216.0					
13.6	110.0	33.0	9.8	91.0	32.0	24.0			14.2	9.3							
16.4	195.0	46.0	14.2	146.0	44.0	36.8			22.4	11.3	150.0	345.0					
									27.5								
21.5	235.0	53.0	17.2	177.0	48.0	44.1			28.0	13.4	178.0	413.0					38.6
24.3	278.0	52.0	16.9	218.0	51.0	55.4	21.9	26.4	39.5	12.7	214.0	492.0	29.5		54.4	34.9	46.4
				300.0	68.0	66.0	28.1	29.7		18.1	293.0		36.6		66.5	44.7	53.2
				316.0	72.0	63.4	24.4	28.6		19.6	310.0		40.8		70.0	50.4	
31.2	438.0	83.0	26.2	329.0	74.0	76.3	29.0	31.0	49.8	21.5	333.0	771.0		70.9	73.4	51.5	57.5
28.2	435.0	90.0	25.4	353.0	76.0	71.2	27.8	34.0	53.1	19.6	338.0	773.0			77.7	56.5	60.3

RIGHT	RIGHT	RIGHT	RIGHT
67	**68**	**69**	**70**
21.3		34.3	5.7
22.9	50.4		
27.6	69.0		
			6.0
28.5	71.0		7.4
29.4	77.0		

D-3 Sacred Heart adult BSI measurements (mm)

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	Age	Sex	1	2	3	4	5	6	7	8	9	10	11	12
88	20.0-24.0	F	137.0	172.0	101.0	94.7	34.6	38.6	94.6	106.4	25.4	11.0	130.0	38.4
24	22.0-29.0	F	139.0	169.0	97.0	89.7	36.2	38.9	94.2	98.1	21.7	8.4	120.0	36.9
9	35.0-39.0	F	139.0	186.0	103.0	95.6	32.2	38.4	92.2	98.9	27.6	12.2	126.0	37.5
120	35.0-39.0	F	140.0	183.0	104.0	95.9	36.1	37.2	93.1	101.3	22.9	10.8	123.0	36.7
124B	40.0-45.0	F	132.0	179.0	106.0	99.8	37.8	41.2	102.9	101.7	19.3	12.6	130.0	37.9
97	40.0-50.0	F	136.0	188.0	105.0	97.8	33.8	37.7	96.6	105.5	26.9	13.6	134.0	37.9
71	45.0-60.0	F	138.0	174.0	100.0		33.8	36.3	97.5	93.4	22.6	13.4	129.0	36.3
5	50.0-59.0	F		178.0	95.0	88.3	32.3	36.6	93.5	92.5	17.0	10.0	121.0	32.0
114	50.0+	F	139.0		100.0	94.4	35.7	38.6	92.7	97.2	21.2	15.0	132.0	35.4
122	50.0+	F	123.0	181.0	103.0	96.7	32.7	39.7	100.3	95.4				
139	30.0-35.0	M	136.0		102.0	91.6	29.8	38.3	95.1					
115	35.0-39.0	M	141.0	195.0	107.0	99.0	36.6	38.3	100.4	109.4	18.9	14.6	130.0	35.5
145	35.0-45.0	M	137.0	182.0			33.7	39.8	94.8	102.9	21.6	15.6	130.0	37.4
30	40.0-45.0	M	141.0	193.0	108.0	98.8	40.0	41.6	105.4	104.3	26.0	13.7	137.0	39.1
72	40.0-45.0	M	143.0	193.0	108.0	99.8	39.2	40.1	106.2	111.0	22.1	12.2	138.0	39.7
33	40.0-49.0	M	134.0	189.0	103.0	95.8	39.6	37.0	96.2	106.5	24.5	11.8	131.0	36.8
73	40.0-50.0	M	144.0	183.0	104.0	97.0	35.5	39.5	100.5	110.3	23.9	14.1	135.0	38.5
64	45.0-60.0	M	139.0	187.0	111.0	102.7	35.1	41.7	101.7	114.0	27.1	12.7	130.0	44.2
83	50.0-60.0	M	142.0	187.0	104.0	98.3	35.7	41.4	95.3	103.0	26.7	12.7	132.0	36.0
55	60.0+	M	144.0	188.0	105.0	99.3	40.8	41.4	94.5	112.1	28.5	13.4	138.0	38.5

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
34.9	20.4				23.8		15.5	23.8	26.8	37.4	28.0	42.0	32.7	55.2	30.8
30.0	17.8			85.8	21.7	46.4	12.9	24.0	24.6	32.4	25.1	35.9	27.5	42.3	26.0
32.4	19.4			92.4		50.9	15.6	22.8	26.6	38.2	27.2	39.5	34.6	51.8	30.8
31.5	23.0			94.8	24.7	54.4	17.7	24.8	29.0	37.7	27.9	39.7			29.0
30.7	22.0			94.4		47.5	19.0	23.9	26.3	39.8	27.1	40.5	32.6	53.3	29.4
34.3	21.8			97.9	25.4	58.8	16.6	26.3	30.6	43.3	32.7	43.7	35.0	53.4	32.8
27.6	22.1			91.6	20.4	47.5	14.1	23.7	26.7	37.3	27.9	41.1	32.2	51.1	
25.9	14.8			78.9		53.7	17.4	22.6	25.2	36.5		40.2	28.6	41.7	23.4
30.0	22.8			96.6		50.2	17.3	24.3	28.7	36.6	28.7	38.3	31.1	45.9	
	23.4			88.5	24.8	56.1	16.8	26.4	31.3	40.3	32.4	42.6	35.6	55.0	33.7
	18.3		28.7	90.0	21.4	48.5	16.8	21.7	30.9	42.4	32.8	45.1	36.1	53.6	31.8
28.6	23.8		36.3	101.3	24.2		15.9	25.1		43.4	30.2	45.8	32.5	51.6	31.3
32.8	20.9		28.4	93.6		50.2	16.9	28.4	30.5	46.9	32.7	52.7			31.5
31.4	19.1		36.9	104.1	24.0	52.6	20.0	26.5	39.3	49.2	42.0	54.1	40.4	60.8	35.9
32.4	22.2		27.5	99.0		57.3	16.0	23.1	28.5	40.7	30.9	40.9	32.9	54.4	30.2
31.6	20.7		29.8	98.0	25.7	59.1	16.9	26.3	29.5	42.5	32.4	46.4			
35.1	19.5		26.7	105.4	24.9	52.8	15.1	25.3	33.2	42.0	31.5	44.5	34.8	54.8	31.3
38.7	22.7		34.8	100.8	23.9	53.2	20.8	27.9	32.6	43.7	36.7	46.6	35.8	59.3	33.9
32.4	19.6			102.7		50.9	20.2	28.7	32.6	45.4	32.3	46.1	33.3	53.2	32.1
33.8	18.3		38.7	97.9	22.9	63.4	20.2	28.6	38.2	49.4	38.7	54.4	39.4	62.9	36.1

				LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
52.3	37.4		284.0	312.0	61.0	57.0	56.7	40.6	41.3	19.4	246.0	226.0	20.0	538.0	42.6
38.8	27.4		278.0	307.0	54.0	53.0	49.7	37.5	38.2	16.3	228.0	220.0	19.6	527.0	39.1
51.5	32.5			289.0	65.0	62.0	55.6	42.7	40.0	20.2	223.0	206.0	19.6	495.0	42.7
44.9	32.5			330.0	70.0	67.0	55.5	42.0	43.1	19.9	244.0	234.0	19.7	564.0	45.8
47.1	28.1		286.0	304.0	63.0	58.0	53.8	38.3	40.9	19.1		216.0	18.4	520.0	41.5
55.9	33.9		302.0	318.0	65.0	61.0	58.0	43.3	41.4	19.8	245.0	226.0	21.6	544.0	43.2
			288.0	308.0	65.0	61.0	57.3	41.2	44.5	20.4	241.0	222.0	21.9	530.0	43.6
41.3	29.0		277.0	293.0	57.0	55.0		36.6	34.9	17.5	243.0	226.0	19.2	519.0	35.5
60.0	32.1		276.0	284.0	57.0	55.0	54.4	38.9	39.3	18.6	224.0	210.0	18.5	494.0	42.6
53.4	36.6		296.0	317.0	66.0	60.0	55.9	40.4	42.1	18.8	241.0		18.7		45.5
53.4	33.8			322.0	65.0	64.0	61.0	48.1	48.8	23.7		235.0	23.7	557.0	48.5
51.1	34.7			342.0	68.0	65.0	59.9	44.9	42.2	20.5	267.0	242.0	21.9	584.0	45.8
58.9	30.8		270.0	321.0	65.0	61.0	59.5	44.0	42.7	19.9	250.0	232.0	22.2	553.0	43.5
58.0	32.4		291.0	355.0	68.0	67.0	64.7	52.8	48.7	23.5	289.0	268.0	25.8	623.0	49.3
51.6	30.7			335.0	57.0	55.0			44.0		242.0	227.0	27.1	562.0	45.3
			292.0	347.0	64.0	64.0	57.9	44.2	43.2	21.3	272.0	258.0	22.5	605.0	46.4
50.3	30.5			320.0	68.0	65.0	62.4	43.4	43.0	21.2	255.0	232.0	20.4	552.0	46.7
56.7	34.9		290.0	366.0	70.0	66.0	67.4	48.4	50.2	22.3	263.0	243.0	24.1	609.0	48.8
60.8	34.9			330.0	69.0	63.0	63.2	46.4	49.2	20.6	258.0	245.0	22.1	575.0	48.2
61.7	38.5			342.0	73.0	70.0	66.0	50.0	48.1	23.5	282.0	262.0	24.7	604.0	50.8

LEFT 45	LEFT 46	LEFT 47	LEFT 48	LEFT 49	LEFT 50	LEFT 51	LEFT 52	LEFT 53	LEFT 54	LEFT 55	LEFT 56	LEFT 57	LEFT 58	LEFT 59	LEFT 60
42.7	24.3	28.3	73.5	24.1	435.0	80.0	24.7	354.0	76.0	69.4	30.4	32.5	46.7	20.9	345.0
40.4	25.5	28.5	72.7	25.8	428.0	78.0	24.0	342.0	78.0	66.7	30.1		45.7	20.8	323.0
41.4	31.7	28.2	72.8	25.7	406.0	82.0	25.4	336.0	74.0	66.2	25.9	33.7	46.0	20.1	333.0
45.7	28.6	32.0	73.7	26.4	463.0	99.0	27.1	405.0	90.0	77.3	31.1	36.7	53.3	27.2	387.0
39.2	30.0	29.5	68.5	22.0	410.0	81.0	25.6	332.0	78.0	64.7	27.7	30.2	44.9	22.4	323.0
43.1	33.1	27.2	79.5	27.2	446.0	87.0	26.5	361.0	78.0		34.4	35.0		22.3	
43.0	26.6	31.0	77.0	26.4	424.0	87.0	27.7	349.0	79.0	70.6	27.0	30.6	49.9	21.3	341.0
34.8	27.0	25.8	65.4	25.8	422.0	75.0	24.1	357.0	74.0	63.1	25.4	28.1	40.4	19.8	332.0
41.9	23.6	32.4	76.6	24.9	413.0	82.0	26.9	337.0	80.0	72.5	25.5	31.8	41.5	22.3	326.0
44.7	30.5	27.4	74.0	29.9	446.0	85.0	24.9	361.0	79.0	69.9	30.6	32.4		23.1	
47.3	29.6	31.9	85.5	31.1	471.0	88.0	27.9	376.0	88.0	79.8	33.8	37.0	52.1	25.2	357.0
45.9	27.0	36.0	83.1	30.6	468.0	93.0	30.3	384.0	90.0	78.3	31.6	32.5	51.0	25.3	370.0
44.4	31.1	29.9	77.2	31.4	426.0	86.0	26.1	343.0	85.0	75.9	30.7	33.4	49.6	20.5	338.0
48.9	29.2	33.9	86.4	32.1	499.0	92.0	29.2	404.0	87.0	84.3	33.2	38.2	57.5	24.8	384.0
44.6	23.2	33.0	76.3	27.2	467.0	84.0	26.8	359.0	86.0	71.0	30.9	34.6	48.8	21.8	
47.0	32.7	29.1	80.4	30.1	504.0	91.0	26.7	400.0	98.0	77.1	33.7	35.3		27.2	372.0
46.2	28.0	32.8	78.6	30.2	449.0	99.0	28.4	360.0	83.0	75.1	29.7	31.9	55.7	22.5	352.0
49.0	31.6	32.4	86.1	29.7	483.0	98.0	31.5	395.0	91.0	82.0	31.1	36.5	57.4	24.4	371.0
48.7	30.2	31.9	80.9	27.0	471.0	90.0	28.0	388.0	95.0	80.4	31.4	33.8	51.3	25.6	379.0
50.5	31.9	32.7	87.8	35.7	480.0		30.0	394.0	88.0	77.2	34.2	35.5	57.7	25.5	379.0

LEFT 61	LEFT 62	LEFT 63	LEFT 64	LEFT 65	LEFT 66	LEFT 67	LEFT 68	LEFT 69	LEFT 70	RIGHT 33	RIGHT 34	RIGHT 35	RIGHT 36	RIGHT 37	RIGHT 38
780.0	48.9		74.9	51.4	58.0	30.5	72.0	69.8	7.9	317.0	61.0	58.0	57.0	41.3	41.8
751.0	40.5		67.9	47.4	50.2	26.3	67.0	62.9	7.3	308.0	55.0	53.0	50.1	37.9	38.0
739.0	40.4		76.2	51.1	59.2	30.5	76.0	64.2	7.0	294.0	66.0	62.0	56.2	41.4	40.5
850.0										337.0	70.0	68.0		42.1	44.1
733.0	41.0		77.3	50.1	52.3	26.7	66.0	65.6	7.9	309.0	64.0	60.0	55.8	39.7	41.5
	47.0		78.6	54.4	61.4	32.8	80.0	65.8	8.7	321.0	66.0	60.0	54.3	44.2	42.2
765.0	40.5		74.3	52.8	57.8	29.7	76.0	65.9	8.2	311.0	65.0	63.0	56.7	42.6	44.2
754.0	36.8		68.8	46.8	46.9	26.4	67.0	65.3	7.3	301.0	58.0	54.0	51.1	36.5	35.1
739.0	39.4		71.9	52.2	51.8	27.3	71.0	61.8	7.8	288.0	59.0	57.0	50.6	40.3	39.9
	42.5		79.8	56.9	55.6	31.3	75.0			320.0	67.0	60.0	56.2	39.7	42.7
828.0	45.1		73.5	49.1	58.3	34.1	80.0	68.6	8.2	325.0	66.0	64.0	61.3	47.3	
838.0	43.8		79.0	57.8	57.0	31.4	78.0	69.8	10.3	341.0	71.0	68.0	59.7	44.6	43.0
764.0	40.5		75.4	53.4	57.6	30.2	75.0	67.3	7.9	324.0	66.0	63.0	57.5	43.8	43.7
883.0	51.7		82.6	58.8	63.7	34.7	89.0	72.9	8.5	360.0	71.0	67.0	64.2	53.0	50.0
	41.3		76.1	51.5	58.6	30.9	76.0	65.1	7.9	339.0	62.0	60.0	56.9	43.9	45.8
876.0	44.0		81.9	58.3	59.9	31.6	82.0	70.6	8.5	350.0	67.0	64.0	57.4	45.7	44.1
801.0	43.8		78.9	53.6	61.7	31.6	78.0	67.0	8.8	329.0	71.0	68.0	63.4	45.6	44.7
854.0	55.3		82.6	59.0	65.0	33.1	82.0	71.1	9.0	360.0	72.0	69.0	66.0	50.3	49.6
850.0	47.7		84.9	62.6	61.9	31.4	85.0	71.2	8.6	333.0	69.0	65.0	64.5	45.3	48.9
859.0	43.9		87.2	60.0	59.4	30.6	83.0	71.5	9.0	345.0	74.0	68.0	68.7	48.8	48.8

RIGHT 39	RIGHT 40	RIGHT 41	RIGHT 42	RIGHT 43	RIGHT 44	RIGHT 45	RIGHT 46	RIGHT 47	RIGHT 48	RIGHT 49	RIGHT 50	RIGHT 51	RIGHT 52	RIGHT 53	RIGHT 54
19.3	246.0	226.0	20.2	543.0	43.9	43.3	22.1	29.0	75.0	23.9	434.0	78.0	25.1	359.0	79.0
16.5	230.0	223.0	19.5	531.0			24.2	25.9	72.8	24.1	433.0	75.0	20.6	344.0	77.0
21.2	225.0	209.0	20.0	503.0	42.8	42.2	28.6	28.5	73.8	24.9	407.0	83.0	24.8	332.0	75.0
20.2		237.0	19.8	574.0	43.8	43.3	27.9	32.2	77.4	26.1	454.0	99.0	26.0	404.0	89.0
18.7		218.0	19.0	527.0	41.7	40.3	27.3	30.4	69.8	22.1	408.0	81.0	25.1	330.0	80.0
19.7	251.0	230.0	22.6	551.0	44.2	44.1	28.6	30.4	80.5	26.0	445.0	85.0	27.4	368.0	80.0
20.4	242.0	220.0	21.4	531.0	44.4	43.9	27.5	32.4	77.4	27.6	422.0	90.0	26.2	350.0	79.0
16.9	241.0	225.0	17.5	526.0	35.8	35.8	25.4	26.7	68.0	25.2	420.0	77.0	23.2	353.0	76.0
18.2	233.0	215.0	19.3	503.0	41.9	41.8	24.3	31.9	76.7	25.0	414.0	83.0	26.9		80.0
19.6	241.0	226.0	19.7	546.0	46.2	45.3	27.8	29.5	74.7	28.4	441.0	87.0	25.3	358.0	79.0
23.8	250.0	234.0	23.4	559.0	49.7	48.2	27.8	33.3	86.2	32.2	464.0	87.0	28.6	374.0	85.0
21.1	271.0	242.0	22.5	583.0	45.5	46.4	26.2	37.1	84.1	28.6	468.0	91.0	30.1	382.0	90.0
19.8	256.0	233.0	20.9	557.0	44.5	44.5	30.2	30.9	78.6	26.9	420.0	86.0	28.3	350.0	85.0
24.4	289.0	269.0	26.0	629.0	49.0	49.4	28.4	34.4	88.8	31.6	494.0	92.0	29.5	405.0	88.0
19.2	246.0	231.0	22.7	570.0	45.6	44.8	22.4	32.8	74.9	25.4	461.0	83.0	26.5	364.0	86.0
20.4	275.0	260.0	22.6	610.0	46.3	46.8	30.8	29.2	79.6	30.0	501.0	92.0	25.5	394.0	91.0
21.7	261.0	238.0	21.3	567.0	48.9	47.6	26.9	30.7	79.8	31.6	449.0	92.0	27.3	354.0	82.0
23.4	262.0	242.0	25.0	602.0	49.0	49.7	31.0	31.8	88.0	29.1	490.0	100.0	30.1	394.0	91.0
20.6	268.0	251.0	22.7	584.0	47.1	47.9	31.1	31.1	81.1	28.4	477.0	93.0	28.7	383.0	95.0
24.1	287.0	267.0	24.2	612.0	51.6	51.2	31.7	33.7	87.6	34.3	485.0	91.0	29.0	400.0	90.0

RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT
55	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
69.1	32.3	33.4	46.1	22.6	347.0	781.0	49.8		73.9	50.8	59.3	30.8	73.0	69.7	8.2
65.7		28.6	44.2	22.0	328.0	761.0	39.7		65.5	47.4		25.8	68.0	65.0	7.5
66.3	29.7	35.1	46.0	21.1	330.0	737.0	40.8		76.4	51.0	59.2	32.4	75.0	66.1	7.5
75.8	29.6		53.0	25.4	387.0	841.0									
66.0	26.1	30.6	43.5	23.3	323.0	731.0	39.0		74.9	50.7	52.4	27.6	68.0		7.4
72.4	35.5	34.7		22.2			45.5		77.9	53.3	61.7	31.0	81.0	67.8	9.0
71.2	26.0	32.4	50.3	21.3	344.0	766.0	42.2		77.2	52.9	57.0	28.7	76.0	65.6	8.4
62.6	22.4	28.6	39.1	21.6	338.0	758.0	37.8		71.2	49.6	47.4	26.9	66.0	65.9	8.1
72.5	26.7	31.1	41.7	20.9			38.5		73.9	51.8	51.8	27.8	69.0	61.6	7.3
69.5	29.9	31.6	48.9	23.5			42.2		80.1	58.5	56.4	30.9	79.0	68.0	8.7
77.9	32.4	37.6	53.4	24.5			45.4		73.7	52.4	60.7	34.7	78.0	68.1	8.6
78.6	30.2	32.2	51.8	26.0	366.0	834.0	42.6		78.9	55.8				69.2	10.7
73.6	27.9	32.3	50.3	22.1	346.0	766.0			76.3	53.0	58.5	30.0	74.0	68.0	8.9
84.1	36.4	39.4	57.9	25.3			51.6		83.7	58.6	64.2	35.0	91.0	73.7	8.9
70.7	32.8	34.4	48.5	21.6			40.9		74.9	50.5	58.4	31.0	80.0	67.2	7.2
	28.8	36.3	49.6	26.3			46.4		84.1	60.3	59.8	32.0	78.0	70.0	8.5
75.2	33.5	31.9	52.7	22.2	350.0	799.0	44.5		81.9	53.6	62.6	31.7	77.0	65.1	9.8
82.1	31.6	35.5	56.9	24.6	381.0	871.0	50.6		82.7	61.2	65.5	32.5	81.0	69.9	8.7
77.0	32.9	33.9	54.6	26.3			47.4		84.2	61.4	59.9	32.2	83.0	72.3	8.6
78.8	34.6	36.8	56.9	25.3	383.0	868.0	45.5		90.7	60.3	61.3	31.9	83.0	72.4	8.6

D-4 Sacred Heart sub-adult BSI measurements (mm)

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	Age	Sex	1	2	3	4	5	6	7	8	9	10	11	12
56	3.0mons-6.0mons	?									14.1	7.8		
44	6.0mons-1.0	?						26.7						
66A	2.5-3.5	?			76.7	73.5		28.8	76.8					
25	3.0-4.0	?						29.2				11.4		
36	4.0-6.0	?	135.0	168.0	85.0	80.4	30.1	33.4	83.7	89.1	23.9	10.8	116.0	34.7
67	5.0-7.0	?		166.0	85.0	81.9	32.2	32.8	85.2		17.2	10.0		
12	8.0-10.0	?	139.0	172.0	92.0	84.0	32.2	33.8	91.0	95.7	26.5	11.3	136.0	34.6
141	14.0-17.0	M	137.0	182.0	101.0	96.6	38.2	36.9	93.3	101.0	23.0	11.4	127.0	36.3
63	18.0-20.0	M	139.0	171.0	110.0	103.0	35.2	40.3	102.0		25.8	10.5	135.0	38.6
90	18.0-20.0	F	133.0	178.0	96.0	89.3	36.9	37.1	91.6	95.1	20.7	10.0	123.0	34.3

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
			17.9	62.6											
			15.2	64.2											
28.3	18.1		21.7	69.0											
			20.3	68.9			10.5	18.7	17.4	25.3	17.2	26.4	18.7	32.1	18.2
30.5	14.6		23.5	73.6	23.5	40.3									
26.2	18.1		23.2	73.5	20.7	37.6	9.3	15.9					19.1	31.1	16.9
30.0	19.3		26.9	84.4	26.2	45.0	12.9	21.5	21.9	31.2	21.6	29.2	24.4	39.2	21.7
30.3	24.3		29.1	94.0	23.6	48.3	15.5	24.9	26.5	37.5	28.7	40.5	33.6	52.9	31.7
33.9	24.9		34.3	99.1	26.3	51.4	15.2	22.5	32.9	39.4	32.9	41.6	32.8	47.3	27.0
28.6	16.7			96.3	20.6		15.0	23.2	28.0	37.0	28.9	41.1			31.8

				LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT
29	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**
				80.0	28.0	28.0					69.0	62.0		142.0	
				97.0	25.0	25.0					80.0	72.0		169.0	
				125.0	32.0	32.0					100.0	90.0		215.0	
41.6	15.7			149.0	35.0	35.0			18.8		123.0	113.0		262.0	
				168.0	41.0	41.0					139.0	124.0		292.0	24.3
34.2	15.1			157.0	37.0	37.0					123.0	111.0		268.0	21.1
41.8	17.5			215.0	48.0	46.0					170.0	158.0		373.0	
52.0	30.5			295.0	70.0	66.0	59.2	41.0	43.6	17.7	245.0	222.0	18.1	517.0	41.3
45.9	33.6			325.0	60.0	56.0	55.0	37.7	40.9	19.5		221.0	18.2	546.0	41.6
49.4	30.4			288.0	61.0	59.0	56.0	39.2	37.1	18.7		220.0	18.4	508.0	39.6

LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT
45	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
	11.3	10.5			91.0	32.0	9.6	81.0	30.0	20.5				7.7	76.0
	10.8	9.7		10.3	123.0	28.0	8.5	100.0	28.0	22.7				7.3	95.0
	14.1	14.4			166.0	42.0	12.0	132.0	35.0	29.6				9.8	125.0
	16.3	17.3	48.4	18.0	206.0	42.0	13.6	170.0	41.0	39.0				12.8	167.0
24.6	17.6	17.8	51.9	17.0	230.0	49.0	14.0	191.0	45.0	42.5	19.1	22.5		14.1	186.0
22.6	15.5	17.5		18.1	215.0	46.0	14.3	176.0	47.0	38.2	14.8	22.3		13.6	170.0
	22.1	20.9	61.1	21.8	309.0	59.0	16.6	250.0	60.0	52.4	25.3	30.7		17.5	242.0
43.1	29.4	34.2	75.2	29.1	420.0	88.0	29.0	358.0	80.0	68.7	30.9	30.4	46.4	21.7	329.0
40.8	25.7	27.0	73.6	25.4	451.0	78.0	22.9	360.0	70.0	66.0	30.0	31.7	45.1	20.4	345.0
39.3	25.4	30.5	69.4	25.3	418.0	81.0	25.1	341.0	76.0	63.7	28.5	28.9	42.6	23.3	322.0

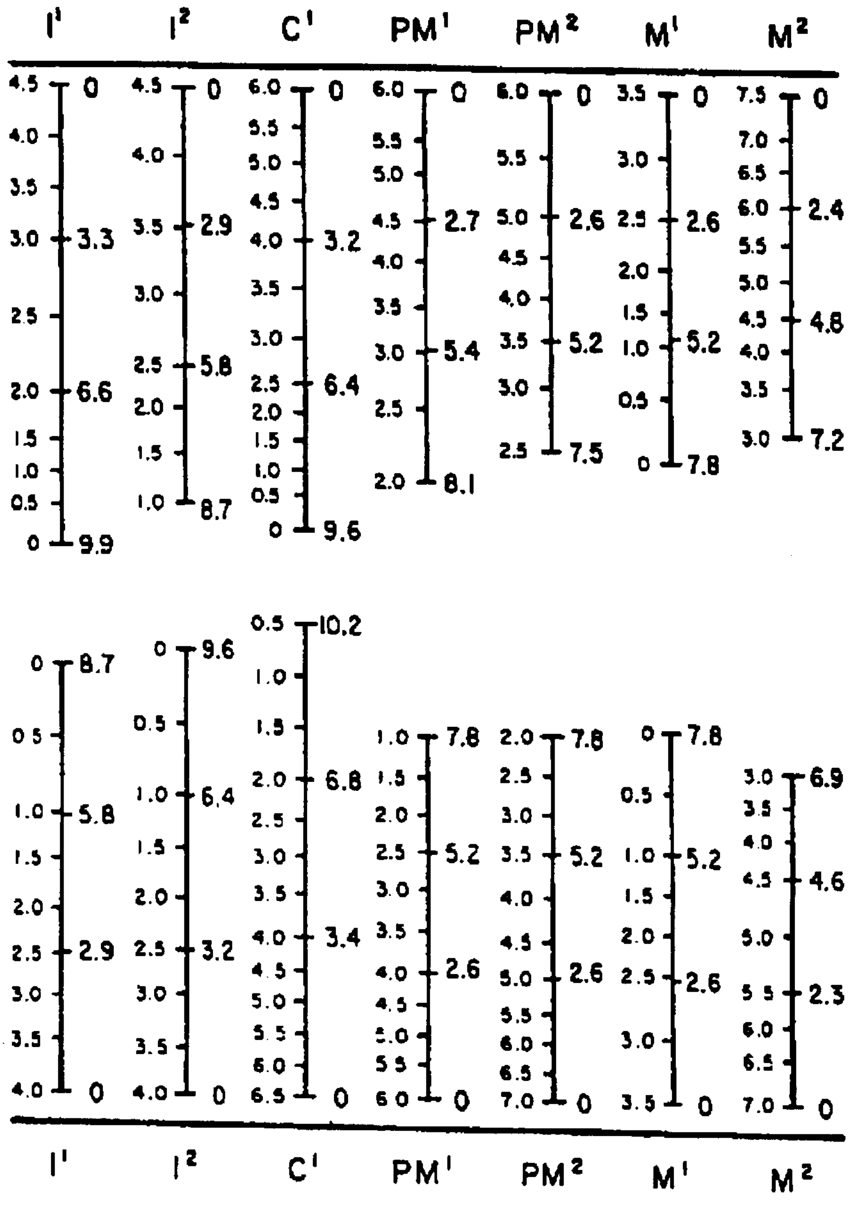
LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	LEFT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT
61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**33**	**34**	**35**	**36**	**37**	**38**
167.0			16.3		13.7					81.0	27.0	27.0			
218.0										97.0	27.0	27.0			
291.0			31.5	20.9	22.7			25.2	4.3	125.0	33.0	33.0			
373.0			40.5	25.4	33.2	18.0		27.6	6.2	147.0	35.0	35.0			19.1
416.0			43.2	27.8	35.0	20.9		31.8	5.3	168.0	41.0	40.0			
385.0			41.8	25.5	32.9	20.2	42.0				36.0	36.0			
551.0			58.8	36.7	48.1	27.2	59.0	35.7	6.1	214.0	49.0	46.0			
749.0	37.6		75.2	51.9	55.2	29.7	76.0		7.9	300.0	72.0	67.0	60.2	40.7	43.3
796.0	40.9		76.6	54.1	56.5	28.3	72.0	64.9	7.3	322.0	60.0	59.0	55.7	38.8	40.9
740.0	36.5				50.1	24.1		60.0	7.2	294.0	63.0	61.0	56.1	39.9	37.5

RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT
39	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**
	70.0	63.0		144.0			11.1	11.0			92.0	31.0	9.5	81.1	31.0
	81.0	74.0		171.0			10.3	10.2		9.5	122.0	29.0	8.6	100.0	28.0
	102.0	90.0		215.0			14.5	13.9			165.0	39.0	11.9	131.0	37.0
	123.0	112.0		259.0			15.5	18.8	47.8	18.5	205.0	43.0	14.1	175.0	42.0
							17.3	17.7		16.4	231.0	49.0	13.8	187.0	45.0
					21.8	22.8	15.3	17.8		17.6	214.0	47.0	14.3	181.0	48.0
							23.6	21.1	58.7	22.1	306.0	60.0	16.6	248.0	59.0
18.9	244.0	223.0	19.0	523.0	40.3	44.1	28.7	36.0	75.8	29.7	421.0	90.0	27.7	379.0	83.0
19.7			19.4		42.7	42.1	24.9	26.5	73.6	25.3	456.0	78.0	23.2	360.0	70.0
18.6		221.0	18.6	515.0	38.3	39.6	24.6	34.9	71.1	25.4	418.0	81.0	26.1	340.0	79.0

RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT	RIGHT
55	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**
20.6				7.9	76.0	168.0			17.3		13.7				
21.6				7.3	94.0	216.0									
29.3				10.1	126.0	291.0			30.7	19.3	22.2			26.5	4.4
39.6				12.5	171.0	376.0			39.8	25.8	33.0	18.5		27.6	6.0
42.8	19.3	22.9		13.6	184.0	415.0			43.1	27.4	35.7	20.4			
38.2	16.8	24.2		14.0	170.0	384.0			42.1	26.4	34.3	21.9	41.0		
50.9	23.3	31.8		17.6	240.0	546.0			58.5	36.6	48.1	26.9	56.0		7.1
68.9	30.5	33.3	48.1	24.1	327.0	748.0	39.6		76.5	51.8	55.7	30.0	75.0	69.9	9.1
65.3	28.2	31.3	43.9	19.8	344.0	800.0	39.8		76.5	53.5	56.0	28.6	72.0	65.9	7.6
65.2	28.2	26.7	42.5	23.7	328.0	746.0	38.0		70.0	49.3	51.7	27.0	68.0	61.2	7.8

APPENDIX E: SUPPLEMENTARY DATA

E-1 EHL age at formation chart



(Swardstedt 1966, modified by Goodman *et al.* 1980)

The top graph represents the maxilla and the bottom graph represents the mandible. Numbers on the right side of the line represent the distance from the cemento-enamel junction to the EHL, and the numbers on the left side of the line represent the corresponding ages of when the EHL would have occurred during growth (Goodman and Song 1990).

E-2 Sadlermiut Harris line measurements
(#1 most proximal Harris line)

	LEFT						RIGHT							Total Count	
Skeleton #	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**LEFT**	**RIGHT**
111	150.33	86.51	60.82				149.04	60.82	44.97	38.97				3	4
98	51.41	46.56	40.56	34.56	29.99		69.98	41.13	35.7					5	3
112	121.67	48.84	44.56				124.81	43.7						3	2
126							124.24							0	1
96							87.11							0	1
99	129.38	44.56	36.27				132.81	44.56	36.27					3	3
100	108.82	33.99												2	0*
230							37.13							0*	1
219	91.97	35.13	32.27				95.97	45.41						3	2
104	113.39						114.82							1	1
216	118.82						106.25	50.55	42.56					1	3
221	156.8						152.52	43.13	36.56					1	3
246	118.53						131.67							1	1
217	165.94	145.09					213.36	123.96						2	2
181	113.1	46.27	39.42				107.96							3	1
183	106.54	43.99					77.69	59.41	50.84					2	3
101	109.68	95.4	32.56				113.68							3	1
192														0	0
175	105.68	77.4	39.42				115.1	83.11	78.83					3	3
149	110.53	107.68	98.25	86.83	82.26	75.69	110.25	79.4	76.83	74.26				6	4
105	92.25	77.12					103.39	88.26	78.54	67.69				2	4
103	122.24	104.82					111.11	77.69						2	2
156	133.1						133.38	104.25						1	2
157							123.67	51.98	41.99	34.56				0	4
155	102.54	96.82	89.11	71.4	39.7	36.56	105.96	70.55	67.69	63.69	58.55	43.7	41.41	6	7
145	114.53						127.39							1	1
153	115.96	41.7	35.42				114.82	76.55						3	2
74	134.81													1	0
182	107.39						111.39							1	1
148							96.25	38.27						0	2
179							55.12	48.27	43.99	39.99				0	4
243	117.67	54.27	34.27	28.56			141.09	41.41	32.85					4	3

* missing tibia

E-3 Sacred Heart Harris line measurements
(#1 most proximal Harris line)

	LEFT				RIGHT					Total Count	
Skeleton #	**#1**	**#2**	**#3**	**#4**	**#1**	**#2**	**#3**	**#4**	**#5**	**LEFT**	**RIGHT**
5	74.67	61.2	53.33		73.33	60.27	53.07			3	3
9	71.38				68.78					1	1
55	76.79				122.91	45.06				1	2
64	94.35	70.89	55.97	39.45	94.35	81.82	71.43	57.57	40.51	4	5
83	104.93									1	0
97	65.03	44.51			75.43	63.17	58.1			2	3
122	58.79				59.39					1	2
139	60.77	55.78	49.38		58.93	45.33	41.6			3	3

E-4 Harris lines age at formation charts

Chronology of limb bone growth (percent of mature bone length)
MALES

Age	Humerus	Radius	Femur	Tibia
1	32.3	32.7	29.6	28.8
2	40.0	39.5	37.1	36.5
3	45.2	44.8	43.1	42.4
4	50.0	49.5	48.5	47.6
5	54.3	53.9	54.3	53.5
6	58.7	58.2	59.1	57.9
7	63.0	62.2	63.7	62.3
8	66.9	66.1	68.8	67.5
9	70.6	69.9	73.0	71.6
10	74.1	73.5	76.9	75.7
11	77.5	77.1	80.6	79.6
12	80.8	80.9	84.4	83.7
13	85.3	85.0	88.8	88.5
14	90.2	90.3	93.1	93.0
15	94.6	95.0	96.9	96.7
16	97.8	98.0	98.9	99.0
17	99.0	99.7	99.7	100.0
18	100.0	100.0	100.0	100.0

(Byers 1991)

Chronology of limb bone growth (percent of mature bone length)
FEMALES

Age	Humerus	Radius	Femur	Tibia
1	34.5	35.3	31.7	31.5
2	42.8	42.7	40.2	40.1
3	48.8	48.8	46.4	46.6
4	54.0	53.9	52.3	52.4
5	59.2	59.1	60.0	58.6
6	63.5	63.5	65.0	63.9
7	68.5	67.9	70.0	69.0
8	72.5	72.4	75.2	74.3
9	76.4	76.4	79.6	79.4
10	79.8	80.4	83.9	83.9
11	85.3	85.6	88.7	88.8
12	90.0	91.0	93.1	93.0
13	93.8	95.1	96.9	96.5
14	97.2	97.6	99.1	98.3
15	99.2	99.5	99.8	99.1
16	100.0	100.0	100.0	100.0

(Byers 1991)

E-5 Sadlermiut females asymmetry calulations and Z-scores

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	33	34	37	38	39	40	41	44	45	48	50	51	53	57	59	60	64	66
XIV-C:96	3.42	4.55	4.58	7.13	7.25	3.48	1.94						0.89	3.00	3.06		3.64	
XIV-C:112	3.04	4.41	3.55	-1.90	-0.52	0.39	0.43	1.07	1.91	2.06	0.22	0.00	0.54	1.86	4.69	0.82	-0.27	-0.71
XIV-C:175	1.23	3.57	-0.52	3.56	1.78	0.00	1.13	-1.07	1.27		0.83	1.39	1.03	-1.55	2.42			
XIV-C:105	3.50	0.00	8.06	-0.50	-1.71	0.00	2.43		3.24		0.76	1.20	0.32	1.54	-1.12	0.32	0.13	-1.72
XIV-C:145	1.60	7.04	0.94	-6.76	-1.08	0.85	1.38						1.11	-3.46	0.88	0.57	1.67	
XIV-C:149	2.11	6.78	0.26	1.08	2.21	0.89	1.00	1.20	0.24	-8.39	-0.99	0.00	-0.60	6.12	6.38	-0.93	-0.86	
XIV-C:153	2.78	-1.59	-1.26	-7.69	3.66	-0.47	1.00	-0.70	2.51		-0.51	-2.60	0.00		-3.11	-0.33	-3.29	
XIV-C:103	1.77	0.00	0.49	0.74	-2.78			-3.37	-0.23	6.88	1.22	-2.50	0.00	-3.85	-2.72	0.93		-2.08
XIV-C:104	0.35	6.56	3.28	-2.43	-1.74			-0.48	-0.47		1.47	0.00	0.93	1.24	5.80	0.65	2.09	
XIV-C:98	2.13	7.58	4.40	3.33	3.51	-0.46	-0.50	0.27	0.67	2.02	0.48	-2.41	1.52	6.39	2.63	0.32	3.07	-0.54
XIV-C:155	2.52	5.80	0.51	-0.26	-6.86	1.41	2.05	0.98	-1.83	1.05	0.50	4.60	1.25	-2.06	6.07	-0.32	-1.26	2.30
XIV-C:219	2.35	4.76	6.01	-0.74	3.65	0.90	1.00	0.23	-1.62	1.71	-0.73	4.55	1.85	2.93	-1.08	0.64	1.54	
XIV-C:183	2.09	5.00	-129.44	0.74	1.12	2.78	3.54	-0.97	-1.91	0.91	-1.22	1.18	0.30	3.03	5.71	-0.96	1.02	0.38
XIV-C:148	2.72	6.67	2.96	2.49	-1.26	2.00	2.23	0.97	0.00	1.89	0.80	1.25	-0.35	-0.70	1.62	0.36		-1.57
XIV-C:100	1.33	3.03	1.47	-0.72	5.70		-3.48								3.29			
XIV-C:192	1.05	3.39	5.11	-0.26	0.00	-1.77	-1.47	0.47	1.36	1.63	0.00	0.00	-0.61	-1.59	4.69	0.95		-1.50
XIV-C:221	1.37	3.28	3.80	1.47	1.52	0.00	0.97	0.00	1.10	-0.13	-0.47	2.53	0.00	4.60	-0.57	-1.26	-0.42	0.00

Sadlermiut females corresponding Z-scores

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	33	34	37	38	39	40	41	44	45	48	50	51	53	57	59	60	64	66
XIV-C:96	1.54	0.14	0.30	2.02	1.87	2.01	0.60						0.51	0.56	0.25		1.55	
XIV-C:112	1.11	0.09	0.27	-0.52	-0.40	-0.24	-0.28	0.94	0.92	0.29	0.06	-0.29	0.04	0.21	0.77	0.93	-0.44	-0.08
XIV-C:175	-0.98	-0.22	0.14	1.02	0.27	-0.52	0.13	-0.77	0.52		0.79	0.32	0.69	-0.83	0.05			
XIV-C:105	1.63	-1.56	0.41	-0.13	-0.75	-0.52	0.89		1.76		0.70	0.24	-0.26	0.11	-1.09	0.26	-0.23	-0.82
XIV-C:145	-0.55	1.08	0.19	-1.90	-0.56	0.10	0.28						0.80	-1.42	-0.45	0.59	0.55	
XIV-C:149	0.03	0.98	0.17	0.32	0.40	0.13	0.05	1.04	-0.13	-2.48	-1.38	-0.29	-1.48	1.52	1.31	-1.41	-0.74	
XIV-C:153	0.81	-2.16	0.12	-2.16	0.82	-0.86	0.05	-0.47	1.30		-0.81	-1.43	-0.68		-1.72	-0.61	-1.97	
XIV-C:103	-0.36	-1.56	0.17	0.22	-1.06			-2.60	-0.43	1.57	1.25	-1.39	-0.68	-1.53	-1.60	1.07		-1.08
XIV-C:104	-1.99	0.90	0.26	-0.67	-0.76			-0.30	-0.58		1.55	-0.29	0.56	0.02	1.13	0.70	0.76	
XIV-C:98	0.06	1.28	0.29	0.95	0.78	-0.85	-0.83	0.30	0.14	0.28	0.37	-1.35	1.35	1.60	0.11	0.26	1.26	0.05
XIV-C:155	0.51	0.61	0.17	-0.06	-2.25	0.50	0.67	0.87	-1.43	0.02	0.39	1.73	0.99	-0.99	1.22	-0.59	-0.94	2.13
XIV-C:219	0.31	0.22	0.34	-0.20	0.82	0.13	0.05	0.27	-1.30	0.20	-1.07	1.71	1.79	0.54	-1.07	0.69	0.48	
XIV-C:183	0.01	0.31	-3.87	0.22	0.08	1.50	1.54	-0.69	-1.48	-0.01	-1.65	0.23	-0.28	0.57	1.10	-1.45	0.22	0.72
XIV-C:148	0.74	0.94	0.25	0.71	-0.62	0.93	0.77	0.86	-0.28	0.25	0.75	0.26	-1.15	-0.57	-0.21	0.31		-0.71
XIV-C:100	-0.86	-0.43	0.20	-0.19	1.42		-2.57								0.33			
XIV-C:192	-1.19	-0.29	0.32	-0.06	-0.25	-1.80	-1.39	0.46	0.58	0.18	-0.20	-0.29	-1.50	-0.84	0.77	1.10		-0.66
XIV-C:221	-0.82	-0.33	0.28	0.43	0.20	-0.52	0.04	0.09	0.41	-0.29	-0.76	0.82	-0.68	1.05	-0.91	-1.85	-0.51	0.44

