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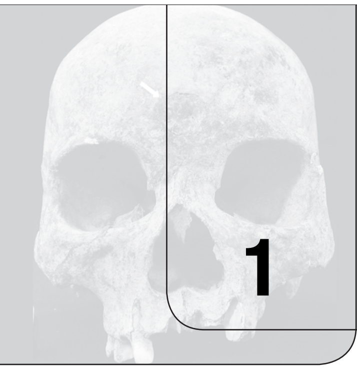

1 Introduction

Many thousands of archaeological human skeletons are currently housed in various institutional repositories throughout the world. Some of these collections are extensive: The Natural History Museum in London holds some 10 000 cataloged individuals, the Smithsonian Institution has at least 30 000 skeletons, and the Bavarian State Collection more than 50 000 sets of human remains (Loring & Prokopec, 1994; McGlynn, personal communication; Molleson, 2003). These and many other major collections around the world started during the nineteenth century, mostly for purposes of collecting crania and other remains for investigations of racial classification (Larsen & Williams, 2012; Little & Sussman, 2010) or as "curiosities" without any manner of context (Taylor, 2014). While these motives for collection have largely disappeared, these collections in Europe, North America, and elsewhere still provide today an essential foundation for the study of past human variation and evolution. The importance of the collections lies in the fund of biological information they offer for interpreting lifeways of past peoples and for developing an informed understanding of the history of the human condition generally.

One could argue that earlier generations of anthropologists may not have appreciated the enormous value of human remains for interpreting the past, especially in view of the high volume of excavated remains versus the remarkably low frequency of analysis and publication on those studied by biological anthropologists (Steele & Olive, 1989). Today, however, human remains have become a key element of archaeological research and have contributed to a burgeoning understanding of past population dynamics in general and the human condition in particular. This is especially the case for developing and testing hypotheses and drawing inferences about the human experience relating to diet, health, and lifestyle at all levels, from the individual (various in Stodder & Palkovich, 2012; and see Knudson, Pestle et al., 2012; Tiesler & Cucina, 2006) to large swaths of the globe (Steckel & Rose, 2002; Verano & Ubelaker, 1992; White, 1999). In addition, the study of ancient human remains is important in the ongoing discussions in anthropology about social organization, identity, and the linkages between health and gender and health and status (various authors in Gowland & Knüsel, 2006; Grauer & Stuart-Macadam, 1998; Knudson & Stojanowski, 2009). The study of these remains has played a fundamental role in investigating key adaptive shifts in recent human evolution, such as the foraging-to-farming transition and European exploration and colonization during the post-Columbian era (Bocquet-Appel & Bar-Yosef, 2008; Cohen, 1989; Cohen & Armelagos, 1984; Cohen & Crane-Kramer, 2007; Klaus, 2014a; Lambert, 2000a; Larsen, 2006; Larsen & Milner, 1994; Pinhasi & Stock, 2011), and documentation and interpretation of specific disease histories (Palfi et al., 1999; Powell & Cook, 2005; Roberts & Buikstra, 2003; Roberts et al., 2002). Especially in the last decade or so, regional analysis has provided compelling insights into human adaptation in broad perspective from a diverse range of settings globally (Domett, 2001; Fitzpatrick & Ross, 2011; Hanson & Pietrusewsky, 1997; Hemphill & Larsen, 2010; Hutchinson, 2002, 2004, 2006; Judd, 2012; Lambert, 2000a; Larsen, 2001; Mushrif-Tripathy & Walimbe, 2006; Ortner & Frohlich, 2008; Oxenham & Tayles, 2006; Pechenkina & Oxenham, 2012; Pietrusewsky & Douglas, 2002a,b; Robbins Schug, 2011b; Roberts & Cox, 2003; Ruff, 2010a; Schepartz et al., 2009; Steckel & Rose, 2002; Stodder, 2008; Tung, 2012a; Weber et al., 2010; Whittington & Reed, 1997; Williamson & Pfeiffer, 2003; Wright, 2006). These regional studies have provided new perspectives on variation in human adaptation, including the foraging-to-farming transition. For example, the experience of this transition in the western hemisphere has shown a general decline in health, linked in part to maize farming. By contrast, rice farming in Asia may have promoted better health, especially in relation to oral health (Domett, 2001; Domett & Tayles, 2007; Douglas & Pietrusewsky, 2007; Oxenham, 2006). It is especially exciting to see the development of insights into past lives and lifestyles in the regional context. In the mid-1980s, the record of poor health in the later prehistoric American Southwest was beginning to emerge (Merbs & Miller, 1985). Building on this record, discussions of conflict, its causes and consequences, and the crucial importance of human remains in these discussions have developed, creating a forum for anthropologists and other social scientists to engage in developing new solutions to long-standing problems. In particular, it is through regional and continental comparisons that we are beginning to understand the patterns and prevalence of violence and its effects on society, demography, and health (Schulting & Fibiger, 2012).