* shaded squares denote significant asymmetry present

E-6 Sadlermiut males asymmetry calculations and Z-scores

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	34	37	39	40	42	44	45	48	50	52	53	55	56 and 57	58	59	60	62	64	65	68
XIV-C:230	0.00	0.00	-1.08	0.00		-1.35	-0.42	-0.61	0.63	4.95		-1.34			-1.83	-0.28				
XIV-C:74	6.94	3.00	0.95	0.82	-7.96						0.00	-9.96	0.11	5.97	-3.47			-4.73	1.33	10.71
XIV-C:117	4.29	3.46	0.98	2.58		-1.00	-2.03	1.64	1.38	-30.77	-2.90	-0.13	-11.04	3.73	8.74	-1.20	2.11	-1.73	-0.39	2.46
XIV-C:126	5.33	-0.89	0.00	1.28		0.00	0.21	1.64	-0.23	1.75	-0.58	3.15	12.10	0.38	1.27		-2.55	3.14	3.13	-1.35
XIV-C:246	2.74	0.42	-0.99	-1.75		3.36	4.05	0.71	-0.70	0.00	2.31		8.84	-0.37	5.29	1.53	-1.32	2.74	0.36	0.00
XIV-C:111	5.80	5.59	-3.17	2.37		-0.42	2.07	-0.60	6.07	-23.84	1.09	0.27	8.66	2.54	3.25	0.28	-0.23	-0.96	-0.51	
XIV-C:243	4.17	4.32	-3.89	0.81		-5.59	0.64	1.13	-0.67	5.97	1.12	2.16	-1.16		0.00	-0.57		2.52	3.14	3.80
XIV-C:216	1.35	-0.61	-2.56	0.42		0.21		0.12	0.68	0.34	-0.29	-0.39		-2.52	2.64	3.85		2.26	-0.18	-3.95
XIV-C:217	12.00	6.17	-1.47	1.24		1.12	2.45	1.68	0.89	1.49	-0.29		18.73		4.25	-2.45		1.56	3.25	
XIV-C:179	-1.37	0.63	-0.49			-1.26	1.35		0.23	1.37	0.60	2.23	-13.80	0.86	-2.21	0.30		0.00	-1.45	-3.95
XIV-C:182	6.10	3.40	3.69	1.65		-0.22	3.66	0.00	1.86	-8.24	0.59	0.76	20.32	-2.30	-0.44	0.59	-4.53	0.13	0.55	1.27
XIV-C:157	3.08	0.68	1.07	0.84	2.43	7.80	2.24	-1.75	-1.60	4.09	0.29	1.54	-8.24	-4.18	0.96	-0.90	0.00			
XIV-C:181	6.33	2.81	-0.47	-0.87		-6.10	-1.17	1.75	-0.66	-0.31	-2.37	0.00	5.63	-6.13	-1.61	-2.72	0.58	0.45	-2.01	-1.15
XIV-C:101						-1.86	8.13				0.00	-6.63	10.94	-2.13	6.07			2.75	6.35	-2.45
XIV-C:156	2.70	2.93	3.64	1.74		-6.68	0.97	-0.56	0.44	-2.95	0.29	0.87	-12.08	1.61	7.17	-1.47		-1.89	0.33	1.14
XIV-C:99	3.75	-6.56	-2.91	2.06		-1.03	2.05	1.06	-1.35	-1.33	1.64	-3.48	7.13	0.93	10.42	0.57	1.58	-1.38	5.88	

Sadlermiut males corresponding Z-scores

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	34	37	39	40	42	44	45	48	50	52	53	55	56 and 57	58	59	60	62	64	65	68
XIV-C:230	-1.32	-0.54	-0.28	-0.78		-0.13	-0.85	-0.96	0.07	0.77		-0.15			-1.05	-0.05				
XIV-C:74	0.85	0.42	0.62	-0.10	-0.71						-0.07	-2.52	-0.28	1.84	-1.44			-2.20	-0.03	2.42
XIV-C:117	0.02	0.56	0.63	1.35		-0.04	-1.49	1.03	0.47	-2.53	-2.21	0.18	-1.28	1.16	1.49	-0.59	1.21	-0.90	-0.70	0.45
XIV-C:126	0.35	-0.82	0.20	0.28		0.24	-0.60	1.03	-0.39	0.48	-0.50	1.08	0.78	0.15	-0.30		-0.91	1.21	0.67	-0.47
XIV-C:246	-0.46	-0.40	-0.24	-2.22		1.17	0.92	0.21	-0.63	0.31	1.63		0.49	-0.07	0.66	1.00	-0.35	1.04	-0.41	-0.14
XIV-C:111	0.50	1.24	-1.20	1.18		0.12	0.14	-0.95	2.95	-1.89	0.73	0.29	0.48	0.80	0.17	0.27	0.14	-0.57	-0.75	
XIV-C:243	-0.01	0.83	-1.52	-0.11		-1.30	-0.43	0.58	-0.62	0.87	0.75	0.81	-0.40		-0.61	-0.22		0.94	0.67	0.77
XIV-C:216	-0.90	-0.73	-0.93	-0.43		0.30		-0.32	0.10	0.35	-0.29	0.11		-0.72	0.03	2.34		0.83	-0.62	-1.09
XIV-C:217	2.44	1.42	-0.45	0.25		0.55	0.29	1.06	0.21	0.45	-0.29		1.37		0.41	-1.31		0.53	0.71	
XIV-C:179	-1.75	-0.34	-0.02			-0.11	-0.15		-0.14	0.44	0.37	0.83	-1.52	0.30	-1.14	0.28		-0.15	-1.11	-1.09
XIV-C:182	0.59	0.54	1.83	0.58		0.18	0.77	-0.42	0.72	-0.45	0.36	0.42	1.52	-0.66	-0.71	0.45	-1.82	-0.09	-0.34	0.16
XIV-C:157	-0.35	-0.32	0.67	-0.08	0.71	2.39	0.20	-1.97	-1.11	0.69	0.14	0.64	-1.03	-1.23	-0.38	-0.41	0.25			
XIV-C:181	0.66	0.35	-0.01	-1.50		-1.44	-1.15	1.13	-0.61	0.29	-1.82	0.22	0.21	-1.81	-0.99	-1.47	0.51	0.04	-1.33	-0.42
XIV-C:101						-0.27	2.54				-0.07	-1.61	0.68	-0.61	0.85			1.04	1.92	-0.73
XIV-C:156	-0.47	0.39	1.80	0.66		-1.60	-0.30	-0.92	-0.03	0.04	0.14	0.45	-1.37	0.52	1.11	-0.74		-0.97	-0.42	0.13
XIV-C:99	-0.15	-2.61	-1.09	0.92		-0.04	0.13	0.52	-0.98	0.19	1.14	-0.74	0.34	0.32	1.90	0.44	0.97	-0.75	1.74	

* shaded squares denote significant asymmetry present

E-7 Sacred Heart females asymmetry calculations and Z-scores

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	33	34	37	38	39	40	41	44	45	48	50	51	53	57	59	60	64	66
88	1.58	0.00	1.69	1.20	-0.52	0.00	0.00	2.96	1.39	2.00	-0.23	-2.54	1.39	2.69	7.52	0.58	-1.35	2.19
24	0.32	1.82	1.06	-0.53	1.21	0.87	1.35			0.14	1.15	-4.00	0.58		5.45	1.52	-3.66	
9	1.70	1.52	-3.14	1.23	4.72	0.89	1.44	0.23	1.90	1.36	0.25	1.20	-1.20	3.99	4.74	-0.91	0.26	0.00
120	2.08	0.00	0.24	2.27	1.49		1.27	-4.57	-5.54	4.78	-1.98	0.00	-0.25		-7.09	0.00		
124B	1.62	1.56	3.53	1.45	-2.14		0.92	0.48	2.73	1.86	-0.49	0.00	-0.61	1.31	3.86	0.00	-3.20	0.19
97	0.93	1.52	2.04	1.90	-5.10	2.39	1.74	2.26	2.27	1.24	-0.22	-2.35	1.90	-0.86	-0.45		-0.90	0.49
71	0.96	0.00	3.29	-0.68	0.00	0.41	-0.91	1.80	2.05	0.52	-0.47	3.33	0.29	5.56	0.00	0.87	3.76	-1.40
5	2.66	1.72	-0.27	0.57	-3.55	-0.83	-0.44	0.84	2.79	3.82	-0.48	2.60	-1.13	1.75	8.33	1.78	3.37	1.05
114	1.39	3.39	3.47	1.50	-2.20	3.86	2.33	-1.67	-0.24	0.13	0.24	1.20		-2.25	-6.70		2.71	0.00
122	0.94	1.49	-1.76	1.41	4.08	0.00		1.52	1.32	0.94	-1.13	2.30	-0.84	-2.53	1.70		0.37	1.42

Sacred Heart females corresponding Z-scores

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	33	34	37	38	39	40	41	44	45	48	50	51	53	57	59	60	64	66
88	0.24	-1.23	0.30	0.17	-0.10	-0.63	-0.80	1.10	0.16	0.21	0.13	-1.11	1.24	0.51	1.07	0.03	-0.55	1.57
24	-1.64	0.49	0.02	-1.61	0.44	-0.05	0.46			-1.00	1.78	-1.71	0.51		0.69	1.03	-1.40	
9	0.42	0.21	-1.83	0.20	1.55	-0.04	0.54	-0.09	0.36	-0.21	0.70	0.42	-1.10	0.96	0.56	-1.55	0.04	-0.45
120	0.99	-1.23	-0.34	1.28	0.53		0.39	-2.17	-2.50	2.02	-1.96	-0.07	-0.24		-1.64	-0.58		
124B	0.30	0.24	1.11	0.43	-0.61		0.06	0.02	0.68	0.12	-0.18	-0.07	-0.56	0.04	0.39	-0.58	-1.23	-0.28
97	-0.73	0.21	0.45	0.89	-1.54	0.96	0.82	0.80	0.50	-0.29	0.14	-1.03	1.70	-0.71	-0.41		-0.39	0.00
71	-0.69	-1.23	1.00	-1.76	0.06	-0.36	-1.64	0.60	0.42	-0.75	-0.16	1.29	0.25	1.49	-0.32	0.34	1.33	-1.75
5	1.86	0.39	-0.57	-0.48	-1.06	-1.18	-1.21	0.18	0.70	1.39	-0.17	0.99	-1.03	0.19	1.22	1.31	1.18	0.51
114	-0.04	1.97	1.08	0.48	-0.63	1.94	1.37	-0.91	-0.46	-1.01	0.69	0.42		-1.19	-1.57		0.94	-0.45
122	-0.72	0.18	-1.22	0.39	1.35	-0.63		0.47	0.14	-0.48	-0.95	0.87	-0.77	-1.28	-0.01		0.08	0.86

* shaded squares denote significant asymmetry present

E-8 Sacred Heart males asymmetry calculations and Z-scores

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	34	37	39	40	42	44	45	48	50	52	53	55	56 and 57	58	59	60	62	64	65	68
139	1.52	-1.69	0.42		-1.28	1.00	1.87	0.81	-1.51	2.45	-0.53	-2.44	-2.66	2.43	-2.86		0.66	0.27	6.30	-2.56
115	4.22	-0.67	2.84	1.48	2.67	-0.66	1.08	1.19	0.00	-0.66	-0.52	0.38	-5.61	1.54	2.69	-1.09	-2.82	-0.13	-3.58	
145	1.52	-0.46	-0.51	2.34	-6.22	2.25	0.22	1.78	-1.43	7.77	2.00	-3.13	-13.78	1.39	7.24	2.31		1.18	-0.75	-1.35
30	4.20	0.38	3.69	0.00	0.77	-0.61	1.01	2.70	-1.01	1.02	0.25	-0.24	11.57	0.69	1.98		-0.19	1.31	-0.34	2.20
72	8.06			1.63	-19.38	0.66	0.45	-1.87	-1.30	-1.13	1.37	-0.43	5.25	-0.62	-0.93		-0.98	-1.60	-1.98	5.00
33	4.48	3.28	-4.41	1.09	0.44	-0.22	-0.43	-1.01	-0.60	-4.71	-1.52		-13.78		-3.42		5.17	2.62	3.32	-5.13
73	4.23	4.82	2.30	2.30	4.23	4.50	2.94	1.50	0.00	-4.03	-1.69	0.13	11.35	-5.69	-1.35	-0.57	1.57	3.66	0.00	-1.30
64	2.78	3.78	4.70	-0.38	3.60	0.41	1.41	2.16	1.43	-4.65	-0.25	0.12	-1.19	-0.88	0.81	2.62	-9.29	0.12	3.59	-1.23
83	0.00	-2.43	0.00	3.73	2.64	-2.33	-1.67	0.25	1.26	2.44	-1.31	-4.42	4.84	6.04	2.66		-0.63	-0.83	-1.95	-2.41
55	1.35	-2.46	2.49	1.74	-2.07	1.55	1.37	-0.23	1.03	-3.45	1.50	2.03	4.64	-1.41	-0.79	1.04	3.52	3.86	0.50	0.00

Sacred Heart males corresponding Z-scores

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	34	37	39	40	42	44	45	48	50	52	53	55	56 and 57	58	59	60	62	64	65	68
139	-0.74	-0.79	-0.31		0.03	0.18	0.82	0.06	-1.14	0.73	-0.35	-0.77	-0.30	0.64	-1.09		0.24	-0.42	1.91	-0.62
115	0.43	-0.42	0.57	-0.05	0.59	-0.70	0.20	0.32	0.19	-0.04	-0.34	0.63	-0.62	0.36	0.66	-1.17	-0.60	-0.64	-1.35	
145	-0.74	-0.35	-0.65	0.64	-0.68	0.86	-0.47	0.73	-1.07	2.06	1.57	-1.11	-1.51	0.31	2.09	0.87		0.07	-0.42	-0.20
30	0.42	-0.05	0.88	-1.25	0.32	-0.68	0.15	1.37	-0.70	0.38	0.24	0.32	1.26	0.09	0.43		0.03	0.14	-0.28	1.01
72	2.09			0.07	-2.55	0.00	-0.29	-1.80	-0.96	-0.16	1.09	0.23	0.57	-0.32	-0.48		-0.16	-1.43	-0.82	1.97
33	0.54	1.00	-2.07	-0.37	0.27	-0.47	-0.98	-1.20	-0.34	-1.05	-1.10		-1.51		-1.27		1.33	0.85	0.93	-1.50
73	0.43	1.55	0.37	0.61	0.81	2.06	1.66	0.53	0.19	-0.88	-1.23	0.50	1.23	-1.91	-0.61	-0.86	0.46	1.42	-0.17	-0.19
64	-0.20	1.18	1.24	-1.55	0.72	-0.13	0.46	0.99	1.45	-1.04	-0.14	0.50	-0.14	-0.40	0.07	1.06	-2.17	-0.50	1.02	-0.16
83	-1.40	-1.06	-0.47	1.76	0.58	-1.60	-1.96	-0.33	1.30	0.73	-0.94	-1.75	0.52	1.77	0.65		-0.07	-1.02	-0.81	-0.57
55	-0.82	-1.07	0.44	0.15	-0.09	0.48	0.43	-0.66	1.09	-0.74	1.19	1.44	0.50	-0.56	-0.44	0.11	0.93	1.52	0.00	0.26

* shaded squares denote significant asymmetry present

E-9 Sadlermiut female and male stature estimates

Skeleton #	Adult/Sub-Adult	Sex	Femur Length (cm)	Stature Estimate (cm)
XIV-C:96	adult	F?	42.2	157.82
XIV-C:112	adult	F	45.2	169.04
XIV-C:175	adult	F	35.8	133.88
XIV-C:105	adult	F	39.0	145.85
XIV-C:145	adult	F		
XIV-C:149	adult	F	41.0	153.33
XIV-C:153	adult	F	39.8	148.84
XIV-C:103	adult	F	40.4	151.08
XIV-C:104	adult	F	40.1	150.00
XIV-C:98	adult	F	41.2	154.08
XIV-C:155	adult	F	40.1	150.00
XIV-C:219	adult	F	41.4	154.82
XIV-C:183	adult	?F	41.6	155.57
XIV-C:148	adult	F	37.0	138.37
XIV-C:100	adult	F		
XIV-C:192	adult	F	41.3	154.45
XIV-C:221	adult	F	43.0	160.81
			AVERAGE	**151.86**

XIV-C:230	adult	M	47.3	176.89
XIV-C:74	adult	M		
XIV-C:117	adult	M	42.9	160.43
XIV-C:126	adult	M	43.5	162.68
XIV-C:246	adult	M	43.2	161.56
XIV-C:111	adult	M	41.8	156.32
XIV-C:243	adult	M	45.4	169.78
XIV-C:216	adult	M	44.1	164.92
XIV-C:217	adult	M	44.3	165.67
XIV-C:179	adult	M	43.6	163.05
XIV-C:182	adult	M	42.1	157.44
XIV-C:157	adult	M	43.9	164.17
XIV-C:181	adult	M	45.5	170.16
XIV-C:101	adult	M	40.9	152.95
XIV-C:156	adult	M	45.2	169.04
XIV-C:99	adult	M	45.0	168.29
			AVERAGE	**164.22**

E-10 Sacred Heart female and male stature estimates

Skeleton #	AdultSub-Adult	Sex	Femur Length (cm)	Stature Estimate (cm)
88	Adult	F	43.5	162.68
24	Adult	F	42.8	160.06
9	Adult	F	40.6	151.83
120	Adult	F	46.3	173.15
124B	Adult	F	41.0	153.33
97	Adult	F	44.6	166.79
71	Adult	F	42.4	158.56
5	Adult	F	42.2	157.82
114	Adult	F	41.3	154.45
122	Adult	F	44.6	166.79
			AVERAGE	**160.55**

139	Adult	M	47.1	176.14
115	Adult	M	46.8	175.02
145	Adult	M	42.6	159.31
30	Adult	M	49.9	186.61
72	Adult	M	46.7	174.64
33	Adult	M	50.4	188.48
73	Adult	M	44.9	167.91
64	Adult	M	48.3	180.63
83	Adult	M	47.1	176.14
55	Adult	M	48.0	179.51
			AVERAGE	**176.44**

APPENDIX F: THE HOWELLS DATASET

Introduction

The Howells dataset (1973) was chosen as a published dataset to establish proof of principle that there are significant correlations among cranial BSIs. The purpose of using these data, and more specifically three populations within this dataset, was to provide the evidence needed to demonstrate the viability of this method and the relationship between the different variables measured. This dataset is commonly used as a reference population in craniometric studies, and is comprised of cranial measurement data from 17 different regional populations, three of which were used in this study: the Buriat Siberian population, the Inugsuk Greenland population and the Early Arikara South Dakota population. These populations were chosen to establish this correlation among cranial BSIs because they occupied regions with similar environments to the Sadlermiut and Sacred Heart population samples and would, therefore, presumably be subject to similar types of environmental stress.

The Buriat Population

The Buriat population was located at the southern tip of Lake Baikal in Siberia and was characterized as a pastoralist population (Howells 1973). Howells presents data for 54 male and 55 female crania; unfortunately, no archaeological date is provided for this population (Howells 1973).

The Inugsuk Population

The Inugsuk culture was predominantly located along the southwestern and eastern regions of Greenland and showed no evidence of Danish colonization until 1750 (Howells 1973). The 108 crania measured by Howells, 54 males and 54 females, were collected on various expeditions to Greenland between 1898 and 1935, contemporary with the contact time period of the Sadlermiut (Howells 1973).

The Arikara Population

Located in the center of what is now South Dakota, the early Arikara people date from about 1600-1750 and occupied one single village settlement (Howells 1973). Excavated by Robert Stephenson and William M. Bass, this site contained 566 human burials that were located and collected during the field seasons of 1957, 1958, 1961 and 1962 (Howells 1973).

These three populations were used only to provide a broad comparative context for this research and their importance in the establishment of this stress analysis model will be described below.

Correlation Analysis and Results

The Howells dataset was used for this correlation analysis because measurements taken within this dataset are consistent with the cranial BSIs selected for this study. This dataset was also used because of the inclusion of both cold climate and temperate climate populations. Although correlation analysis could be completed on random populations to demonstrate the correlation between BSIs, specific care was taken to ensure a correlation analysis of cold climate populations, similar to the Sadlermiut and a temperate climate population, similar to the Sacred Heart sample. Six cranial measurements were used from each population to assess the correlation relationship examined using SPSS software 16.0 (Statistical Package for Social Sciences). These six measurements were chosen from the Howells dataset as they were consistent with the cranial BSIs chosen for this study.

The primary purpose of collecting and analyzing data from the Howells dataset was to establish the broad comparative context of this research project. Through the establishment of strong correlations within these environmentally disparate populations, the results should demonstrate the true relationship between different indicators of body size within the human skeleton, specifically the cranium. Tables F-1, F-2 and F-3 below, show the correlation results of each of the three sample populations from the Howells dataset.

Table F-1
Buriat population cranial correlations (males and females combined)

BSI Measurements	GOL	NPH	OBH	OBB	EKB	FOL
GOL	1					
NPH	0.612**	1				
OBH	0.312**	0.507**	1			
OBB	0.549**	0.506**	0.393**	1		
EKB	0.633**	0.474**	0.326**	0.733**	1	
FOL	0.307**	0.302**	0.200*	0.116	0.107	1

Table F-2
Inugsuk population cranial correlations (males and females combined)

BSI Measurements	GOL	NPH	OBH	OBB	EKB	FOL
GOL	1					
NPH	0.601**	1				
OBH	0.282**	0.265**	1			
OBB	0.277**	0.285**	0.345**	1		
EKB	0.290**	0.317**	0.243*	0.765**	1	
FOL	0.195**	0.165	0.169	0.173	0.109	1

Table F-3
Arikara population cranial correlations (males and females combined)

BSI Measurements	GOL	NPH	OBH	OBB	EKB	FOL
GOL	1					
NPH	0.510**	1				
OBH	0.100	0.293*	1			
OBB	0.517**	0.482**	0.340**	1		
EKB	0.655**	0.433**	0.147	0.748**	1	
FOL	0.450**	0.334**	0.172	0.149	0.218	1

GOL=maximum cranial length, NPH=upper facial height, OBH=maximum orbital height, OBB=maximum orbital breadth, EKB=biorbital breadth, FOL=foramen magnum length

** correlation is significant at the 0.01 level
* correlation is significant at the 0.05 level

As illustrated in these tables, the majority of these variables were significantly correlated at the 0.01 confidence interval level. These results substantiate that relationships exist between the cranial BSIs within these three sample groups. Therefore, any stress affecting one variable, should also affect the other BSIs in a similar way if these variables were growing at the same time. However, while the underlying correlations between certain cranial BSIs were strong, there was some variability in the correlation relationship. This variability may in fact be related to specific individuals who deviated from the underlying relationship, possibly the result of stress, or due to sex differences between males and females with regard to which BSIs are correlated with one another.

Conclusions

Overall the use of the Howells dataset to provide a proof of concept worked well for this project to establish that: 1) relationships do exist between certain BSIs within the cranium and 2) if relationships exist within the cranium then it is likely that similar relationships are also present within the infra-cranial skeleton, that may be studied to examine stress patterns within a population sample.

APPENDIX G: CORRELATION ANALYSES

G-1 Sadlermiut females cranial correlations

BSI Measurements	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19
1	1																	
2	0.155	1																
3	0.379	0.85**	1															
4	0.489	0.442	0.712**	1														
5	0.623*	0.313	0.470	0.598*	1													
6	0.118	0.287	0.442	0.576*	0.434	1												
7	.617*	0.516	0.496	0.250	0.402	0.036	1											
8	0.470	0.280	0.497	0.445	0.620	0.374	0.582*	1										
9	0.170	0.135	0.165	0.368	0.464	0.551	0.068	0.549	1									
10	0.284	-0.031	-0.101	0.011	0.391	-0.353	0.109	0.070	-0.012	1								
11	0.623*	0.598*	0.592*	0.527	0.339	-0.039	0.335	0.350	0.235	0.029	1							
12	-0.261	0.540	0.557*	0.481	0.168	0.396	0.135	0.109	0.002	0.018	0.024	1						
13	0.125	0.113	0.208	0.326	-0.080	-0.198	0.073	0.064	-0.370	-0.215	0.417	0.317	1					
14	0.490	0.370	0.486	0.470	0.214	-0.082	0.270	0.231	-0.361	-0.039	0.580*	0.067	0.664**	1				
16	0.360	0.261	0.171	0.067	0.035	0.216	0.655	0.492	0.413	-0.232	0.076	-0.311	-0.598	-0.364	1			
17	0.375	0.400	0.567*	0.381	0.306	0.234	0.238	0.705**	0.116	0.046	0.556*	0.303	0.341	0.630*	-0.228	1		
18	0.118	0.646	0.732*	0.351	-0.294	0.145	0.309	0.030	-0.140	* -0.696	0.640	-0.012	0.542	0.560	0.619	0.173	1	
19	0.100	0.676*	0.762**	0.540*	0.313	0.475	0.303	0.507	0.158	-0.281	0.380	0.607*	0.173	0.286	0.069	0.481	0.534	1

(original BSI numbering see Appendix B, B1)

G-2 Sadlermiut males cranial correlations

BSI Measurements	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19
1	1																	
2	-0.430	1																
3	0.029	0.673*	1															
4	0.022	0.578*	0.885**	1														
5	-0.273	-0.112	-0.323	-0.208	1													
6	-0.251	0.526	0.462	0.607*	0.143	1												
7	0.163	0.177	0.700**	0.588*	-0.353	-0.014	1											
8	0.333	0.490	0.515	0.327	-0.084	0.297	0.155	1										
9	-0.362	-0.338	-0.448	-0.205	0.176	0.000	-0.336	-0.502	1									
10	0.452	-0.087	0.200	-0.031	-0.359	-0.450	0.133	0.224	-0.188	1								
11	-0.016	-0.246	-0.232	-0.189	0.258	-0.196	-0.064	0.030	0.415	-0.067	1							
12	-0.295	0.250	0.012	-0.156	-0.243	-0.330	0.154	0.096	0.156	-0.085	0.449	1						
13	-0.335	-0.026	-0.314	-0.336	0.255	-0.267	-0.210	-0.364	-0.175	-0.322	-0.529	-0.029	1					
14	-0.036	0.061	0.149	0.299	-0.543	-0.165	0.530	-0.278	0.031	-0.154	-0.040	0.284	0.005	1				
16	-0.465	0.417	0.360	0.316	0.179	0.551	0.146	-0.027	-0.328	-0.219	-0.318	-0.350	0.042	0.068	1			
17	0.291	0.146	0.300	0.258	-0.139	-0.149	0.025	0.288	-0.012	0.424	0.308	0.220	-0.273	-0.296	-0.601	1		
18	0.311	0.160	0.005	0.048	-0.127	0.367	-0.344	0.381	-0.196	-0.155	* -0.676	-0.252	0.372	-0.246	-0.377	0.057	1	
19	-0.039	0.563*	0.639	0.485	* -0.610	0.111	0.445	0.348	-0.180	0.574	-0.300	0.127	-0.356	0.382	0.202	0.036	0.023	1

(original BSI numbering see Appendix B, B1)

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

G-3 Sadlermiut females vertebral correlations

BSI Measurements	20	21	22	23	24	25	26	27	28	29	30	32
20	1											
21	0.474	1										
22	0.344	0.462	1									
23	-0.142	0.525	0.853**	1								
24	0.434	0.534	0.273	-0.001	1							
25	0.515	0.598	0.220	0.232	0.631**	1						
26	0.673	0.112	0.543	0.276	0.865**	0.819*	1					
27	0.274	0.262	0.242	0.310	0.542	0.942**	0.752*	1				
28	0.487	-0.360	0.003	-0.037	0.434	0.579*	0.821*	0.479	1			
29	0.373	0.496	0.297	0.385	0.510	0.903**	0.689	0.928**	0.500	1		
30	-0.143	0.103	0.273	0.141	0.163	0.452	0.151	0.404	-0.029	0.290	1	
32	0.246	-0.603	-0.441	-0.587	0.208	0.117	0.291	-0.173	0.488	-0.139	-0.029	1

(original BSI numbering see Appendix B, B1)

G-4 Sadlermiut males vertebral correlations

BSI Measurements	20	21	22	23	24	25	26	27	28	29	30	32
20	1											
21	0.569	1										
22	0.563	0.267	1									
23	0.770**	0.393	0.512	1								
24	0.471	0.335	0.933**	0.535	1							
25	0.800**	0.351	0.738**	0.744**	0.756**	1						
26	0.651*	0.887**	0.586	0.606*	0.495	0.519	1					
27	0.84**	0.505	0.577	0.599	0.504	0.855**	0.586*	1				
28	0.688*	0.756**	0.749**	0.336	0.578*	0.555*	0.679*	0.642*	1			
29	0.218	0.452	0.387	0.056	0.112	-0.106	0.555	0.159	0.605*	1		
30	0.672*	0.292	0.724**	0.555	0.590*	0.767**	0.541	0.803**	0.605*	0.009	1	
32	0.580	0.451	0.688*	0.446	0.797**	0.740	0.446	0.748	0.659*	0.049	0.532	1

(original BSI numbering see Appendix B, B1)

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

G-5 Sadlermiut females arm correlations

BSI Measurements	33	34	35	36	37	38	39	40	41	42	43
33	1										
34	0.604*	1									
35	0.758**	0.826**	1								
36	0.718**	0.576*	0.738**	1							
37	0.658**	0.582*	0.741**	0.818**	1						
38	0.756**	0.676**	0.793**	0.823**	0.708**	1					
39	0.702**	0.640**	0.579*	0.530*	0.689**	0.506*	1				
40	0.877**	0.532*	0.665**	0.727**	0.570*	0.662**	0.589*	1			
41	0.909**	0.623**	.721**	0.764**	0.638**	0.736**	0.639**	0.985**	1		
42	0.508*	0.721**	0.568*	0.569*	0.651**	0.624**	0.530*	0.376	0.491*	1	
43	0.983**	0.626**	0.759**	0.755**	0.664**	0.765**	0.691**	0.945**	0.970**	0.512*	1

(original BSI numbering see Appendix B, B1)

G-6 Sadlermiut males arm correlations

BSI Measurements	33	34	35	36	37	38	39	40	41	42	43
33	1										
34	-0.382	1									
35	-0.291	0.754**	1								
36	0.009	0.648**	0.649**	1							
37	-0.082	0.648**	0.518*	0.506*	1						
38	-0.041	0.428	0.371	0.334	0.749**	1					
39	-0.229	0.667**	0.610*	0.660**	0.576*	0.347	1				
40	0.533*	-0.144	-0.227	-0.051	-0.245	-0.319	-0.377	1			
41	0.476	-0.155	-0.213	-0.058	-0.345	-0.328	-0.271	0.931**	1		
42	0.087	0.522*	0.159	0.391	0.633*	0.204	0.516*	-0.063	-0.093	1	
43	0.889**	-0.326	-0.270	0.072	-0.124	0.038	-0.206	0.733**	0.761**	0.016	1

(original BSI numbering see Appendix B, B1)

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

G-7 Sadlermiut females leg correlations

BSI Measurements	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
44	1																		
45	0.777**	1																	
46	0.305	0.657*	1																
47	0.313	0.449	0.401	1															
48	0.563	0.700*	0.511	0.130	1														
49	0.318	0.363	0.424	0.335	0.437	1													
50	0.782**	0.880**	0.531	0.263	0.629*	0.373	1												
51	0.754**	0.739**	0.747**	0.403	0.596*	0.529	0.736**	1											
52	0.610*	0.618*	0.640*	0.679**	0.476	0.618*	0.525	0.843**	1										
53	0.750**	0.721**	0.489	0.294	0.374	0.412	0.919**	0.750**	0.564*	1									
54	0.479	0.427	0.567*	0.255	0.148	0.221	0.418	0.687**	0.408	0.624**	1								
55	0.532	0.514	0.275	0.118	0.837**	0.532	0.535	0.574	0.410	0.497	0.463	1							
56	-0.116	0.271	0.331	-0.117	0.021	-0.312	0.285	-0.010	-0.159	0.106	0.021	-0.139	1						
57	0.655*	0.594*	0.454	0.113	0.571	-0.131	0.579*	0.594	0.449	0.490	0.246	0.406	0.389	1					
58	0.173	0.246	0.358	0.046	0.382	0.355	0.215	0.230	0.038	0.319	0.417	0.372	-0.052	0.213	1				
59	0.545*	0.638*	0.552*	0.599*	0.349	0.400	0.380	0.618*	0.791**	0.539*	0.698**	0.455	0.028	0.386	0.289	1			
60	0.664*	0.681*	0.488	0.093	0.190	0.370	0.916**	0.692**	0.389	0.989**	0.717**	0.410	0.150	0.269	0.366	0.461	1		
61	0.670*	0.762**	0.478	0.018	0.292	0.288	0.980**	0.652*	0.279	0.962**	0.606*	0.325	0.271	0.274	0.210	0.163	0.978**	1	
62	0.335	0.018	-0.380	0.587	-0.147	0.036	-0.018	-0.064	0.129	0.419	0.549	0.556	-0.454	0.064	0.231	0.515	0.399	0.060	1

(original BSI numbering see Appendix B, B1)

G-8 Sadlermiut males leg correlations

BSI Measurements	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
44	1																		
45	0.692**	1																	
46	0.088	0.523	1																
47	0.703**	0.403	0.113	1															
48	0.733**	0.776**	0.526	0.757**	1														
49	0.490	0.768**	0.685**	0.607*	0.799**	1													
50	-0.005	0.439	0.627*	0.062	0.210	0.350	1												
51	0.478	0.486	0.483	0.602*	0.601	0.482	0.126	1											
52	0.551*	0.485	0.279	0.686**	0.682**	0.428	-0.001	0.884**	1										
53	0.403	0.304	0.172	0.533*	0.304	0.108	0.428	0.658*	0.536*	1									
54	0.347	0.466	0.691**	0.395	0.588*	0.463	0.471	0.630*	0.575*	0.352	1								
55	0.663**	0.807**	0.587*	0.583*	0.914**	0.778**	0.327	0.484	0.587*	0.166	0.678**	1							
56	0.177	0.615*	0.315	-0.291	0.217	0.436	0.400	-0.136	-0.159	-0.304	0.146	0.290	1						
57	0.176	0.320	-0.085	-0.019	0.276	0.069	-0.078	0.071	0.094	0.028	-0.251	0.172	0.153	1					
58	0.320	0.752**	0.743**	0.161	0.677*	0.687*	0.667*	0.370	0.286	-0.072	0.471	0.580*	0.655*	0.353	1				
59	0.242	0.413	0.587*	0.429	0.554*	0.692**	0.254	0.720**	0.603*	0.237	0.579*	0.491	0.185	0.014	0.597*	1			
60	-0.103	-0.285	0.152	0.331	-0.119	-0.048	0.503	0.300	0.236	0.718**	0.418	-0.067	* -0.582	* -0.627	-0.470	0.131	1		
61	-0.170	-0.060	0.412	0.166	-0.020	0.094	0.896**	0.067	-0.013	0.518	0.503	0.054	-0.098	* -0.576	0.176	0.170	0.834**	1	
62	0.620*	0.696*	0.711*	0.677*	0.769**	0.753**	0.628*	0.431	0.396	0.304	0.669	0.890**	0.209	0.082	0.700*	0.512	0.199	0.489	1

(original BSI numbering see Appendix B, B1)

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

G-9 Sadlermiut females tarsal and metacarpal correlations

BSI Measurements	64	65	66	67	68	70
64	1					
65	0.814**	1				
66	0.834**	0.753*	1			
67	0.580	0.531	0.481	1		
68	0.241	0.103	0.291	0.051	1	
70	0.843*	0.677	0.455	-0.202	-0.011	1

(original BSI numbering see Appendix B, B1)

G-10 Sadlermiut males tarsal and metacarpal correlations

BSI Measurements	64	65	66	67	68	70
64	1					
65	0.900**	1				
66	0.762**	0.654*	1			
67	0.550	0.686**	0.540*	1		
68	0.821**	0.931**	0.611*	0.703*	1	
70	0.374	0.362	-0.085	0.090	0.499	1

(original BSI numbering see Appendix B, B1)

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

G-11 Sacred Heart females cranial correlations

BSI Measurements	1	2	3	4	5	6	7	8	9	10	11	12	13	14	17	18	19
1	1																
2	-0.134	1															
3	-0.357	0.627	1														
4	-0.443	0.552	0.978**	1													
5	0.220	-0.318	0.271	0.275	1												
6	-0.567	-0.034	0.459	0.553	0.482	1											
7	* -0.759	-0.007	0.484	0.597	0.266	0.582	1										
8	0.179	0.205	0.598	0.567	0.374	0.317	0.039	1									
9	0.289	0.410	0.491	0.424	-0.302	-0.059	-0.245	0.592	1								
10	-0.221	0.562	0.476	0.643	-0.016	0.043	0.222	0.067	0.232	1							
11	-0.499	0.358	0.587	0.728*	0.089	0.231	0.387	0.475	0.399	0.862**	1						
12	-0.558	0.096	0.733*	0.713*	0.380	0.512	0.339	0.789*	0.706*	0.163	0.467	1					
13	-0.153	0.315	0.649	0.640	0.131	0.359	-0.011	0.948**	0.797*	0.142	0.490	0.830**	1				
14	-0.427	0.318	0.744*	0.822**	0.321	0.285	0.404	0.289	0.355	0.679*	0.669*	0.589	0.429	1			
17	0.270	0.556	0.789*	0.803*	0.394	0.217	0.127	0.714*	0.587	0.731*	0.788*	0.740*	0.754*	0.803**	1		
18	-0.377	0.768	0.830*	0.996**	-0.189	0.369	0.055	0.604	0.713	0.145	0.341	0.610	0.842	0.455	0.522	1	
19	-0.337	0.750*	0.294	0.220	-0.478	-0.224	-0.057	0.302	0.342	0.159	0.232	-0.097	0.419	0.161	0.123	0.946*	1

(original BSI numbering see Appendix B, B1)

G-12 Sacred Heart males cranial correlations

BSI Measurements	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	17	18	19
1	1																	
2	0.127	1																
3	0.281	0.372	1															
4	0.499	0.151	0.869**	1														
5	0.387	0.594	0.290	0.514	1													
6	0.590	-0.106	0.558	0.653	0.228	1												
7	0.375	0.568	0.732*	0.499	0.363	0.255	1											
8	0.359	0.150	0.465	0.569	0.173	0.096	0.300	1										
9	0.163	-0.249	-0.034	0.194	0.314	0.639	-0.206	0.138	1									
10	0.088	-0.301	0.066	0.020	-0.502	0.009	-0.186	-0.274	-0.452	1								
11	0.671*	0.251	-0.041	-0.043	0.696*	0.382	0.392	0.221	0.331	-0.223	1							
12	0.064	-0.106	0.753*	0.748*	-0.046	0.523	0.458	0.612	0.428	-0.269	0.135	1						
13	0.080	-0.576	0.355	0.515	-0.305	0.493	0.013	0.505	0.579	-0.197	-0.013	0.833**	1					
14	-0.058	0.379	0.623	0.550	0.059	-0.168	0.420	0.307	-0.665	0.022	-0.546	0.145	-0.107	1				
16	0.265	0.459	0.426	0.488	0.458	0.484	0.052	0.197	0.409	0.038	0.096	0.088	-0.103	0.025	1			
17	0.623	0.223	0.409	0.606	0.509	0.391	0.539	0.117	0.186	-0.159	0.240	0.078	0.063	0.180	0.278	1		
18	-0.014	-0.154	0.153	0.348	0.549	-0.220	0.355	-0.448	-0.428	-0.366	-0.476	-0.317	-0.189	0.435	-0.144	0.697	1	
19	0.275	0.382	0.076	0.343	0.814**	0.012	0.019	0.523	0.336	-0.466	0.493	-0.003	-0.101	0.024	0.429	0.141	0.315	1

(original BSI numbering see Appendix B, B1)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

G-13 Sacred Heart females vertebral correlations

BSI Measurements	20	21	22	23	24	25	26	27	28	29	30	32
20	1											
21	0.154	1										
22	0.364	0.875**	1									
23	0.541	0.586	0.724*	1								
24	0.352	0.854**	0.934**	0.815**	1							
25	0.336	0.493	0.616	0.869**	0.802**	1						
26	0.305	0.547	0.765*	0.845**	0.759*	0.756*	1					
27	0.224	0.466	0.573	0.729*	0.566	0.753*	0.895**	1				
28	0.123	0.704	0.807*	0.730*	0.904**	0.673	0.936**	0.917**	1			
29	0.262	0.436	0.686*	0.574	0.663	0.483	0.698	0.561	0.914**	1		
30	0.009	0.484	0.676*	0.475	0.653	0.681*	0.709*	0.710*	0.752*	0.653	1	
32	0.111	0.822*	0.748*	0.853**	0.830*	0.812*	0.863**	0.746*	0.886*	0.410	0.525	1

(original BSI numbering see Appendix B, B1)

G-14 Sacred Heart males vertebral correlations

BSI Measurements	20	21	22	23	24	25	26	27	28	29	30	32
20	1											
21	0.645*	1										
22	0.617	0.405	1									
23	0.662*	0.667*	0.815**	1								
24	0.754*	0.392	0.886**	0.777**	1							
25	0.533	0.624	0.741*	0.957**	0.755*	1						
26	0.552	0.294	0.900**	0.801*	0.937**	0.883**	1					
27	0.678	0.533	0.812*	0.752*	0.909**	0.805*	0.876**	1				
28	0.789*	0.501	0.925**	0.822**	0.954**	0.784*	0.911**	0.913**	1			
29	0.822**	0.789*	0.507	0.828**	0.592	0.734*	0.552	0.630	0.657	1		
30	0.631	0.378	0.501	0.441	0.364	0.346	0.317	0.416	0.598	0.533	1	
32	0.508	-0.772	0.351	-0.301	0.451	-0.456	1.00**	1.00**	0.909	-0.784	0.770	1

(original BSI numbering see Appendix B, B1)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

G-15 Sacred Heart females arm correlations

BSI Measurements	33	34	35	36	37	38	39	40	41	42	43
33	1										
34	0.605	1									
35	0.572	0.961**	1								
36	0.248	0.690*	0.597	1							
37	0.418	0.783**	0.797**	0.807**	1						
38	0.603	0.766**	0.694*	0.712*	0.696*	1					
39	0.239	0.828**	0.793**	0.881**	0.832**	0.747*	1				
40	0.710*	0.413	0.321	0.595	0.174	0.301	0.243	1			
41	0.823**	0.293	0.310	0.253	0.075	0.199	0.003	0.895**	1		
42	0.358	0.292	0.336	0.526	0.570	0.452	0.447	0.422	0.380	1	
43	0.975**	0.490	0.493	0.241	0.306	0.457	0.173	0.806*	0.929**	0.459	1

(original BSI numbering see Appendix B, B1)

G-16 Sacred Heart males arm correlations

BSI Measurements	33	34	35	36	37	38	39	40	41	42	43
33	1										
34	0.274	1									
35	0.369	0.913**	1								
36	0.503	0.835**	0.671*	1							
37	0.532	0.475	0.664	0.692*	1						
38	0.397	0.454	0.408	0.766*	0.777*	1					
39	0.328	0.316	0.707*	0.538	0.826**	0.671*	1				
40	0.581	0.614	0.828**	0.331	0.801*	0.422	0.846**	1			
41	0.608	0.530	0.704*	0.308	0.673*	0.381	0.499	0.962**	1		
42	0.430	-0.345	-0.228	0.560	0.943**	0.385	0.793*	0.159	0.212	1	
43	0.907**	0.442	0.590	0.457	0.656	0.434	0.446	0.863**	0.886**	0.364	1

(original BSI numbering see Appendix B, B1)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

G-17 Sacred Heart females leg correlations

BSI Measurements	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
44	1																		
45	0.953**	1																	
46	0.289	0.165	1																
47	0.506	0.483	-0.385	1															
48	0.670*	0.756*	0.094	0.389	1														
49	0.350	0.443	0.325	-0.245	0.386	1													
50	0.476	0.616	0.173	0.021	0.328	0.565	1												
51	0.791**	0.791**	0.300	0.560	0.493	0.324	0.687*	1											
52	0.621	0.548	0.082	0.749*	0.637*	0.038	0.160	0.720*	1										
53	0.391	0.481	0.136	0.150	0.120	0.432	0.898**	0.766**	0.261	1									
54	0.593	0.638*	-0.034	0.689*	0.294	0.166	0.669*	0.876**	0.570	0.756*	1								
55	0.766*	0.841**	-0.197	0.768*	0.714*	0.305	0.667*	0.863**	0.694*	0.672*	0.865**	1							
56	0.429	0.564	0.382	-0.173	0.481	0.370	0.791**	0.452	0.038	0.507	0.357	0.444	1						
57	0.750*	0.796*	0.378	0.299	0.593	0.306	0.628	0.797*	0.412	0.593	0.614	0.767*	0.666	1					
58	0.764*	0.813*	0.252	0.480	0.463	0.324	0.694	0.856**	0.522	0.646	0.693	0.665	0.674	0.724	1				
59	0.671*	0.664*	0.165	0.560	0.258	0.203	0.708*	0.887**	0.517	0.768**	0.956**	0.809**	0.445	0.666	0.661	1			
60	0.600	0.651	0.126	0.389	0.223	0.419	0.886**	0.874**	0.439	0.952**	0.789*	0.764*	0.567	0.766*	0.784*	0.799*	1		
61	0.509	0.617	-0.016	0.349	0.199	0.424	0.966**	0.814*	0.333	0.974**	0.804*	0.751*	0.686	0.696	0.764*	0.789*	0.975**	1	
62	0.513	0.606	0.154	-0.141	0.506	0.041	0.616	0.399	0.048	0.402	0.099	0.356	0.789*	0.675	0.487	0.292	0.578	0.634	1

(original BSI numbering see Appendix B, B1)

G-18 Sacred Heart males leg correlations

BSI Measurements	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
44	1																		
45	0.954**	1																	
46	0.362	0.552	1																
47	0.229	0.108	-0.574	1															
48	0.864**	0.842**	0.442	0.331	1														
49	0.442	0.437	0.464	0.064	0.611	1													
50	0.613	0.618	0.240	0.068	0.570	0.095	1												
51	0.442	0.491	0.289	0.273	0.409	0.215	0.191	1											
52	0.628	0.631	0.136	0.640	0.754*	0.317	0.340	0.720*	1										
53	0.736*	0.800**	0.428	0.167	0.746*	0.229	0.921**	0.376	0.561	1									
54	0.166	0.333	0.467	-0.328	0.157	-0.265	0.616	0.018	0.022	0.639*	1								
55	0.598	0.669*	0.501	0.170	0.745*	0.213	0.484	0.394	0.545	0.694*	0.307	1							
56	0.587	0.562	0.442	-0.130	0.662*	0.568	0.669*	-0.250	0.086	0.645*	0.394	0.367	1						
57	0.607	0.548	0.283	-0.085	0.653*	0.276	0.661*	-0.113	0.210	0.583	0.161	0.595	0.674*	1					
58	0.784*	0.786*	0.526	0.169	0.728*	0.572	0.580	0.799*	0.710*	0.668*	-0.025	0.555	0.349	0.456	1				
59	0.601	0.650*	0.445	0.037	0.611	0.160	0.815**	0.254	0.355	0.881**	0.778**	0.516	0.710*	0.366	0.431	1			
60	0.733*	0.812**	0.110	0.365	0.660	0.056	0.844**	0.225	0.525	0.944**	0.528	0.630	0.509	0.464	0.527	0.788*	1		
61	0.692*	0.746*	0.230	0.195	0.659	0.066	0.977**	0.209	0.425	0.994**	0.606	0.624	0.635	0.608	0.614	0.870**	0.939**	1	
62	0.611	0.658*	0.315	0.201	0.629	-0.038	0.541	0.566	0.680*	0.667*	0.261	0.826**	0.095	0.587	0.656	0.367	0.568	0.578	1

(original BSI numbering see Appendix B, B1)

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

G-19 Sacred Heart females tarsal and metacarpal correlations

BSI Measurements	64	65	66	67	68	69	70
64	1						
65	0.828**	1					
66	0.729*	0.683*	1				
67	0.762*	0.795*	0.912**	1			
68	0.627	0.762*	0.886**	0.928**	1		
69	0.412	0.193	0.415	0.465	0.182	1	
70	0.567	0.747*	0.506	0.535	0.506	0.348	1

(original BSI numbering see Appendix B, B1)

G-20 Sacred Heart males tarsal and metacarpal correlations

BSI Measurements	64	65	66	67	68	69	70
64	1						
65	0.920**	1					
66	0.526	0.476	1				
67	-0.065	-0.077	0.519	1			
68	0.706*	0.667*	0.664*	0.590	1		
69	0.761*	0.794**	0.516	0.437	0.886**	1	
70	0.362	0.461	-0.014	-0.025	0.106	0.391	1

(original BSI numbering see Appendix B, B1)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

G-21 Sadlermiut and Sacred Heart final female correlations

BSI Measurements	3	4	11	12 and 13	14	17	24 and 25	26 and 27	28 and 29	33	34	37	38	39	40	41	44	45	48	50	51	53	57	59	60	64	66
3	1																										
4	.831**	1																									
11	.660**	.641**	1																								
12 and 13	.483*	.532*	.262	1																							
14	.514**	.627**	.483*	.468*	1																						
17	.681**	.537**	.741**	.430	.440*	1																					
24 and 25	.565**	.626**	.818**	.106	.264	.417	1																				
26 and 27	.772**	.778**	.850**	.301	.381	.626*	.859**	1																			
28 and 29	.762**	.725**	.859**	.302	.463*	.662**	.791**	.906**	1																		
33	.198	.193	-.184	.294	.246	-.156	.167	.397	.129	1																	
34	.322	.347	.154	.320	.359	.152	.382	.740**	.417	.590**	1																
37	.408*	.420*	.216	.452*	.257	.132	.413	.657**	.501*	.522**	.697**	1															
38	.390	.339	.144	.337	.253	.144	.299	.634**	.531*	.664**	.720**	.696**	1														
39	.273	.441*	.192	.349	.335	.096	.196	.595**	.396	.636**	.735**	.750**	.613**	1													
40	.160	.026	-.107	.144	.155	-.098	.251	.290	.065	.892**	.502*	.449*	.553**	.582**	1												
41	.093	-.018	-.221	.154	.075	-.168	.050	.188	-.083	.925**	.485*	.406*	.540**	.569**	.973**	1											
44	.564**	.496*	.400	.376	.473*	.399	.453	.709**	.617**	.489*	.657**	.613**	.812**	.525**	.388	.322	1										
45	.564**	.526*	.573**	.440*	.526**	.525*	.646**	.700**	.691**	.318	.532**	.541**	.627**	.369	.202	.115	.847**	1									
48	.218	.357	.332	.392	.349	.169	.414	.363	.544*	.233	.288	.447*	.489*	.264	.075	.047	.589**	.730**	1								
50	.184	.138	-.075	.263	.233	-.170	.309	.394	.126	.925**	.529**	.527**	.615**	.568**	.857**	.871**	.502*	.454*	.368	1							
51	.393	.380	.071	.169	.444*	.213	.311	.497*	.377	.581**	.680**	.498*	.599**	.434*	.475*	.466*	.684**	.687**	.557**	.642**	1						
53	.075	.024	-.286	.148	.181	-.192	.142	.301	-.058	.903**	.570**	.525**	.550**	.594**	.894**	.915**	.416*	.270	.125	.923**	.626**	1					
57	.265	.276	-.011	.369	.288	-.185	.207	.509*	.283	.670**	.620**	.692**	.508**	.584**	.502*	.542**	.637**	.516*	.481*	.674**	.687**	.634**	1				
59	.038	.143	-.249	.284	.482*	-.152	-.028	.232	-.009	.749**	.685**	.378	.470*	.530**	.609**	.686**	.375	.246	.164	.665**	.635**	.750**	.652**	1			
60	.123	.044	-.243	.135	.210	-.064	-.031	.437	-.101	.893**	.574**	.597**	.572**	.635**	.848**	.866**	.380	.251	.011	.915**	.662**	.978**	.561**	.705**	1		
64	.250	.315	.293	.375	.362	-.048	.404	.609**	.421	.714**	.711**	.546**	.607**	.736**	.659**	.598**	.605**	.316	.238	.578**	.421	.621**	.707**	.649**	.489*	1	
66	.460*	.556*	.422	.658**	.390	.373	.493*	.614*	.700**	.542*	.730**	.799**	.708**	.706**	.454*	.381	.744**	.704**	.703**	.546*	.695**	.474*	.748**	.386	.418	.725**	1

(original BSI numbering see Appendix B, B1)

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level

G-22 Sadlermiut and Sacred Heart final male correlations

BSI Measurements	3	21	23	25	27	28	32	34	35	37	39	40	42	44	45	48	50	52	53	55	57	58	59	60	62	64	65	68
3	1																											
20 and 21	0.253	1																										
22 and 23	0.015	.699**	1																									
24 and 25	0.098	.634**	.914**	1																								
26 and 27	0.158	.780**	.811**	.811**	1																							
28	0.392	.733**	.549**	.582**	.705**	1																						
32	-0.089	0.399	0.35	.615*	.600*	.635*	1																					
34	0.047	.515*	.544**	.507*	.505*	.437*	0.226	1																				
35	0.008	.469*	.670**	.634**	.548*	.562**	0.414	.793**	1																			
37	-0.172	0.42	.629**	.731**	.605**	.479*	0.448	.421*	.549**	1																		
39	-0.37	0.298	.484*	.590**	.469*	0.374	.669**	0.263	.556**	.729**	1																	
40	-0.258	0.01	0.233	0.341	0.144	0.194	.572*	-0.086	0.205	.441*	.556**	1																
42	-0.31	-0.011	0.207	0.36	0.215	0.049	.550*	-0.145	-0.089	.810**	.780**	.510*	1															
44	-0.234	.478*	.447*	.446*	.512*	.519*	0.351	.468*	.555**	.570**	.665**	0.209	0.324	1														
45	0.047	.709**	.490*	.557**	.681**	.868**	0.51	.592**	.643**	.648**	.516*	0.086	0.131	.728**	1													
48	-0.097	.499*	.560*	.628**	.663**	.537**	0.478	.683**	.707**	.710**	.628**	0.052	0.251	.731**	.787**	1												
50	-0.377	-0.028	0.057	0.21	0.149	0.307	.699**	-0.122	0.095	.532**	.596**	.767**	.660**	0.273	0.273	0.197	1											
52	0.161	0.284	.499*	.537**	0.37	0.383	.599*	.435*	.403*	0.284	0.332	0.103	0.1	.552**	.522**	.685**	0.041	1										
53	-0.413	-0.027	0.165	0.245	0.056	0.185	.590*	-0.112	0.164	.452*	.651**	.890**	.602**	.418*	0.204	0.232	.888**	0.247	1									
55	-0.069	.538**	.540*	.644**	.478*	.545**	.775**	.481*	.617**	.734**	.755**	0.384	0.391	.631**	.663**	.735**	.480*	.498*	.502*	1								
56 and 57	-0.173	0.256	0.39	.485*	0.424	.685**	0.513	0.106	.411*	.687**	.480*	0.372	0.317	0.382	.592**	0.352	.483*	-0.057	0.31	.436*	1							
58	-0.027	.612**	.737**	.694**	.727**	.709**	.697**	.585**	.635**	.736**	.465*	0.249	0.245	.476*	.747**	.692**	0.412	0.402	0.214	.552**	.602**	1						
59	-.477*	0.208	0.31	0.324	0.289	0.367	.759**	0.167	0.355	.452*	.582**	.655**	0.37	0.387	0.337	.406*	.696**	0.383	.743**	.561**	0.39	.489*	1					
60	-0.236	-0.027	0.059	0.139	-0.112	0.085	.622*	-0.202	0.062	0.228	.456*	.842**	.544**	0.251	-0.029	0.092	.829**	0.166	.935**	.418*	0.078	0.007	.660**	1				
62	0.279	.632**	.481*	.527*	.511*	.565*	.578*	.616**	.574**	.594**	.497*	0.087	0.213	.567**	.624**	.676**	0.318	.488*	0.29	.772**	0.238	.652**	0.306	0.217	1			
64	-0.119	.499*	.610**	.619**	.516*	.578**	.776**	0.306	0.332	.486*	.435*	0.382	0.334	.553**	.612**	.575**	.474*	.686**	.514*	.555**	0.259	.645**	.636**	.447*	0.42	1		
65	0.042	.671**	.624**	.582**	.472*	.630**	.750**	0.397	0.355	.480*	0.278	0.314	0.157	0.395	.613**	.528*	0.381	.595**	0.371	.530**	0.286	.694**	.608**	0.285	.507*	.904**	1	
68	-0.332	0.367	.503*	.567**	0.416	.609**	.735**	0.334	0.352	.731**	.564**	0.43	0.432	0.434	.638**	.552*	.667**	.558*	.490*	.624**	.663**	.780**	.733**	0.318	.520*	.799**	.848**	1

(original BSI numbering see Appendix B, B1)

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

APPENDIX H: r-VALUES AND STATISTICAL SIGNIFICANCE

H-1 Sadlermiut and Sacred Heart female BSI chronological re-numbering

Chronological number	BSIs with original numbering
1	3. Upper facial breadth
2	4. Biorbital breadth
3	66. Maximum length of talus
4	28/29. Sacrum superior surface area
5	37. Humerus distal joint breadth
6	39. Humerus capitual height
7	33. Maximum humerus length
8	34. Humerus midshaft circumference
9	59. Tibia midshaft width
10	51. Femur midshaft circumference
11	11. Maximum cranial height
12	14. Interorbital breadth
13	17. Maximum breath of the mandible
14	12/13. Foramen magnum area
15	44. Femur maximum superior/inferior diameter of head
16	45. Femur head breadth
17	50. Maximum femur length
18	60. Maximum fibula length
19	38. Humerus anteroposterior diameter of head
20	53. Maximum tibia length
21	57. Tibia transverse diameter of talar facet
22	41. Maximum radius length
23	64. Maximum length of calcaneus
24	40. Maximum ulna length
25	48. Biepicondylar diameter of distal femur
26	24/25. L1 superior surface area
27	26/27. L5 superior surface area

H-2 Sadlermiut and Sacred Heart male BSI chronological re-numbering

Chronological number	BSIs with original numbering
1	3. Upper facial breadth
2	20/21. C7 superior surface area
3	28. Sacrum anterior height of first segment
4	34. Humerus midshaft circumference
5	52. Femur midshaft width
6	59. Tibia midshaft width
7	37. Humerus distal joint breadth
8	39. Humerus capitual height
9	62. Patella maximum breadth
10	42. Transverse diameter of radius head
11	56/57. Talar facet area
12	60. Maximum fibula length
13	44. Femur maximum superior/inferior diameter of head
14	45. Femur head breadth
15	48. Biepicondylar diameter of distal femur
16	50. Maximum femur length
17	53. Maximum tibia length
18	55. Proximal tibia breadth
19	58. Anteroposterior diameter of proximal tibia
20	40. Maximum ulna length
21	64. Maximum length of calcaneus
22	65. Posterior length of calcaneus
23	68. Articulated height of calcaneus/talus
24	22/23. T12 superior surface area
25	24/25. L1 superior surface area
26	26/27. L5 superior surface area
27	32. Bi-iliac breadth

H-3 Sadlermiut females r-values and significant association
(chronological BSI numbering see Appendix H, H-1)

Variables	r-value	r2-value	Significance	Reject Null?
V1:V2	0.712	0.506	0.003	YES
V1:V3	0.403	0.162	0.219	NO
V1:V4	0.700	0.491	0.011	YES
V1:V5	0.450	0.202	0.092	NO
V1:V6	0.407	0.166	0.132	NO
V1:V7	0.663	0.440	0.007	YES
V1:V8	0.236	0.056	0.396	NO
V1:V9	0.389	0.152	0.151	NO
V1:V10	0.402	0.162	0.154	NO
V1:V11	0.592	0.351	0.033	YES
V1:V12	0.486	0.237	0.066	NO
V1:V13	0.567	0.321	0.035	YES
V1:V14	0.417	0.174	0.156	NO
V1:V15	0.478	0.228	0.084	NO
V1:V16	0.511	0.261	0.062	NO
V1:V17	0.559	0.312	0.038	YES
V1:V18	0.510	0.260	0.062	NO
V1:V19	0.422	0.178	0.117	NO
V1:V20	0.542	0.294	0.037	YES
V1:V21	0.388	0.150	0.171	NO
V1:V22	0.688	0.474	0.005	YES
V1:V23	0.234	0.055	0.464	NO
V1:V24	0.694	0.482	0.006	YES
V1:V25	0.054	0.003	0.867	NO
V1:V26	0.432	0.187	0.184	NO
V1:V27	0.688	0.473	0.088	NO
V2:V3	0.414	0.172	0.205	NO
V2:V4	0.644	0.415	0.024	YES
V2:V5	0.327	0.107	0.233	NO
V2:V6	0.436	0.190	0.104	NO
V2:V7	0.506	0.256	0.054	NO
V2:V8	0.108	0.012	0.702	NO
V2:V9	0.430	0.185	0.110	NO
V2:V10	0.321	0.103	0.263	NO
V2:V11	0.527	0.278	0.064	NO
V2:V12	0.470	0.221	0.077	NO
V2:V13	0.381	0.145	0.178	NO
V2:V14	0.494	0.244	0.086	NO
V2:V15	0.176	0.031	0.547	NO
V2:V16	0.423	0.179	0.132	NO
V2:V17	0.424	0.179	0.131	NO
V2:V18	0.295	0.087	0.305	NO
V2:V19	0.066	0.004	0.816	NO
V2:V20	0.351	0.123	0.200	NO
V2:V21	0.302	0.092	0.293	NO
V2:V22	0.361	0.130	0.187	NO
V2:V23	0.053	0.003	0.871	NO
V2:V24	0.326	0.106	0.255	NO
V2:V25	0.223	0.050	0.486	NO
V2:V26	0.684	0.468	0.020	YES
V2:V27	0.853	0.727	0.015	YES
V3:V4	0.626	0.391	0.053	NO
V3:V5	0.497	0.247	0.100	NO
V3:V6	0.638	0.406	0.026	YES
V3:V7	0.848	0.719	0.000	YES
V3:V8	0.707	0.500	0.010	YES
V3:V9	0.698	0.488	0.012	YES
V3:V10	0.756	0.572	0.007	YES
V3:V11	0.465	0.217	0.175	NO
V3:V12	0.086	0.007	0.791	NO

V3:V13	0.323	0.105	0.362	NO
V3:V14	0.426	0.182	0.219	NO
V3:V15	0.802	0.644	0.003	YES
V3:V16	0.919	0.844	0.000	YES
V3:V17	0.864	0.747	0.001	YES
V3:V18	0.840	0.705	0.001	YES
V3:V19	0.733	0.538	0.007	YES
V3:V20	0.799	0.639	0.002	YES
V3:V21	0.645	0.415	0.024	YES
V3:V22	0.777	0.604	0.003	YES
V3:V23	0.834	0.696	0.005	YES
V3:V24	0.721	0.520	0.008	YES
V3:V25	0.726	0.527	0.017	YES
V3:V26	0.647	0.419	0.043	YES
V3:V27	0.581	0.337	0.172	NO
V4:V5	0.479	0.230	0.097	NO
V4:V6	0.636	0.405	0.019	YES
V4:V7	0.705	0.497	0.007	YES
V4:V8	0.636	0.404	0.020	YES
V4:V9	0.629	0.396	0.021	YES
V4:V10	0.581	0.338	0.061	NO
V4:V11	0.715	0.511	0.020	YES
V4:V12	0.276	0.076	0.361	NO
V4:V13	0.449	0.201	0.166	NO
V4:V14	0.048	0.002	0.888	NO
V4:V15	0.577	0.333	0.063	NO
V4:V16	0.686	0.470	0.020	YES
V4:V17	0.528	0.279	0.095	NO
V4:V18	0.289	0.084	0.362	NO
V4:V19	0.570	0.325	0.042	YES
V4:V20	0.444	0.197	0.129	NO
V4:V21	0.646	0.417	0.017	YES
V4:V22	0.562	0.316	0.046	YES
V4:V23	0.642	0.412	0.033	YES
V4:V24	0.517	0.267	0.085	NO
V4:V25	0.299	0.090	0.371	NO
V4:V26	0.658	0.433	0.020	YES
V4:V27	0.862	0.743	0.006	YES
V5:V6	0.689	0.474	0.002	YES
V5:V7	0.658	0.433	0.004	YES
V5:V8	0.582	0.339	0.014	YES
V5:V9	0.365	0.133	0.150	NO
V5:V10	0.295	0.087	0.285	NO
V5:V11	0.343	0.118	0.251	NO
V5:V12	0.154	0.024	0.555	NO
V5:V13	0.111	0.012	0.706	NO
V5:V14	0.070	0.005	0.821	NO
V5:V15	0.432	0.187	0.108	NO
V5:V16	0.494	0.244	0.061	NO
V5:V17	0.637	0.406	0.011	YES
V5:V18	0.718	0.516	0.003	YES
V5:V19	0.708	0.502	0.001	YES
V5:V20	0.704	0.496	0.002	YES
V5:V21	0.479	0.230	0.060	NO
V5:V22	0.638	0.407	0.006	YES
V5:V23	0.429	0.184	0.126	NO
V5:V24	0.570	0.324	0.021	YES
V5:V25	0.183	0.033	0.550	NO
V5:V26	0.572	0.327	0.052	NO
V5:V27	0.800	0.639	0.010	YES
V6:V7	0.702	0.493	0.002	YES
V6:V8	0.640	0.409	0.006	YES
V6:V9	0.416	0.173	0.096	NO

V6:V10	0.311	0.097	0.260	NO
V6:V11	0.513	0.263	0.073	NO
V6:V12	0.044	0.002	0.866	NO
V6:V13	0.391	0.153	0.166	NO
V6:V14	0.225	0.051	0.460	NO
V6:V15	0.490	0.240	0.064	NO
V6:V16	0.648	0.420	0.009	YES
V6:V17	0.661	0.437	0.007	YES
V6:V18	0.644	0.415	0.010	YES
V6:V19	0.506	0.256	0.038	YES
V6:V20	0.655	0.429	0.004	YES
V6:V21	0.376	0.141	0.151	NO
V6:V22	0.639	0.409	0.006	YES
V6:V23	0.651	0.423	0.012	YES
V6:V24	0.589	0.347	0.016	YES
V6:V25	0.274	0.075	0.366	NO
V6:V26	0.523	0.273	0.081	NO
V6:V27	0.770	0.594	0.015	YES
V7:V8	0.604	0.365	0.010	YES
V7:V9	0.580	0.337	0.015	YES
V7:V10	0.732	0.535	0.002	YES
V7:V11	0.370	0.137	0.213	NO
V7:V12	0.151	0.023	0.564	NO
V7:V13	0.407	0.166	0.148	NO
V7:V14	0.220	0.048	0.470	NO
V7:V15	0.828	0.686	0.000	YES
V7:V16	0.825	0.681	0.000	YES
V7:V17	0.924	0.853	0.000	YES
V7:V18	0.909	0.827	0.000	YES
V7:V19	0.756	0.572	0.000	YES
V7:V20	0.910	0.828	0.000	YES
V7:V21	0.603	0.364	0.013	YES
V7:V22	0.909	0.827	0.000	YES
V7:V23	0.730	0.532	0.003	YES
V7:V24	0.877	0.769	0.000	YES
V7:V25	0.552	0.304	0.051	NO
V7:V26	0.719	0.516	0.008	YES
V7:V27	0.736	0.541	0.024	YES
V8:V9	0.794	0.630	0.000	YES
V8:V10	0.565	0.319	0.028	YES
V8:V11	0.397	0.158	0.179	NO
V8:V12	0.045	0.002	0.865	NO
V8:V13	0.366	0.134	0.197	NO
V8:V14	0.187	0.035	0.540	NO
V8:V15	0.570	0.325	0.027	YES
V8:V16	0.677	0.458	0.006	YES
V8:V17	0.467	0.218	0.079	NO
V8:V18	0.501	0.251	0.057	NO
V8:V19	0.676	0.457	0.003	YES
V8:V20	0.551	0.304	0.022	YES
V8:V21	0.431	0.186	0.095	NO
V8:V22	0.623	0.389	0.008	YES
V8:V23	0.649	0.421	0.012	YES
V8:V24	0.532	0.283	0.034	YES
V8:V25	0.420	0.177	0.153	NO
V8:V26	0.643	0.413	0.024	YES
V8:V27	0.739	0.546	0.023	YES
V9:V10	0.731	0.534	0.002	YES
V9:V11	0.452	0.204	0.121	NO
V9:V12	0.436	0.190	0.080	NO
V9:V13	0.629	0.395	0.016	YES
V9:V14	0.439	0.193	0.133	NO
V9:V15	0.344	0.118	0.209	NO

V9:V16	0.579	0.335	0.024	YES
V9:V17	0.413	0.170	0.126	NO
V9:V18	0.461	0.212	0.084	NO
V9:V19	0.412	0.170	0.100	NO
V9:V20	0.520	0.270	0.032	YES
V9:V21	0.456	0.208	0.076	NO
V9:V22	0.528	0.279	0.029	YES
V9:V23	0.525	0.276	0.054	NO
V9:V24	0.461	0.213	0.072	NO
V9:V25	0.476	0.227	0.100	NO
V9:V26	0.633	0.400	0.027	YES
V9:V27	0.486	0.236	0.185	NO
V10:V11	0.117	0.014	0.704	NO
V10:V12	0.179	0.032	0.524	NO
V10:V13	0.184	0.034	0.547	NO
V10:V14	0.024	0.001	0.940	NO
V10:V15	0.583	0.340	0.023	YES
V10:V16	0.701	0.491	0.004	YES
V10:V17	0.722	0.522	0.002	YES
V10:V18	0.692	0.479	0.009	YES
V10:V19	0.490	0.240	0.064	NO
V10:V20	0.713	0.508	0.003	YES
V10:V21	0.645	0.416	0.013	YES
V10:V22	0.674	0.455	0.006	YES
V10:V23	0.540	0.292	0.070	NO
V10:V24	0.655	0.429	0.008	YES
V10:V25	0.658	0.433	0.014	YES
V10:V26	0.596	0.355	0.069	NO
V10:V27	0.388	0.150	0.343	NO
V11:V12	0.580	0.337	0.038	YES
V11:V13	0.556	0.309	0.049	YES
V11:V14	0.238	0.057	0.481	NO
V11:V15	0.223	0.050	0.464	NO
V11:V16	0.682	0.465	0.010	YES
V11:V17	0.404	0.163	0.171	NO
V11:V18	0.244	0.060	0.422	NO
V11:V19	0.128	0.016	0.676	NO
V11:V20	0.242	0.059	0.425	NO
V11:V21	0.334	0.112	0.289	NO
V11:V22	0.387	0.150	0.191	NO
V11:V23	0.371	0.138	0.291	NO
V11:V24	0.350	0.123	0.241	NO
V11:V25	0.144	0.021	0.672	NO
V11:V26	0.735	0.540	0.024	YES
V11:V27	0.869	0.755	0.025	YES
V12:V13	0.630	0.397	0.016	YES
V12:V14	0.419	0.176	0.154	NO
V12:V15	0.168	0.028	0.549	NO
V12:V16	0.187	0.035	0.504	NO
V12:V17	0.136	0.018	0.629	NO
V12:V18	0.113	0.013	0.689	NO
V12:V19	0.262	0.069	0.309	NO
V12:V20	0.116	0.013	0.657	NO
V12:V21	0.059	0.003	0.829	NO
V12:V22	0.142	0.020	0.588	NO
V12:V23	0.059	0.003	0.842	NO
V12:V24	0.192	0.037	0.475	NO
V12:V25	0.097	0.009	0.752	NO
V12:V26	0.283	0.080	0.373	NO
V12:V27	0.040	0.002	0.918	NO
V13:V14	0.395	0.156	0.204	NO
V13:V15	0.173	0.030	0.573	NO

V13:V16	0.272	0.074	0.369	NO
V13:V17	0.180	0.033	0.555	NO
V13:V18	0.350	0.122	0.220	NO
V13:V19	0.130	0.017	0.658	NO
V13:V20	0.355	0.126	0.213	NO
V13:V21	0.300	0.090	0.319	NO
V13:V22	0.456	0.208	0.101	NO
V13:V23	0.169	0.028	0.620	NO
V13:V24	0.507	0.258	0.077	NO
V13:V25	0.578	0.334	0.063	NO
V13:V26	0.142	0.020	0.695	NO
V13:V27	0.529	0.280	0.281	NO
V14:V15	0.039	0.002	0.904	NO
V14:V16	0.330	0.109	0.295	NO
V14:V17	0.208	0.043	0.516	NO
V14:V18	0.108	0.012	0.738	NO
V14:V19	0.168	0.028	0.584	NO
V14:V20	0.169	0.028	0.582	NO
V14:V21	0.132	0.018	0.666	NO
V14:V22	0.203	0.041	0.506	NO
V14:V23	0.025	0.001	0.942	NO
V14:V24	0.103	0.011	0.750	NO
V14:V25	0.274	0.075	0.414	NO
V14:V26	0.011	0.000	0.977	NO
V14:V27	0.291	0.085	0.526	NO
V15:V16	0.746	0.557	0.001	YES
V15:V17	0.736	0.542	0.002	YES
V15:V18	0.664	0.440	0.013	YES
V15:V19	0.836	0.699	0.000	YES
V15:V20	0.719	0.517	0.003	YES
V15:V21	0.581	0.337	0.029	YES
V15:V22	0.849	0.722	0.000	YES
V15:V23	0.762	0.581	0.004	YES
V15:V24	0.792	0.628	0.000	YES
V15:V25	0.487	0.237	0.092	NO
V15:V26	0.521	0.271	0.123	NO
V15:V27	0.627	0.393	0.096	NO
V16:V17	0.881	0.776	0.000	YES
V16:V18	0.681	0.463	0.010	YES
V16:V19	0.705	0.497	0.003	YES
V16:V20	0.726	0.527	0.002	YES
V16:V21	0.600	0.360	0.023	YES
V16:V22	0.762	0.580	0.001	YES
V16:V23	0.712	0.506	0.009	YES
V16:V24	0.694	0.481	0.004	YES
V16:V25	0.692	0.479	0.009	YES
V16:V26	0.742	0.551	0.014	YES
V16:V27	0.721	0.521	0.043	YES
V17:V18	0.916	0.840	0.000	YES
V17:V19	0.676	0.457	0.006	YES
V17:V20	0.920	0.846	0.000	YES
V17:V21	0.599	0.359	0.024	YES
V17:V22	0.855	0.731	0.000	YES
V17:V23	0.623	0.388	0.031	YES
V17:V24	0.824	0.680	0.000	YES
V17:V25	0.642	0.412	0.018	YES
V17:V26	0.672	0.451	0.033	YES
V17:V27	0.584	0.341	0.129	NO
V18:V19	0.684	0.467	0.005	YES
V18:V20	0.989	0.978	0.000	YES
V18:V21	0.269	0.073	0.352	NO

V18:V22	0.903	0.815	0.000	YES
V18:V23	0.557	0.311	0.060	NO
V18:V24	0.891	0.794	0.000	YES
V18:V25	0.190	0.036	0.576	NO
V18:V26	0.444	0.197	0.172	NO
V18:V27	0.639	0.408	0.122	YES
V19:V20	0.689	0.475	0.002	YES
V19:V21	0.437	0.191	0.090	NO
V19:V22	0.736	0.541	0.001	YES
V19:V23	0.636	0.404	0.015	YES
V19:V24	0.662	0.438	0.005	YES
V19:V25	0.486	0.236	0.093	NO
V19:V26	0.467	0.218	0.126	NO
V19:V27	0.650	0.423	0.058	NO
V20:V21	0.493	0.243	0.053	NO
V20:V22	0.933	0.870	0.000	YES
V20:V23	0.679	0.461	0.008	YES
V20:V24	0.926	0.857	0.000	YES
V20:V25	0.392	0.154	0.185	NO
V20:V26	0.621	0.385	0.031	YES
V20:V27	0.610	0.372	0.081	NO
V21:V22	0.519	0.270	0.039	YES
V21:V23	0.664	0.441	0.013	YES
V21:V24	0.503	0.253	0.056	NO
V21:V25	0.623	0.388	0.023	YES
V21:V26	0.803	0.645	0.002	YES
V21:V27	0.646	0.418	0.060	NO
V22:V23	0.728	0.530	0.003	YES
V22:V24	0.985	0.970	0.000	YES
V22:V25	0.322	0.104	0.283	NO
V22:V26	0.626	0.392	0.029	YES
V22:V27	0.691	0.477	0.039	YES
V23:V24	0.735	0.540	0.004	YES
V23:V25	0.641	0.411	0.046	YES
V23:V26	0.761	0.579	0.011	YES
V23:V27	0.792	0.628	0.011	YES
V24:V25	0.231	0.053	0.447	NO
V24:V26	0.557	0.310	0.075	NO
V24:V27	0.638	0.407	0.065	NO
V25:V26	0.432	0.186	0.213	NO
V25:V27	0.260	0.068	0.534	NO
V26:V27	0.947	0.896	0.000	YES

H-4 Sadlermiut males r-values and significant association
(chronological BSI numbering see Appendix H, H-2)

Variables	r-value	r2-value	Significance	Reject Null?
V1:V2	0.145	0.021	0.637	NO
V1:V3	0.387	0.150	0.191	NO
V1:V4	0.264	0.069	0.384	NO
V1:V5	0.003	0.000	0.991	NO
V1:V6	0.209	0.044	0.493	NO
V1:V7	0.350	0.122	0.242	NO
V1:V8	0.150	0.022	0.625	NO
V1:V9	0.068	0.005	0.862	NO
V1:V10	0.508	0.258	0.092	NO
V1:V11	0.126	0.016	0.712	NO
V1:V12	0.286	0.082	0.344	NO
V1:V13	0.211	0.045	0.489	NO
V1:V14	0.235	0.055	0.461	NO
V1:V15	0.373	0.139	0.232	NO
V1:V16	0.125	0.016	0.684	NO
V1:V17	0.351	0.123	0.263	NO
V1:V18	0.017	0.000	0.959	NO
V1:V19	0.240	0.058	0.477	NO
V1:V20	0.279	0.078	0.381	NO
V1:V21	0.151	0.023	0.658	NO
V1:V22	0.067	0.005	0.844	NO
V1:V23	0.442	0.195	0.234	NO
V1:V24	0.120	0.014	0.726	NO
V1:V25	0.005	0.000	0.989	NO
V1:V26	0.061	0.004	0.858	NO
V1:V27	0.092	0.008	0.788	NO
V2:V3	0.744	0.553	0.004	YES
V2:V4	0.384	0.148	0.195	NO
V2:V5	0.207	0.043	0.497	NO
V2:V6	0.371	0.138	0.212	NO
V2:V7	0.432	0.186	0.141	NO
V2:V8	0.701	0.491	0.008	YES
V2:V9	0.747	0.558	0.021	YES
V2:V10	0.132	0.017	0.683	NO
V2:V11	0.315	0.099	0.346	NO
V2:V12	0.335	0.112	0.263	NO
V2:V13	0.484	0.234	0.094	NO
V2:V14	0.665	0.442	0.018	YES
V2:V15	0.503	0.253	0.096	NO
V2:V16	0.117	0.014	0.704	NO
V2:V17	0.327	0.107	0.300	NO
V2:V18	0.619	0.384	0.032	YES
V2:V19	0.668	0.447	0.025	YES
V2:V20	0.534	0.285	0.074	NO
V2:V21	0.382	0.146	0.246	NO
V2:V22	0.579	0.335	0.062	NO
V2:V23	0.315	0.099	0.408	NO
V2:V24	0.744	0.553	0.009	YES
V2:V25	0.660	0.436	0.019	YES
V2:V26	0.951	0.904	0.000	YES
V2:V27	0.481	0.231	0.134	NO
V3:V4	0.399	0.159	0.141	NO
V3:V5	0.345	0.119	0.227	NO
V3:V6	0.443	0.196	0.098	NO
V3:V7	0.443	0.197	0.098	NO
V3:V8	0.424	0.180	0.115	NO
V3:V9	0.736	0.542	0.015	YES
V3:V10	0.151	0.023	0.606	NO
V3:V11	0.733	0.537	0.004	YES
V3.V12	0.003	0.000	0.993	NO

V3:V13	0.489	0.239	0.076	NO
V3:V14	0.873	0.762	0.000	YES
V3:V15	0.447	0.200	0.125	NO
V3:V16	0.459	0.210	0.099	NO
V3:V17	0.127	0.016	0.665	NO
V3:V18	0.611	0.374	0.020	YES
V3:V19	0.695	0.482	0.008	YES
V3:V20	0.100	0.010	0.733	NO
V3:V21	0.587	0.345	0.035	YES
V3:V22	0.678	0.460	0.011	YES
V3:V23	0.636	0.405	0.035	YES
V3:V24	0.467	0.218	0.107	NO
V3:V25	0.539	0.290	0.047	YES
V3:V26	0.683	0.467	0.010	YES
V3:V27	0.660	0.436	0.019	YES
V4:V5	0.343	0.117	0.211	NO
V4:V6	0.501	0.251	0.048	YES
V4:V7	0.648	0.420	0.007	YES
V4:V8	0.667	0.445	0.005	YES
V4:V9	0.873	0.762	0.000	YES
V4:V10	0.522	0.273	0.046	YES
V4:V11	0.281	0.079	0.331	NO
V4:V12	0.209	0.044	0.454	NO
V4:V13	0.525	0.275	0.045	YES
V4:V14	0.513	0.263	0.061	YES
V4:V15	0.671	0.450	0.009	YES
V4:V16	0.206	0.042	0.461	NO
V4:V17	0.057	0.003	0.841	NO
V4:V18	0.712	0.508	0.003	YES
V4:V19	0.605	0.367	0.022	YES
V4:V20	0.144	0.021	0.609	NO
V4:V21	0.345	0.119	0.228	NO
V4:V22	0.429	0.184	0.125	NO
V4:V23	0.775	0.601	0.005	YES
V4:V24	0.497	0.247	0.084	NO
V4:V25	0.609	0.371	0.021	YES
V4:V26	0.480	0.230	0.097	NO
V4:V27	0.525	0.275	0.080	NO
V5:V6	0.603	0.364	0.017	YES
V5:V7	0.245	0.060	0.378	NO
V5:V8	0.484	0.234	0.068	NO
V5:V9	0.396	0.157	0.228	NO
V5:V10	0.233	0.054	0.424	NO
V5:V11	0.109	0.012	0.722	NO
V5:V12	0.236	0.056	0.416	NO
V5:V13	0.551	0.304	0.033	YES
V5:V14	0.485	0.235	0.079	NO
V5:V15	0.682	0.465	0.007	YES
V5:V16	0.001	0.000	0.998	NO
V5:V17	0.536	0.288	0.048	YES
V5:V18	0.587	0.344	0.027	YES
V5:V19	0.286	0.082	0.344	NO
V5:V20	0.099	0.010	0.736	NO
V5:V21	0.830	0.689	0.000	YES
V5:V22	0.694	0.481	0.009	YES
V5:V23	0.692	0.479	0.027	YES
V5:V24	0.487	0.237	0.108	NO
V5:V25	0.730	0.533	0.005	YES
V5:V26	0.412	0.170	0.183	NO
V5:V27	0.758	0.575	0.004	YES
V6:V7	0.379	0.143	0.148	NO
V6:V8	0.364	0.133	0.165	NO
V6:V9	0.512	0.263	0.107	NO

V6:V10	0.056	0.003	0.844	NO
V6:V11	0.144	0.021	0.623	NO
V6:V12	0.131	0.017	0.642	NO
V6:V13	0.242	0.059	0.384	NO
V6:V14	0.413	0.171	0.142	NO
V6:V15	0.554	0.307	0.040	YES
V6:V16	0.254	0.064	0.362	NO
V6:V17	0.237	0.056	0.394	NO
V6:V18	0.491	0.241	0.063	NO
V6:V19	0.597	0.356	0.024	YES
V6:V20	0.156	0.024	0.578	NO
V6:V21	0.678	0.460	0.008	YES
V6:V22	0.716	0.512	0.004	YES
V6:V23	0.794	0.630	0.004	YES
V6:V24	0.459	0.210	0.115	NO
V6:V25	0.539	0.290	0.047	YES
V6:V26	0.601	0.361	0.030	YES
V6:V27	0.643	0.413	0.024	YES
V7:V8	0.576	0.332	0.020	YES
V7:V9	0.652	0.425	0.030	YES
V7:V10	0.633	0.400	0.011	YES
V7:V11	0.630	0.397	0.016	YES
V7:V12	0.610	0.372	0.016	YES
V7:V13	0.419	0.176	0.120	NO
V7:V14	0.807	0.652	0.000	YES
V7:V15	0.716	0.513	0.004	YES
V7:V16	0.366	0.134	0.180	NO
V7:V17	0.057	0.003	0.839	NO
V7:V18	0.654	0.428	0.008	YES
V7:V19	0.842	0.709	0.000	YES
V7:V20	0.245	0.060	0.378	NO
V7:V21	0.476	0.226	0.086	NO
V7:V22	0.589	0.347	0.027	YES
V7:V23	0.775	0.600	0.005	YES
V7:V24	0.507	0.257	0.077	NO
V7:V25	0.611	0.374	0.020	YES
V7:V26	0.695	0.484	0.008	YES
V7:V27	0.372	0.138	0.234	NO
V8:V9	0.945	0.893	0.000	YES
V8:V10	0.516	0.266	0.049	YES
V8:V11	0.165	0.027	0.572	NO
V8:V12	0.247	0.061	0.374	NO
V8:V13	0.650	0.422	0.009	YES
V8:V14	0.733	0.537	0.003	YES
V8:V15	0.804	0.646	0.001	YES
V8:V16	0.137	0.019	0.625	NO
V8:V17	0.265	0.070	0.340	NO
V8:V18	0.845	0.715	0.000	YES
V8:V19	0.404	0.163	0.152	NO
V8:V20	0.377	0.142	0.166	NO
V8:V21	0.500	0.250	0.069	NO
V8:V22	0.464	0.215	0.095	NO
V8:V23	0.501	0.251	0.116	NO
V8:V24	0.555	0.308	0.049	YES
V8:V25	0.648	0.420	0.012	YES
V8:V26	0.653	0.426	0.016	YES
V8:V27	0.500	0.250	0.098	NO
V9:V10	0.548	0.300	0.101	NO
V9:V11	0.233	0.054	0.517	NO
V9:V12	0.199	0.040	0.582	NO
V9:V13	0.620	0.384	0.042	YES
V9:V14	0.696	0.485	0.025	YES
V9:V15	0.769	0.592	0.006	YES