Skeletal remains offer an important source of information for the study of human variation. Archaeological skeletons from specific localities are more homogeneous both genetically and in terms of the environments from where they came than are dissecting room or anatomical skeletal series. Skeletons from the latter contexts are from many populations and highly diverse circumstances. The use of archaeological series becomes especially important when making conclusions about intra-population variability for a range of topics where sex and age may be important factors.

Various surveys and manuals of human osteology and application to archaeological settings are available (Baker et al., 2005; Bass, 2005; DiGangi & Moore, 2013; Roberts, 2009; Scheuer & Black, 2000, 2004; Schwartz, 2006; Ubelaker, 1999; White et al., 2012). In order to address the incompatibility of different researchers' methods and results, "standards" for skeletal data collection have been developed (Buikstra & Ubelaker, 1994). Although dealing with the interpretive role in the study and documentation of human remains, these works serve primarily as "how to" guides for bone identification and skeletal analysis and not as resources for the investigation of broader issues in biological anthropology and sister disciplines. The present book focuses on the relevance of skeletal remains to the study of the human condition and human behavior generally; namely, how skeletal and dental remains derived from archaeological settings reveal life history at both the individual and population levels. It does not advocate a reliance on only human remains in order to tell the whole story of the human condition. Rather, human remains represent a part of the broad sweep of data derived from past settings. Human remains do not simply augment other data sources, archaeological or historical. Rather, they provide perspectives and understandings of past societies that pertain to human biology that simply may not be visible in other sources (Perry, 2007).

The goal of this book is to provide a synthesis of bioarchaeology – the study of human remains from archaeological contexts. Although the term was first applied to the study of animal remains from archaeological settings (Clark, 1972), the focus of study then surfaced with reference to the study of human remains in the regional "bioarcheological investigation" of the lower Illinois River valley, an ambitious and innovative research program directed by Jane Buikstra (1977a). This set into motion the future course of the field (Buikstra, 2006; Knüsel, 2010; Larsen & Walker, 2010).

The field emphasizes integrative, interdisciplinary study. By doing so, the wide breadth of bioarchaeology has engendered cross-fertilization between different disciplines, contributing to its method and theory in approaching a wide diversity of problems. The field recognizes the inextricable connection between biology and culture – one simply would not exist without the other (Goodman, 2013). Just as human remains are a crucial component of study, it is the *context* of these remains that provide us with meaning and substance. Context is a broad term to include all potential sources, archaeological and otherwise, such as burial and social inference, diet, climate, living conditions, and all else that is inferred or documented that may inform our understanding of the people the skeletons represent.

The enormous potential of bioarchaeology for understanding the past is growing (Buikstra & Beck, 2006; Katzenberg & Saunders, 2008; Larsen and Walker, 2010; Martin et al., 2013; Stojanowski & Duncan, 2014). I believe that this is the case for two key reasons. First, in contrast to earlier work that emphasized description, often poorly connected to any manner of context, there is a growing interest in the central role that human remains play in understanding patterns and trends in past societies. Second, the centrality of human remains for understanding past biological, social, and behavioral dynamics has motivated an emphasis on integrative research strategies, resulting in excavations of human remains having clear agendas and questions that guide both their recovery and their study. Today, there is a very different research profile, one that emphasizes the links between biological variation, health and well-being, and behavior viewed broadly. This contrasts with the descriptive orientation of earlier generations of osteologists, but it was the work of these predecessors that provided many of the tools that served to form the field (Buikstra & Beck [2006], an historical treatment of bioarchaeology).