V9:V16	0.628	0.395	0.038	YES
V9:V17	0.304	0.093	0.363	NO
V9:V18	0.890	0.792	0.000	YES
V9:V19	0.700	0.490	0.017	YES
V9:V20	0.207	0.043	0.542	NO
V9:V21	0.516	0.266	0.127	NO
V9:V22	0.628	0.395	0.052	NO
V9:V23	0.774	0.599	0.024	YES
V9:V24	0.710	0.505	0.032	YES
V9:V25	0.761	0.579	0.017	YES
V9:V26	0.716	0.512	0.030	YES
V9:V27	0.699	0.489	0.036	YES
V10:V11	0.215	0.046	0.480	NO
V10:V12	0.083	0.007	0.777	NO
V10:V13	0.310	0.096	0.281	NO
V10:V14	0.419	0.176	0.154	NO
V10:V15	0.600	0.361	0.030	YES
V10:V16	0.424	0.179	0.131	NO
V10:V17	0.345	0.119	0.227	NO
V10:V18	0.543	0.295	0.045	YES
V10:V19	0.323	0.104	0.281	NO
V10:V20	0.063	0.004	0.831	NO
V10:V21	0.287	0.083	0.341	NO
V10:V22	0.131	0.017	0.668	NO
V10:V23	0.260	0.068	0.468	NO
V10:V24	0.020	0.000	0.950	NO
V10:V25	0.209	0.044	0.494	NO
V10:V26	0.347	0.120	0.269	NO
V10:V27	0.075	0.006	0.827	NO
V11:V12	0.733	0.537	0.004	YES
V11:V13	0.249	0.062	0.411	NO
V11:V14	0.672	0.452	0.012	YES
V11:V15	0.239	0.057	0.454	NO
V11:V16	0.265	0.070	0.381	NO
V11:V17	0.316	0.100	0.271	NO
V11:V18	0.326	0.106	0.277	NO
V11:V19	0.663	0.440	0.013	YES
V11:V20	0.400	0.160	0.176	NO
V11:V21	0.187	0.035	0.541	NO
V11:V22	0.323	0.104	0.282	NO
V11:V23	0.663	0.440	0.037	YES
V11:V24	0.436	0.190	0.180	NO
V11:V25	0.441	0.195	0.151	NO
V11:V26	0.404	0.163	0.193	NO
V11:V27	0.389	0.151	0.267	NO
V12:V13	0.103	0.011	0.726	NO
V12:V14	0.285	0.081	0.345	NO
V12:V15	0.119	0.014	0.699	NO
V12:V16	0.503	0.253	0.067	NO
V12:V17	0.718	0.516	0.004	YES
V12:V18	0.067	0.004	0.820	NO
V12:V19	0.470	0.221	0.105	NO
V12:V20	0.518	0.269	0.058	NO
V12:V21	0.136	0.018	0.658	NO
V12:V22	0.104	0.011	0.735	NO
V12:V23	0.322	0.104	0.364	NO
V12:V24	0.470	0.221	0.123	NO
V12:V25	0.353	0.124	0.237	NO
V12:V26	0.341	0.116	0.278	NO
V12:V27	0.289	0.084	0.389	NO
V13:V14	0.692	0.479	0.006	YES
V13:V15	0.733	0.537	0.003	YES

V13:V16	0.005	0.000	0.987	NO
V13:V17	0.403	0.162	0.153	NO
V13:V18	0.663	0.440	0.010	YES
V13:V19	0.320	0.102	0.286	NO
V13:V20	0.322	0.103	0.262	NO
V13:V21	0.505	0.255	0.078	NO
V13:V22	0.356	0.127	0.233	NO
V13:V23	0.302	0.091	0.396	NO
V13:V24	0.345	0.119	0.272	NO
V13:V25	0.358	0.128	0.229	NO
V13:V26	0.491	0.241	0.105	NO
V13:V27	0.255	0.065	0.424	NO
V14:V15	0.776	0.603	0.002	YES
V14:V16	0.439	0.193	0.116	NO
V14:V17	0.304	0.092	0.313	NO
V14:V18	0.807	0.652	0.001	YES
V14:V19	0.752	0.565	0.005	YES
V14:V20	0.150	0.022	0.625	NO
V14:V21	0.613	0.375	0.034	YES
V14:V22	0.630	0.397	0.028	YES
V14:V23	0.732	0.535	0.025	YES
V14:V24	0.404	0.163	0.218	NO
V14:V25	0.583	0.340	0.047	YES
V14:V26	0.685	0.469	0.014	YES
V14:V27	0.623	0.388	0.041	YES
V15:V16	0.210	0.044	0.472	NO
V15:V17	0.304	0.930	0.312	NO
V15:V18	0.914	0.835	0.000	YES
V15:V19	0.677	0.458	0.016	YES
V15:V20	0.327	0.107	0.254	NO
V15:V21	0.822	0.675	0.001	YES
V15:V22	0.746	0.557	0.005	YES
V15:V23	0.790	0.624	0.011	YES
V15:V24	0.485	0.236	0.130	NO
V15:V25	0.656	0.431	0.020	YES
V15:V26	0.637	0.406	0.035	YES
V15:V27	0.638	0.407	0.035	YES
V16:V17	0.428	0.183	0.127	NO
V16:V18	0.327	0.107	0.253	NO
V16:V19	0.667	0.445	0.013	YES
V16:V20	0.344	0.118	0.228	NO
V16:V21	0.473	0.223	0.103	NO
V16:V22	0.532	0.283	0.061	NO
V16:V23	0.770	0.592	0.009	YES
V16:V24	0.132	0.017	0.683	NO
V16:V25	0.061	0.004	0.844	NO
V16:V26	0.239	0.057	0.455	NO
V16:V27	0.461	0.213	0.131	NO
V17:V18	0.166	0.027	0.571	NO
V17:V19	0.072	0.005	0.806	NO
V17:V20	0.431	0.186	0.124	NO
V17:V21	0.415	0.172	0.140	NO
V17:V22	0.197	0.039	0.500	NO
V17:V23	0.116	0.013	0.734	NO
V17:V24	0.085	0.007	0.793	NO
V17:V25	0.020	0.000	0.947	NO
V17:V26	0.125	0.016	0.699	NO
V17:V27	0.017	0.000	0.961	NO
V18:V19	0.580	0.337	0.030	YES
V18:V20	0.296	0.088	0.304	NO
V18:V21	0.644	0.415	0.018	YES

V18:V22	0.549	0.302	0.052	NO
V18:V23	0.589	0.346	0.057	NO
V18:V24	0.538	0.290	0.071	NO
V18:V25	0.725	0.526	0.005	YES
V18:V26	0.683	0.466	0.010	YES
V18:V27	0.762	0.581	0.006	YES
V19:V20	0.253	0.064	0.404	NO
V19:V21	0.655	0.429	0.015	YES
V19:V22	0.810	0.655	0.001	YES
V19:V23	0.901	0.811	0.000	YES
V19:V24	0.792	0.627	0.004	YES
V19:V25	0.752	0.556	0.005	YES
V19:V26	0.764	0.584	0.004	YES
V19:V27	0.693	0.480	0.026	YES
V20:V21	0.157	0.025	0.609	NO
V20:V22	0.102	0.010	0.740	NO
V20:V23	0.169	0.028	0.641	NO
V20:V24	0.474	0.225	0.119	NO
V20:V25	0.325	0.105	0.279	NO
V20:V26	0.309	0.096	0.328	NO
V20:V27	0.031	0.001	0.927	NO
V21:V22	0.900	0.811	0.000	YES
V21:V23	0.821	0.675	0.002	YES
V21:V24	0.710	0.504	0.014	YES
V21:V25	0.782	0.612	0.003	YES
V21:V26	0.661	0.437	0.027	YES
V21:V27	0.742	0.551	0.014	YES
V22:V23	0.931	0.867	0.000	YES
V22:V24	0.750	0.562	0.008	YES
V22:V25	0.774	0.599	0.003	YES
V22:V26	0.682	0.465	0.021	YES
V22:V27	0.747	0.558	0.013	YES
V23:V24	0.605	0.366	0.064	NO
V23:V25	0.667	0.445	0.025	YES
V23:V26	0.578	0.334	0.080	NO
V23:V27	0.686	0.470	0.041	YES
V24:V25	0.910	0.828	0.000	YES
V24:V26	0.780	0.608	0.005	YES
V24:V27	0.428	0.184	0.165	NO
V25:V26	0.736	0.541	0.006	YES
V25:V27	0.701	0.491	0.011	YES
V26:V27	0.595	0.354	0.070	NO

H-5 Sacred Heart females r-values and significant association

(chronological BSI numbering see Appendix H, H-1)

Variables	r-value	r2-value	Significance	Reject Null?
V1:V2	0.978	0.956	0.000	YES
V1:V3	0.659	0.434	0.053	NO
V1:V4	0.721	0.519	0.044	YES
V1:V5	0.655	0.429	0.040	YES
V1:V6	0.674	0.454	0.033	YES
V1:V7	0.426	0.181	0.220	NO
V1:V8	0.752	0.566	0.012	YES
V1:V9	0.533	0.284	0.112	NO
V1:V10	0.570	0.325	0.085	NO
V1:V11	0.587	0.344	0.097	NO
V1:V12	0.744	0.553	0.014	YES
V1:V13	0.789	0.622	0.012	YES
V1:V14	0.698	0.487	0.037	YES
V1:V15	0.730	0.534	0.016	YES
V1:V16	0.573	0.329	0.083	NO
V1:V17	0.224	0.050	0.534	NO
V1:V18	0.316	0.100	0.446	NO
V1:V19	0.652	0.425	0.041	YES
V1:V20	0.156	0.024	0.667	NO
V1:V21	0.631	0.398	0.069	NO
V1:V22	0.044	0.002	0.910	NO
V1:V23	0.904	0.816	0.001	YES
V1:V24	0.170	0.029	0.661	NO
V1:V25	0.349	0.122	0.322	NO
V1:V26	0.552	0.304	0.124	NO
V1:V27	0.854	0.730	0.003	YES
V2:V3	0.648	0.419	0.082	NO
V2:V4	0.750	0.562	0.032	YES
V2:V5	0.602	0.362	0.086	NO
V2:V6	0.762	0.580	0.017	YES
V2:V7	0.332	0.110	0.383	NO
V2:V8	0.712	0.507	0.031	YES
V2:V9	0.453	0.206	0.220	NO
V2:V10	0.498	0.248	0.172	NO
V2:V11	0.728	0.530	0.041	YES
V2:V12	0.822	0.676	0.007	YES
V2:V13	0.803	0.645	0.016	YES
V2:V14	0.677	0.459	0.065	NO
V2:V15	0.744	0.554	0.021	YES
V2:V16	0.557	0.310	0.119	NO
V2:V17	0.113	0.013	0.772	NO
V2:V18	0.182	0.033	0.697	NO
V2:V19	0.814	0.663	0.008	YES
V2:V20	0.022	0.000	0.955	NO
V2:V21	0.476	0.226	0.234	NO
V2:V22	0.128	0.016	0.763	NO
V2:V23	0.900	0.811	0.002	YES
V2:V24	0.162	0.026	0.701	NO
V2:V25	0.405	0.164	0.279	NO
V2:V26	0.605	0.366	0.112	NO
V2:V27	0.854	0.729	0.007	YES
V3:V4	0.899	0.809	0.006	YES
V3:V5	0.978	0.956	0.000	YES
V3:V6	0.819	0.671	0.007	YES
V3:V7	0.445	0.198	0.230	NO
V3:V8	0.777	0.603	0.014	YES
V3:V9	0.228	0.052	0.556	NO
V3:V10	0.786	0.617	0.012	YES
V3:V11	0.642	0.413	0.086	NO
V3:V12	0.544	0.296	0.130	NO

V3:V13	0.674	0.454	0.670	NO
V3:V14	0.741	0.550	0.035	YES
V3:V15	0.762	0.580	0.017	YES
V3:V16	0.755	0.570	0.019	YES
V3:V17	0.329	0.108	0.388	NO
V3:V18	0.638	0.407	0.123	NO
V3:V19	0.750	0.562	0.020	YES
V3:V20	0.222	0.049	0.566	NO
V3:V21	0.866	0.749	0.005	YES
V3:V22	0.018	0.000	0.966	NO
V3:V23	0.729	0.531	0.026	YES
V3:V24	0.206	0.043	0.624	NO
V3:V25	0.718	0.515	0.029	YES
V3:V26	0.650	0.422	0.081	NO
V3:V27	0.817	0.668	0.007	YES
V4:V5	0.774	0.599	0.024	YES
V4:V6	0.719	0.517	0.044	YES
V4:V7	0.313	0.098	0.450	NO
V4:V8	0.633	0.401	0.092	NO
V4:V9	0.158	0.025	0.709	NO
V4:V10	0.328	0.104	0.436	NO
V4:V11	0.900	0.810	0.006	YES
V4:V12	0.713	0.508	0.047	YES
V4:V13	0.673	0.454	0.097	NO
V4:V14	0.851	0.724	0.015	YES
V4:V15	0.737	0.543	0.037	YES
V4:V16	0.646	0.418	0.083	NO
V4:V17	0.237	0.056	0.572	NO
V4:V18	0.174	0.030	0.742	NO
V4:V19	0.706	0.498	0.051	NO
V4:V20	0.012	0.000	0.978	NO
V4:V21	0.511	0.261	0.242	NO
V4:V22	0.141	0.020	0.764	NO
V4:V23	0.929	0.863	0.002	YES
V4:V24	0.209	0.044	0.653	NO
V4:V25	0.712	0.508	0.047	YES
V4:V26	0.915	0.836	0.004	YES
V4:V27	0.964	0.929	0.000	YES
V5:V6	0.832	0.692	0.003	YES
V5:V7	0.418	0.175	0.229	NO
V5:V8	0.783	0.612	0.007	YES
V5:V9	0.341	0.116	0.335	NO
V5:V10	0.668	0.446	0.035	YES
V5:V11	0.459	0.211	0.214	NO
V5:V12	0.542	0.294	0.105	NO
V5:V13	0.664	0.441	0.051	NO
V5:V14	0.642	0.412	0.062	NO
V5:V15	0.755	0.569	0.012	YES
V5:V16	0.734	0.539	0.016	YES
V45:V17	0.384	0.147	0.027	NO
V5:V18	0.583	0.339	0.130	NO
V5:V19	0.696	0.485	0.025	YES
V5:V20	0.352	0.124	0.319	NO
V5:V21	0.837	0.701	0.005	YES
V5:V22	0.075	0.006	0.847	NO
V5:V23	0.710	0.504	0.032	YES
V5:V24	0.174	0.030	0.653	NO
V5:V25	0.695	0.482	0.026	YES
V5:V26	0.574	0.329	0.106	NO
V5:V27	0.779	0.606	0.013	YES
V6:V7	0.239	0.057	0.507	NO
V6:V8	0.828	0.685	0.003	YES
V6:V9	0.306	0.094	0.389	NO

V6:V10	0.606	0.367	0.063	NO
V6:V11	0.574	0.330	0.106	NO
V6:V12	0.594	0.353	0.070	NO
V6:V13	0.655	0.429	0.056	NO
V6:V14	0.420	0.177	0.260	NO
V6:V15	0.697	0.485	0.025	YES
V6:V16	0.550	0.302	0.100	NO
V6:V17	0.125	0.016	0.730	NO
V6:V18	0.471	0.222	0.239	NO
V6:V19	0.747	0.559	0.013	YES
V6:V20	0.223	0.050	0.536	NO
V6:V21	0.617	0.380	0.077	NO
V6:V22	0.003	0.000	0.994	NO
V6:V23	0.724	0.525	0.027	YES
V6:V24	0.243	0.059	0.529	NO
V6:V25	0.458	0.209	0.184	NO
V6:V26	0.460	0.212	0.213	NO
V6:V27	0.784	0.615	0.012	YES
V7:V8	0.605	0.366	0.064	NO
V7:V9	0.682	0.465	0.030	YES
V7:V10	0.691	0.477	0.027	YES
V7:V11	0.028	0.001	0.944	NO
V7:V12	0.418	0.175	0.229	NO
V7:V13	0.205	0.042	0.597	NO
V7:V14	0.416	0.173	0.266	NO
V7:V15	0.536	0.287	0.110	NO
V7:V16	0.629	0.396	0.051	NO
V7:V17	0.900	0.810	0.000	YES
V7:V18	0.777	0.603	0.023	YES
V7:V19	0.603	0.363	0.065	NO
V7:V20	0.761	0.579	0.011	YES
V7:V21	0.583	0.340	0.099	NO
V7:V22	0.823	0.678	0.006	YES
V7:V23	0.485	0.236	0.185	NO
V7:V24	0.710	0.504	0.032	YES
V7:V25	0.282	0.080	0.429	NO
V7:V26	0.391	0.153	0.298	NO
V7:V27	0.492	0.242	0.179	NO
V8:V9	0.631	0.399	0.050	NO
V8:V10	0.817	0.668	0.004	YES
V8:V11	0.263	0.069	0.494	NO
V8:V12	0.628	0.394	0.052	NO
V8:V13	0.493	0.243	0.178	NO
V8:V14	0.385	0.148	0.306	NO
V8:V15	0.783	0.613	0.007	YES
V8:V16	0.666	0.443	0.036	YES
V8:V17	0.496	0.246	0.145	NO
V8:V18	0.739	0.546	0.036	YES
V8:V19	0.766	0.587	0.010	YES
V8:V20	0.568	0.323	0.086	NO
V8:V21	0.719	0.517	0.029	YES
V8:V22	0.293	0.086	0.444	NO
V8:V23	0.912	0.833	0.001	YES
V8:V24	0.413	0.171	0.269	NO
V8:V25	0.311	0.097	0.381	NO
V8:V26	0.525	0.276	0.146	NO
V8:V27	0.908	0.825	0.001	YES
V9:V10	0.887	0.787	0.001	YES
V9:V11	0.034	0.001	0.930	NO
V9:V12	0.669	0.448	0.034	YES
V9:V13	0.490	0.240	0.181	NO
V9:V14	0.206	0.043	0.594	NO
V9:V15	0.671	0.450	0.034	YES

V9:V16	0.664	0.441	0.036	YES
V9:V17	0.708	0.501	0.022	YES
V9:V18	0.799	0.638	0.017	YES
V9:V19	0.541	0.293	0.106	NO
V9:V20	0.768	0.590	0.009	YES
V9:V21	0.666	0.443	0.050	NO
V9:V22	0.491	0.241	0.179	NO
V9:V23	0.630	0.397	0.069	NO
V9:V24	0.302	0.091	0.429	NO
V9:V25	0.258	0.067	0.472	NO
V9:V26	0.180	0.032	0.644	NO
V9:V27	0.519	0.270	0.152	NO
V10:V11	0.126	0.016	0.746	NO
V10:V12	0.686	0.471	0.028	YES
V10:V13	0.586	0.343	0.097	NO
V10:V14	0.275	0.075	0.474	NO
V10:V15	0.791	0.625	0.006	YES
V10:V16	0.791	0.625	0.006	YES
V10:V17	0.687	0.472	0.028	YES
V10:V18	0.874	0.764	0.005	YES
V10:V19	0.742	0.551	0.014	YES
V10:V20	0.766	0.587	0.010	YES
V10:V21	*			
V10:V22	0.447	0.200	0.227	NO
V10:V23	0.733	0.538	0.025	YES
V10:V24	0.313	0.098	0.413	NO
V10:V25	0.493	0.243	0.148	NO
V10:V26	0.274	0.075	0.476	NO
V10:V27	0.716	0.513	0.030	YES
V11:V12	0.669	0.448	0.049	YES
V11:V13	0.788	0.621	0.020	YES
V11:V14	0.501	0.251	0.170	NO
V11:V15	0.497	0.247	0.173	NO
V11:V16	0.364	0.133	0.335	NO
V11:V17	0.097	0.009	0.803	NO
V11:V18	0.184	0.034	0.662	NO
V11:V19	0.467	0.218	0.205	NO
V11:V20	0.261	0.068	0.498	NO
V11:V21	0.154	0.024	0.717	NO
V11:V22	0.222	0.049	0.566	NO
V11:V23	0.789	0.623	0.020	YES
V11:V24	0.107	0.011	0.800	NO
V11:V25	0.606	0.367	0.084	NO
V11:V26	0.785	0.616	0.021	YES
V11:V27	0.763	0.582	0.028	YES
V12:V13	0.803	0.646	0.009	YES
V12:V14	0.484	0.234	0.187	NO
V12:V15	0.916	0.838	0.000	YES
V12:V16	0.826	0.683	0.003	YES
V12:V17	0.335	0.112	0.344	NO
V12:V18	0.375	0.141	0.360	NO
V12:V19	0.833	0.693	0.003	YES
V12:V20	0.220	0.048	0.541	NO
V12:V21	0.541	0.292	0.133	NO
V12:V22	0.011	0.000	0.977	NO
V12:V23	0.728	0.529	0.026	YES
V12:V24	0.095	0.009	0.808	NO
V12:V25	0.644	0.415	0.045	YES
V12:V26	0.597	0.356	0.090	NO
V12:V27	0.702	0.493	0.035	YES
V13:V14	0.775	0.601	0.024	YES
V13:V15	0.723	0.523	0.028	YES

V13:V16	0.649	0.421	0.059	NO
V13:V17	0.114	0.013	0.770	NO
V13:V18	0.253	0.064	0.585	NO
V13:V19	0.648	0.420	0.059	NO
V13:V20	0.050	0.003	0.898	NO
V13:V21	0.658	0.433	0.076	NO
V13:V22	0.164	0.027	0.698	NO
V13:V23	0.594	0.353	0.120	NO
V13:V24	0.110	0.012	0.796	NO
V13:V25	0.699	0.489	0.036	YES
V13:V26	0.379	0.143	0.355	NO
V13:V27	0.601	0.361	0.115	NO
V14:V15	0.609	0.371	0.082	NO
V14:V16	0.620	0.385	0.075	NO
V14:V17	0.277	0.077	0.471	NO
V14:V18	0.202	0.041	0.623	NO
V14:V19	0.478	0.229	0.193	NO
V14:V20	0.052	0.003	0.895	NO
V14:V21	0.675	0.456	0.066	NO
V14:V22	0.006	0.000	0.988	NO
V14:V23	0.679	0.461	0.064	NO
V14:V24	0.087	0.008	0.837	NO
V14:V25	0.482	0.233	0.189	NO
V14:V26	0.508	0.258	0.199	NO
V14:V27	0.756	0.572	0.030	YES
V15:V16	0.953	0.907	0.000	YES
V15:V17	0.476	0.227	0.164	NO
V15:V18	0.600	0.306	0.116	NO
V15:V19	0.888	0.789	0.001	YES
V15:V20	0.391	0.153	0.264	NO
V15:V21	0.750	0.562	0.020	YES
V15:V22	0.074	0.005	0.851	NO
V15:V23	0.800	0.640	0.010	YES
V15:V24	0.129	0.017	0.742	NO
V15:V25	0.670	0.449	0.034	YES
V15:V26	0.618	0.382	0.076	NO
V15:V27	0.834	0.695	0.005	YES
V16:V17	0.616	0.379	0.058	NO
V16:V18	0.651	0.424	0.080	NO
V16:V19	0.845	0.713	0.002	YES
V16:V20	0.481	0.232	0.159	NO
V16:V21	0.796	0.633	0.010	YES
V16:V22	0.213	0.045	0.582	NO
V16:V23	0.634	0.402	0.067	NO
V16:V24	0.156	0.024	0.688	NO
V16:V25	0.756	0.572	0.011	YES
V16:V26	0.523	0.273	0.149	NO
V16:V27	0.699	0.488	0.036	YES
V17:V18	0.886	0.785	0.003	YES
V17:V19	0.408	0.166	0.242	NO
V17:V20	0.898	0.806	0.000	YES
V17:V21	0.628	0.394	0.070	NO
V17:V22	0.879	0.772	0.002	YES
V17:V23	0.319	0.102	0.402	NO
V17:V24	0.717	0.514	0.030	YES
V17:V25	0.328	0.107	0.355	NO
V17:V26	0.453	0.205	0.221	NO
V17:V27	0.330	0.109	0.386	NO
V18:V19	0.515	0.266	0.191	NO
V18:V20	0.952	0.907	0.000	YES
V18:V21	0.766	0.587	0.045	YES

V18:V22	0.703	0.495	0.052	NO
V18:V23	0.284	0.081	0.537	NO
V18:V24	0.587	0.345	0.166	NO
V18:V25	0.223	0.050	0.596	NO
V18:V26	0.365	0.133	0.421	NO
V18:V27	0.483	0.233	0.273	NO
V19:V20	0.318	0.101	0.370	NO
V19:V21	0.530	0.281	0.142	NO
V19:V22	0.199	0.039	0.609	NO
V19:V23	0.691	0.478	0.039	YES
V19:V24	0.301	0.091	0.431	NO
V19:V25	0.634	0.402	0.049	YES
V19:V26	0.456	0.208	0.217	NO
V19:V27	0.739	0.545	0.023	YES
V20:V21	0.593	0.352	0.092	NO
V20:V22	0.827	0.684	0.006	YES
V20:V23	0.203	0.041	0.601	NO
V20:V24	0.649	0.422	0.058	NO
V20:V25	0.120	0.014	0.741	NO
V20:V26	0.275	0.076	0.474	NO
V20:V27	0.222	0.049	0.566	NO
V21:V22	0.242	0.059	0.564	NO
V21:V23	0.677	0.458	0.065	NO
V21:V24	0.036	0.001	0.933	NO
V21:V25	0.593	0.352	0.092	NO
V21:V26	0.216	0.047	0.608	NO
V21:V27	0.743	0.551	0.035	YES
V22:V23	0.108	0.012	0.799	NO
V22:V24	0.895	0.801	0.003	YES
V22:V25	0.009	0.000	0.981	NO
V22:V26	0.321	0.103	0.437	NO
V22:V27	0.079	0.006	0.853	NO
V23:V24	0.308	0.095	0.457	NO
V23:V25	0.379	0.144	0.314	NO
V23:V26	0.832	0.693	0.010	YES
V23:V27	0.972	0.945	0.000	YES
V24:V25	0.025	0.001	0.950	NO
V24:V26	0.610	0.372	0.108	NO
V24:V27	0.319	0.102	0.441	NO
V25:V26	0.515	0.265	0.156	NO
V25:V27	0.423	0.179	0.257	NO
V26:V27	0.805	0.649	0.016	YES

H-6 Sacred Heart males r-values and significant association

(chronological BSI numbering see Appendix H, H-2)

Variables	r-value	r2-value	Significance	Reject Null?
V1:V2	0.334	0.111	0.380	NO
V1:V3	0.224	0.050	0.594	NO
V1:V4	0.026	0.001	0.946	NO
V1:V5	0.604	0.364	0.085	NO
V1:V6	0.371	0.138	0.325	NO
V1:V7	0.408	0.166	0.316	NO
V1:V8	0.053	0.003	0.900	NO
V1:V9	0.569	0.324	0.110	NO
V1:V10	0.480	0.230	0.191	NO
V1:V11	0.065	0.004	0.867	NO
V1:V12	0.391	0.153	0.338	NO
V1:V13	0.017	0.000	0.966	NO
V1:V14	0.059	0.003	0.881	NO
V1:V15	0.158	0.025	0.684	NO
V1:V16	0.134	0.180	0.731	NO
V1:V17	0.157	0.025	0.687	NO
V1:V18	0.186	0.035	0.632	NO
V1:V19	0.231	0.053	0.582	NO
V1:V20	0.042	0.002	0.922	NO
V1:V21	0.164	0.027	0.673	NO
V1:V22	0.228	0.052	0.556	NO
V1:V23	0.063	0.004	0.872	NO
V1:V24	0.183	0.033	0.665	NO
V1:V25	0.242	0.059	0.531	NO
V1:V26	0.191	0.036	0.651	NO
V1:V27	0.990	0.980	0.091	NO
V2:V3	0.727	0.529	0.026	YES
V2:V4	0.672	0.452	0.033	YES
V2:V5	0.432	0.187	0.212	NO
V2:V6	0.267	0.071	0.456	NO
V2:V7	0.517	0.267	0.154	NO
V2:V8	0.139	0.019	0.721	NO
V2:V9	0.594	0.353	0.070	NO
V2:V10	0.119	0.014	0.744	NO
V2:V11	0.278	0.077	0.437	NO
V2:V12	0.549	0.302	0.125	NO
V2:V13	0.551	0.304	0.099	NO
V2:V14	0.746	0.556	0.013	YES
V2:V15	0.485	0.235	0.155	NO
V2:V16	0.282	0.080	0.430	NO
V2:V17	0.519	0.270	0.124	NO
V2:V18	0.567	0.321	0.088	NO
V2:V19	0.524	0.274	0.148	NO
V2:V20	0.481	0.231	0.190	NO
V2:V21	0.810	0.657	0.004	YES
V2:V22	0.812	0.660	0.004	YES
V2:V23	0.641	0.411	0.046	YES
V2:V24	0.651	0.424	0.057	NO
V2:V25	0.666	0.443	0.036	YES
V2:V26	0.572	0.327	0.139	NO
V2:V27	0.249	0.062	0.751	NO
V3:V4	0.690	0.476	0.040	YES
V3:V5	0.564	0.319	0.113	NO
V3:V6	0.506	0.256	0.165	NO
V3:V7	0.891	0.794	0.003	YES
V3:V8	0.706	0.498	0.051	NO
V3:V9	0.564	0.318	0.114	NO
V3:V10	0.333	0.111	0.381	NO
V3:V11	0.704	0.495	0.034	YES
V3:V12	0.685	0.469	0.061	NO

V3:V13	0.801	0.641	0.010	YES
V3:V14	0.853	0.727	0.003	YES
V3:V15	0.810	0.657	0.008	YES
V3:V16	0.659	0.434	0.054	NO
V3:V17	0.758	0.574	0.018	YES
V3:V18	0.635	0.403	0.066	NO
V3:V19	0.836	0.699	0.005	YES
V3:V20	0.904	0.817	0.002	YES
V3:V21	0.729	0.531	0.026	YES
V3:V22	0.576	0.331	0.105	NO
V3:V23	0.782	0.612	0.013	YES
V3:V24	0.931	0.866	0.001	YES
V3:V25	0.938	0.880	0.000	YES
V3:V26	0.946	0.894	0.000	YES
V3:V27	0.909	0.827	0.273	NO
V4:V5	0.703	0.494	0.023	YES
V4:V6	0.401	0.161	0.251	NO
V4:V7	0.475	0.225	0.197	NO
V4:V8	0.316	0.100	0.408	NO
V4:V9	0.472	0.223	0.168	NO
V4:V10	0.345	0.119	0.329	NO
V4:V11	0.142	0.020	0.695	NO
V4:V12	0.524	0.274	0.148	NO
V4:V13	0.652	0.425	0.041	YES
V4:V14	0.762	0.581	0.010	YES
V4:V15	0.698	0.487	0.025	YES
V4:V16	0.143	0.021	0.693	NO
V4:V17	0.489	0.239	0.151	NO
V4:V18	0.609	0.371	0.062	NO
V4:V19	0.727	0.529	0.026	YES
V4:V20	0.614	0.377	0.079	NO
V4:V21	0.688	0.473	0.028	YES
V4:V22	0.644	0.414	0.045	YES
V4:V23	0.512	0.262	0.130	NO
V4:V24	0.715	0.512	0.030	YES
V4:V25	0.563	0.317	0.090	NO
V4:V26	0.494	0.244	0.213	NO
V4:V27	0.353	0.125	0.647	NO
V5:V6	0.355	0.126	0.315	NO
V5:V7	0.483	0.234	0.187	NO
V5:V8	0.385	0.148	0.306	NO
V5:V9	0.680	0.463	0.030	YES
V5:V10	0.063	0.004	0.862	NO
V5:V11	0.164	0.027	0.652	NO
V5:V12	0.525	0.275	0.147	NO
V5:V13	0.628	0.394	0.052	NO
V5:V14	0.631	0.398	0.051	NO
V5:V15	0.754	0.568	0.012	YES
V5:V16	0.340	0.116	0.336	NO
V5:V17	0.561	0.315	0.092	NO
V5:V18	0.545	0.297	0.103	NO
V5:V19	0.710	0.505	0.032	YES
V5:V20	0.483	0.233	0.188	NO
V5:V21	0.499	0.249	0.142	NO
V5:V22	0.463	0.215	0.178	NO
V5:V23	0.388	0.151	0.268	NO
V5:V24	0.526	0.277	0.146	NO
V5:V25	0.345	0.119	0.330	NO
V5:V26	0.386	0.149	0.345	NO
V5:V27	0.549	0.301	0.451	NO
V6:V7	0.296	0.088	0.439	NO
V6:V8	0.375	0.141	0.320	NO
V6:V9	0.367	0.145	0.296	NO

V6:V10	0.053	0.003	0.884	NO
V6:V11	0.569	0.323	0.086	NO
V6:V12	0.788	0.621	0.012	YES
V6:V13	0.601	0.361	0.066	NO
V6:V14	0.650	0.423	0.042	YES
V6:V15	0.611	0.374	0.060	NO
V6:V16	0.815	0.664	0.004	YES
V6:V17	0.881	0.775	0.001	YES
V6:V18	0.516	0.266	0.127	NO
V6:V19	0.431	0.186	0.247	NO
V6:V20	0.686	0.471	0.041	YES
V6:V21	0.551	0.304	0.098	NO
V6:V22	0.547	0.299	0.102	NO
V6:V23	0.651	0.424	0.041	YES
V6:V24	0.228	0.052	0.554	NO
V6:V25	0.157	0.025	0.666	NO
V6:V26	0.262	0.069	0.530	NO
V6:V27	0.924	0.855	0.076	NO
V7:V8	0.826	0.682	0.006	YES
V7:V9	0.620	0.384	0.075	NO
V7:V10	0.943	0.889	0.000	YES
V7:V11	0.780	0.609	0.013	YES
V7:V12	0.639	0.409	0.064	NO
V7:V13	0.804	0.646	0.009	YES
V7:V14	0.771	0.594	0.015	YES
V7:V15	0.862	0.743	0.003	YES
V7:V16	0.552	0.304	0.124	NO
V7:V17	0.619	0.383	0.075	NO
V7:V18	0.785	0.617	0.012	YES
V7:V19	0.647	0.418	0.083	NO
V7:V20	0.801	0.641	0.017	YES
V7:V21	0.407	0.165	0.278	NO
V7:V22	0.266	0.071	0.489	NO
V7:V23	0.782	0.611	0.013	YES
V7:V24	0.789	0.623	0.020	YES
V7:V25	0.824	0.678	0.006	YES
V7:V26	0.845	0.713	0.017	YES
V7:V27	0.503	0.253	0.497	NO
V8:V9	0.420	0.176	0.261	NO
V8:V10	0.793	0.629	0.011	YES
V8:V11	0.834	0.696	0.005	YES
V8:V12	0.433	0.188	0.244	NO
V8:V13	0.834	0.696	0.005	YES
V8:V14	0.696	0.485	0.037	YES
V8:V15	0.853	0.728	0.003	YES
V8:V16	0.553	0.306	0.122	NO
V8:V17	0.520	0.271	0.151	NO
V8:V18	0.499	0.249	0.172	NO
V8:V19	0.680	0.463	0.063	NO
V8:V20	0.846	0.716	0.008	YES
V8:V21	0.181	0.033	0.641	NO
V8:V22	0.111	0.012	0.776	NO
V8:V23	0.560	0.314	0.117	NO
V8:V24	0.504	0.254	0.202	NO
V8:V25	0.582	0.338	0.100	NO
V8:V26	0.793	0.628	0.033	YES
V8:V27	0.785	0.616	0.215	NO
V9:V10	0.190	0.036	0.598	NO
V9:V11	0.392	0.154	0.263	NO
V9:V12	0.568	0.323	0.110	NO
V9:V13	0.611	0.373	0.061	NO
V9:V14	0.658	0.433	0.039	YES
V9:V15	0.629	0.396	0.051	NO

V9:V16	0.541	0.292	0.107	NO
V9:V17	0.667	0.444	0.035	YES
V9:V18	0.826	0.682	0.003	YES
V9:V19	0.656	0.430	0.055	NO
V9:V20	0.446	0.199	0.229	NO
V9:V21	0.455	0.207	0.186	NO
V9:V22	0.486	0.236	0.154	NO
V9:V23	0.703	0.495	0.023	YES
V9:V24	0.366	0.134	0.332	NO
V9:V25	0.429	0.184	0.217	NO
V9:V26	0.416	0.173	0.305	NO
V9:V27	0.667	0.445	0.333	NO
V10:V11	0.568	0.322	0.087	NO
V10:V12	0.558	0.311	0.118	NO
V10:V13	0.293	0.086	0.412	NO
V10:V14	0.178	0.032	0.622	NO
V10:V15	0.239	0.057	0.506	NO
V10:V16	0.404	0.163	0.247	NO
V10:V17	0.209	0.044	0.562	NO
V10:V18	0.001	0.000	0.998	NO
V10:V19	0.077	0.006	0.843	NO
V10:V20	0.159	0.025	0.683	NO
V10:V21	0.040	0.002	0.913	NO
V10:V22	0.102	0.010	0.779	NO
V10:V23	0.235	0.055	0.513	NO
V10:V24	0.199	0.039	0.609	NO
V10:V25	0.345	0.119	0.328	NO
V10:V26	0.427	0.182	0.292	NO
V10:V27	0.551	0.303	0.449	NO
V11:V12	0.521	0.272	0.150	NO
V11:V13	0.655	0.429	0.040	YES
V11:V14	0.605	0.365	0.064	NO
V11:V15	0.718	0.516	0.019	YES
V11:V16	0.722	0.522	0.018	YES
V11:V17	0.663	0.440	0.037	YES
V11:V18	0.537	0.288	0.110	NO
V11:V19	0.448	0.201	0.226	NO
V11:V20	0.798	0.637	0.010	YES
V11:V21	0.237	0.056	0.510	NO
V11:V22	0.104	0.011	0.774	NO
V11:V23	0.646	0.417	0.044	YES
V11:V24	0.439	0.193	0.237	NO
V11:V25	0.605	0.366	0.064	NO
V11:V26	0.710	0.505	0.048	YES
V11:V27	0.859	0.738	0.141	NO
V12:V13	0.733	0.537	0.025	YES
V12:V14	0.812	0.659	0.008	YES
V12:V15	0.660	0.435	0.053	NO
V12:V16	0.844	0.713	0.004	YES
V12:V17	0.944	0.891	0.000	YES
V12:V18	0.630	0.397	0.069	NO
V12:V19	0.527	0.278	0.180	NO
V12:V20	0.773	0.598	0.024	YES
V12:V21	0.801	0.642	0.009	YES
V12:V22	0.777	0.604	0.014	YES
V12:V23	0.873	0.762	0.002	YES
V12:V24	0.555	0.308	0.153	NO
V12:V25	0.424	0.180	0.255	NO
V12:V26	0.493	0.243	0.261	NO
V12:V27	0.953	0.908	0.047	YES
V13:V14	0.954	0.911	0.000	YES
V13:V15	0.864	0.746	0.001	YES

V13:V16	0.613	0.376	0.059	NO
V13:V17	0.736	0.542	0.015	YES
V13:V18	0.598	0.358	0.068	NO
V13:V19	0.784	0.615	0.012	YES
V13:V20	0.721	0.520	0.028	YES
V13:V21	0.658	0.433	0.038	YES
V13:V22	0.445	0.198	0.197	NO
V13:V23	0.776	0.602	0.008	YES
V13:V24	0.659	0.434	0.053	NO
V13:V25	0.588	0.346	0.074	NO
V13:V26	0.839	0.703	0.009	YES
V13:V27	0.848	0.719	0.152	NO
V14:V15	0.842	0.709	0.002	YES
V14:V16	0.618	0.382	0.057	NO
V14:V17	0.800	0.640	0.005	YES
V14:V18	0.669	0.448	0.034	YES
V14:V19	0.786	0.618	0.012	YES
V14:V20	0.740	0.548	0.023	YES
V14:V21	0.810	0.656	0.005	YES
V14:V22	0.658	0.434	0.038	YES
V14:V23	0.829	0.687	0.003	YES
V14:V24	0.703	0.494	0.035	YES
V14:V25	0.649	0.421	0.043	YES
V14:V26	0.759	0.577	0.029	YES
V14:V27	0.872	0.761	0.128	NO
V15:V16	0.570	0.325	0.086	NO
V15:V17	0.746	0.556	0.013	YES
V15:V18	0.745	0.556	0.013	YES
V15:V19	0.728	0.530	0.026	YES
V15:V20	0.848	0.720	0.004	YES
V15:V21	0.485	0.235	0.155	NO
V15:V22	0.379	0.144	0.280	NO
V15:V23	0.665	0.442	0.036	YES
V15:V24	0.673	0.452	0.047	YES
V15:V25	0.649	0.421	0.042	YES
V15:V26	0.711	0.506	0.048	YES
V15:V27	0.747	0.558	0.253	NO
V16:V17	0.921	0.849	0.000	YES
V16:V18	0.484	0.234	0.157	NO
V16:V19	0.580	0.337	0.101	NO
V16:V20	0.696	0.485	0.037	YES
V16:V21	0.536	0.287	0.111	NO
V16:V22	0.466	0.217	0.175	NO
V16:V23	0.747	0.558	0.013	YES
V16:V24	0.268	0.072	0.486	NO
V16:V25	0.331	0.110	0.350	NO
V16:V26	0.707	0.500	0.050	NO
V16:V27	0.984	0.968	0.016	YES
V17:V18	0.694	0.482	0.026	YES
V17:V19	0.668	0.446	0.049	YES
V17:V20	0.819	0.671	0.007	YES
V17:V21	0.718	0.515	0.019	YES
V17:V22	0.693	0.480	0.026	YES
V17:V23	0.851	0.725	0.002	YES
V17:V24	0.485	0.235	0.186	NO
V17:V25	0.470	0.221	0.170	NO
V17:V26	0.638	0.407	0.089	NO
V17:V27	0.994	0.988	0.006	YES
V18:V19	0.555	0.308	0.121	NO
V18:V20	0.689	0.474	0.040	YES
V18:V21	0.396	0.157	0.257	NO

V18:V22	0.496	0.246	0.145	NO
V18:V23	0.792	0.628	0.006	YES
V18:V24	0.564	0.319	0.113	NO
V18:V25	0.582	0.338	0.078	NO
V18:V26	0.435	0.189	0.282	NO
V18:V27	0.616	0.380	0.384	NO
V19:V20	0.749	0.560	0.033	YES
V19:V21	0.642	0.413	0.062	NO
V19:V22	0.438	0.192	0.238	NO
V19:V23	0.647	0.419	0.059	NO
V19:V24	0.710	0.504	0.048	YES
V19:V25	0.695	0.484	0.038	YES
V19:V26	0.846	0.716	0.008	YES
V19:V27	1.000	0.999	0.020	YES
V20:V21	0.703	0.494	0.035	YES
V20:V22	0.638	0.407	0.065	NO
V20:V23	0.787	0.620	0.012	YES
V20:V24	0.816	0.666	0.013	YES
V20:V25	0.786	0.618	0.012	YES
V20:V26	0.800	0.641	0.031	YES
V20:V27	0.768	0.590	0.232	NO
V21:V22	0.925	0.846	0.000	YES
V21:V23	0.706	0.498	0.023	YES
V21:V24	0.631	0.398	0.068	NO
V21:V25	0.530	0.281	0.115	NO
V21:V26	0.550	0.302	0.158	NO
V21:V27	0.986	0.973	0.014	YES
V22:V23	0.667	0.444	0.035	YES
V22:V24	0.540	0.292	0.133	NO
V22:V25	0.419	0.176	0.228	NO
V22:V26	0.301	0.091	0.469	NO
V22:V27	0.983	0.965	0.017	YES
V23:V24	0.688	0.474	0.040	YES
V23:V25	0.661	0.437	0.037	YES
V23:V26	0.665	0.443	0.072	NO
V23:V27	0.814	0.663	0.186	NO
V24:V25	0.941	0.886	0.000	YES
V24:V26	0.889	0.809	0.006	YES
V24:V27	0.163	0.027	0.837	NO
V25:V26	0.952	0.906	0.000	YES
V25:V27	0.140	0.019	0.860	NO

APPENDIX I: REGRESSION ANALYSIS

All regression graphs can be found on an accompanying CD found at the back of this thesis. A legend is provided at the beginning of these figures to explain the re-numbering of each individual. All BSI measurements correspond to their chronological re-numbering shown in Appendix H, H-1 (females) and H-2 (males). Further BSI measurement descriptions can be found in Appendix B.

APPENDIX J: GROWTH SEQUENCING DATA

J-1 Sadlermiut and Sacred Heart females BSI age at maturation

Body Size Indicators (original numbering)	**Age at Maturation (yrs)**
3. Upper facial breadth	3.0
4. Biorbital breadth	3.0
66. Maximum length of talus	9.0
28/29. Sacrum superior surface area	10.0
37. Humerus distal joint breadth	11.0
39. Humerus capitual height	11.0
33. Maximum humerus length	11.5
34. Humerus midshaft circumference	12.0
59. Tibia midshaft width	12.0
51. Femur midshaft circumference	12.0
11. Maximum cranial height	13.0
14. Interorbital breadth	13.0
17. Maximum breath of the mandible	13.0
12/13. Foramen magnum area	13.5
44. Femur maximum superior/inferior diameter of head	14.0
45. Femur head breadth	14.0
50. Maximum femur length	14.0
60. Maximum fibula length	14.0
38. Humerus anteroposterior diameter of head	15.0
53. Maximum tibia length	15.0
57. Tibia transverse diameter of talar facet	15.0
41. Maximum radius length	15.0
64. Maximum length of calcaneus	15.5
40. Maximum ulna length	16.0
48. Biepicondylar diameter of distal femur	16.0
24/25. L1 superior surface area	20.0
26/27. L5 superior surface area	20.0

* maturation data from Scheuer and Black (2000)

J-2 Sadlermiut and Sacred Heart males BSI age at maturation

Body Size Indicators (original numbering)	**Age at Maturation (yrs)**
3. Upper facial breadth	3.0
20/21. C7 superior surface area	4.5
28. Sacrum anterior height of first segment	10.0
34. Humerus midshaft circumference	12.0
52. Femur midshaft width	12.0
59. Tibia midshaft width	12.0
37. Humerus distal joint breadth	13.5
39. Humerus capitual height	13.5
62. Patella maximum breadth	16.0
42. Transverse diameter of radius head	16.5
56/57. Talar facet area	16.5
60. Maximum fibula length	17.0
44. Femur maximum superior/inferior diameter of head	17.5
45. Femur head breadth	17.5
48. Biepicondylar diameter of distal femur	17.5
50. Maximum femur length	17.5
53. Maximum tibia length	18.4
55. Proximal tibia breadth	18.4
58. Anteroposterior diameter of proximal tibia	18.4
40. Maximum ulna length	18.5
64. Maximum length of calcaneus	19.0
65. Posterior length of calcaneus	19.0
68. Articulated height of calcaneus/talus	19.0
22/23. T12 superior surface area	20.0
24/25. L1 superior surface area	20.0
26/27. L5 superior surface area	20.0
32. Bi-iliac breadth	21.5

* maturation data from Scheuer and Black (2000)

J-3 Scheuer and Black (2000) skeletal maturation sequencing

Bone	BSI Measurements	Comments on Morphology	Male Average Age (yrs)	Female Average Age (yrs)
cranium	upper facial breadth	adult morphology of frontal and zygomatic bones	3.0	3.0
cranium	biorbital breadth	adult morphology of frontal and zygomatic bones	3.0	3.0
cranium	postorbital breadth	adult morphology of the frontal bone	3.0	3.0
cranium	biporionic breadth	growth of tympanic plate, formation of temporal mastoid process	3.0	3.0
C7	anteroposterior diameter of the superior aspect on the vertebral body	neural arches fuse to the centrum	4.5	4.5
C7	transverse diameters of the superior aspect on the vertebral body	neural arches fuse to the centrum	4.5	4.5
cranium	maximum cranial breadth	loss of parietal eminences	5.0	5.0
sacrum	anteroposterior diameter of superior surface	fusion complete	10.0	10.0
sacrum	transverse diameter of superior surface	fusion complete	10.0	10.0
sacrum	anterior height of first segment	fusion complete	10.0	10.0
talus	mediolateral diameter of the tibial facet	fusion of talar epiphysis complete	12.0	9.0
talus	maximum length of the talus	fusion of talar epiphysis complete	12.0	9.0
femur	*midshaft circumference*	*adult length of femur shaft*	*12.0*	12.0
femur	midshaft width	adult length of femur shaft	12.0	12.0
humerus	midshaft circumference	adult length of humerus shaft	12.0	12.0
humerus	minimum shaft circumference	adult length of humerus shaft	12.0	12.0
mandible	lateral incisors and canines mesiodistal widths	total eruption of mandibular canines and lateral incisors	12.0	12.0
maxilla	intercanine breadth	total eruption of maxillary canines	12.0	12.0
tibia	midshaft circumference	adult length of tibia shaft	12.0	12.0
tibia	midshaft width	adult length of tibia shaft	12.0	12.0
cranium	maximum cranial length	adult size and morphology of nasal bones	13.0	13.0
cranium	maximum orbital height	adult morphology of frontal, maxilla and nasal bones	13.0	13.0
cranium	maximum orbital breadth	adult morphology of frontal, maxilla and nasal bones	13.0	13.0
cranium	orbital area	adult morphology of frontal, maxilla and nasal bones	13.0	13.0
cranium	interorbital breadth	adult morphology of frontal, maxilla and nasal bones	13.0	13.0
mandible	chin depth (males)	all permanent teeth emerged except third molars	13.0	13.0
mandible	maximum width	all permanent teeth emerged except third molars	13.0	13.0
maxilla	palate length	all permanent teeth emerged except third molars	13.0	13.0
humerus	distal epiphyseal breadth	fusion of epiphysis to humerus shaft	13.5	11.0
humerus	distal joint breadth	fusion of epiphysis to humerus shaft	13.5	11.0
humerus	capitual height	fusion of distal epiphysis to humerus shaft	13.5	11.0
humerus	maximum humerus length	fusion of proxmial and distal epiphyses	13.5	11.5
cranium	occipital condyle length	fusion of spheno-occipital synchondrosis	15.5	13.5
cranium	occpitial condyle breadth	fusion of spheno-occipital synchondrosis	15.5	13.5
cranium	occipital condyle area	fusion of spheno-occipital synchondrosis	15.5	13.5
cranium	basion-bregma height	appearance of the foramen magnum	15.5	13.5
foramen magnum	maximum length (anterior to posterior)	appearance at the base of the occipital bone	15.5	13.5
foramen magnum	maximum breadth	appearance at the base of the occipital bone	15.5	13.5
foramen magnum	total area	appearance at the base of the occipital bone	15.5	13.5
patella	maximum width	adult size and morphology	16.0	14.0
metacarpal	second metacarpal length	heads of metacarpals fuse and reach adult size and morphology	16.3	14.3
metacarpal	second metacarpal width	heads of metacarpals fuse and reach adult size and morphology	16.3	14.3
radius	mediolateral diameter of the radial head	fusion of epiphysis to radius shaft	16.5	12.3
tibia	anteroposterior diameters of the talar facet on the distal tibia	fusion to tibia shaft	16.5	15.0
tibia	transverse diameter of the talar facet on the distal tibia	fusion to tibia shaft	16.5	15.0

femur	anteroposterior diameter of femoral shaft inferior to the lesser trochante	fusion to the lesser trochanter to femur shaft	16.5	16.5
femur	transverse diameter of the femoral shaft inferior to the lesser trochanter	fusion to the lesser trochanter to femur shaft	16.5	16.5
fibula	maximum fibula length	fusion of proxmial and distal epiphyses	17	14
femur	maximum superoinferior diameter of the femoral head	fusion of head to the femur shaft	17.5	14.0
femur	femoral head breadth	fusion of head to the femur shaft	17.5	14
femur	maximum femur length	fusion of head and distal epiphyses	17.5	14
femur/fibula	total leg length	fusion of proximal and distal epiphyses in fibula and femur	17.5	14
radius	maximum radius length	fusion of proximal and distal epiphyses	17.5	14.0
femur	biepicondylar diameter of the distal femur	fusion of distal epiphysis to femur shaft	17.5	16.0
femur	shaft anteroposterior diameter of the distal femur	fusion of distal epiphysis to femur shaft	17.5	16.0
tibia	anteroposterior diameter of proximal tibia	fusion of epiphysis to tibia shaft	18.4	15.0
tibia	maximum tibia length	fusion of proximal and distal epiphyses	18.4	15.0
tibia	proximal breadth	fusion of epiphysis to tibia shaft	18.4	15.0
humerus	maximum anterior posterior diameter of humerus head	fusion of head to proximal humerus epiphysis	18.5	15.0
humerus/radius	total arm length	fusion of proxmimal and distal epiphyses of radius and humerus	18.5	15.5
ulna	maximum ulna length	fusion of proximal and distal epiphyses	18.5	16.0
ankle	maximum breadth	adult morhpology of tibia, fibular, calcaneus and talus	19.0	15.5
calcaneus	maximum length of the calcaneus as taken parallel to the long axis	complete fusion of the calcaneal epiphysis	19.0	15.5
calcaneus	posterior length of the calcaneus	complete fusion of the calcaneal epiphysis	19.0	15.5
talus/calcaneus	articulated height	adult morphology and size of the talus and calcaneus	19.0	15.5
L1	anteroposterior diameter of superior surface	complete fusion of epiphyses	20.0	20.0
L1	transverse diameter of superior surface	complete fusion of epiphyses	20.0	20.0
L5	anteroposterior diameter of superior surface	complete fusion of epiphyses	20.0	20.0
L5	transverse diameter of superior surface	complete fusion of epiphyses	20.0	20.0
T12	anteroposterior diameter of superior surface	complete fusion of epiphyses	20.0	20.0
T12	transverse diameter of superior surface	complete fusion of epiphyses	20.0	20.0
pelvis	bi-iliac breadth	iliac crest fusion complete	21.5	21.5
vertebrae	maximum height of C2-L5	vertebral column complete	25.0	25.0

J-4 Sadlermiut females sub-adult calibration data

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	Adult/Sub-Adult	Average Age	3	%	4	%	66	%	28 and 29	%	37	%	39	%	33	%	34	%	59
XIV-C:96	adult	32.5									39.6		17.9		282.0		63.0		22.2
XIV-C:112	adult	30.0	108.0		98.3		57.0		1641.8		40.8		19.4		319.0		65.0		20.3
XIV-C:175	adult	35.0	102.0		94.4		46.7		1039.8		38.6		16.6		241.0		54.0		16.1
XIV-C:105	adult	37.5	101.0		90.6		53.1				38.8		17.8		276.0		62.0		18.0
XIV-C:145	adult	40.0					57.0		1608.0		42.3		18.8		307.0		66.0		22.6
XIV-C:149	adult	45.0	101.0		94.8		54.4		945.8		38.2		17.7		279.0		55.0		17.6
XIV-C:153	adult	50.0	104.0		97.4						40.2		18.4		280.0		64.0		19.9
XIV-C:103	adult	50.0	107.0		97.3		54.1		1419.8		40.8		18.5		278.0		62.0		18.9
XIV-C:104	adult	50.0	108.0		102.2				1452.4		38.3		17.5		287.0		57.0		19.5
XIV-C:98	adult	52.5	103.0		93.3		55.5		1164.9		39.1		16.5		276.0		61.0		18.5
XIV-C:155	adult	50.0	101.0		96.5		55.3		1397.5		39.1		18.7		271.0		65.0		20.1
XIV-C:219	adult	57.5	108.0		97.6				1739.2		39.1		18.5		291.0		60.0		18.8
XIV-C:183	adult	55.0	101.0		96.0		53.1		1299.3		41.3		17.7		281.0		57.0		16.5
XIV-C:148	adult	55.0	97.0		93.1		51.9				36.1		16.1		250.0		56.0		18.2
XIV-C:100	adult	60.0	104.9		96.3				1374.5		40.1		18.2		296.0		64.0		20.6
XIV-C:192	adult	60.0	109.0		96.8		54.1		1345.6		39.0		16.8		283.0		57.0		18.3
XIV-C:221	adult	60.0	105.0		97.2		55.9		1380.1		40.5		19.5		287.0		59.0		17.5
XIV-C:122	sub-adult	0.1	55.0	**53.0**	52.5	**55.0**									63.0	**22.0**	17.0	**28.0**	5.5
XIV-C:107	sub-adult	0.5																	6.4
XIV-C:120	sub-adult	1.0	62.9	**60.0**	58.2	**61.0**									89.0	**32.0**	25.0	**41.0**	7.5
XIV-C:77	sub-adult	1.5	67.8	**65.0**	61.4	**64.0**									94.0	**33.0**	33.0	**55.0**	8.8
XIV-C:79	sub-adult	1.5	71.5	**69.0**	66.0	**69.0**									87.0	**31.0**	32.0	**53.0**	8.9
XIV-C:78	sub-adult	6.0																	
XIV-C:118	sub-adult	6.5													146.0	**52.0**	39.0	**65.0**	11.2
XIV-C:76	sub-adult	8.0	98.0	**94.0**	88.0	**92.0**			630.7	**46.0**									
XIV-C:124	sub-adult	10.0	96.2	**93.0**	88.5	**92.0**	38.4	**71.0**							168.0	**60.0**	41.0	**68.0**	14.3
XIV-C:220	sub-adult	10.5	91.0	**88.0**	85.4	**89.0**	44.3	**82.0**							203.0	**72.0**	40.0	**66.0**	12.5
XIV-C:75	sub-adult	11.5							709.7	**52.0**									
XIV-C:73	sub-adult	17.5							1164.8	**85.0**	37.1	**94.0**	17.9	**100.0**	262.0	**93.0**	60.0	**99.0**	
		AVERAGE	104.0	**100.0**	96.1	**100.0**	54.0	**100.0**	1369.9	**100.0**	39.5	**100.0**	17.9	**100.0**	281.4	**100.0**	60.4	**100.0**	19.0

* shaded squares denote the closest percentage to the adult average of 100%

%	51	%	11	%	14	%	17	%	12 and 13	%	44	%	45	%	50	%	60	%	38	%
	93.0				22.7						41.4		43.9		422.0				37.8	
	94.0		138.0		20.8		107.0		797.3		46.4		46.3		452.0		363.0		42.8	
	71.0				20.4				816.6		37.8		38.8		358.0				35.2	
	82.0		127.0		16.8		97.0		771.0		43.6		41.8		390.0		307.0		40.6	
					20.6												346.0		44.2	
	81.0		124.0		20.8		101.4		891.1		41.2		41.5		410.0		327.0		36.8	
	79.0		133.0		20.2		97.7				43.1		42.7		398.0		305.0		39.2	
	82.0		136.0		19.8		114.9		884.6		42.9		42.8		404.0		320.0		40.2	
	85.0		132.0		20.7		103.2		967.8		42.2		42.9		401.0		307.0		37.9	
	85.0		128.0		18.3		92.4		929.0		44.0		44.2		412.0		315.0		43.6	
	83.0		138.0		21.2		103.2		919.8		40.5		44.5		401.0		311.0		38.2	
	84.0		136.0		22.1		110.9		852.5		42.8		44.0		414.0		312.0		41.0	
	84.0		129.0		17.0		86.2		760.19		41.6		42.6		416.0		316.0		40.1	
	79.0		131.0		20.5		97.4		778.4		41.0		41.2		370.0		276.0		35.2	
					21.4		117.1		951.3								330.0		41.8	
	82.0		139.0		23.6		104.2				42.4		43.4		413.0		314.0		38.1	
	77.0		139.0		19.7		99.9		944.6		43.4		44.9		430.0		321.0		40.3	
29.0	21.0	**25.0**			10.9	**53.0**	48.3	**47.0**							72.0	**18.0**	58.0	**18.0**		
34.0							58.8	**57.0**												
39.0	29.0	**35.0**			14.0	**69.0**	55.9	**55.0**							110.0	**27.0**	88.0	**28.0**		
46.0	36.0	**44.0**			15.1	**74.0**	65.8	**64.0**	660.3	**76.0**					122.0	**30.0**	94.0	**30.0**		
47.0					16.9	**83.0**	61.4	**60.0**												
							80.9	**79.0**												
59.0	46.0	**56.0**			18.4	**90.0**	75.2	**74.0**							195.0	**48.0**	150.0	**47.0**		
			133.0	**100.0**	17.6	**86.0**	87.3	**85.0**	772.2	**89.0**									25.5	**64.0**
75.0	54.0	**65.0**			19.0	**93.0**	86.5	**85.0**			29.3	**69.0**	29.0	**67.0**	236.0	**58.0**				
66.0	53.0	**64.0**	126.0	**95.0**	18.9	**93.0**	88.0	**86.0**	860.9	**99.0**	34.5	**82.0**	35.5	**83.0**	276.0	**68.0**	213.0	**67.0**		
																	308.0	**97.0**	31.1	**79.0**
100.0	82.7	**100.0**	133.1	**100.0**	20.4	**100.0**	102.3	**100.0**	866.5	**100.0**	42.3	**100.0**	43.0	**100.0**	406.1	**100.0**	318.0	**100.0**	39.6	**100.0**

53	%	57	%	41	%	64	%	40	%	48	%	24 and 25	%	26 and 27	%
333.0		32.3		202.0		68.9		222.0		77.8				1166.9	
371.0		31.7		233.0		74.8		253.0		75.9		1138.7		1956.4	
289.0		26.2		175.0		63.2		198.0		68.0		837.9		1163.4	
316.0		32.0		200.0		74.0		220.0							
355.0		32.9		214.0		76.7		232.0				1119.2		1830.8	
337.0		27.6		198.0		70.0		223.0		73.6		877.9		1003.9	
314.0				198.0		69.1		215.0							
335.0		29.7		210.0				231.0		69.0		951.8			
318.0		31.8		198.0		70.3		216.0		76.0					
323.0		29.3		202.0		69.5		220.0		77.5		912.3		1201.4	
315.0		29.7		191.0		72.5		210.0		75.3		1086.0		1578.4	
318.0		29.8		198.0		70.3		221.0		74.9		965.7		1490.8	
327.0		32.0		191.0		68.2		210.0		76.1		1040.2			
289.0		28.9		175.0				196.0		72.8					
338.0		28.5		208.0		68.8						1072.2			
328.0		31.9		207.0				230.0		72.5		1120.1			
331.0		31.1		204.0		71.5		221.0		76.2		1034.2		1526.5	
62.0	**19.0**			50.0	**25.0**			58.0	**26.0**						
77.0	**24.0**			61.0	**30.0**			69.0	**31.0**						
88.0	**27.0**							76.0	**35.0**						
97.0	**30.0**			69.0	**34.0**			81.0	**37.0**						
90.0	**28.0**			67.0	**33.0**										
				106.0	**53.0**										
146.0	**45.0**			103.0	**51.0**	36.2	**51.0**								
				131.0	**65.0**							536.9	**53.0**	689.7	**48.0**
180.0	**55.0**			122.0	**61.0**			137.0	**62.0**	56.2	**76.0**	471.0	**46.0**	731.6	**51.0**
217.0	**67.0**	25.2	**83.0**	143.0	**71.0**	54.9	**78.0**	157.0	**71.0**			538.1	**53.0**		
				144.0	**72.0**							565.2	**56.0**	788.8	**55.0**
				185.0	**92.0**	68.9	**98.0**	208.0	**95.0**			942.5	**93.0**	1127.5	**79.0**
325.7	**100.0**	30.3	**100.0**	200.2	**100.0**	70.6	**100.0**	219.9	**100.0**	74.3	**100.0**	1013.0	**100.0**	1435.4	**100.0**

J-5 Sadlermiut males sub-adult calibration data

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	Adult/Sub-Adult	Average Age	3	%	20 and 21	%	28	%	34	%	52	%	59	%	37	%	39	%	62
XIV-C:230	adult	27.5	113.0		291.2		34.1		68.0		28.8		22.2		45.1		18.7		
XIV-C:74	adult	30.0					26.2		67.0				20.9		42.0		20.8		
XIV-C:117	adult	30.0	112.0		401.6		36.7		67.0		28.9		18.8		44.6		20.2		46.3
XIV-C:126	adult	30.0	110.0		433.0		34.7		71.0		28.0		23.4		45.4		20.9		48.2
XIV-C:246	adult	35.0	106.0		409.5		31.6		71.0		26.8		21.5		46.9		20.5		46.2
XIV-C:111	adult	45.0	110.0		362.0		32.7		65.0		34.8		23.8		42.2		19.5		43.4
XIV-C:243	adult	40.0	106.0		327.0		34.4		69.0		25.2		22.3		42.1		18.7		
XIV-C:216	adult	43.5	103.0		317.3		28.4		73.0		29.2		22.1		49.3		20.0		45.8
XIV-C:217	adult	43.5	111.0		417.6		33.9		66.0		26.5		20.3		45.6		20.7		
XIV-C:179	adult	45.0	111.0		501.1		38.5		74.0		28.8		23.1		47.1		20.5		
XIV-C:182	adult	47.5	112.0		362.0		32.7		77.0		30.2		22.9		45.5		20.9		48.5
XIV-C:157	adult	50.0	111.0		322.0		30.8		63.0		25.8		20.6		43.8		18.5		42.0
XIV-C:181	adult	50.0	109.0		563.3		39.0		74.0		31.9		25.2		48.4		21.5		51.2
XIV-C:101	adult	52.5					24.9		65.0		25.6		20.1		41.4		18.0		42.3
XIV-C:156	adult	50.0	104.0		358.5		34.3		72.0		31.4		23.3		46.4		21.2		47.6
XIV-C:99	adult	55.0							77.0		30.4		21.5		45.5		21.2		49.9
XIV-C:122	sub-adult	0.1	55.0	**50.0**					17.0	**24.0**	6.0	**21.0**	5.5	**25.0**					
XIV-C:107	sub-adult	0.5											6.4	**29.0**					
XIV-C:120	sub-adult	1.0	62.9	**58.0**					25.0	**36.0**	7.6	**26.0**	7.5	**34.0**					
XIV-C:77	sub-adult	1.5	67.8	**62.0**					33.0	**47.0**	11.1	**39.0**	8.8	**40.0**					
XIV-C:79	sub-adult	1.5	71.5	**66.0**					32.0	**46.0**			8.9	**40.0**					
XIV-C:78	sub-adult	6.0																	
XIV-C:118	sub-adult	6.5							39.0	**56.0**	14.4	**5.0**	11.2	**51.0**					
XIV-C:76	sub-adult	8.0	98.0	**90.0**	218.2	**56.0**	20.6	**63.0**											
XIV-C:124	sub-adult	10.0	96.2	**88.0**			21.7	**66.0**	41.0	**59.0**	17.4	**60.0**	14.3	**65.0**					
XIV-C:220	sub-adult	10.5	91.0	**83.0**	241.6	**62.0**			40.0	**57.0**	17.2	**60.0**	12.5	**57.0**					30.4
XIV-C:75	sub-adult	11.5			251.3	**64.0**	23.3	**71.0**											
XIV-C:158	sub-adult	14.5	102.0	**93.0**	290.4	**75.0**	28.4	**86.0**	52.0	**74.0**	25.7	**89.0**	17.5	**80.0**	37.2	**82.0**	17.5	**87.0**	35.4
XIV-C:73	sub-adult	17.5					28.7	**87.0**	60.0	**86.0**					37.1	**82.0**	17.9	**89.0**	40.6
XIV-C:146	sub-adult	18.5	102.0	**93.0**	323.7	**83.0**	27.9	**85.0**	62.0	**89.0**	25.3	**88.0**	21.6	**98.0**	40.5	**90.0**	18.3	**91.0**	43.8
XIV-C:193	sub-adult	19.5	109.0	**100.0**			30.9	**94.0**			26.4	**92.0**	19.7	**90.0**	42.2	**94.0**	18.2	**91.0**	45.6
		AVERAGE	109.1	**100.0**	389.7	**100.0**	32.9	**100.0**	69.9	**100.0**	28.8	**100.0**	22.0	**100.0**	45.1	**100.0**	20.1	**100.0**	46.5

* shaded squares denote the closest percentage to the adult average of 100%

%	42	%	56 and 57	%	60	%	44	%	45	%	48	%	50	%	53	%	55	%	58	%
	21.0				364.0		44.9		48.2		82.0		473.0				75.6			
	21.7		608.5		353.0										353.0		76.2		44.1	
	20.4		947.2		338.0		50.7		50.3		84.0		429.0		348.0		77.9		51.6	
	20.9		755.6		346.0		47.7		47.3		83.9		435.0		349.0		76.8		52.7	
	20.2		961.2		321.0		48.9		49.8		83.4		432.0		338.0		73.7		53.6	
	19.4		677.6		351.0		47.9		47.3		83.2		418.0		362.0		73.6		49.9	
	19.5		858.9		353.0		44.9		46.5		79.0		454.0		353.0		72.5		52.7	
	23.8				325.0		47.2				86.5		441.0		351.0		76.5		56.9	
	21.0		767.3		335.0		44.0		47.7		82.1		443.0		340.0					
	20.8		1002.1		329.0		48.1		51.0				436.0		332.0		78.9		57.5	
	20.3		860.3		336.0		45.5		47.4		84.6		421.0		335.0		78.3		53.4	
	20.1		839.0		336.0		40.2		44.7		75.6		439.0		340.0		70.5		52.3	
			881.7		340.0		48.7		51.7		89.6		455.0		346.0		81.8		62.3	
	19.6		636.4				43.8		40.7		79.2		409.0		324.0		70.8		47.9	
	22.0		874.2		346.0		47.9		50.8		89.6		452.0		349.0		80.2		55.1	
	23.1		647.0		351.0		49.2		47.8		84.3		450.0		359.0		77.4		53.3	
					58.0	**17.0**							72.0	**16.0**	62.0	**18.0**	14.1	**19.0**	11.8	**22.0**
															77.0	**22.0**	16.3	**21.0**	12.0	**23.0**
					88.0	**26.0**							110.0	**25.0**	88.0	**25.0**	22.1	**29.0**	14.5	**27.0**
					94.0	**28.0**							122.0	**28.0**	97.0	**28.0**	26.0	**34.0**	15.9	**30.0**
															90.0	**26.0**	21.3	**28.0**	14.4	**27.0**
					150.0	**44.0**							195.0	**44.0**	146.0	**42.0**	36.6	**48.0**	22.0	**41.0**
																	48	**63.0**		
							29.3	**63.0**	29.0	**61.0**	56.2	**67.0**	236.0	**54.0**	180.0	**52.0**	40.4	**53.0**	28.4	**53.0**
65.0			443.1	**55.0**	213.0	**62.0**	34.5	**74.0**	35.5	**74.0**			276.0	**63.0**	217.0	**63.0**	56.6	**74.0**	40.3	**76.0**
76.0			634.0	**78.0**	308.0	**90.0**	42.2	**91.0**	42.7	**89.0**	71.8	**86.0**	385.0	**88.0**	320.0	**93.0**	65.4	**86.0**	44.8	**84.0**
87.0	17.3	**83.0**			308.0	**90.0**														
94.0	20.0	**96.0**	773.0	**96.0**	337.0	**99.0**	44.1	**95.0**	42.4	**89.0**	79.7	**96.0**	433.0	**99.0**	335.0	**97.0**	75.3	**99.0**	52.0	**98.0**
98.0	18.9	**90.0**	739.3	**91.0**	334.0	**98.0**	42.6	**91.0**	45.3	**95.0**	77.2	**93.0**	434.0	**99.0**	346.0	**100.0**	69.8	**92.0**	51.1	**96.0**
100.0	20.9	**100.0**	808.4	**100.0**	341.6	**100.0**	46.6	**100.0**	47.9	**100.0**	83.4	**100.0**	439.1	**100.0**	345.3	**100.0**	76.0	**100.0**	53.1	**100.0**

40	**%**	**64**	**%**	**65**	**%**	**68**	**%**	**22 and 23**	**%**	**24 and 25**	**%**	**26 and 27**	**%**	**32**	**%**
254.0								771.3		1044.4		1472.8		276.0	
241.0		70.8		44.4		59.2		1017.6		1117.0		1618.0			
227.0		76.6		51.3		67.4		1202.6		1273.1		1631.7		264.0	
231.0		77.0		55.7		75.0		1118.3		1113.3		1733.4		257.0	
233.0		74.5		55.1		79.0		1108.3		1191.1		1624.6		260.0	
247.0		83.9		59.4								1630.4			
244.0		73.5		52.5		76.0				1103.4		1524.3			
239.0		77.7		54.6		79.0		1187.8		1251.8				258.0	
238.0		75.5		56.5				1132.0		1264.6				270.0	
		77.0		55.9		79.0		1218.2		1299.6		1929.1		284.0	
239.0		75.3		54.6		78.0		1274.0		1464.7		1518.9		278.0	
237.0								1136.3		1196.3		1585.7		259.0	
232.0		89.2		66.1		88.0		1639.1		1728.5		2160.0		294.0	
230.0		70.6		48.7		62.6		1030.5		1046.5		1394.5		260.0	
226.0		86.1		59.7		87.0		1093.2		1320.0		1651.4		286.0	
238.0		80.8		57.6											
58.0	**24.0**														
69.0	**29.0**														
76.0	**32.0**														
81.0	**34.0**														
		36.2	**47.0**	20.6	**37.0**										
								462.8	**40.0**	536.9	**43.0**	689.7	**42.0**	182.0	**67.0**
137.0	**58.0**							419.1	**36.0**	471.0	**38.0**	731.6	**44.0**		
157.0	**66.0**	54.9	**71.0**	35.2	**64.0**	44.8	**59.0**	541.7	**47.0**	538.1	**43.0**				
										565.2	**45.0**	788.8	**48.0**	203.0	**75.0**
212.0	**89.0**	66.6	**86.0**	43.2	**78.0**	69.0	**91.0**	794.7	**69.0**	883.6	**71.0**	1346.6	**82.0**	244.0	**90.0**
208.0	**88.0**	68.9	**89.0**	51.0	**92.0**			806.9	**70.0**	942.5	**76.0**	1127.5	**68.0**	253.0	**94.0**
218.0	**92.0**	73.7	**95.0**	51.6	**93.0**	75.0	**99.0**	871.7	**76.0**	940.1	**76.0**	1553	**94.0**		
238.0	**100.0**	77.3	**99.0**	55.2	**100.0**			1039.1	**90.0**	1097.7	**88.0**	1406.5	**85.0**	250.0	**92.0**
237.1	**100.0**	77.8	**100.0**	55.2	**100.0**	75.5	**100.0**	1148.4	**100.0**	1243.9	**100.0**	1651.9	**100.0**	270.5	**100.0**

J-6 Sacred Heart females sub-adult calibration data

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	Adult/Sub-Adult	Average Age	3	%	4	%	66	%	28 and 29	%	37	%	39	%	33	%	34	%	59
88	Adult	22.0	101.0	100.0	94.7	100.0	58.0	106.0	1264.5	112.0	40.6	101.0	19.4	102.0	312.0	102.0	61.0	98.0	20.9
24	Adult	25.5	97.0	96.0	89.7	95.0	50.2	92.0	791.9	70.0	37.5	93.0	16.3	86.0	307.0	100.0	54.0	87.0	20.8
9	Adult	37.0	103.0	102.0	95.6	101.0	59.2	108.0	1245.2	110.0	42.7	106.0	20.2	106.0	289.0	94.0	65.0	104.0	20.1
120	Adult	37.0	104.0	103.0	95.9	101.0			1022.1	91.0	42.0	104.0	19.9	105.0	330.0	108.0	70.0	112.0	27.2
124B	Adult	42.5	106.0	105.0	99.8	105.0	52.3	95.0	1087.0	96.0	38.3	95.0	19.1	101.0	304.0	99.0	63.0	101.0	22.4
97	Adult	45.0	105.0	104.0	97.8	103.0	61.4	112.0	1439.3	128.0	43.3	108.0	19.8	104.0	318.0	104.0	65.0	104.0	22.3
71	Adult	52.5	100.0	99.0			57.8	105.0			41.2	102.0	20.4	107.0	308.0	101.0	65.0	104.0	21.3
5	Adult	54.5	95.0	94.0	88.3	93.0	46.9	86.0	758.6	67.0	36.6	91.0	17.5	92.0	293.0	96.0	57.0	91.0	19.8
114	Adult	50.0	100.0	99.0	94.4	100.0	51.8	95.0			38.9	97.0	18.6	98.0	284.0	93.0	57.0	91.0	22.3
122	Adult	50.0	103.0	102.0	96.7	102.0	55.6	101.0	1412.7	125.0	40.4	100.0	18.8	99.0	317.0	104.0	66.0	106.0	23.1
56	Sub-adult	0.5					13.7	25.0							80.0	26.0	28.0	45.0	7.7
44	Sub-adult	0.8													97.0	32.0	25.0	40.0	7.3
66A	Sub-adult	3.0	76.7	76.0	73.5	78.0	22.7	41.0							125.0	41.0	32.0	51.0	9.8
25	Sub-adult	3.5					33.2	61.0	594.3	53.0					149.0	49.0	35.0	56.0	12.8
36	Sub-adult	5.0	85.0	84.0	80.4	85.0	35.0	64.0							168.0	55.0	41.0	66.0	14.1
67	Sub-adult	6.0	85.0	84.0	81.9	86.0	32.9	60.0	453.7	40.0					157.0	51.0	37.0	59.0	13.6
12	Sub-adult	9.0	92.0	91.0	84.0	89.0	48.1	88.0	712.0	63.0					215.0	70.0	48.0	77.0	17.5
90	Sub-adult	19.0	96.0	95.0	89.3	94.0	50.1	91.0	1233.2	109.0	39.2	98.0	18.7	98.0	288.0	94.0	61.0	98.0	23.3
		AVERAGE	101.4	100.0	94.8	100.0	54.8	100.0	1127.7	100.0	40.2	100.0	19.0	100.0	306.2	100.0	62.3	100.0	22.0

* shaded squares denote the closest percentage to the adult average of 100%

%	51	%	11	%	14	%	17	%	12 and 13	%	44	%	45	%	50	%	60	%	38	%
	80.0		130.0		20.4				1052.1		42.6		42.7		435.0		345.0		41.3	
	78.0		120.0		17.8		85.8		869.0		39.1		40.4		428.0		323.0		38.2	
	82.0		126.0		19.4		92.4		953.8		42.7		41.4		406.0		333.0		40.0	
	99.0		123.0		23.0		94.8		907.5		45.8		45.7		463.0		387.0		43.1	
	81.0		130.0		22.0		94.4		913.4		41.5		39.2		410.0		323.0		40.9	
	87.0		134.0		21.8		97.9		1020.5		43.2		43.1		446.0				41.4	
	87.0		129.0		22.1		91.6		786.5		43.6		43.0		424.0		341.0		44.5	
	75.0		121.0		14.8		78.9		650.6		35.5		34.8		422.0		332.0		34.9	
	82.0		132.0		22.8		96.6		833.7		42.6		41.9		413.0		326.0		39.3	
	85.0				23.4		88.5				45.5		44.7		446.0				42.1	
35.0	32.0	**38.0**					62.6	**69.0**							91.0	**21.0**	76.0	**22.0**		
33.0	28.0	**33.0**					64.2	**70.0**							123.0	**29.0**	95.0	**28.0**		
45.0	42.0	**50.0**			18.1	**87.0**	69.0	**76.0**							166.0	**39.0**	125.0	**37.0**		
58.0	42.0	**50.0**					68.9	**76.0**							206.0	**48.0**	167.0	**49.0**	18.8	**46.0**
64.0	49.0	**59.0**	116.0	**91.0**	14.6	**70.0**	73.6	**81.0**	830.8	**94.0**	24.3	**58.0**	24.6	**59.0**	230.0	**54.0**	186.0	**55.0**		
62.0	46.0	**55.0**			18.1	**87.0**	73.5	**81.0**			21.1	**50.0**	22.6	**54.0**	215.0	**50.0**	170.0	**50.0**		
80.0	59.0	**71.0**	136.0	**107.0**	19.3	**93.0**	84.4	**93.0**	814.8	**92.0**					309.0	**72.0**	242.0	**71.0**		
106.0	81.0	**97.0**	123.0	**97.0**	16.7	**80.0**	96.3	**106.0**	770.1	**87.0**	39.6	**94.0**	39.3	**94.0**	418.0	**97.0**	322.0	**95.0**	37.1	**91.0**
100.0	83.6	**100.0**	127.2	**100.0**	20.8	**100.0**	91.2	**100.0**	887.4	**100.0**	42.2	**100.0**	41.7	**100.0**	429.3	**100.0**	338.8	**100.0**	40.6	**100.0**

53	%	57	%	41	%	64	%	40	%	48	%	24 and 25	%	26 and 27	%
354.0		32.5		226.0		74.9		246.0		73.5		923.2		1416.9	
342.0				220.0		67.9		228.0		72.7		707.4		913.2	
336.0		33.7		206.0		76.2		223.0		72.8		843.4		1407.0	
405.0		36.7		234.0				244.0		73.7		869.5			
332.0		30.2		216.0		77.3				68.5		861.6		1364.0	
361.0		35.0		226.0		78.6		245.0		79.5		1121.8		1467.2	
349.0		30.6		222.0		74.3		241.0		77.0		900.2		1291.6	
357.0		28.1		226.0		68.8		243.0		65.4				936.2	
337.0		31.8		210.0		71.9		224.0		76.6		862.9		1120.6	
361.0		32.4				79.8		241.0		74.0		1083.5		1537.0	
81.0	**23.0**			62.0	**28.0**	16.3	**22.0**	69.0	**29.0**						
100.0	**28.0**			72.0	**33.0**			80.0	**34.0**						
132.0	**37.0**			90.0	**41.0**	31.5	**42.0**	100.0	**42.0**						
170.0	**48.0**			113.0	**51.0**	40.5	**54.0**	123.0	**52.0**	48.4	**66.0**	356.5	**39.0**	471.2	**37.0**
191.0	**54.0**	22.5	**70.0**	124.0	**56.0**	43.2	**58.0**	139.0	**59.0**	51.9	**71.0**				
176.0	**50.0**	22.3	**69.0**	111.0	**50.0**	41.8	**56.0**	123.0	**52.0**					466.3	**37.0**
250.0	**71.0**	30.7	**95.0**	158.0	**72.0**	58.8	**79.0**	170.0	**72.0**	61.1	**83.0**	495.1	**55.0**	750.8	**59.0**
341.0	**96.0**	28.9	**89.0**	220.0	**100.0**					69.4	**95.0**	932.4	**103.0**		
353.4	**100.0**	32.3	**100.0**	220.7	**100.0**	74.4	**100.0**	237.2	**100.0**	73.4	**100.0**	908.2	**100.0**	1272.6	**100.0**

J-7 Sacred Heart males sub-adult calibration data

BSI Measurements (original numbering see Appendix B, B-1)

Skeleton #	Adult/Sub-Adult	Average Age	3	%	20 and 21	%	28	%	34	%	52	%	59	%	37	%	39	%	62
139	Adult	32.5	102.0	**96.0**	286.2	**77.0**	31.8	**97.0**	65.0	**97.0**	27.9	**98.0**	25.2	**104.0**	48.1	**103.0**	23.7	**109.0**	45.1
115	Adult	37.0	107.0	**101.0**	313.3	**85.0**	31.3	**96.0**	68.0	**102.0**	30.3	**106.0**	25.3	**104.0**	44.9	**96.0**	20.5	**94.0**	43.8
145	Adult	40.0			376.8	**102.0**	31.5	**96.0**	65.0	**97.0**	26.1	**92.0**	20.5	**84.0**	44.0	**94.0**	19.9	**91.0**	40.5
30	Adult	42.5	108.0	**102.0**	416.1	**113.0**	35.9	**110.0**	68.0	**102.0**	29.2	**102.0**	24.8	**102.0**	52.8	**113.0**	23.5	**108.0**	51.7
72	Adult	42.5	108.0	**102.0**	290.1	**79.0**	30.2	**92.0**	57.0	**85.0**	26.8	**94.0**	21.8	**90.0**					41.3
33	Adult	44.5	103.0	**97.0**	348.9	**94.0**			64.0	**96.0**	26.7	**94.0**	27.2	**112.0**	44.2	**94.0**	21.3	**98.0**	44.0
73	Adult	45.0	104.0	**98.0**	299.9	**81.0**	31.3	**96.0**	68.0	**102.0**	28.4	**100.0**	22.5	**93.0**	43.4	**93.0**	21.2	**97.0**	43.8
64	Adult	52.5	111.0	**105.0**	455.5	**123.0**	33.9	**104.0**	70.0	**105.0**	31.5	**111.0**	24.4	**100.0**	48.4	**103.0**	22.3	**102.0**	55.3
83	Adult	55.0	104.0	**98.0**	455.1	**123.0**	32.1	**98.0**	69.0	**103.0**	28.0	**98.0**	25.6	**105.0**	46.4	**99.0**	20.6	**94.0**	47.7
55	Adult	60.0	105.0	**99.0**	453.5	**123.0**	36.1	**110.0**	73.0	**109.0**	30.0	**105.0**	25.5	**105.0**	50.0	**107.0**	23.5	**108.0**	43.9
56	Sub-adult	0.5							28.0	**42.0**	9.6	**34.0**	7.7	**32.0**					
44	Sub-adult	0.8							25.0	**37.0**	8.5	**30.0**	7.3	**30.0**					
66A	Sub-adult	3.0	76.7	**72.0**					32.0	**48.0**	12.0	**42.0**	9.8	**40.0**					
25	Sub-adult	3.5			154.1	**42.0**	18.2	**56.0**	35.0	**52.0**	13.6	**48.0**	12.8	**53.0**					
36	Sub-adult	5.0	85.0	**80.0**					41.0	**61.0**	14.0	**49.0**	14.1	**58.0**					
67	Sub-adult	6.0	85.0	**80.0**	116.1	**31.0**	16.9	**52.0**	37.0	**55.0**	14.3	**50.0**	13.6	**56.0**					
12	Sub-adult	9.0	92.0	**87.0**	217.7	**59.0**	21.7	**66.0**	48.0	**72.0**	16.6	**58.0**	17.5	**72.0**					
141	Sub-adult	15.5	101.0	**95.0**	303.0	**82.0**	31.7	**97.0**	70.0	**105.0**	29.0	**102.0**	21.7	**89.0**	41.0	**87.0**	17.7	**81.0**	37.6
63	Sub-adult	19.0	110.0	**104.0**	268.5	**73.0**	27.0	**83.0**	60.0	**90.0**	22.9	**80.0**	20.4	**84.0**	37.7	**80.0**	19.5	**89.0**	40.9
		AVERAGE	105.8	**100.0**	369.5	**100.0**	32.7	**100.0**	66.7	**100.0**	28.5	**100.0**	24.3	**100.0**	46.9	**100.0**	21.8	**100.0**	45.7

*** shaded squares denote the closest percentage to the adult average of 100%**

%	42	%	56 and 57	%	60	%	44	%	45	%	48	%	50	%	53	%	55	%	58	%
99.0	23.7	101.0	981.7	112.0	357.0	97.0	48.5	103.0	47.3	100.0	85.5	104.0	471.0	100.0	376.0	99.0	79.8	102.0	52.1	97.0
96.0	21.9	93.0	806.2	92.0	370.0	101.0	45.8	97.0	45.9	97.0	83.1	101.0	468.0	99.0	384.0	101.0	78.3	100.0	51.0	95.0
89.0	22.2	94.0	804.9	92.0	338.0	92.0	43.5	92.0	44.4	94.0	77.2	94.0	426.0	90.0	343.0	90.0	75.9	97.0	49.6	93.0
113.0	25.8	110.0	995.5	113.0	384.0	105.0	49.3	104.0	48.9	103.0	86.4	105.0	499.0	106.0	404.0	106.0	84.3	108.0	57.5	107.0
90.0	27.1	115.0	839.2	96.0			45.3	96.0	44.6	94.0	76.3	93.0	467.0	99.0	359.0	94.0	71.0	91.0	48.8	91.0
96.0	22.5	96.0	933.8	106.0	372.0	101.0	46.4	98.0	47.0	99.0	80.4	98.0	504.0	107.0	400.0	105.0	77.1	99.0		
96.0	20.4	87.0	743.7	85.0	352.0	96.0	46.7	99.0	46.2	98.0	78.6	96.0	449.0	95.0	360.0	95.0	75.1	96.0	55.7	104.0
121.0	24.1	102.0	891.1	101.0	371.0	101.0	48.8	103.0	49.0	104.0	86.1	105.0	483.0	102.0	395.0	104.0	82.0	105.0	57.4	107.0
104.0	22.1	94.0	833.1	95.0	379.0	103.0	48.2	102.0	48.7	103.0	80.9	98.0	471.0	100.0	388.0	102.0	80.4	103.0	51.3	96.0
96.0	24.7	105.0	953.1	109.0	379.0	103.0	50.8	107.0	50.5	107.0	87.8	107.0	480.0	102.0	394.0	104.0	77.2	99.0	57.7	108.0
					76.0	21.0							91.0	19.0	81.0	21.0	20.5	26.0		
					95.0	26.0							123.0	26.0	100.0	26.0	22.7	29.0		
					125,0	34.0							166.0	35.0	132.0	35.0	29.6	38.0		
					167.0	46.0					48.4	59.0	206.0	44.0	170.0	45.0	39.0	50.0		
			337.4	38.0	186.0	51.0	24.3	51.0	24.6	52.0	51.9	63.0	230.0	49.0	191.0	50.0	42.5	54.0		
			259.1	30.0	170.0	46.0	21.1	45.0	22.6	48.0			215.0	46.0	176.0	46.0	38.2	49.0		
			609.7	69.0	242.0	66.0					61.1	74.0	309.0	65.0	250.0	66.0	52.4	67.0		
82.0	18.1	77.0	737.4	84.0	329.0	90.0	41.3	87.0	43.1	91.0	75.2	91.0	420.0	89.0	358.0	94.0	68.7	88.0	46.4	87.0
89.0	18.2	77.0	746.5	85.0	345.0	94.0	41.6	88.0	40.8	86.0	73.6	90.0	451.0	96.0	360.0	95.0	66.0	85.0	45.1	84.0
100.0	23.5	100.0	878.2	100.0	366.9	100.0	47.3	100.0	47.3	100.0	82.2	100.0	471.8	100.0	380.3	100.0	78.1	100.0	53.5	100.0

40	%	64	%	65	%	68	%	22 and 23	%	24 and 25	%	26 and 27	%	32	%
		73.5	**92.0**	49.1	**87.0**	80.0	**99.0**	1028.5	**89.0**	1161.3	**91.0**	1519.0	**96.0**		
267.0	**101.0**	79.0	**99.0**	57.8	**102.0**	78.0	**97.0**			1085.8	**85.0**	1316.4	**83.0**		
250.0	**95.0**	75.4	**94.0**	53.4	**95.0**	75.0	**93.0**	1122.9	**97.0**	1352.8	**106.0**			270.0	
289.0	**109.0**	82.6	**103.0**	58.8	**104.0**	89.0	**110.0**	1517.9	**131.0**	1783.7	**139.0**	1928.2	**121.0**	291.0	
242.0	**92.0**	76.1	**95.0**	51.5	**91.0**	76.0	**94.0**	910.6	**79.0**	992.1	**77.0**	1405.0	**89.0**		
272.0	**103.0**	81.9	**102.0**	58.3	**103.0**	82.0	**101.0**	984.2	**85.0**	1180.2	**92.0**			292.0	
255.0	**97.0**	78.9	**98.0**	53.6	**95.0**	78.0	**97.0**	1094.6	**95.0**	1100.4	**86.0**	1497.0	**95.0**		
263.0	**100.0**	82.6	**103.0**	59.0	**105.0**	82.0	**101.0**	1118.3	**97.0**	1342.5	**105.0**	1666.5	**105.0**	290.0	
258.0	**98.0**	84.9	**106.0**	62.6	**111.0**	85.0	**105.0**	1161.8	**100.0**	1168.9	**91.0**	1390.7	**88.0**		
282.0	**107.0**	87.2	**109.0**	60.0	**106.0**	83.0	**103.0**	1481.4	**128.0**	1652.7	**78.0**	1945.5	**123.0**		
69.0	**26.0**	16.3	**20.0**												
80.0	**30.0**														
100.0	**38.0**	31.5	**39.0**	20.9	**37.0**										
123.0	**47.0**	40.5	**50.0**	25.4	**45.0**			345.6	**30.0**	356.5	**28.0**	471.2	**30.0**		
139.0	**53.0**	43.2	**54.0**	27.8	**49.0**										
123.0	**47.0**	41.8	**52.0**	25.5	**45.0**	42.0	**52.0**					466.3	**29.0**		
170.0	**64.0**	58.8	**73.0**	36.7	**65.0**	59.0	**73.0**	536.4	**46.0**	495.1	**39.0**	750.8	**47.0**		
245.0	**93.0**	75.2	**94.0**	51.9	**92.0**	76.0	**94.0**	780.1	**67.0**	912.4	**71.0**	1395.3	**88.0**		
		76.6	**96.0**	54.1	**96.0**	72.0	**89.0**	1017.6	**88.0**	1074.4	**84.0**	1217.9	**77.0**		
264.2	**100.0**	80.2	**100.0**	56.4	**100.0**	80.8	**100.0**	1157.8	**100.0**	1282.0	**100.0**	1583.5	**100.0**	no data	no data

APPENDIX K: GROWTH FLUCTUATION PATTERNING DATA

K-1 Sadlermiut females regression summary

BSI Pairs (Chronological numbering see Appendix H, H-1)

Skeleton #	V1:V2	V1:V4	V1:V7	V1:V11	V1:V13	V1:V17	V1:V20	V1:V22	V1:V24	V2:V4	V2:V26	V2:V27	V3:V6	V3:V7	V3:V8	V3:V9	V3:V10	V3:V15	V3:V16	V3:V17
XIV-C:96																				
XIV-C:112			+			+	+	+		+				+			+	+	+	+
XIV-C:175		-	-			-	-	-	-											
XIV-C:105	-							+	+						+			+		
XIV-C:145																+				
XIV-C:149		-		-			+		+	-		-			-	-		-	-	
XIV-C:153	+																			
XIV-C:103			-		+						-									
XIV-C:104	+			-					-											
XIV-C:98	-			-	-								-	-						
XIV-C:155	+	+		+							+			-	+			-		-
XIV-C:219		+								+	-									
XIV-C:183			+		-	+										-				+
XIV-C:148													-	-						-
XIV-C:100			+		+		+				+									
XIV-C:192		-									+		-		-					
XIV-C:221				+		+							+		-	-	-			

plus (+) = above the regression line

minus (-) = below the regression line

V3:V18	V3:V19	V3:V20	V3:V21	V3:V22	V3:V23	V3:V24	V3:V25	V3:V26	V4:V6	V4:V7	V4:V8	V4:V9	V4:V11	V4:V16	V4:V19	V4:V21	V4:V22	V4:V23	V4:V26	V4:V27	V5:V6
+		+		+		+				+							+				+
														-		-	-	-			-
	+		+		+																
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											-	-				-	-		-	-	+
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	-		+			+		+	-		-		+		-	+			+		-
-									+			-	+	+							+

Row	V5:V7	V5:V8	V5:V17	V5:V18	V5:V19	V5:V20	V5:V22	V5:V24	V5:V27	V6:V7	V6:V8
1		+	+		-				-		+
2	+	+	+	+	+	+	+	+	+	+	
3	-	-	-		-	-	-	-		-	-
4		+			+						+
5										+	+
6		-	+	+		+		+			-
7		+	-	-	-	-		-			+
8	-		-							-	
9	+									+	-
10					+					+	+
11		+					-	-	+	-	+
12	+				+						
13	-	-		-	-	-	-	-			-
14											
15	+	+			+					+	+
16		-					+	+		+	
17		-								-	-

Row	V6:V16	V6:V17	V6:V18	V6:V19	V6:V20	V6:V22	V6:V23	V6:V24	V6:V27	V7:V8	V7:V9
1		+		-					-	+	+
2		+	+		+	+		+			
3	-	-		-	-	-	-	-			
4	-	-					+			+	
5			+	+	+		+		+		+
6	-		+	-	+				-	-	-
7	-	-	-		-		-	-		+	+
8										+	
9										-	
10	+	+		+	+	+		+			
11		-	-	-	-	-		-		+	+
12			-		-	-					
13		+				-		-		-	-
14											
15				+			-				
16	+	+			+	+		+		-	-
17										-	-

V7:V10	V7:V15	V7:V16	V7:V17	V7:V18	V7:V19	V7:V20	V7:V21	V7:V22	V7:V23	V7:V24	V7:V26	V7:V27	V8:V9	V8:V10	V8:V15	V8:V16	V8:V19	V8:V20	V8:V22	V8:V23	V8:V24
+	-		+		-	+	+					-	+	+	-		-			-	
														+	+	+		+	+		+
														-	-	-				-	
	+	-	-		+		+		+				-			-		-		+	
					+				+				+							+	
	-	-		+	-	+	-				-	-						+			+
-			-	-		-				-				-		-	-	-	-	-	-
				+		+		+		+			-								+
	-	-	-	-	-	-	+	-		-			+	+							
+	+	+	+		+			+			-		-		+		+				
	-	+		+					+		+	+			-		-	-	-		-
				-		-	-	-		-	-					+	+				
	-		+				+	-	-	-			-	+			+				
	+																-	-	-		-
							-		-											-	
					-		+	+		+	+					+			+		+
-		+	+										-	-	+	+	+		+	+	

V8:V26	V8:V27	V9:V10	V9:V13	V9:V16	V9:V20	V9:V22	V9:V26	V10:V15	V10:V16	V10:V17	V10:V18	V10:V20	V10:V21	V10:V22	V10:V24	V10:V25	V11:V12	V11:V13	V11:V16	V11:V26	V11:V27
	-							-						-	-						
	+	+		+	+	+	+					+		+	+				+	+	+
				-	-	-															
								+	-	-			+				-				
					+		-		-		+	+	-				+				
		-	-		-			+													
-			+		+	+	-					+		+	+	-		+	-	-	
					-					-	-	-	+								
-	-	+	-	+			-	+					-			+			+		
		-			-	-		-	+					-	-						
			+														+	+		-	
+		+					+						+	-	-		-	-		+	
				-	-	-			-	-	-	-		-	-				-		
+						+	+						+	+	+		+				
				+	+	+		+	+	+	+	+	+	+	+	+	-				

V12:V13	V15:V16	V15:V17	V15:V18	V15:V19	V15:V20	V15:V21	V15:V22	V15:V23	V15:V24	V16:V17	V16:V18	V16:V19	V16:V20	V16:V21	V16:V22	V16:V23	V16:V24	V16:V25	V16:V26	V16:V27	V17:V18
	+	+			+	+	+		+			-		+		-		+		-	
													+		+		+				
		-	-		-		-	+				+		+	+	+					+
		+	+	-	+	-	+		+	+	+		+	-	+		+				+
-	-	-	-		-			-	-												
+							+		+			+	+		+		+	-			+
	-			-		+								+				+			
				+	-	-	-	-	-			+		-		-		+	-	-	
	+							+		-	-	-	-	-	-		-				
				+			-						-								-
		+		+		+				+		+		+			-	+	+		
-		-	-	-	-		-		-	-	-	-	-		-		-				
+																					
				-		+	+		+			-		+	+		+	-	+		
	+	+																			-

V17:V19	V17:V20	V17:V21	V17:V22	V17:V23	V17:V24	V17:V25	V17:V26	V18:V19	V18:V20	V18:V22	V18:V24	V18:V27	V19:V20	V19:V22	V19:V23	V19:V24	V20:V22	V20:V23	V20:V24	V20:V26	V21:V22
-		+		-		+							+	+		+		-			
			+		+								+	+		+					+
+		+	+	+	+			+		+	+		-		+		+	+	+		
																		+	-		
-	+	-					-	-		-		-	+	+		+	-		-	-	
													-				+				
+	+		+		+	-			+	+	+			+		+	+		+	-	+
		+				+															
+		-				+	-	+					-	-	-	-	+			-	
			-	+	-		+		-	-	-				+			+		+	
+	-							+	-				-	-					+		
		+	-	-	-					-	-			-	-	-	-	-	-		-
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															-			-			+
-		+			+	-	+	-	+	+	+			+		+	+		+	+	
	-		-		-								+								

V21:V23	V21:V25	V21:V26	V22:V23	V22:V24	V22:V26	V22:V27	V23:V24	V23:V25	V23:V26	V23:V27	V26:V27
-			-			-	+	+			
+							+				
			+				-				
+			+								
				+	-	-			-	-	
				-							
	-	-			-						
				-							
	+	-		-	-	-		+	-		
+		+	+		+	+	-				
				+							
-					+				+		
		+	-						+		
	-			+	+						
				-							

K-2 Sadlermiut males regression summary

Skeleton #	V2:V3	V2:V8	V2:V9	V2:V14	V2:V18	V2:V19	V2:V24	V2:V25	V2:V26	V3:V9	V3:V11	V3:V14	V3:V18	V3:V19	V3:V21	V3:V22	V3:V23	V3:V25	V3:V26	V3:V27
	BSI Pairs (Chronological numbering see Appendix H, H-2)																			
XIV-C:230	+						-											-	-	
XIV-C:74													+	-					+	
XIV-C:117	+			+		-			-					-		-	-		-	-
XIV-C:126				-		-	-	-			-	-						-		-
XIV-C:246	-				-			-	-		+	+								
XIV-C:111			-		-	-				-	-		-	-	+	+				
XIV-C:243	+	-										-	-		-	-		-	-	
XIV-C:216	-					+	+						+	+			+			
XIV-C:217				-							-									
XIV-C:179																				
XIV-C:182		+	+		+		+	+	-	+			+					+	-	+
XIV-C:157		-	-	-	-				+	-	+		-							
XIV-C:181														+	+	+		+	+	
XIV-C:101																				
XIV-C:156		+	+	+	+							+	+		+	+	+			+
XIV-C:99																				

plus (+) = above the regression line

minus (-) = below the regression line

V4:V6	V4:V7	V4:V8	V4:V9	V4:V10	V4:V13	V4:V14	V4:V15	V4:V18	V4:V19	V4:V23	V4:V25	V5:V6	V5:V13	V5:V15	V5:V17	V5:V18	V5:V21	V5:V22	V5:V23	V5:V25	V5:V27
		-									-		-							-	
	-	+		+				+	-	-											
-			+		+	+	+	+				-	+			+		-	-		-
+		+	+								-	+	+		+					-	-
	+			-	+			-					+						+		
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	-	-		-			-	-			-	+			+						
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	+	+																+		+	+
												+	+		-	+					+
	-			-	-					-			-		-		-	-			
					-		-						-	-		-					
+	+	+	+			+	+	+	+	+	+	+		+		+	+	+		+	
	-	-				-		-							-			-			
		+				+	+	+		+				+			+				
-	-											-	+		+						

V6:V15	V6:V19	V6:V21	V6:V22	V6:V23	V6:V25	V6:V26	V6:V27	V7:V8	V7:V9	V7:V10	V7:V11	V7:V12	V7:V14	V7:V15	V7:V18	V7:V19	V7:V22	V7:V23	V7:V25	V7:V26	V8:V9
					-	-		-				+							-	-	
	-	-	-	-				+		+					+	-	-				
+		+			+						+		+		+		-	-			
		-		-	-		-	+	+		-								-		
				+			-			-		-			-	-			-	-	-
	-												+	+			+				-
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			+								-			-							
	+					+				-	+										
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								-					-								
+		+		+			+	+				+		+	+			+			-
		+	+					+	+	+	-	+									

V8:V10	V8:V13	V8:V14	V8:V15	V8:V18	V8:V24	V8:V25	V8:V26	V9:V13	V9:V14	V9:V15	V9:V16	V9:V18	V9:V19	V9:V23	V9:V24	V9:V25	V9:V26	V9:V27	V10:V15	V10:V18	V11:V12
		+		+	-																
				-	-	-															
	+	+		+				+	+			+		-						+	
		-				-									-	-		-			
-	+			-		-		+	+			-									-
-	+							+													
																					+
+			+							+			+								
	-		-																		-
		+		+			+													+	
-	-	-				+	-	-			-						-		+	+	
	-		-					-		-	+								-	-	
				+	+	+	+						+		+		+				
		-							-											-	
			+		-				+	+	+	+		+	-			+	+	+	+
+		-	-							-		-	-								

V11:V14	V11:V19	V11:V23	V12:V17	V13:V14	V13:V15	V13:V18	V14:V15	V14:V18	V14:V19	V14:V21	V14:V22	V14:V23	V14:V25	V14:V26	V14:V27	V15:V18	V15:V19	V15:V21	V15:V22	V15:V23	V15:V25
													-	-							-
	-																				
	-	-			-				-	-	-	-			-	+	-		-	-	
															-						-
					-	-		-		-					-	-		-			
			+	-		-		-	-	+	+					-	-	+	+		
-					-		-	-												+	
			+		+											-		-	-		
																			+		
			-	+						-											
			-		+	+	+	+					+		+	+		-			+
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+	+	+		+	+	+			+	+	+		+	+	+		+		+		+
-				-		-										-	-				
+		+		+	+	+	+			+											
+	+			-				+													

V15:V26	V15:V27	V16:V19	V16:V23	V18:V19	V18:V21	V18:V25	V18:V26	V18:V27	V19:V21	V19:V22	V19:V23	V19:V24	V19:V25	V19:V26	V19:V27	V21:V22	V21:V23	V21:V24	V21:V25	V21:V26	V21:V27
-	+					-	-	+													
				-	-	-								+		-	-				
			-	-				-			-					-	-				
	-					-		-					-						-	-	-
	-								-		+	-				+	+				
					+				+	+											
		-	-						-				-	-			+				
	-	+		+				-		-			-		-						-
																+					
		+			-		+		-	-											+
-			+		-	+	-					+	+	-	+		+	+	+	+	+
		-				+															
+	+	+		+		+	+					+	+								
							-		+	+	+	-			+			-	-	-	
		-								+											

V22:V23	V22:V24	V22:V25	V22:V26	V22:V27	V23:V25	V23:V27	V24:V25	V24:V26	V25:V26	V25:V27
										+
-										-
		-		-	-	-	-		+	
		-		-	-	-				
			-							
		-			-					
+				-		-				-
	-									
			+	+		+		+	+	+
	+	+	-	+	+		+	-	-	
										-
	+				+					
-							-	-		
	-						+			+

K-3 Sacred Heart females regression summary

BSI Pairs (Chronological numbering see Appendix H, H-1)

Skeleton #	V1:V2	V1:V4	V1:V5	V1:V6	V1:V8	V1:V12	V1:V13	V1:V14	V1:V15	V1:V19	V1:V23	V1:V27	V2:V4	V2:V6	V2:V8	V2:V11	V2:V12	V2:V13	V2:V15	V2:V19
88								+				+								
24				-																
9			+			-								+			-			
120	-	-			+										+	-	+		+	+
124B			-						-				-						-	
97																				
71			+	+	+	+			+	+										
5																				
114	+				-	+	+								-	+	+	+		
122		+				+	-		+		+	+	+					-	+	

plus (+) = above the regression line

minus (-) = below the regression line

V2:V23	V2:V27	V3:V4	V3:V5	V3:V6	V3:V8	V3:V10	V3:V14	V3:V15	V3:V16	V3:V19	V3:V21	V3:V23	V3:V25	V3:V27	V4:V5	V4:V6	V4:V11	V4:V12	V4:V14	V4:V15	V4:V23
	+		-			-															
				-	-									-							
			+														-				
															+	+		+		+	
					+							+	-	+	-		+				+
						+	-			+	-										
-	-							+	+		+		+								
+	+	+			+	+		+	+			+		+							

V4:V25	V4:V26	V4:V27	V5:V6	V5:V8	V5:V10	V5:V15	V5:V16	V5:V19	V5:V21	V5:V23	V5:V25	V5:V27	V6:V8	V6:V15	V6:V19	V6:V23	V6:V27	V7:V9	V7:V10	V7:V17	V7:V18
					-								-		-			-	-		
			-															-	-		-
	-				-		-	-			-										
				+	+				+				+					+	+		
-		+	+	+						+		+								-	-
			+					+	-											-	
						-	-							-	-						
				-							+		-					+			
				+		+	+			+		+	+	+	+	+	+				

V7:V20	V7:V22	V7:V24	V8:V10	V8:V15	V8:V16	V8:V18	V8:V19	V8:V21	V8:V23	V8:V27	V9:V10	V9:V12	V9:V15	V9:V16	V9:V17	V9:V18	V9:V20	V10:V12	V10:V15	V10:V16	V10:V17
										+					+					+	+
-		-																			
			-				-				+										-
+			+																		
-			-		-	-		-			-			-	-	-	-	+			-
								+							+						
							+	-	-	-	+	+	+	+							
+	+	+		-	-		-			-		-	-	-			+	-	-	-	
				+								+			-	-	-	+			-
													+					+	+	+	+

V10:V18	V10:V19	V10:V20	V10:V23	V10:V27	V11:V12	V11:V13	V11:V23	V11:V26	V11:V27	V12:V13	V12:V15	V12:V16	V12:V19	V12:V23	V12:V25	V12:V27	V13:V14	V13:V15	V13:V25	V14:V27	V15:V16
+	+			+												+					
																				-	+
		-					+		+		+			+		+	+				
					+	+						+									
-		-	+								-	-			-				-		-
								+		+					+						
	+	-											+				-		+	+	
	-	+			-	-															
		-	-	-			-	-	-		-		-	-		-	-				
										-								+			

V15:V19	V15:V21	V15:V23	V15:V25	V15:V27	V16:V19	V16:V21	V16:V25	V16:V27	V17:V18	V17:V20	V17:V22	V17:V24	V18:V20	V18:V21	V19:V23	V19:V25	V19:V27	V20:V22	V21:V27	V22:V24	V23:V26
												+						+			
		-		-	-			-	-	-		-			-		-			-	
						+							-	+			+	-			-
							-			+											
		+	-		+			+								-					-
	+	+	+			+	+			+					+	+					+
+	-				+	-						+									
											+	+	+	-							
-		-	+	-	-		+	-								+			-		
															+				+		

V23:V27	V26:V27
+	
	+
-	
	-

K-4 Sacred Heart males regression summary

BSI Pairs (Chronological numbering see Appendix H, H-2)

Skeleton #	V2:V3	V2:V4	V2:V14	V2:V21	V2:V22	V2:V23	V2:V25	V3:V4	V3:V7	V3:V11	V3:V13	V3:V14	V3:V15	V3:V17	V3:V19	V3:V20	V3:V21	V3:V23	V3:V24	V3:V25
139			+		-				+	+	+		+				-			
115		+			+								+	+		+				
145	-		-	-	-	-		-			-	-	-	-	-			-		+
30	+					+	+	+												
72		-																		
33				+	+															
73		+								-					+					
64															+				-	
83	-						-	-			+	+		+			+	+		
55																				

plus (+) = above the regression line

minus (-) = below the regression line

V3:V26	V4:V5	V4:V13	V4:V14	V4:V15	V4:V19	V4:V21	V4:V22	V4:V24	V5:V9	V5:V15	V5:V19	V6:V12	V6:V14	V6:V16	V6:V17	V6:V20	V6:V23	V7:V8	V7:V10	V7:V11	V7:V13
		+		+		-	-			+		-			-			+		+	
-	+	-	-		-				-		-		-	-			-				
	-	-	-	-	-	-															-
		+	+	+	+			+	+	+	+	+	+	+	+	+	+				
														+							
						+	+												+	+	
			-	-			-			-	+								-		
	+												+		+						
-	-			-	-	+	+		+							-		-	-		
									-				+								

V7:V14	V7:V15	V7:V18	V7:V20	V7:V23	V7:V24	V7:V25	V7:V26	V8:V10	V8:V11	V8:V13	V8:V14	V8:V15	V8:V20	V8:V26	V9:V14	V9:V17	V9:V18	V9:V23	V11:V13	V11:V15	V11:V16
				-	-	-								-			+				-
	+											+	+							+	
-	-					+										-			-		-
																		+			
																	-			-	
			+	+					+				+			+			-	-	+
								-	-			-	-			-					
		+	-		-							+	-							+	
+		+		+						+	+							+	+		
+		-													+	+		+	+		

V11:V17	V11:V20	V11:V23	V11:V26	V12:V13	V12:V14	V12:V16	V12:V17	V12:V20	V12:V21	V12:V22	V12:V23	V12:V27	V13:V14	V13:V15	V13:V17	V13:V19	V13:V20	V13:V21	V13:V23	V13:V26	V14:V15
-			-	+					-	-			-			-		-	-		+
	+			-	-				-		-			+	+						+
-																					
											+						+		+	+	
-	-	-											-	-			-				
				-	-	+	+						+		+		+	+	+		
														-	-	+					
+					+		+														
+		+				-	-	-		+			+	-		-	-	+	+	-	-
			+	+	+				+												

V14:V17	V14:V18	V14:V19	V14:V20	V14:V21	V14:V22	V14:V23	V14:V24	V14:V25	V14:V26	V15:V17	V15:V18	V15:V19	V15:V20	V15:V23	V15:V24	V15:V25	V15:V26	V16:V17	V16:V20	V16:V23	V16:V27
				-	-					-		-			-	-					
+					+							-		-		-	-	+			
								+		-						+					
	+		+			+	+	+	+		+		+	+	+	+				+	
																		-	-	-	
+			+	+			-			+			+								
-		+										+									
													-								
		-	-		+			-	-	+	+			+				+		+	
	-										-								+		

V17:V18	V17:V19	V17:V20	V17:V21	V17:V22	V17:V23	V17:V27	V18:V20	V18:V23	V19:V20	V19:V24	V19:V25	V19:V26	V19:V27	V20:V21	V20:V23	V20:V24	V20:V25	V20:V26	V21:V22	V21:V23	V21:V27
+			-	-																	
	-				-			-							-		-	-	+		
								-			+						+				
		+			+						+									+	
-																					
-							+									-	-				
	+								-		-	-							-		
		-								-											
	-	-	+	+	+		-							+	+						
-		+	+				+	+													

V22:V23	V22:V27	V23:V24	V23:V25	V24:V25	V24:V26	V25:V26
-						-
-			+	+		
+						
		-				
				-		
				+		
			-	-	-	-
		+	+			

K-5 Sadlermiut females growth fluctuation pattern maps
(chronological numbering see Appendix H, H-1)

Age Range

VIX-C:96	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V5:V8									+	+								
V5:V17									+	+	+	+						
V5:V19									-	-	-	-	-					
V5:V27									-	-	-	-	-	-	-	-	-	-
V6:V8									+	+								
V6:V17									+	+	+	+						
V6:V19									-	-	-	-	-					
V6:V27									-	-	-	-	-	-	-	-	-	-
V7:V8									+	+								
V7:V9									+	+								
V7:V10									+	+								
V7:V15									-	-	-	-						
V7:V17									+	+	+	+						
V7:V19									-	-	-	-	-					
V7:V20									+	+	+	+	+					
V7:V21									+	+	+	+	+					
V7:V27									-	-	-	-	-	-	-	-	-	-
V8:V9										+								
V8:V10										+								
V8:V15										-	-	-						
V8:V19										-	-	-	-					
V8:V23										-	-	-	-					
V8:V27										-	-	-	-	-	-	-	-	-
V10:V15										-	-	-						
V10:V22										-	-	-	-					
V10:V24										-	-	-	-	-				
V15:V16												+						
V15:V17												+						
V15:V20												+	+					
V15:V21												+	+					
V15:V22												+	+					
V15:V24												+	+	+				
V16:V19												-	-					
V16:V21												+	+					
V16:V23												-	-					
V16:V25												+	+	+				
V16:V27												-	-	-	-	-	-	-
V17:V19												-	-					
V17:V21												+	+					
V17:V23												-	-					
V17:V25												+	+	+				
V19:V20													+					

V19:V22													+					
V19:V24													+	+				
V20:V23													-					
V21:V23													-					
V22:V23													-					
V22:V27													-	-	-	-	-	-
V23:V24													+	+				
V23:V25													+	+				

Age Range

XIV-C:112	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V7	+	+	+	+	+	+	+	+	+									
V1:V17	+	+	+	+	+	+	+	+	+	+	+	+						
V1:V20	+	+	+	+	+	+	+	+	+	+	+	+	+					
V1:V22	+	+	+	+	+	+	+	+	+	+	+	+	+					
V2:V4	+	+	+	+	+	+	+	+										
V3:V7							+	+	+									
V3:V10							+	+	+	+								
V3:V15							+	+	+	+	+	+						
V3:V16							+	+	+	+	+	+						
V3:V17							+	+	+	+	+	+						
V3:V18							+	+	+	+	+	+						
V3:V20							+	+	+	+	+	+	+					
V3:V22							+	+	+	+	+	+	+					
V3:V24							+	+	+	+	+	+	+	+				
V4:V7								+	+									
V4:V22								+	+	+	+	+	+					
V5:V6									+									
V5:V7									+									
V5:V8									+	+								
V5:V17									+	+	+	+						
V5:V18									+	+	+	+						
V5:V19									+	+	+	+						
V5:V20									+	+	+	+	+					
V5:V22									+	+	+	+	+					
V5:V24									+	+	+	+	+	+				
V5:V27									+	+	+	+	+	+	+	+	+	+
V6:V7									+									
V6:V17									+	+	+	+						
V6:V18									+	+	+	+						
V6:V20									+	+	+	+	+					
V6:V22									+	+	+	+	+					
V6:V24									+	+	+	+	+	+				
V8:V10										+								
V8:V15										+	+	+						
V8:V16										+	+	+						
V8:V20										+	+	+	+					
V8:V22										+	+	+	+					

V8:V24										+	+	+	+	+				
V8:V27										+	+	+	+	+	+	+	+	+
V9:V10										+								
V9:V16										+	+	+						
V9:V20										+	+	+	+					
V9:V22										+	+	+	+					
V9:V26										+	+	+	+	+	+	+	+	+
V10:V20										+	+	+	+					
V10:V22										+	+	+	+					
V10:V24										+	+	+	+	+				
V11:V16											+	+						
V11:V26											+	+	+	+	+	+	+	+
V11:V27											+	+	+	+	+	+	+	+
V16:V20												+	+					
V16:V22												+	+					
V16:V24												+	+	+				
V17:V22												+	+					
V17:V24												+	+	+				
V19:V20													+					
V19:V22													+					
V19:V24													+	+				
V21:V22													+					
V21:V23													+					
V23:V24													+	+				

Age Range

XIV-C:175	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V4	-	-	-	-	-	-	-	-										
V1:V7	-	-	-	-	-	-	-	-	-									
V1:V17	-	-	-	-	-	-	-	-	-	-	-	-						
V1:V20	-	-	-	-	-	-	-	-	-	-	-	-	-					
V1:V22	-	-	-	-	-	-	-	-	-	-	-	-	-					
V1:V24	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
V4:V16								-	-	-	-	-						
V4:V21								-	-	-	-	-	-					
V4:V22								-	-	-	-	-	-					
V4:V23								-	-	-	-	-	-					
V5:V6									-									
V5:V7									-									
V5:V8									-	-								
V5:V17									-	-	-	-						
V5:V19									-	-	-	-	-					
V5:V20									-	-	-	-	-					
V5:V22									-	-	-	-	-					
V5:V24									-	-	-	-	-	-				
V6:V7									-									
V6:V8									-	-								

V6:V16									-	-	-	-						
V6:V17									-	-	-	-						
V6:V19									-	-	-	-	-					
V6:V20									-	-	-	-	-					
V6:V22									-	-	-	-	-					
V6:V23									-	-	-	-	-					
V6:V24									-	-	-	-	-	-				
V8:V10										-								
V8:V15										-	-	-						
V8:V16										-	-	-						
V8:V23										-	-	-	-					
V9:V16										-	-	-						
V9:V20										-	-	-	-					
V9:V22										-	-	-	-					

Age Range

XIV-C:105	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V2	-																	
V1:V22	+	+	+	+	+	+	+	+	+	+	+	+	+					
V1:V24	+	+	+	+	+	+	+	+	+	+	+	+	+	+				
V3:V8							+	+	+	+								
V3:V15							+	+	+	+	+	+						
V3:V19							+	+	+	+	+	+	+					
V3:V21							+	+	+	+	+	+	+					
V3:V23							+	+	+	+	+	+	+					
V5:V8									+	+								
V5:V19									+	+	+	+	+					
V6:V8									+	+								
V6:V16									-	-	-	-						
V6:V17									-	-	-	-						
V6:V23									+	+	+	+	+					
V7:V8									+	+								
V7:V15									+	+	+							
V7:V16									-	-	-	-						
V7:V17									-	-	-	-						
V7:V19									+	+	+	+	+					
V7:V21									+	+	+	+	+					
V7:V23									+	+	+	+	+					
V8:V9										-								
V8:V16										-	-	-						
V8:V20										-	-	-	-					
V8:V23										+	+	+	+					
V10:V15										+	+	+						
V10:V16										-	-	-						
V10:V17										-	-	-						
V10:V21										+	+	+	+					
V11:V12											-							

V15:V17												-						
V15:V18												-						
V15:V20												-	-					
V15:V22												-	-					
V15:V23												+	+					
V16:V19												+	+					
V16:V21												+	+					
V16:V22												+	+					
V16:V23												+	+					
V17:V18												+						
V17:V19												+	+					
V17:V21												+	+					
V17:V22												+	+					
V17:V23												+	+					
V17:V24												+	+	+				
V18:V19												+	+					
V18:V22												+	+					
V18:V24												+	+	+				
V19:V20													-					
V19:V23													+					
V20:V22													+					
V20:V23													+					
V20:V24													+	+				
V22:V23													+					
V23:V24													-	-				

	Age Range																	
XIV-C:145	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V3:V9							+	+	+	+								
V4:V9								+	+	+								
V4:V19								+	+	+	+	+	+					
V4:V23								+	+	+	+	+	+					
V6:V7									+									
V6:V8									+	+								
V6:V18									+	+	+	+						
V6:V19									+	+	+	+	+					
V6:V20									+	+	+	+	+					
V6:V23									+	+	+	+	+					
V6:V27									+	+	+	+	+	+	+	+	+	+
V7:V9									+	+								
V7:V19									+	+	+	+	+					
V7:V23									+	+	+	+	+					
V8:V9										+								
V8:V23										+	+	+	+					
V20:V23													+					

V20:V24													-	-				
V21:V23													+					
V22:V23													+					

Age Range

XIV-C:149	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V4	-	-	-	-	-	-	-	-										
V1:V11	-	-	-	-	-	-	-	-	-	-	-							
V1:V20	+	+	+	+	+	+	+	+	+	+	+	+	+					
V1:V24	+	+	+	+	+	+	+	+	+	+	+	+	+	+				
V2:V4	-	-	-	-	-	-	-	-										
V2:V27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3:V8							-	-	-	-								
V3:V9							-	-	-	-								
V3:V15							-	-	-	-	-	-						
V3:V16							-	-	-	-	-	-						
V3:V18							+	+	+	+	+	+						
V3:V19							-	-	-	-	-	-	-					
V3:V21							-	-	-	-	-	-	-					
V3:V26							-	-	-	-	-	-	-	-	-	-	-	-
V4:V7								+	+									
V5:V8									-	-								
V5:V17									+	+	+	+						
V5:V18									+	+	+	+						
V5:V20									+	+	+	+	+					
V5:V24									+	+	+	+	+	+				
V6:V8									-	-								
V6:V16									-	-	-	-						
V6:V18									+	+	+	+						
V6:V19									-	-	-	-	-					
V6:V20									+	+	+	+	+					
V6:V27									-	-	-	-	-	-	-	-	-	-
V7:V8									-	-								
V7:V9									-	-								
V7:V15									-	-	-	-						
V7:V16									-	-	-	-						
V7:V18									+	+	+	+						
V7:V19									-	-	-	-	-					
V7:V20									+	+	+	+	+					
V7:V21									-	-	-	-	-					
V7:V26									-	-	-	-	-	-	-	-	-	-
V7:V27									-	-	-	-	-	-	-	-	-	-
V8:V20										+	+	+	+					
V8:V24										+	+	+	+	+				
V9:V20										+	+	+	+					
V9:V26										-	-	-	-	-	-	-	-	-
V10:V16										-	-	-						

V10:V18										+	+	+						
V10:V20										+	+	+	+					
V10:V21										-	-	-	-					
V11:V12											+							
V15:V17												+						
V15:V18												+						
V15:V19												-	-					
V15:V20												+	+					
V15:V21												-	-					
V15:V22												+	+					
V15:V24												+	+	+				
V16:V17												+						
V16:V18												+						
V16:V20												+	+					
V16:V21												-	-					
V16:V22												+	+					
V16:V24												+	+	+				
V17:V18												+						
V17:V19												-	-					
V17:V20												+	+					
V17:V21												-	-					
V17:V26												-	-	-	-	-	-	-
V18:V19												-	-					
V18:V22												-	-					
V18:V27												-	-	-	-	-	-	-
V19:V20													+					
V19:V22													+					
V19:V24													+	+				
V20:V22													-					
V20:V24													-	-				
V20:V26													-	-	-	-	-	-
V22:V24													+	+				
V22:V26													-	-	-	-	-	-
V22:V27													-	-	-	-	-	-
V23:V26													-	-	-	-	-	-
V23:V27													-	-	-	-	-	-

Age Range

XIV-C:153	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V2	+																	
V5:V8									+	+								
V5:V17									-	-	-	-						
V5:V18									-	-	-	-						
V5:V19									-	-	-	-	-					
V5:V20									-	-	-	-	-					
V5:V24									-	-	-	-	-	-				
V6:V8									+	+								

V6:V16									-	-	-	-						
V6:V17									-	-	-	-						
V6:V18									-	-	-	-						
V6:V20									-	-	-	-	-					
V6:V23									-	-	-	-	-					
V6:V24									-	-	-	-	-	-				
V7:V8									+	+								
V7:V9									+	+								
V7:V10									-	-								
V7:V17									-	-	-	-						
V7:V18									-	-	-	-						
V7:V20									-	-	-	-	-					
V7:V24									-	-	-	-	-	-				
V8:V10										-								
V8:V16										-	-	-						
V8:V19										-	-	-	-					
V8:V20										-	-	-	-					
V8:V22										-	-	-	-					
V8:V23										-	-	-	-					
V8:V24										-	-	-	-	-				
V9:V10										-								
V9:V13										-	-							
V9:V20										-	-	-	-					
V10:V15										+	+	+						
V12:V13											-							
V15:V16												-						
V15:V17												-						
V15:V18												-						
V15:V20												-	-					
V15:V23												-	-					
V15:V24												-	-	-				
V19:V20													-					
V20:V22													+					
V22:V24													-	-				

	Age Range																	
XIV-C:103	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V7	-	-	-	-	-	-	-	-	-									
V1:V13	+	+	+	+	+	+	+	+	+	+	+							
V2:V26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3:V22							+	+	+	+	+	+	+					
V3:V24							+	+	+	+	+	+	+	+				
V3:V25							-	-	-	-	-	-	-	-				
V4:V26								-	-	-	-	-	-	-	-	-	-	-
V5:V7									-									
V5:V17									-	-	-	-						
V6:V7									-									

V7:V8									+	+								
V7:V18									+	+	+	+						
V7:V20									+	+	+	+	+					
V7:V22									+	+	+	+	+					
V7:V24									+	+	+	+	+	+				
V8:V9										-								
V8:V24										+	+	+	+	+				
V8:V26										-	-	-	-	-	-	-	-	-
V9:V13										+	+							
V9:V20										+	+	+	+					
V9:V22										+	+	+	+					
V9:V26										-	-	-	-	-	-	-	-	-
V10:V20										+	+	+	+					
V10:V22										+	+	+	+					
V10:V24										+	+	+	+	+				
V10:V25										-	-	-	-	-				
V11:V13											+							
V11:V16											-	-						
V11:V26											-	-	-	-	-	-	-	-
V12:V13											+							
V15:V22												+	+					
V15:V24												+	+	+				
V16:V19												+	+					
V16:V20												+	+					
V16:V22												+	+					
V16:V24												+	+	+				
V16:V25												-	-	-				
V17:V18												+						
V17:V19												+	+					
V17:V20												+	+					
V17:V22												+	+					
V17:V24												+	+	+				
V17:V25												-	-	-				
V18:V20												+	+					
V18:V22												+	+					
V18:V24												+	+	+				
V19:V22													+					
V19:V24													+	+				
V20:V22													+					
V20:V24													+	+				
V20:V26													-	-	-	-	-	-
V21:V22													+					
V21:V25													-	-				
V21:V26													-	-	-	-	-	-

XIV-C:104	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Age Range																	
V1:V2	+																	
V1:V11	-	-	-	-	-	-	-	-	-	-	-							
V1:V24	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
V4:V6								-	-									
V4:V8								-	-	-								
V4:V19								-	-	-	-	-	-					
V4:V21								+	+	+								
V5:V7									+									
V6:V7									+									
V6:V8									-	-								
V7:V8									-	-								
V7:V15									-	-	-	-						
V7:V16									-	-	-	-						
V7:V17									-	-	-	-						
V7:V18									-	-	-	-						
V7:V19									-	-	-	-	-					
V7:V20									-	-	-	-	-					
V7:V21									+	+	+	+	+					
V7:V22									-	-	-	-	-					
V7:V24									-	-	-	-	-	-				
V8:V9										+								
V8:V10										+								
V9:V20										-	-	-	-					
V10:V17										-	-	-						
V10:V18										-	-	-						
V10:V20										-	-	-	-					
V10:V21										+	+	+	+					
V15:V16												-						
V15:V19												-	-					
V15:V21												+	+					
V16:V21												+	+					
V16:V25												+	+	+				
V17:V21												+	+					
V17:V25												+	+	+				
V22:V24													-	-				

XIV-C:98	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Age Range																	
V1:V2	-																	
V1:V11	-	-	-	-	-	-	-	-	-	-	-							
V1:V13	-	-	-	-	-	-	-	-	-	-	-							
V3:V6							-	-	-									
V3:V7							-	-	-									
V3:V18							-	-	-	-	-	-						
V3:V19							+	+	+	+	+	+	+					

V3:V20							-	-	-	-	-	-	-					
V3:V21							-	-	-	-	-	-	-					
V3:V23							-	-	-	-	-	-	-					
V3:V25							+	+	+	+	+	+	+	+				
V3:V26							-	-	-	-	-	-	-	-	-	-	-	-
V4:V6								-	-									
V4:V8								+	+	+								
V4:V16								+	+	+	+	+						
V4:V19								+	+	+	+	+	+					
V5:V6									-									
V5:V19									+	+	+	+	+					
V6:V7									+									
V6:V8									+	+								
V6:V16									+	+	+	+						
V6:V17									+	+	+	+						
V6:V19									+	+	+	+	+					
V6:V20									+	+	+	+	+					
V6:V22									+	+	+	+	+					
V6:V24									+	+	+	+	+	+				
V7:V10									+	+								
V7:V15									+	+	+	+						
V7:V16									+	+	+	+						
V7:V17									+	+	+	+						
V7:V19									+	+	+	+	+					
V7:V22									+	+	+	+	+					
V7:V26									-	-	-	-	-	-	-	-	-	-
V8:V9										-								
V8:V15										+	+	+						
V8:V19										+	+	+	+					
V8:V26										-	-	-	-	-	-	-	-	-
V8:V27										-	-	-	-	-	-	-	-	-
V9:V10										+								
V9:V13										-	-							
V9:V16										+	+	+						
V9:V26										-	-	-	-	-	-	-	-	-
V10:V15										+	+	+						
V10:V21										-	-	-	-					
V10:V25										+	+	+	+	+				
V11:V16											+	+						
V15:V19												+						
V15:V20												-	-					
V15:V21												-	-					
V15:V22												-	-					
V15:V23												-	-					
V15:V24												-	-	-				
V16:V19												+	+					
V16:V21												-	-					

V16:V23												-	-					
V16:V25												+	+	+				
V16:V26												-	-	-	-	-	-	-
V16:V27												-	-	-	-	-	-	-
V17:V19												+	+					
V17:V21												-	-					
V17:V25												+	+	+				
V17:V26												-	-	-	-	-	-	-
V18:V19												+	+					
V19:V20													-					
V19:V22													-					
V19:V23													-					
V19:V24													-	-				
V20:V22													+					
V20:V26													-	-	-	-	-	-
V21:V25													+	+				
V21:V26													-	-	-	-	-	-
V22:V24													-	-				
V22:V26													-	-	-	-	-	
V22:V27													-	-	-	-	-	-
V23:V25													+	+				
V23:V26													-	-	-	-	-	-

	Age Range																	
XIV-C:219	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
V1:V4	+	+	+	+	+	+	+	+										
V2:V4	+	+	+	+	+	+	+	+										
V2:V26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V4:V8								-	-	-								
V4:V9								-	-	-								
V4:V21								-	-	-	-	-	-					
V4:V22								-	-	-	-	-	-					
V4:V26								-	-	-	-	-	-	-	-	-	-	-
V4:V27								-	-	-	-	-	-	-	-	-	-	-
V5:V6									+									
V5:V7									+									
V5:V19									+	+	+	+	+					
V6:V18									-	-	-	-						
V6:V20									-	-	-	-	-					
V6:V22									-	-	-	-	-					
V7:V18									-	-	-	-						
V7:V20									-	-	-	-	-					
V7:V21									-	-	-	-	-					
V7:V22									-	-	-	-	-					
V7:V24									-	-	-	-	-	-				

V7:V26									-	-	-	-	-	-	-	-	-	-
V8:V16										+	+	+						
V8:V19										+	+	+	+					
V9:V13										+	+							
V11:V12											+							
V11:V13											+							
V11:V26											-	-	-	-	-	-	-	-
V15:V19												+	+					
V15:V22												-	-					
V16:V20												-	-					
V17:V18												-						
V17:V19												+	+					
V17:V20												-	-					
V18:V19												+	+					
V18:V20												-	-					
V19:V20													-					
V19:V22													-					
V20:V24													-	-				
V22:V24													+	+				

	Age Range																	
XIV-C:183	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
V1:V7	+	+	+	+	+	+	+	+	+									
V1:V13	-	-	-	-	-	-	-	-	-	-	-							
V1:V17	+	+	+	+	+	+	+	+	+	+	+	+						
V3:V9							-	-	-	-								
V3:V17							+	+	+	+	+	+						
V3:V18							+	+	+	+	+	+						
V3:V21							+	+	+	+	+	+	+					
V3:V25							+	+	+	+	+	+	+					
V4:V8								-	-	-								
V4:V9								-	-	-								
V4:V11								-	-	-	-							
V4:V21								+	+	+	+	+	+					
V4:V22								-	-	-	-	-	-					
V5:V6									-									
V5:V7									-									
V5:V8									-	-								
V5:V18									-	-	-	-						
V5:V19									-	-	-	-	-					
V5:V20									-	-	-	-	-					
V5:V22									-	-	-	-	-					
V5:V24									-	-	-	-	-	-				
V6:V8									-	-								
V6:V17									+	+	+	+						
V6:V22									+	+	+	+	+					
V6:V24									-	-	-	-	-	-				

V7:V8									-	-								
V7:V9									-	-								
V7:V15									-	-	-	-						
V7:V17									+	+	+	+						
V7:V21									+	+	+	+	+					
V7:V22									-	-	-	-	-					
V7:V23									-	-	-	-	-					
V7:V24									-	-	-	-	-	-				
V8:V9										-								
V8:V10										+								
V8:V19										+	+	+	+					
V8:V26										+	+	+	+	+	+	+	+	+
V9:V10										+								
V9:V26										+	+	+	+	+	+	+	+	+
V10:V21										+	+	+	+					
V10:V22										-	-	-	-					
V10:V24										-	-	-	-	-				
V11:V12											-							
V11:V13											-							
V11:V26											+	+	+	+	+	+	+	+
V15:V17												+						
V15:V19												+	+					
V15:V21												+	+					
V16:V17												+						
V16:V19												+	+					
V16:V21												+	+					
V16:V24												-	-	-				
V16:V25												+	+	+				
V16:V26												+	+	+	+	+	+	+
V17:V21												+	+					
V17:V22												-	-					
V17:V23												-	-					
V17:V24												-	-	-				
V18:V22												-	-					
V18:V24												-	-	-				
V19:V22													-					
V19:V23													-					
V19:V24													-	-				
V20:V22													-					
V20:V23													-					
V20:V24													-	-				
V21:V22													-					
V21:V23													-					
V22:V26													+	+	+	+	+	+
V23:V26													+	+	+	+	+	+

Age Range

XIV-C:148	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V3:V6							-	-	-									
V3:V7							-	-	-									
V3:V17							-	-	-	-	-	-						
V3:V19							-	-	-	-	-	-	-					
V3:V20							-	-	-	-	-	-	-					
V3:V22							-	-	-	-	-	-	-					
V3:V24							-	-	-	-	-	-	-	-				
V7:V15									+	+	+	+						
V8:V19										-	-	-	-					
V8:V20										-	-	-	-					
V8:V22										-	-	-	-					
V8:V24										-	-	-	-	-				
V9:V16										-	-	-						
V9:V20										-	-	-	-					
V9:V22										-	-	-	-					
V10:V16										-	-	-						
V10:V17										-	-	-						
V10:V18										-	-	-						
V10:V20										-	-	-	-					
V10:V22										-	-	-	-					
V10:V24										-	-	-	-	-				
V11:V16											-	-						
V12:V13											-							
V15:V17												-						
V15:V18												-						
V15:V19												-	-					
V15:V20												-	-					
V15:V22												-	-					
V15:V24												-	-	-				
V16:V17												-						
V16:V18												-						
V16:V19												-	-					
V16:V20												-	-					
V16:V22												-	-					
V16:V24												-	-	-				
V21:V22													-					

Age Range

XIV-C:100	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V7	+	+	+	+	+	+	+	+	+									
V1:V13	+	+	+	+	+	+	+	+	+	+	+							
V1:V20	+	+	+	+	+	+	+	+	+	+	+	+	+					
V2:V26	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

V4:V7								+	+									
V4:V8								+	+	+								
V4:V9								+	+	+								
V4:V19								+	+	+	+	+	+					
V4:V21								-	-	-	-	-	-					
V5:V7									+									
V5:V8									+	+								
V5:V19									+	+	+	+	+					
V6:V7									+									
V6:V8									+	+								
V6:V19									+	+	+	+	+					
V6:V23									-	-	-	-	-					
V7:V21									-	-	-	-	-					
V7:V23									-	-	-	-	-					
V8:V23										-	-	-	-					
V12:V13											+							
V19:V23													-					
V20:V23													-					
V21:V22													+					
V21:V26													+	+	+	+	+	+
V22:V23													-					
V23:V26													+	+	+	+	+	+

	Age Range																	
XIV-C:192	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V4	-	-	-	-	-	-	-	-										
V2:V26	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V3:V6							-	-	-									
V3:V8							-	-	-	-								
V3:V19							-	-	-	-	-	-	-					
V3:V21							+	+	+	+	+	+	+					
V3:V24							+	+	+	+	+	+	+	+				
V3:V26							+	+	+	+	+	+	+	+	+	+	+	+
V4:V6								-	-									
V4:V8								-	-	-								
V4:V11								+	+	+	+							
V4:V19								-	-	-	-	-	-					
V4:V21								+	+	+	+	+	+					
V4:V26								+	+	+	+	+	+	+	+	+	+	+
V5:V6									-									
V5:V8									-	-								
V5:V22									+	+	+	+	+					
V5:V24									+	+	+	+	+	+				
V6:V7									+									
V6:V16									+	+	+	+						
V6:V17									+	+	+	+						
V6:V20									+	+	+	+	+					

V6:V22									+	+	+	+	+					
V6:V24									+	+	+	+	+	+				
V7:V8									-	-								
V7:V9									-	-								
V7:V19									-	-	-	-	-					
V7:V21									+	+	+	+	+					
V7:V22									+	+	+	+	+					
V7:V24									+	+	+	+	+	+				
V7:V26									+	+	+	+	+	+	+	+	+	+
V8:V16										+	+	+						
V8:V22										+	+	+	+					
V8:V24										+	+	+	+	+				
V8:V26										+	+	+	+	+	+	+	+	+
V9:V22										+	+	+	+					
V9:V26										+	+	+	+	+	+	+	+	+
V10:V21										+	+	+	+					
V10:V22										+	+	+	+					
V10:V24										+	+	+	+	+				
V11:V12											+							
V15:V19												-	-					
V15:V21												+	+					
V15:V22												+	+					
V15:V24												+	+	+				
V16:V19												-	-					
V16:V21												+	+					
V16:V22												+	+					
V16:V24												+	+	+				
V16:V25												-	-	-				
V16:V26												+	+	+	+	+	+	+
V17:V19												-	-					
V17:V21												+	+					
V17:V24												+	+	+				
V17:V25												-	-	-				
V17:V26												+	+	+	+	+	+	+
V18:V19												-	-					
V18:V20												+	+					
V18:V22												+	+					
V18:V24												+	+	+				
V19:V22													+					
V19:V24													+	+				
V20:V22													+					
V20:V24													+	+				
V20:V26													+	+	+	+	+	+
V21:V25													-	-				
V22:V24													+	+				
V22:V26													+	+	+	+	+	+

Age Range

XIV-C:221	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V11	+	+	+	+	+	+	+	+	+	+	+							
V1:V17	+	+	+	+	+	+	+	+	+	+	+	+						
V3:V6							+	+	+									
V3:V8							-	-	-	-								
V3:V9							-	-	-	-								
V3:V10							-	-	-	-								
V3:V18							-	-	-	-	-	-						
V4:V6								+	+									
V4:V9								-	-	-								
V4:V11								+	+	+	+							
V4:V16								+	+	+	+	+						
V5:V6									+									
V5:V8									-	-								
V6:V7									-									
V6:V8									-	-								
V7:V8									-	-								
V7:V9									-	-								
V7:V10									-	-								
V7:V16									+	+	+	+						
V7:V17									+	+	+	+						
V8:V9										-								
V8:V10										-								
V8:V15										+	+	+						
V8:V16										+	+	+						
V8:V19										+	+	+	+					
V8:V22										+	+	+	+					
V8:V23										+	+	+	+					
V9:V16										+	+	+						
V9:V20										+	+	+	+					
V9:V22										+	+	+	+					
V10:V15										+	+	+						
V10:V16										+	+	+						
V10:V17										+	+	+						
V10:V18										+	+	+						
V10:V20										+	+	+	+					
V10:V21										+	+	+	+					
V10:V22										+	+	+	+					
V10:V24										+	+	+	+	+				
V10:V25										+	+	+	+	+				
V11:V12											-							
V15:V16												+						
V15:V17												+						
V17:V18												-						
V17:V20												-	-					
V17:V22												-	-					

V17:V24												-	-	-				
V19:V20													+					
V22:V24													-	-				

K-6 Sadlermiut males growth fluctuation pattern maps

(chronological numbering see Appendix H, H-2)

	Age Range																	
XIV-C:230	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V3		+	+	+	+	+	+	+										
V2:V24		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3:V25								-	-	-	-	-	-	-	-	-	-	-
V3:V26								-	-	-	-	-	-	-	-	-	-	-
V4:V8										-	-							
V4:V25										-	-	-	-	-	-	-	-	-
V5:V13										-	-	-	-	-	-			
V5:V25										-	-	-	-	-	-	-	-	
V6:V25										-	-	-	-	-	-	-	-	-
V6:V26										-	-	-	-	-	-	-	-	-
V7:V8											-							
V7:V12											+	+	+	+	+			
V7:V25											-	-	-	-	-	-	-	-
V7:V26											-	-	-	-	-	-	-	-
V8:V14											+	+	+	+	+			
V8:V18											+	+	+	+	+	+		
V8:V24											-	-	-	-	-	-	-	-
V14:V25															-	-	-	-
V14:V26															-	-	-	-
V15:V25															-	-	-	-
V15:V26															-	-	-	-
V15:V27															+	+	+	+
V18:V25																-	-	-
V18:V26																-	-	-
V18:V27																+	+	+
V25:V27																		+

	Age Range																	
XIV-C:74	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V3:V18								+	+	+	+	+	+	+	+	+		
V3:V19								-	-	-	-	-	-	-	-	-		
V3:V26								+	+	+	+	+	+	+	+	+	+	+
V4:V7										-	-							
V4:V8										+	+							
V4:V10										+	+	+	+	+				
V4:V18										+	+	+	+	+	+	+		
V4:V19										-	-	-	-	-	-	-		
V4:V23										-	-	-	-	-	-	-	-	
V6:V19										-	-	-	-	-	-	-		
V6:V21										-	-	-	-	-	-	-	-	
V6:V22										-	-	-	-	-	-	-	-	
V6:V23										-	-	-	-	-	-	-	-	
V7:V8											+							
V7:V10											+	+	+	+				

V7:V18											+	+	+	+	+	+		
V7:V19											-	-	-	-	-	-		
V7:V22											-	-	-	-	-	-	-	
V8:V18											-	-	-	-	-	-		
V8:V24											-	-	-	-	-	-	-	-
V8:V25											-	-	-	-	-	-	-	-
V11:V19														-	-	-		
V18:V19																-		
V18:V21																-	-	
V18:V25																-	-	-
V19:V26																+	+	+
V21:V22																	-	
V21:V23																	-	

Age Range

XIV-C:117	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V3		+	+	+	+	+	+	+										
V2:V14		+	+	+	+	+	+	+	+	+	+	+	+	+	+			
V2:V19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
V2:V26		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3:V19								-	-	-	-	-	-	-	-	-		
V3:V22								-	-	-	-	-	-	-	-	-	-	
V3:V23								-	-	-	-	-	-	-	-	-	-	
V3:V26								-	-	-	-	-	-	-	-	-	-	-
V3:V27								-	-	-	-	-	-	-	-	-	-	-
V4:V6										-								
V4:V9										+	+	+	+	+				
V4:V13										+	+	+	+	+	+			
V4:V14										+	+	+	+	+	+			
V4:V15										+	+	+	+	+	+			
V4:V18										+	+	+	+	+	+	+		
V5:V6										-								
V5:V13										+	+	+	+	+	+			
V5:V18										+	+	+	+	+	+	+		
V5:V22										-	-	-	-	-	-	-	-	
V5:V23										-	-	-	-	-	-	-	-	
V5:V27										-	-	-	-	-	-	-	-	-
V6:V15										+	+	+	+	+	+			
V6:V21										+	+	+	+	+	+	+	+	
V6:V25										+	+	+	+	+	+	+	+	+
V7:V11											+	+	+	+				
V7:V14											+	+	+	+	+			
V7:V18											+	+	+	+	+	+		
V7:V22											-	-	-	-	-	-	-	
V7:V23											-	-	-	-	-	-	-	
V8:V13											+	+	+	+	+			
V8:V14											+	+	+	+	+			
V8:V18											+	+	+	+	+	+		
V9:V13														+	+			

V9:V14														+	+			
V9:V18														+	+	+		
V9:V23														-	-	-	-	
V10:V18														+	+	+		
V11:V19														-	-	-		
V11:V23														-	-	-	-	
V13:V15															-			
V14:V19															-	-		
V14:V21															-	-	-	
V14:V22															-	-	-	
V14:V23															-	-	-	
V14:V27															-	-	-	-
V15:V18															+	+		
V15:V19															-	-		
V15:V22															-	-	-	
V15:V23															-	-	-	
V16:V23															-	-	-	
V18:V19																-		
V18:V27																-	-	-
V19:V23																-	-	
V21:V22																	-	
V21:V23																	-	
V22:V23																	-	
V25:V27																		-

Age Range

XIV-C:126	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V14		-	-	-	-	-	-	-	-	-	-	-	-	-	-			
V2:V19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
V2:V24		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V2:V25		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3:V11								-	-	-	-	-	-	-				
V3:V14								-	-	-	-	-	-	-	-			
V3:V25								-	-	-	-	-	-	-	-	-	-	-
V3:V27								-	-	-	-	-	-	-	-	-	-	-
V4:V6										+								
V4:V8										+	+							
V4:V9										+	+	+	+	+				
V4:V25										-	-	-	-	-	-	-	-	-
V5:V6										+								
V5:V13										+	+	+	+	+	+			
V5:V17										+	+	+	+	+	+	+		
V5:V25										-	-	-	-	-	-	-	-	-
V5:V27										-	-	-	-	-	-	-	-	-
V6:V21										-	-	-	-	-	-	-	-	
V6:V23										-	-	-	-	-	-	-	-	
V6:V25										-	-	-	-	-	-	-	-	-
V6:V27										-	-	-	-	-	-	-	-	-
V7:V8											+							

V7:V9											+	+	+	+				
V7:V11											-	-	-	-				
V7:V25											-	-	-	-	-	-	-	-
V8:V14											-	-	-	-	-			
V8:V25											-	-	-	-	-	-	-	-
V9:V24														-	-	-	-	-
V9:V25														-	-	-	-	-
V9:V27														-	-	-	-	-
V14:V27															-	-	-	-
V15:V25															-	-	-	-
V15:V27															-	-	-	-
V18:V25																-	-	-
V18:V27																-	-	-
V19:V25																-	-	-
V21:V25																	-	-
V21:V26																	-	-
V21:V27																	-	-
V22:V25																	-	-
V22:V27																	-	-
V23:V25																	-	-
V23:V27																	-	-
V24:V25																		-
V25:V26																		+

Age Range

XIV-C:246	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V3		-	-	-	-	-	-	-										
V2:V18		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
V2:V25		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V2:V26		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3:V11								+	+	+	+	+	+	+				
V3:V14								+	+	+	+	+	+	+	+			
V4:V7										+	+							
V4:V10										-	-	-	-	-				
V4:V13										+	+	+	+	+	+			
V4:V18										-	-	-	-	-	-	-		
V5:V13										+	+	+	+	+	+			
V5:V23										+	+	+	+	+	+	+	+	
V6:V23										+	+	+	+	+	+	+	+	
V6:V27										-	-	-	-	-	-	-	-	-
V7:V10											-	-	-	-				
V7:V12											-	-	-	-	-			
V7:V18											-	-	-	-	-	-		
V7:V19											-	-	-	-	-	-		
V7:V25											-	-	-	-	-	-	-	-
V7:V26											-	-	-	-	-	-	-	-
V8:V9											-	-	-	-				
V8:V10											-	-	-	-				
V8:V13											+	+	+	+	+			

V8:V18											-	-	-	-	-	-		
V8:V25											-	-	-	-	-	-	-	-
V9:V13														+	+			
V9:V14														+	+			
V9:V18														-	-	-		
V11:V12														-	-			
V13:V15															-			
V13:V18															-	-		
V14:V18															-	-		
V14:V21															-	-	-	
V14:V27															-	-	-	-
V15:V18															-	-		
V15:V21															-	-	-	
V15:V27															-	-	-	-
V19:V21																-	-	
V19:V23																+	+	
V19:V24																-	-	-
V21:V22																	+	
V21:V23																	+	
V22:V25																	-	-
V22:V27																	-	-
V23:V25																	-	-
V23:V27																	-	-

	Age Range																	
XIV-C:111	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
V2:V9		-	-	-	-	-	-	-	-	-	-	-	-	-				
V2:V18		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
V2:V19		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
V3:V9								-	-	-	-	-	-	-				
V3:V11								-	-	-	-	-	-	-				
V3:V18								-	-	-	-	-	-	-	-	-		
V3:V19								-	-	-	-	-	-	-	-	-		
V3:V21								+	+	+	+	+	+	+	+	+	+	
V3:V22								+	+	+	+	+	+	+	+	+	+	
V4:V6										+								
V4:V13										+	+	+	+	+	+			
V5:V15										-	-	-	-	-	-			
V5:V18										-	-	-	-	-	-	-		
V6:V19										-	-	-	-	-	-	-		
V7:V14											+	+	+	+	+			
V7:V15											+	+	+	+	+			
V7:V22											+	+	+	+	+	+	+	
V8:V9											-	-	-	-				
V8:V10											-	-	-	-				
V8:V13											-	-	-	-	-			
V9:V13														-	-			
V12:V17															-	-		
V13:V14															-			

V13:V18															-	-		
V14:V18															-	-		
V14:V19															-	-		
V14;V21															+	+	+	
V14:V22															+	+	+	
V15:V18															-	-		
V15:V19															-	-		
V15:V21															+	+	+	
V15:V22															+	+	+	
V18:V21																+	+	
V19:V21																+	+	
V19:V22																+	+	
V22:V26																	-	-

Age Range

XIV-C:243	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V3		+	+	+	+	+	+	+										
V2:V8		-	-	-	-	-	-	-	-	-	-							
V3:V14								-	-	-	-	-	-	-	-			
V3:V18								-	-	-	-	-	-	-	-	-		
V3:V21								-	-	-	-	-	-	-	-	-	-	
V3:V22								-	-	-	-	-	-	-	-	-	-	
V3:V25								-	-	-	-	-	-	-	-	-	-	-
V3:V26								-	-	-	-	-	-	-	-	-	-	-
V4:V7										-	-							
V4:V8										-	-							
V4:V10										-	-	-	-	-				
V4:V15										-	-	-	-	-	-			
V4:V18										-	-	-	-	-	-	-		
V4:V25										-	-	-	-	-	-	-	-	-
V5:V6										+								
V5:V17										+	+	+	+	+	+	+		
V6:V15										-	-	-	-	-	-			
V6:V21										-	-	-	-	-	-	-	-	
V6:V22										-	-	-	-	-	-	-	-	
V6:V25										-	-	-	-	-	-	-	-	-
V6:V26										-	-	-	-	-	-	-	-	-
V7:V11											+	+	+	+				
V7:V19											+	+	+	+	+	+		
V7:V23											+	+	+	+	+	+	+	
V11:V12														+	+			
V11:V14														-	-			
V13:V15															-			
V14:V15															-			
V14:V18															-	-		
V15:V23															+	+	+	
V16:V19															-	-		
V16:V23															-	-	-	
V19:V21																-	-	

V19:V25																-	-	-
V19:V26																-	-	-
V21:V23																	+	
V22:V25																	-	-
V23:V25																	-	-

	Age Range																	
XIV-C:216	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
V2:V3		-	-	-	-	-	-	-										
V2:V19		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
V2:V24		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V3:V18								+	+	+	+	+	+	+	+	+		
V3:V19								+	+	+	+	+	+	+	+	+		
V3:V23								+	+	+	+	+	+	+	+	+	+	
V4:V7										+	+							
V4:V8										-	-							
V4:V9										-	-	-	-	-				
V4:V10										+	+	+	+	+				
V5:V15										+	+	+	+	+	+			
V5:V27										-	-	-	-	-	-	-	-	-
V6:V15										+	+	+	+	+	+			
V6:V19										+	+	+	+	+	+	+		
V6:V27										-	-	-	-	-	-	-	-	-
V7:V8											-							
V7:V9											-	-	-	-				
V7:V18											-	-	-	-	-	-		
V7:V22											-	-	-	-	-	-	-	
V8:V10											+	+	+	+				
V8:V15											+	+	+	+	+			
V9:V15														+	+			
V9:V19														+	+	+		
V12:V17															+	+		
V13:V15															+			
V15:V18															-	-		
V15:V21															-	-	-	
V15:V22															-	-	-	
V15:V27															-	-	-	-
V16:V19															+	+		
V18:V19																+		
V18:V27																-	-	-
V19:V22																-	-	
V19:V25																-	-	-
V19:V27																-	-	-
V21:V27																	-	
V22:V23																	+	
V22:V27																	-	-
V23:V27																	-	-
V25:V27																		-

Age Range

XIV-C:217	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V14		-	-	-	-	-	-	-	-	-	-	-	-	-	-			
V3:V11								-	-	-	-	-	-	-				
V4:V7										+	+							
V4:V8										+	+							
V5:V22										+	+	+	+	+	+	+	+	
V5:V25										+	+	+	+	+	+	+	+	+
V5:V27										+	+	+	+	+	+	+	+	+
V6:V22										+	+	+	+	+	+	+	+	
V7:V11											-	-	-	-				
V7:V15											-	-	-	-	-			
V8:V13											-	-	-	-	-			
V8:V15											-	-	-	-	-			
V11:V12														-	-			
V15:V22															+	+	+	
V21:V22																	+	
V22:V24																	-	-

Age Range

XIV-C:179	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V5:V6										+								
V5:V13										+	+	+	+	+	+			
V5:V17										-	-	-	-	-	-	-		
V5:V18										+	+	+	+	+	+	+		
V5:V27										+	+	+	+	+	+	+	+	+
V6:V19										+	+	+	+	+	+	+		
V6:V26										+	+	+	+	+	+	+	+	+
V7:V10											-	-	-	-				
V7:V11											+	+	+	+				
V8:V14											+	+	+	+	+			
V8:V18											+	+	+	+	+	+		
V8:V26											+	+	+	+	+	+	+	+
V10:V18														+	+	+		
V12:V17															-	-		
V13:V14															+			
V14:V21															-	-	-	
V16:V19															+	+		
V18:V21																-	-	
V18:V26																+	+	+
V19:V21																-	-	
V19:V22																-	-	
V21:V27																	+	+
V22:V26																	+	+
V22:V27																	+	+
V23:V27																	+	+
V24:V26																		+
V25:V26																		+
V25:V27																		+

Age Range

XIV-C:182	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V8		+	+	+	+	+	+	+	+	+	+							
V2:V9		+	+	+	+	+	+	+	+	+	+	+	+	+				
V2:V18		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
V2:V24		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V2:V25		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V2:V26		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3:V9								+	+	+	+	+	+	+				
V3:V18								+	+	+	+	+	+	+	+	+		
V3:V25								+	+	+	+	+	+	+	+	+	+	+
V3:V26								-	-	-	-	-	-	-	-	-	-	-
V3:V27								+	+	+	+	+	+	+	+	+	+	+
V4:V7										-	-							
V4:V10										-	-	-	-	-				
V4:V13										-	-	-	-	-	-			
V4:V23										-	-	-	-	-	-	-	-	
V5:V13										-	-	-	-	-	-			
V5:V17										-	-	-	-	-	-	-		
V5:V21										-	-	-	-	-	-	-	-	
V5:V22										-	-	-	-	-	-	-	-	
V6:V21										-	-	-	-	-	-	-	-	
V6:V25										+	+	+	+	+	+	+	+	+
V6:V26										-	-	-	-	-	-	-	-	-
V7:V8											+							
V7:V9											+	+	+	+				
V7:V10											-	-	-	-				
V7:V18											+	+	+	+	+	+		
V7:V25											+	+	+	+	+	+	+	+
V7:V26											-	-	-	-	-	-	-	-
V8:V10											-	-	-	-				
V8:V13											-	-	-	-	-			
V8:V14											-	-	-	-	-			
V8:V25											+	+	+	+	+	+	+	+
V8:V26											-	-	-	-	-	-	-	-
V9:V13														-	-			
V9:V16														-	-			
V9:V26														-	-	-	-	-
V10:V15														+	+			
V10:V18														+	+	+		
V12:V17															-	-		
V13:V15															+			
V13:V18															+	+		
V14:V15															+			
V14:V18															+	+		
V14:V25															+	+	+	+
V14:V27															+	+	+	+
V15:V18															+	+		

V15:V21															-	-	-	
V15:V25															+	+	+	+
V15:V26															-	-	-	-
V16:V23															+	+	+	
V18:V21																-	-	
V18:V25																+	+	+
V18:V26																-	-	-
V19:V24																+	+	+
V19:V25																+	+	+
V19:V26																-	-	-
V19:V27																+	+	+
V21:V23																	+	
V21:V24																	+	+
V21:V25																	+	+
V21:V26																	+	+
V21:V27																	+	+
V22:V24																	+	+
V22:V25																	+	+
V22:V26																	-	-
V22:V27																	+	+
V23:V25																	+	+
V24:V25																		+
V24:V26																		-
V25:V26																		-

Age Range

XIV-C:157	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V8		-	-	-	-	-	-	-	-	-	-							
V2:V9		-	-	-	-	-	-	-	-	-	-	-	-	-				
V2:V14		-	-	-	-	-	-	-	-	-	-	-	-	-	-			
V2:V18		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
V2:V26		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V3:V9								-	-	-	-	-	-	-				
V3:V11								+	+	+	+	+	+	+				
V3:V18								-	-	-	-	-	-	-	-	-		
V4:V13										-	-	-	-	-	-			
V4:V15										-	-	-	-	-	-			
V5:V13										-	-	-	-	-	-			
V5:V15										-	-	-	-	-	-			
V5:V18										-	-	-	-	-	-	-		
V6:V15										-	-	-	-	-	-			
V7:V8											-							
V7:V9											-	-	-	-				
V7:V12											-	-	-	-	-			
V7:V14											-	-	-	-	-			
V7:V15											-	-	-	-	-			
V7:V18											-	-	-	-	-	-		
V8:V13											-	-	-	-	-			
V8:V15											-	-	-	-	-			

V9:V13														-	-			
V9:V15														-	-			
V9:V16														+	+			
V10:V15														-	-			
V10:V18														-	-	-		
V11:V14														-	-			
V12:V17															-	-		
V14:V15															-			
V14:V18															-	-		
V16:V19															-	-		
V18:V25																+	+	+
V25:V27																		-

Age Range

XIV-C:181	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V3:V19								+	+	+	+	+	+	+	+	+		
V3:V21								+	+	+	+	+	+	+	+	+	+	
V3:V22								+	+	+	+	+	+	+	+	+	+	
V3:V25								+	+	+	+	+	+	+	+	+	+	+
V3:V26								+	+	+	+	+	+	+	+	+	+	+
V4:V6										+								
V4:V7										+	+							
V4:V8										+	+							
V4:V9										+	+	+	+	+				
V4:V14										+	+	+	+	+	+			
V4:V15										+	+	+	+	+	+			
V4:V18										+	+	+	+	+	+	+		
V4:V19										+	+	+	+	+	+	+		
V4:V23										+	+	+	+	+	+	+	+	
V4:V25										+	+	+	+	+	+	+	+	+
V5:V6										+								
V5:V15										+	+	+	+	+	+			
V5:V18										+	+	+	+	+	+	+		
V5:V21										+	+	+	+	+	+	+	+	
V5:V22										+	+	+	+	+	+	+	+	
V5:V25										+	+	+	+	+	+	+	+	+
V6:V25										+	+	+	+	+	+	+	+	+
V6:V26										+	+	+	+	+	+	+	+	+
V7:V18											+	+	+	+	+	+		
V7:V19											+	+	+	+	+	+		
V7:V22											+	+	+	+	+	+	+	
V7:V25											+	+	+	+	+	+	+	+
V7:V26											+	+	+	+	+	+	+	+
V8:V9											+	+	+	+				
V8:V18											+	+	+	+	+	+		
V8:V24											+	+	+	+	+	+	+	+
V8:V25											+	+	+	+	+	+	+	+
V8:V26											+	+	+	+	+	+	+	+
V9:V19														+	+	+		

V9:V24														+	+	+	+	+
V9:V26														+	+	+	+	+
V11:V14														+	+			
V11:V19														+	+	+		
V11:V23														+	+	+	+	
V13:V14															+			
V13:V15															+			
V13:V18															+	+		
V14:V19															+	+		
V14:V21															+	+	+	
V14:V22															+	+	+	
V14:V25															+	+	+	+
V14:V26															+	+	+	+
V14:V27															+	+	+	+
V15:V19															+	+		
V15:V22															+	+	+	
V15:V25															+	+	+	+
V15:V26															+	+	+	+
V15:V27															+	+	+	+
V16:V19															+	+		
V18:V19																+		
V18:V25																+	+	+
V18:V26																+	+	+
V19:V24																+	+	+
V19:V25																+	+	+
V22:V24																	+	+
V23:V25																	+	+

Age Range

XIV-C:101	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V4:V7										-	-							
V4:V8										-	-							
V4:V14										-	-	-	-	-	-			
V4:V18										-	-	-	-	-	-	-		
V5:V17										-	-	-	-	-	-	-		
V5:V22										-	-	-	-	-	-	-	-	
V7:V8											-							
V7:V14											-	-	-	-	-			
V8:V14											-	-	-	-	-			
V9:V14														-	-			
V10:V18														-	-	-		
V11:V14														-	-			
V13:V14															-			
V13:V18															-	-		
V15:V18															-	-		
V15:V19															-	-		
V22:V23																	-	
V24:V25																		-
V24:V26																		-

Age Range

XIV-C:156	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V8		+	+	+	+	+	+	+	+	+	+							
V2:V9		+	+	+	+	+	+	+	+	+	+	+	+	+				
V2:V14		+	+	+	+	+	+	+	+	+	+	+	+	+	+			
V2:V18		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		
V3:V14								+	+	+	+	+	+	+	+			
V3:V18								+	+	+	+	+	+	+	+	+		
V3:V21								+	+	+	+	+	+	+	+	+	+	
V3:V22								+	+	+	+	+	+	+	+	+	+	
V3:V23								+	+	+	+	+	+	+	+	+	+	
V3:V27								+	+	+	+	+	+	+	+	+	+	+
V4:V8										+	+							
V4:V14										+	+	+	+	+	+			
V4:V15										+	+	+	+	+	+			
V4:V18										+	+	+	+	+	+	+		
V4:V23										+	+	+	+	+	+	+	+	
V5:V15										+	+	+	+	+	+			
V5:V21										+	+	+	+	+	+	+	+	
V6:V15										+	+	+	+	+	+			
V6:V21										+	+	+	+	+	+	+	+	
V6:V23										+	+	+	+	+	+	+	+	
V6:V27										+	+	+	+	+	+	+	+	+
V7:V8											+							
V7:V12											+	+	+	+	+			
V7:V15											+	+	+	+	+			
V7:V18											+	+	+	+	+	+		
V7:V23											+	+	+	+	+	+	+	
V8:V9											-	-	-	-				
V8:V15											+	+	+	+	+			
V8:V24											-	-	-	-	-	-	-	-
V9:V14														+	+			
V9:V15														+	+			
V9:V16														+	+			
V9:V18														+	+	+		
V9:V23														+	+	+	+	
V9:V24														-	-	-	-	-
V9:V27														+	+	+	+	+
V10:V15														+	+			
V10:V18														+	+	+		
V11:V12														+	+			
V11:V14														+	+			
V11:V23														+	+	+	+	
V13:V14															+			
V13:V15															+	+		
V13:V18															+	+		
V14:V15															+			
V14:V21															+	+	+	

V18:V26																-	-	-
V19:V21																+	+	
V19:V22																+	+	
V19:V23																+	+	
V19:V24																-	-	-
V19:V27																+	+	+
V21:V24																	-	-
V21:V25																	-	-
V21:V26																	-	-
V22:V24																	-	-
V24:V25																		+
V25:V27																		+

	Age Range																	
XIV-C:99	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V4:V6										-								
V4:V7										-	-							
V5:V6										-								
V5:V13										+	+	+	+	+	+			
V5:V17										+	+	+	+	+	+	+		
V6:V21										+	+	+	+	+	+	+	+	
V6:V22										+	+	+	+	+	+	+	+	
V7:V8											+							
V7:V9											+	+	+	+				
V7:V10											+	+	+	+				
V7:V11											-	-	-	-				
V7:V12											+	+	+	+	+			
V8:V10											+	+	+	+				
V8:V14											-	-	-	-	-			
V8:V15											-	-	-	-	-			
V9:V15														-	-			
V9:V18														-	-	-		
V9:V19														-	-	-		
V11:V14														+	+			
V11:V19														+	+	+		
V13:V14															-			
V14:V18															+	+		
V16:V19															-	-		
V19:V22																+	+	

K-7 Sacred Heart females growth fluctuation pattern maps

(chronological numbering see Appendix H, H-1)

Age Range

SH88	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V27	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V2:V27	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V3:V5							-	-	-									
V3:V10							-	-	-	-								
V5:V10									-	-								
V6:V8									-	-								
V6:V19									-	-	-	-	-					
V7:V9									-	-								
V7:V10									-	-								
V8:V27										+	+	+	+	+	+	+	+	+
V9:V17										+	+	+						
V10:V16										+	+	+						
V10:V17										+	+	+						
V10:V18										+	+	+						
V10:V19										+	+	+	+					
V10:V27										+	+	+	+	+	+	+	+	+
V12:V27											+	+	+	+	+	+	+	+
V17:V24												+	+	+				
V20:V22													+					
V23:V27													+	+	+	+	+	+

Age Range

SH24	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V6	-	-	-	-	-	-	-	-	-									
V3:V6							-	-	-									
V3:V8							-	-	-	-								
V3:V27							-	-	-	-	-	-	-	-	-	-	-	-
V5:V6									-									
V7:V9									-	-								
V7:V10									-	-								
V7:V18									-	-	-	-						
V7:V20									-	-	-	-	-					
V7:V24									-	-	-	-	-	-				
V14:V27											-	-	-	-	-	-	-	-
V15:V16												+						
V15:V23												-	-					
V15:V27												-	-	-	-	-	-	-
V16:V19												-	-					
V16:V27												-	-	-	-	-	-	-
V17:V18												-						
V17:V20												-	-					
V17:V24												-	-	-				
V19:V23													-					
V19:V27													-	-	-	-	-	-
V22:V24													-	-				

Age Range

SH9	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V5	+	+	+	+	+	+	+	+	+									
V1:V12	-	-	-	-	-	-	-	-	-	-	-							
V2:V6	+	+	+	+	+	+	+	+	+									
V2:V12	-	-	-	-	-	-	-	-	-	-	-							
V3:V5							+	+	+									
V4:V11								-	-	-	-							
V4:V26								-	-	-	-	-	-	-	-	-	-	-
V5:V10									-	-								
V5:V16									-	-	-	-						
V5:V19									-	-	-							
V5:V25									-	-	-	-	-	-				
V8:V10										-								
V8:V19										-	-	-	-					
V9:V10										+								
V10:V17										-	-	-						
V10:V20										-	-	-	-					
V11:V23											+	+	+					
V11:V27											+	+	+	+	+	+	+	+
V12:V15											+	+						
V12:V23											+	+	+					
V12:V27											+	+	+	+	+	+	+	+
V13:V14											+							
V16:V21												+	+					
V18:V20												-	-					
V18:V21												+	+					
V19:V27													+	+	+	+	+	+
V20:V22													-					
V23:V26													-	-	-	-	-	-
V26:V27																		+

Age Range

SH120	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V2	-																	
V1:V4	-	-	-	-	-	-	-	-										
V1:V8	+	+	+	+	+	+	+	+	+	+								
V2:V8	+	+	+	+	+	+	+	+	+	+								
V2:V11	-	-	-	-	-	-	-	-	-	-	-							
V2:V12	+	+	+	+	+	+	+	+	+	+								
V2:V15	+	+	+	+	+	+	+	+	+	+	+	+						
V2:V19	+	+	+	+	+	+	+	+	+	+	+	+	+					
V4:V5								+	+									
V4:V6								+	+									
V4:V12								+	+	+	+							
V4:V15								+	+	+	+	+						
V5:V8									+	+								
V5:V10									+	+								

V5:V21									+	+	+	+	+					
V6:V8									+	+								
V7:V9									+	+								
V7:V10									+	+								
V7:V20									+	+	+	+	+					
V8:V10										+								
V11:V12											+							
V11:V13											+							
V12:V16											+	+						
V16:V25												+	+	+				
V17:V20												+	+					

Age Range

SH124B	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V5	-	-	-	-	-	-	-	-	-									
V1:V15	-	-	-	-	-	-	-	-	-	-	-	-						
V2:V4	-	-	-	-	-	-	-	-										
V2:V15	-	-	-	-	-	-	-	-	-	-	-	-						
V3:V8							+	+	+	+								
V3:V23							+	+	+	+	+	+	+					
V3:V25							-	-	-	-	-	-	-	-				
V3:V27							+	+	+	+	+	+	+	+	+	+	+	+
V4:V5								-	-									
V4:V11								+	+	+	+							
V4:V23								+	+	+	+	+	+					
V4:V25								-	-	-	-	-	-	-				
V4:V27								+	+	+	+	+	+	+	+	+	+	+
V5:V6									+									
V5:V8									+	+								
V5:V23									+	+	+	+	+					
V5:V27									+	+	+	+	+	+	+	+	+	+
V7:V17									-	-	-	-						
V7:V18									-	-	-	-						
V7:V20									-	-	-	-	-					
V8:V10										-								
V8:V16										-	-	-						
V8:V18										-	-	-						
V8:V21										-	-	-	-					
V9:V10										-								
V9:V16										-	-	-						
V9:V17										-	-	-						
V9:V18										-	-	-						
V9:V20										-	-	-	-					
V10:V12										+	+							
V10:V17										-	-	-						
V10:V18										-	-	-						
V10:V20										-	-	-	-					
V10:V23										+	+	+	+					
V12:V15											-	-						

V12:V16											-	-						
V12:V25											-	-	-	-				
V13:V25											-	-	-	-				
V15:V16												-						
V15:V23												+	+					
V15:V25												-	-	-				
V16:V19												+	+					
V16:V27												+	+	+	+	+	+	+
V19:V25													-	-				
V23:V26													-	-	-	-	-	-
V23:V27													-	-	-	-	-	-

Age Range

SH97	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V8:V21										+	+	+	+					
V9:V17										+	+	+						
V11:V26											+	+	+	+	+	+	+	+
V12:V13											+							
V12:V25											+	+	+	+				
V15:V21												+	+					
V15:V23												+	+					
V15:V25												+	+	+				
V16:V21												+	+					
V16:V25												+	+	+				
V17:V20												+	+					
V19:V23													+					
V19:V25													+	+				
V23:V26													+	+	+	+	+	+

Age Range

SH71	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V5	+	+	+	+	+	+	+	+	+									
V1:V6	+	+	+	+	+	+	+	+	+									
V1:V8	+	+	+	+	+	+	+	+	+	+								
V1:V12	+	+	+	+	+	+	+	+	+	+	+							
V1:V15	+	+	+	+	+	+	+	+	+	+	+	+						
V1:V19	+	+	+	+	+	+	+	+	+	+	+	+	+					
V3:V10							+	+	+	+								
V3:V14							-	-	-	-	-							
V3:V19							+	+	+	+	+	+	+					
V3:V21							-	-	-	-	-	-	-					
V5:V6									+									
V5:V19									+	+	+	+	+					
V5:V21									-	-	-	-	-					
V7:V17									-	-	-	-						
V8:V19										+	+	+	+					
V8:V21										-	-	-	-					
V8:V23										-	-	-	-					
V8:V27										-	-	-	-	-	-	-	-	-

V9:V10										+								
V9:V12										+	+							
V9:V15										+	+	+						
V9:V16										+	+	+						
V10:V19										+	+	+	+					
V10:V20										-	-	-	-					
V12:V19											+	+	+					
V13:V14											-							
V13:V25											+	+	+	+				
V14:V27											+	+	+	+	+	+	+	+
V15:V19												+	+					
V15:V21												-	-					
V16:V19												+	+					
V16:V21												-	-					
V17:V24												+	+	+				

Age Range

SH5	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V5:V15									-	-	-	-						
V5:V16									-	-	-	-						
V6:V15									-	-	-	-						
V6:V19									-	-	-	-	-					
V7:V20									+	+	+	+	+					
V7:V22									+	+	+	+	+					
V7:V24									+	+	+	+	+	+				
V8:V15										-	-	-						
V8:V16										-	-	-						
V8:V19										-	-	-	-					
V8:V27										-	-	-	-	-	-	-	-	-
V9:V12										-	-							
V9:V15										-	-	-						
V9:V16										-	-	-						
V9:V20										+	+	+	+					
V10:V12										-	-							
V10:V15										-	-	-						
V10:V16										-	-	-						
V10:V19										-	-	-	-					
V10:V20										+	+	+	+					
V11:V12											-							
V11:V13											-							
V17:V22												+	+					
V17:V24												+	+	+				
V18:V20												+	+					
V18:V21												-	-					

SH114	Age Range 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V2	+																	
V1:V8	-	-	-	-	-	-												
V1:V12	+	+	+	+	+	+	+	+	+	+	+							
V1:V13	+	+	+	+	+	+	+	+	+	+	+							
V2:V8	-	-	-	-	-	-	-	-	-	-								
V2:V11	+	+	+	+	+	+	+	+	+	+	+							
V2:V12	+	+	+	+	+	+	+	+	+	+	+							
V2:V13	+	+	+	+	+	+	+	+	+	+	+							
V2:V23	-	-	-	-	-	-	-	-	-	-	-	-	-					
V2:V27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3:V15							+	+	+	+	+	+						
V3:V16							+	+	+	+	+	+						
V3:V21							+	+	+	+	+	+	+					
V3:V25							+	+	+	+	+	+	+	+				
V5:V8									-	-								
V5:V25									+	+	+	+	+	+				
V6:V8									-	-								
V7:V9									+	+								
V8:V15										+	+	+						
V9:V12										+	+							
V9:V17										-	-	-						
V9:V18										-	-	-						
V9:V20										-	-	-	-					
V10:V12										+	+							
V10:V17										-	-	-						
V10:V20										-	-	-	-					
V10:V23										-	-	-	-					
V10:V27										-	-	-	-	-	-	-	-	-
V11:V23											-	-	-					
V11:V26											-	-	-	-	-	-	-	-
V11:V27											-	-	-	-	-	-	-	-
V12:V15											-	-						
V12:V19											-	-	-					
V12:V23											-	-	-					
V12:V27											-	-	-	-	-	-	-	-
V13:V14											-							
V15:V19												-	-					
V15:V23												-	-					
V15:V25												+	+	+				
V15:V27												-	-	-	-	-	-	-
V16:V19												-	-					
V16:V25												+	+	+				
V16:V27												-	-	-	-	-	-	-
V19:V25													+	+				
V21:V27													-	-	-	-	-	-
V26:V27																		-

Age Range

SH122	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V1:V4	+	+	+	+	+	+	+	+										
V1:V12	+	+	+	+	+	+	+	+	+	+	+							
V1:V13	-	-	-	-	-	-	-	-	-	-	-							
V1:V15	+	+	+	+	+	+	+	+	+	+	+	+						
V1:V23	+	+	+	+	+	+	+	+	+	+	+	+	+					
V1:V27	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V2:V4	+	+	+	+	+	+	+	+										
V2:V13	-	-	-	-	-	-	-	-	-	-	-							
V2:V15	+	+	+	+	+	+	+	+	+	+	+	+						
V2:V23	+	+	+	+	+	+	+	+	+	+	+	+	+					
V2:V27	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V3:V4							+	+										
V3:V8							+	+	+	+								
V3:V10							+	+	+	+								
V3:V15							+	+	+	+	+	+						
V3:V16							+	+	+	+	+	+						
V3:V23							+	+	+	+	+	+	+					
V3:V27							+	+	+	+	+	+	+	+	+	+	+	+
V5:V8									+	+								
V5:V15									+	+	+	+						
V5:V16									+	+	+	+						
V5:V23									+	+	+	+	+					
V5:V27									+	+	+	+	+	+	+	+	+	+
V6:V8									+	+								
V6:V15									+	+	+	+						
V6:V19									+	+	+	+	+					
V6:V23									+	+	+	+	+					
V6:V27									+	+	+	+	+	+	+	+	+	+
V9:V15										+	+	+						
V10:V12										+	+							
V10:V15										+	+	+						
V10:V16										+	+	+						
V10:V17										+	+	+						
V13:V15											+	+						
V19:V23													+					
V21:V27													+	+	+	+	+	+

K-8 Sacred Heart males growth fluctuation pattern maps
(chronological numbering see Appendix H, H-2)

Age Range

SH139	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V14		+	+	+	+	+	+	+	+	+	+	+	+	+	+			
V2:V22		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
V3:V7								+	+	+	+							
V3:V11								+	+	+	+	+	+	+				
V3:V13								+	+	+	+	+	+	+	+			
V3:V15								+	+	+	+	+	+	+	+			
V3;V21								-	-	-	-	-	-	-	-	-	-	
V4:V13										+	+	+	+	+	+			
V4:V15										+	+	+	+	+	+			
V4:V21										-	-	-	-	-	-	-	-	
V4:V22										-	-	-	-	-	-	-	-	
V5:V15										+	+	+	+	+	+			
V6:V12										-	-	-	-	-	-			
V6:V17										-	-	-	-	-	-	-		
V7:V8											+							
V7:V11											+	+	+	+				
V7:V23											-	-	-	-	-	-	-	
V7:V24											-	-	-	-	-	-	-	-
V7:V25											-	-	-	-	-	-	-	-
V8:V26											-	-	-	-	-	-	-	-
V9:V18														+	+	+		
V11:V16														-	-			
V11:V17														-	-	-		
V11:V26														-	-	-	-	-
V12:V13															+			
V12:V21															-	-	-	
V12:V22															-	-	-	
V13:V14															-			
V13:V19															-	-		
V13:V21															-	-	-	
V13:V23															-	-	-	
V14:V15															+			
V14:V21															-	-	-	
V14:V22															-	-	-	
V15:V17															-	-		
V15:V19															-	-		
V15:V24															-	-	-	-
V15:V25															-	-	-	-
V17:V18																+		
V17:V21																-	-	
V17:V22																-	-	

Age Range

SH115	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V4		+	+	+	+	+	+	+	+	+								
V2:V22		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
V3:V15								+	+	+	+	+	+	+	+			
V3:V17								+	+	+	+	+	+	+	+	+		
V3:V20								+	+	+	+	+	+	+	+	+		
V3:V26								-	-	-	-	-	-	-	-	-	-	-
V4:V5										+								
V4:V13										-	-	-	-	-	-			
V4:V14										-	-	-	-	-	-			
V4:V19										-	-	-	-	-	-	-		
V5:V9										-	-	-	-	-				
V5:V19										-	-	-	-	-	-	-		
V6:V14										-	-	-	-	-	-			
V6:V16										-	-	-	-	-	-			
V6:V23										-	-	-	-	-	-	-	-	
V7:V15											+	+	+	+	+			
V8:V15											+	+	+	+	+			
V8:V20											+	+	+	+	+	+		
V11:V15														+	+			
V11:V20														+	+	+		
V12:V13															-			
V12:V14															-			
V12:V21															-	-	-	
V12:V23															-	-	-	
V13:V15															+			
V13:V17															+	+		
V14:V15															+			
V14:V17															+	+		
V14:V22															+	+	+	
V15:V19															-	-		
V15:V23															-	-	-	
V15:V25															-	-	-	-
V15:V26															-	-	-	-
V16:V17															+	+		
V17:V19																-		
V17:V23																-	-	
V18:V23																-	-	
V20:V23																-	-	
V20:V25																-	-	-
V20:V26																-	-	-
V21:V22																	+	
V22:V23																	-	
V25:V26																		-

Age Range

SH145	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V3		-	-	-	-	-	-	-										
V2:V14		-	-	-	-	-	-	-	-	-	-	-	-	-	-			
V2:V21		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
V2:V22		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
V2:V23		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
V3:V4								-	-	-								
V3:V13								-	-	-	-	-	-	-	-			
V3:V14								-	-	-	-	-	-	-	-			
V3:V15								-	-	-	-	-	-	-	-			
V3:V17								-	-	-	-	-	-	-	-	-		
V3:V19								-	-	-	-	-	-	-	-	-		
V3:V23								-	-	-	-	-	-	-	-	-	-	
V3:V25								+	+	+	+	+	+	+	+	+	+	+
V4:V5										-								
V4:V13										-	-	-	-	-	-			
V4:V14										-	-	-	-	-	-			
V4:V15										-	-	-	-	-	-			
V4:V19										-	-	-	-	-	-	-		
V4:V21										-	-	-	-	-	-	-	-	
V7:V13											-	-	-	-	-			
V7:V14											-	-	-	-	-			
V7:V15											-	-	-	-	-			
V7:V25											+	+	+	+	+	+	+	+
V9:V17														-	-	-		
V11:V13														-	-			
V11:V16														-	-			
V11:V17														-	-	-		
V14:V25															+	+	+	+
V15:V17															-	-		
V15:V25															+	+	+	+
V18:V23																-	-	
V19:V25																-	-	-
V20:V25																+	+	+
V22:V23																	-	
V23:V25																	+	+
V24:V25																		+

Age Range

SH30	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V3		+	+	+	+	+	+	+										
V2:V23		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
V2:V25		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
V3:V4								+	+	+								
V4:V13										+	+	+	+	+	+			
V4:V14										+	+	+	+	+	+			
V4:V15										+	+	+	+	+	+			
V4:V19										+	+	+	+	+	+	+		

V4:V24										+	+	+	+	+	+	+	+	+
V5:V9										+	+	+	+	+				
V5:V15										+	+	+	+	+	+			
V5:V19										+	+	+	+	+	+	+		
V6:V12										+	+	+	+	+	+			
V6:V14										+	+	+	+	+	+			
V6:V16										+	+	+	+	+	+			
V6:V17										+	+	+	+	+	+	+		
V6:V20										+	+	+	+	+	+	+		
V6:V23										+	+	+	+	+	+	+	+	
V9:V23														+	+	+	+	
V12:V23															+	+	+	
V13:V20															+	+	+	
V13:V23															+	+	+	
V13:V26															+	+	+	+
V14:V18															+	+		
V14:V20															+	+		
V14:V23															+	+	+	
V14:V24															+	+	+	+
V14:V25															+	+	+	+
V14:V26															+	+	+	+
V15:V18															+	+		
V15:V20															+	+		
V15:V23															+	+	+	
V15:V24															+	+	+	+
V15:V25															+	+	+	+
V16:V23															+	+	+	
V17:V20																+		
V17:V23																+	+	
V19:V25																+	+	+
V21:V23																	+	
V22:V23																	+	

Age Range

SH72	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V4		-	-	-	-	-	-	-	-	-								
V6:V16										-	-	-	-	-	-			
V9:V18														-	-	-		
V11:V15														-	-			
V11:V17														-	-	-		
V11:V20														-	-	-		
V11:V23														-	-	-	-	
V13:V14															-			
V13:V15															-			
V13:V20															-	-		
V16:V17															-	-		
V16:V20															-	-		
V16:V23															-	-	-	
V17:V18																-		

Age Range

SH33	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V21		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
V2:V22		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
V4:V21										+	+	+	+	+	+	+	+	
V4:V22										+	+	+	+	+	+	+	+	
V7:V10											+	+	+	+				
V7:V11											+	+	+	+				
V7:V20											+	+	+	+	+	+		
V7:V23											+	+	+	+	+	+	+	
V8:V11											+	+	+	+				
V8:V20											+	+	+	+	+	+		
V9:V17														+	+	+		
V11:V13														-	-			
V11:V15														-	-			
V11:V16														+	+			
V12:V13															-			
V12:V14															-			
V12:V16															+			
V12:V17															+	+		
V13:V14															+			
V13:V17															+	+		
V13:V20															+	+		
V13:V21															+	+	+	
V13:V23															+	+	+	
V14:V17															+	+		
V14:V20															+	+		
V14:V21															+	+	+	
V14:V24															-	-	-	-
V15:V17															+	+		
V15:V20															+	+		
V17:V18																-		
V18:V20																+		
V20:V24																-	-	-
V20:V25																-	-	-
V23:V24																	-	-

Age Range

SH73	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
V2:V4		+	+	+	+	+	+	+	+	+								
V3:V11								-	-	-	-	-	-	-				
V3:V19								-	-	-	-	-	-	-	-	-		
V4:V14										-	-	-	-	-	-			
V4:V15										-	-	-	-	-	-			
V4:V22										-	-	-	-	-	-	-	-	
V5:V15										-	-	-	-	-	-			
V5:V19										+	+	+	+	+	+	+		
V7:V10											-	-	-	-				

V8:V10											-	-	-	-				
V8:V11											-	-	-	-				
V8:V15											-	-	-	-	-			
V8:V20											-	-	-	-	-	-		
V9:V17														-	-	-		
V13:V15															-			
V13:V17															-	-		
V13:V19															+	+		
V14:V17															-	-		
V14:V19															+	+		
V15:V19															+	+		
V17:V19																+		
V19:V20																-		
V19:V25																-	-	-
V19:V26																-	-	-
V21:V22																	-	
V24:V25																		-

	Age Range																	
SH64	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
V3:V19								+	+	+	+	+	+	+	+	+		
V3:V24								-	-	-	-	-	-	-	-	-	-	-
V4:V5										+								
V6:V14										+	+	+	+	+	+			
V6:V17										+	+	+	+	+	+	+		
V7:V18											+	+	+	+	+	+		
V7:V20											-	-	-	-	-	-		
V7:V24											-	-	-	-	-	-	-	-
V8:V15											+	+	+	+	+			
V8:V20											-	-	-	-	-	-		
V11:V15														+	+			
V11:V17														+	+	+		
V12:V14															+			
V12:V17															+	+		
V15:V20															-	-		
V17:V20																-		
V19:V24																-	-	-
V24:V25																		+

	Age Range																	
SH83	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
V2:V3		-	-	-	-	-	-	-										
V2:V25		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V3:V4								-	-	-								
V3:V13								+	+	+	+	+	+	+	+			
V3:V14								+	+	+	+	+	+	+	+			
V3:V17								+	+	+	+	+	+	+	+	+		
V3:V21								+	+	+	+	+	+	+	+	+	+	
V3:V23								+	+	+	+	+	+	+	+	+	+	

V3:V26								-	-	-	-	-	-	-	-	-	-	-
V4:V5										-								
V4:V15										-	-	-	-	-	-			
V4:V19										-	-	-	-	-	-	-		
V4:V21										+	+	+	+	+	+	+	+	
V4:V22										+	+	+	+	+	+	+	+	
V5:V9										+	+	+	+	+				
V6:V20										-	-	-	-	-	-	-		
V7:V8											-							
V7:V10											-	-	-	-				
V7:V14											+	+	+	+	+			
V7:V18											+	+	+	+	+	+		
V7:V23											+	+	+	+	+	+	+	
V8:V13											+	+	+	+	+			
V8:V14											+	+	+	+	+			
V9:V23														+	+	+	+	
V11:V13														+	+			
V11:V17														+	+	+		
V11:V23														+	+	+	+	
V12:V16															-			
V12:V17															-	-		
V12:V20															-	-		
V12:V22															+	+	+	
V13:V14															+			
V13:V15															-			
V13:V19															-	-		
V13:V20															-	-		
V13:V21															+	+	+	
V13:V23															+	+	+	
V13:V26															-	-	-	-
V14:V15															-			
V14:V19															-	-		
V14:V20															-	-		
V14:V22															+	+	+	
V14:V25															-	-	-	-
V14:V26															-	-	-	-
V15:V17															+	+		
V15:V18															+	+		
V15:V23															+	+	+	
V16:V17															+	+		
V16:V23															+	+	+	
V17:V19																-		
V17:V20																-		
V17:V21																+	+	
V17:V22																+	+	
V17:V23																+	+	
V18:V20																-		
V20:V21																+	+	
V20:V23																+	+	

V23:V25																	-	-
V24:V25																		-
V24:V26																		-
V25:V26																		-

	Age Range																	
SH55	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
V5:V9										-	-	-	-	-				
V6:V14										+	+	+	+	+	+			
V7:V14											+	+	+	+	+			
V7:V18											-	-	-	-	-	-		
V9:V14														+	+			
V9:V17														+	+	+		
V9:V23														+	+	+	+	
V11:V13														+	+			
V11:V26														+	+	+	+	+
V12:V13															+			
V12:V14															+			
V12:V21															+	+	+	
V14:V18															-	-		
V15:V18															-	-		
V16:V20															+	+		
V17:V18																-		
V17:V20																+	+	
V17:V21																+	+	+
V18:V20																+		
V18:V23																+	+	
V23:V24																	+	+
V23:V25																	+	+

K-9 Growth fluctuation pattern maps - Individual summaries

These summaries provide a brief overview of the growth disruption and fluctuation patterns noted in each adult individual from the Sadlermiut and Sacred Heart population samples. Statures estimates for each individual are also included.

Sadlermiut Females (Appendix K, Table K-5)

XIV-C:96

XIV-C:96 showed evidence for periods of both growth disruption and growth acceleration beginning around the age of 11 years. Growth disruption was most clearly shown between the ages of 11 and 15 years followed by a short growth acceleration between 14 and 15 years mainly affecting the later maturing BSIs of the foot, the tibia, and the maximum length of the ulna and radius. However, this brief episode of growth acceleration was then followed by another growth disruption period between 15 and 20 years of age. XIV-C:96 was one of the tallest Sadlermiut females with a stature estimate of 157.82cm.

XIV-C:98

XIV-C:98 showed marked growth disruption between nine and 14 years of age, mainly affecting the maximum length of the tibia, the distal tibia and the maximum length of the calcaneus. Growth acceleration was also noted in this individual between the ages of 11 and 14 years, followed by another episode of growth disruption. This secondary growth disruption was mainly present between 15 and 20 years of age affecting the distal femur and lumbar vertebrae. XIV-C:98 was slightly over the stature average for the Sadlermiut females, with a stature estimate of 154.08cm.

XIV-C:100

XIV-C:100 showed an interesting pattern of growth acceleration in her early childhood period that lasted from three years to approximately 11 years of age. Following this initial growth acceleration, this individual again showed acceleration consistently between the ages of 12 to 15 years and 15 to 20 years. There was evidence to suggest that XIV-C:100 did fall below the confidence interval as there was some mild growth disruption between the ages of 11 and 15 years primarily affecting the distal tibia and the calcaneus. A stature estimate for XIV-C:100 was not calculated due to missing skeletal data.

XIV-C:103

XIV-C:103 showed both growth disruption and acceleration in her first three variable pairs. These data provided the preliminary information to further narrow down the age ranges in which this individual experienced either disruption or acceleration. Growth acceleration was present mainly between the ages of 12 and 15 years affecting the tibia, fibula, ulna and radius. Growth disruption appeared to be minimal for this individual but was most evident between the ages of 12 and 16 years, mainly affecting the lumbar spine. XIV-C:103 had a stature estimate that was slightly below the sub-sample average at 151.08cm.

XIV-C:104

XIV-C:104 was mainly affected by growth disruption most prominent between the ages of 11 and 14 years. This disruption mainly affected the femur, fibula and humeral head. Some growth acceleration was present in this individual between the ages of 14 and 15 and affected the distal tibia, the distal femur, and the maximum length of the humerus. The stature estimate for XIV-C:104 was below the average calculated for the Sadlermiut females at 150.00cm.

XIV-C:105

XIV-C:105 showed a consistent growth acceleration pattern between the ages of three and 15 years, during the maturation of the maximum ulna and radius lengths. This acceleration span was further narrowed into a period between nine and 15 years. During this acceleration period there was some evidence of growth disruption between 12 and 15 years in a variety of lower limb bone variables (V16, V17 V18 and V20). The stature estimate for XIV-C:105 was lower than most of the Sadlermiut female sub-sample at 145.85cm.

XIV-C:112

XIV-C:112 was the only Sadlermiut female to have all variable pairs fall above the confidence interval showing growth acceleration relative to the rest of the sample. Her first five variable pairs all showed evidence of growth acceleration between the ages of three and 10 years. XIV-C:112 also showed a consistent growth acceleration period between 11 and 15 years, mainly affecting the maximum length of her femur, tibia and fibula as well as femoral midshaft circumference and femoral head size. XIV-C:112 was the tallest female in the Sadlermiut female sub-sample measuring 169.04cm, which was also well above the Sadlermiut male average (164.22cm).

XIV-C:145

XIV-C:145 showed primary growth acceleration between the ages of 11 and 15 years with no evidence of early childhood growth disruption. This acceleration mainly affected the lower limb bones and the humerus. However, there was some minimal growth disruption during the maturation of V24 (maximum ulna length) between 15 and 16 years. A stature estimate for XIC-C:145 was not calculated due to missing skeletal data.

XIV-C:148

XIV-C:148 was of interest in that she only showed growth acceleration in one variable pairing, V15 affecting her femoral head size, which would mature by 14 years of age. There was some evidence that growth disruption began in this individual around nine years of age; however, she more consistently showed disruption later on in her growth period between the ages of 12 and 15 years mainly affecting her lower limb bones and the maximum length of her ulna and radius. XIV-C:148 was one of the shortest individuals in the Sadlermiut female sub-sample, her stature was estimated to be 138.37cm

XIV-C:149

XIV-C:149 demonstrated both growth disruption and acceleration between the ages of three and 10 years and three and 15 years, respectively. This timeframe of early growth disruption was minimal, with a more consistent disruption period between the ages of nine and 14 years. Evidence of accelerated growth was present later on during growth maturation, specifically between 11 and 14 years and was focused on the maximum length of the tibia, fibula, radius and ulna. This acceleration period was then followed by a final growth disruption between the ages of 16 and 20 years, affecting both the L1 and L5 vertebrae. The stature estimate for XIV-C:149 was 153.33cm, which was above the Sadlermiut female sub-sample average.

XIV-C:153

XIV-C:153 showed growth acceleration in her first variable pair at three years of age. Growth disruption in this individual began primarily at 11 years of age and lasted until 14 years of age. This growth disruption mainly affected the maximum length of the femur, fibula, ulna and radius, as well as the femoral head and humeral head. Some growth acceleration was present in V8, V9, V15 and V22 (humerus midshaft circumference, tibia midshaft width, femoral head diameter and maximum radius length) and occurred mainly between 12 and 14 years of age. XIV-C:153 had a stature estimate that was just slightly below the sub-sample average at 148.84cm.

XIV-C:175

In contrast to XIV-C:112, XIV-C:175 was the only Sadlermiut female to fall consistently below the confidence interval. Interestingly, this individual had five of same the six Y variables affected as XIV-C:112 (V4 – sacrum superior surface area, V7 – maximum humerus length, V17 – maximum femur length, V20 – maximum tibia length, V22 – maximum radius length and V24 – maximum ulna length), the only difference being that in XIV-C:112, these variables were above the confidence interval and in XIV-C:175 they all fell below the confidence interval between three and 15 years of age. The variables affected were: the superior surface area of the sacrum, maximum humerus length, maximum femur length, maximum tibia length, maximum radius length and maximum ulna length. XIV-C:175 also showed a consistent growth disruption pattern between 11 and 15 years of age. XIV-C:175 was the shortest female individual not only within the Sadlermiut female sub-sample but also compared to all four sub-samples. Her stature was estimated to be 133.88cm.

XIV-C:183

XIV-C:183 showed both growth acceleration and disruption among her first three variable pairs from early childhood into adolescence. Through the closer examination of these variables, this timeframe was narrowed down to show consistent growth acceleration between the ages of 10 and 14 years and consistent growth disruption between 11 and 15 years. Following this period of growth disruption, XIV-C:183 showed some growth acceleration in later maturing BSIs between 15 and 20 years. The stature estimate for XIV-C:183 was slightly above the average of this sub-group at 155.57cm.

XIV-C:192

XIV-C:192 in her first two variable pairs showed that during her early childhood years she experienced a growth disruption, approximately between three and 10 years of age which was followed by accelerated growth between 10 and 20 years. Following these first two variables pairs it appeared that XIV-C:192 experienced some growth disruption between nine and 12 years mainly affecting her humerus. This period of growth disruption was then followed by acceleration between the ages of 11 and 15 years. XIV-C:192 had a stature estimate that was above the average for the Sadlermiut female sub-sample; her stature was estimated to be 154.45cm.

XIV-C:219

XIV-C:219 showed growth acceleration during early childhood between three and 10 years. This period of rapid growth was then followed by a growth disruption period where this individual fell consistently below the confidence interval between 11 and 15 years of age. Some minimal growth acceleration was also noted during this time period between the ages of 13 and 15 years. Similar to individual XIV-C:192, XIV-C:219 also had a stature estimate above the sub-sample average at 154.82cm.

XIV-C:221

XIV-C:221 showed evidence of mild growth disruption between the ages of nine and 12 years, followed by extensive growth acceleration between 12 and 15 years of age. This growth acceleration mainly affected the lower limb bones, the foot bones and the radius. Some mild growth disruption was noted following this period of acceleration and mainly affected the later maturing BSIs in the lower legs and the spine. XIV-C:221 had a stature estimate well above the remainder of the Sadlermiut female sub-sample; this individual was estimated to have a stature of 160.81cm.

Sadlermiut Males (Appendix K, Table K-6)

XIV-C:74

XIV-C:74 showed episodes of both growth disruption and acceleration. Acceleration was mainly present between the ages of 12 and 16 years, while disruption was evident for a longer period between 13 and 18 years. Acceleration mainly affected the radius and tibia while growth disruption was most prominent in the tibia, ulna, calcaneus and talus. The stature of XIV-C:74 was not calculated due to missing skeletal data.

XIV-C:99

XIV-C:99 showed minimal growth disruption at the age of 12 years followed by significant growth acceleration from 13 years to approximately 18 years. This acceleration affected the femoral head, maximum tibia length and the calcaneus. Following this period of acceleration there was evidence of further growth disruption between the ages of 13 and 17 years affecting the distal femur and proximal tibia. XIV-C:99 was slightly above the Sadlermiut male stature average at 168.29cm.

XIV-C:101

XIV-C:101 was the only Sadlermiut male to show only growth disruption among his variable pairs. These disruptions were consistent between 13 and 17 years of age and mainly affected femoral head breadth and the proximal tibia. The stature average of XIV-C:101 was significantly lower than the rest of the Sadlermiut males. While the Sadlermiut male average was 164.22cm, this individual was estimated to have the shortest male stature of 152.95cm.

XIV-C:111

XIV-C:111 mainly showed growth disruption that occurred between the ages of 10 and 16 years, affecting the patella and the proximal and distal tibia. Growth acceleration was also noted in this individual between the ages of 13 years and 17 years of age during the maturation of the calcaneus and the femur. Similar to XIV-C:101, XIV-C:111 was also estimated to have a shorter stature than the remainder of the Sadlermiut male sub-sample at 156.32cm.

XIV-C:117

XIV-C:117 showed early childhood acceleration and disruption as the first two variable pairs fell consistently above the confidence interval, while the next two variables fell below the confidence interval. Growth disruption was also evident between the ages of 10 and 20 years, affecting most of the later maturing variables in the legs, the foot and the spine. Between the ages of 12 and 17 years, growth acceleration was present and affected the tibia, patella, the proximal and distal femur and the proximal tibia. The stature estimate of XIV-C:117 160.43cm, slightly less than the Sadlermiut male average.

XIV-C:126

XIV-C:126 mainly showed patterns of growth disruption, specifically between the ages of 10 and 17 years of age. Variables affected during this disruption were: the calcaneus, the talus and the thoracic and lumbar vertebrae. After this initial period of growth disruption, XIV-C:126 was again affected by disruption between 18 and 20 years. Some growth acceleration was noted between the ages of 12 and 16 years mainly affecting the tibia, humerus and patella. The stature estimate for XIV-C:126 was 162.68cm.

XIV-C:156

XIV-C:156 mainly showed patterns of growth acceleration that were most dominant between the ages of 12 and 17 years. This growth acceleration period mainly affected the humerus, femoral head, maximum femur length, proximal tibia and the calcaneus. Some minimal growth disruption was evident but only in variables V24 and V26 (T12 superior surface area and L5 superior surface area) which fell between the ages of 16 and 20 years. XIV-C:156 had a stature estimate that was above most of the remainder of the Sadlermiut male group at 169.04cm.

XIV-C:157

XIV-C:157 primarily demonstrated growth disruption beginning at four years of age which continued until approximately 17 years of age. By examining later maturing variables this time frame was narrowed down to show that XIV-C:157 consistently fell below the confidence interval between 10 and 17 years of age. The BSIs affected the most by this disruption included both arm and leg bones. Some evidence of growth acceleration was present in this individual affecting the lumbar vertebrae. The stature estimate for XIV-C:157 was 164.17cm.

XIV-C:179

XIV-C:179 primarily showed growth acceleration that began at approximately 12 years of age and lasted until 17 years of age, followed by a mild acceleration period between 19 and 20 years. These acceleration periods mainly affected the tibia, femoral head, talus and pelvic width. There was some evidence of growth disruption in XIV-C:179 affecting variables V10, V17, V21 and V22 (radial head diameter, maximum tibia length, maximum calcaneus length and posterior length of calcaneus) and occurred between 13 and 16 years and 17 and 19 years. XIV-C:179 had an estimated stature of 163.05cm, slightly less than the sub-sample average.

XIV-C:181

XIV-C:181 was the only Sadlermiut male to demonstrate only growth acceleration during the growth and development time period. Beginning at approximately 12 years of age XIV-C:181 showed accelerated growth up to 19 years of age affecting nearly all variables in his arms, legs, vertebrae and feet. This individual also had a higher stature estimate than the Sadlermiut male sub-sample at 170.16cm.

XIV-C:182

XIV-C:182 showed significant growth acceleration during much of his growth and development period, specifically between the ages of 10 and 20 years. A growth disruption period was also evident during the same time period between the ages of 12 and 17 years, affecting the humerus, radius, femoral head, maximum tibia length, lumbar vertebrae and the calcaneus. XIV-C:182 was one of the male individuals from this sub-sample that had a stature estimate below average at 157.44cm.

XIV-C:216

XIV-C:216 showed both growth disruption and acceleration in the first two variable pairs, with disruption lasting from four to 10 years of age. The growth acceleration was much more significant in that it spanned from four years to 19 years of age. This acceleration estimate was further narrowed down by examining later maturing variables and is most evident between the ages of 12 and 17 years. This acceleration period mainly affected the humerus, ulna, tibia and femur. There was some growth disruption between the ages of 13 and 17 years followed by another brief disruption at the end of the growth period between 18 and 20 years. The stature estimate for XIV-C:216 was 164.92cm, similar to the sub-sample average.

XIV-C:217

XIV-C:217 demonstrated a distinct period of growth acceleration between the ages of 12 and 19 years affecting the calcaneus, lumbar vertebrae and pelvic width. However, this individual also showed evidence of growth disruption where he consistently fell below the confidence interval between the ages of 13 and 17 years. During this period of disruption the humeral head, calcaneus and proximal and distal femur were affected. XIV-C:217 had an estimated stature of 165.67cm.

XIV-C:230

XIV-C:230 showed an interesting pattern of growth disruption and acceleration through his period of growth and development. Growth acceleration was noted in his first variable pair between the ages of four and 10 years. This acceleration was then followed by significant disruption from approximately 12 years of age to 20 years of age. This growth disruption mainly affected the humerus, the femoral head and the lumbar vertebrae. During this lengthy period of growth disruption, XIV-C:230 did show some evidence of acceleration but only in four variables affecting the fibula, femur and width of the pelvis. XIV-C:230 showed the tallest stature in the Sadlermiut male sub-sample. While the average stature estimate was 164.22cm, XIV-C:230 had an estimated stature of 176.89cm.

XIV-C:243

XIV-C:243 showed early childhood growth acceleration between the ages of four and 10 years. This acceleration period was then followed by a significant growth disruption period from 12 to 17 years of age. This disruption mainly targeted the calcaneus, the lumbar vertebrae, the distal femur and proximal tibia. Some minimal growth acceleration was present between the ages of 13 and 17 years. The stature estimate for XIV-C:243 was 169.78cm, slightly above the sub-sample average.

XIV-C:246

XIV-C:246, similar to XIV-C: 126, mainly showed growth disruption. The first disruption period was during the early childhood years between four and 10 years. This period of disruption was then followed by acceleration between 12 and 17 years, which mainly affected the talus, calcaneus and the femur. Also during this period of acceleration XIV-C:246 experienced another episode of growth disruption between the ages of 13 and 17 years of age. Slightly below the sub-sample stature average, the stature estimate for XIV-C:246 was 161.56cm.

Sacred Heart Females (Appendix K, Table K-7)

Individual 5

Individual 5 showed growth disruption mainly between the ages of 12 and 14 years affecting the growth of the femur and cranium. Growth acceleration was also present in Individual 5 between 12 and 15 years affecting tibial, radial and ulnar length. Individual 5 had an estimated stature that was slightly less than the sub-sample average at 157.82cm.

Individual 9

Individual 9 showed an interesting pattern of growth and development in her early stages of maturation; in particular she demonstrated both disruption and acceleration from three to 11 years of age affecting her distal humeral joint and her interorbital breadth. After this initial period, Individual 9 consistently fell below the confidence interval between the ages of 11 and 14 years which affected some of her lower limb bones and later maturing cranial features; however, she did move above the confidence interval around 13 years of age and continued to show accelerated growth in later maturing BSIs. Individual 9 had a stature estimate that was far below the remainder of the Sacred Heart female sub-sample at 151.83cm.

Individual 24

Individual 24 showed two primary growth disruption events during her growth and development period, specifically between the ages of nine and 13 years and 14 and 16 years. In only one Y variable (V16), did Individual 24 fall above the confidence interval, which occurred at 14 years and affected her femoral head breadth. Because Individual 24 fell below the confidence interval during her later period of growth, it can be assumed that no catch-up growth occurred, or that it may have occurred once certain BSIs had already passed their growth threshold and no longer had the capacity to "catch-up" in size. The stature estimate of Individual 24 was 160.06cm.

Individual 71

Individual 71 had a distinct pattern of growth acceleration between the ages of three and 11 years, primarily affecting the growth of the humerus. There was some evidence that this individual experienced mild growth disruption between the ages of 12 and 15 years affecting the overall size of the lower limb bones; however, there does appear to be further growth acceleration after 15 years in other later maturing BSIs. The stature estimate of Individual 71 was slightly below the Sacred Heart female sub-sample average at 158.56cm.

Individual 88

Individual 88 demonstrated minimal growth disruption during her growth and development period. Between the ages of nine and 12 years, Individual 88 showed mild signs of growth disruption as she consistently fell below the confidence interval while her upper limb bones were reaching maturity. She did however, demonstrate extensive accelerated growth between the ages of 12 and 15 years when her lower limb bones were reaching maturity. Individual 88 had a stature estimate that was slightly above the remainder of the female sub-sample at 162.68cm.

Individual 97

Individual 97 was the only Sacred Heart female who fell above the confidence interval in all variable pairings. Between the age of 13 and 16 years Individual 97 was consistently above the confidence interval demonstrating accelerated growth of her lower limb bones, specifically the distal tibia, distal femur and calcaneus. The statures estimate for Individual 97 was well above the remainder of the Sacred Heart female sub-sample at 166.79cm.

Individual 114

Individual 114 showed early signs of growth acceleration as she consistently fell above the confidence interval during the maturation of her cranial features and femur. The timeframe of this acceleration was mainly between nine and 13 years. There was evidence of growth disruption between the ages of 13 and 15 years as she fell below the confidence interval during the maturation of her foot bones, lumbar spine and tibia. The stature estimate calculated for Individual 114 was 154.45cm, falling below the sub-sample average.

Individual 120

Individual 120 fell above the confidence interval in almost all variable pairings; however there was some evidence of early growth disruption in regards to cranial and spinal column growth up to the age of 10 years. Accelerated growth was consistent in Individual 120 in both the arm and leg bones that mature up to the age of 15 years, after which Individual 120 resumed a normal trajectory within the Sacred Heart female sample. Individual 120 was the tallest Sacred Heart female with a statures estimate of 173.15cm.

Individual 122

Individual 122, comparable to Individual 97, fell above the confidence interval in almost all of her variable pairings. The only exception to this was V13 (maximum mandible breadth) which fell consistently below the confidence interval. This evident growth acceleration was primarily in the lower limbs bones, specifically the femur. The stature estimate for Individual 122 was well above the sub-sample average at 166.79cm.

Individual 124B

Individual 124B demonstrated two growth disruptions between the ages of three and 10 years and 12 and 14 years as she consistently fell below the confidence interval. Between the age of nine and 14 years there was some evidence of growth acceleration in the foot bones and the later maturing cranial bones as Individual 124B moved above the confidence interval. In her final stages of growth and development Individual 124B again fell below the confidence interval at 20 years of age. The stature estimate for Individual 124B was considerably shorter than most of the Sacred Heart female sub-sample at 153.33cm.

Sacred Heart Males (Appendix K, Table K-8)

Individual 30

Individual 30 was the only individual in the Sacred Heart male sample that fell consistently above the confidence interval in every variable pair. The largest growth acceleration in this individual was between the ages of 12 and 17 years. There were no variables that fell below the confidence interval. Individual 30 was one of the tallest males from the Sacred Heart male sub-sample, with an estimated stature of 186.61cm.

Individual 33

Individual 33 primarily showed growth acceleration between the ages of 13 and 17 years, with some evidence of growth disruption during the maturation of the upper arm bones, the foot bones and the lower spine between 16 and 18 years as well as 19 and

20 years. Similar to Individual 30, Individual 33 had the tallest estimated stature of the sub-sample at 188.48cm.

Individual 55

Individual 55 showed accelerated growth between the ages of 13 and 17 years which affected the proximal femur, the calcaneus and the spine. Evidence of growth disruption was only present in V9 (patella maximum breadth) and V18 (proximal tibia breadth) and was present between the ages of 13 and 16 years, followed by further growth acceleration up to 20 years of age. Individual 55 has a stature estimate slightly greater than the sub-sample average at 179.51cm.

Individual 64

Individual 64 demonstrated both accelerated and disrupted growth in his first two variable pairs. The accelerated growth lasted between the ages of 10 and 18 years while the growth disruption period was between 10 and 20 years. This was then followed by accelerated growth between 13 and 18 years and evidence of another growth disruption between 13 and 18 years. Growth acceleration mainly affected the lower limb bones, specifically the femur and tibia while the growth disruptions mainly affected the upper limb bones and the spine, in particular the ulna and the thoracic vertebrae. Individual 64 had a stature estimate of 180.63cm.

Individual 72

Individual 72, in contrast to Individual 30, was the only Sacred Heart male individual that fell completely below the confidence interval in all variable pairs. This growth disruption affecting Individual 72 was present mainly between the ages of 16 and

18 years. Individual 72 had a stature estimate slightly shorter than the sub-sample average at 174.64cm.

Individual 73

Individual 73 showed growth acceleration in his first set of variable pairs suggesting the acceleration of growth between four and 12 years, perhaps in response to growth disruption occurring before four years of age. This acceleration period was then followed by a growth disruption between the ages of 12 and 17 years and again in the final stages of growth between 18 and 20 years. There was some evidence of accelerated growth after the initial period of growth disruption particularly in the proximal tibia between 17 and 18 years. The stature estimate for Individual 73 was far below the stature average for this sub-sample at 167.91cm.

Individual 83

Individual 83 showed consistent growth disruption between the ages of four and 20 years as was illustrated in his first two variable pairs. Growth acceleration, possibly in response to this growth disruption, was evident between the ages of 10 and 17 years. This acceleration mainly affected the femur, tibia and foot bones of this individual. Further growth disruption was evident between the ages of 12 and 18 years also affecting the femur, tibia and the ulna. Individual 83 had a comparable stature estimate to the sub-sample average at 176.14cm.

Individual 115

Individual 115 showed accelerated growth during the early period of growth and development, which was perhaps in response to a growth disruption that occurred before the age of four years. There was also a consistent disruption shown between the ages of

12 and 17 years affecting the patella and the femur. This disruption episode was then followed by another acceleration of growth between the ages of 17 and 18 years with further disruption shown at the very end of the adolescent maturation period around 20 years of age. The stature estimate for individual 155 was 175.02cm.

Individual 139

Individual 139 demonstrated both growth disruption and acceleration in his first two variable pairs between the ages of four and 19 years. This age range was further narrowed down to show the majority of growth disruption between 13 and 20 years and acceleration between 10 and 16 years. Growth disruption mainly affected his spine, lower limbs and foot bones and growth acceleration was most evident in his lower limb bones. Individual 139 had a stature estimate very similar to the sub-sample average at 176.14cm.

Individual 145

Individual 145 showed an interesting pattern of growth disruption and acceleration. This individual consistently fell below the confidence interval in all variable pairs except for the Y variable V25 (L1 superior surface area) which fell above the confidence interval. This suggested that a growth disruption occurring before the maturation of V25 at 20 years caused this acceleration, which may explain the extensive period of growth disruption in Individual 145. This disruption period occurred mainly between the ages of 10 and 17 years. Individual 145 had the shortest estimated stature in this male sub-sample at 159.31cm.