This book takes a largely population perspective. However, individual-based case studies are discussed, especially because collectively they help to build a picture of variability in earlier societies. The population approach is critical for characterizing patterns of behavior, lifestyle, disease, and other parameters that form the fabric of the human condition. The discussion in the following pages also underscores the importance of culture and society in interpreting population characteristics. Dietary behavior, for example, is highly influenced by cultural and social norms of behavior. If an individual is taught that a specific food is "good" to eat, then the consumption of that food item becomes fully appropriate in that cultural context. Food is also an important indicator of a person's place in society – access to resources is influenced not only by where one lives but also by their identity and location within a society. Hence, cultural and social factors play an essential role in determining diets of individual members of a social group or society.

As I have made clear, the book is fundamentally driven by context and especially by the placement of the biological record of skeletons in their archaeological context, recently called "contextualization," or the location of human remains within relevant archaeological and historical frameworks (Knudson & Stojanowski 2009; Thompson et al., 2014), and treatment of the body in funerary settings (Duday, 2009). Contrary to the assertion that those who study human remains have largely disengaged bones from context, whereby the physical anthropologist "does not necessarily need the archaeologist once the archaeologist has excavated bone" (Goldstein, 2006:376–377), there has been a growing movement focusing on the links between archaeology and physical anthropology in the development of research programs globally. Characterizing bioarchaeology as involving a disengagement of bodies from place misrepresents the vast majority of research cultivated in this exciting discipline, especially given the enormous progress of the field today.

Unlike many of the aforementioned guides to osteological analysis, this book is not a book about methods. Certainly, methodological developments make possible much of the discussion presented in the following chapters (see various authors in Katzenberg & Saunders, 2008). Moreover, technological advances, such as imaging, have provided new insights unimaginable a decade ago (various in Chhem & Rühli, 2004). However, this book focuses on how human remains inform our understanding of the past. By doing so, this book is intended to feature the various insights gained about human behavior and biology rather than to describe or evaluate specific methods and techniques of skeletal analysis. This approach is central to the *biocultural* perspective offered by anthropologists – we must seek to envision past populations as though they were alive today, and then ask what information drawn from the study of skeletal tissues would provide understanding of them as functioning, living human beings and members of populations. Nor is this book a critical review, highlighting the shortcomings of the field or what bioarchaeologists should be doing, but are not.

Bioarchaeological findings are important in a number of areas of scientific and scholarly discourse. Within anthropology, the use of human remains in interpreting social behavior from mortuary contexts is especially fruitful (Artelius & Svanberg, 2005; Beck, 1995; Buikstra, 1977a; Chapman et al., 1981; Chesson, 2001; Gowland & Knüsel, 2006; Humphreys & King, 1981; Knudson & Stojanowski, 2009; O'Shea, 1984; Parker Pearson, 2000). The story human remains tell is also reaching an audience outside anthropology. There is an increase in use of bioarchaeological data in history, economics, and nutrition science. Skeletal studies of nutrition, disease, and related topics, and the importance of human remains in developing a broader understanding of economic history are opening a new path of research interest (Steckel & Rose, 2002). The emerging role of skeletal remains in the study of the human condition was underscored by the eminent historian, John Coatsworth (1996:1), who highlights the "masses of evidence" provided from bioarchaeological investigations and the important role they play in understanding historical developments.

Breakthroughs have been made in the analysis of various body tissues in archaeological settings, including hair, muscle, skin, and other soft tissues (Arriaza, 1995; Asingh & Lynnerup, 2007; Aufderheide, 2003; Brothwell, 1987; Chamberlain & Parker Pearson, 2001; Cockburn et al., 1998; Hansen et al., 1991; Lynnerup et al., 2002; Stead et al., 1986). The discussions presented in this book focus largely on skeletal and dental tissues. Building on the study of human remains, the unifying theme in this book is behavioral inference. My discussion of behavior is not limited to physical activity; rather, it is considered in a wider perspective, including (in order of appearance in the book) physiological stress, exposure to pathogenic agents, injury and violence, physical activity, masticatory and extramasticatory uses of the face and jaws, dietary reconstruction and nutritional inference, population history, and social factors and how they influence health and lifestyle. Simply, almost everything available in the study of human remains has behavioral meaning.

Bioarchaeology is represented throughout the world. This book draws upon a sample of this record in illustrating important points and issues. The book deals with all regions of the globe, but especially in those areas that have been studied in depth by bioarchaeologists. One of the exciting advances in the field in the last decade or so is the proliferation of bioarchaeological treatments outside North America, especially Europe, Asia, and the Pacific (Domett, 2001; Lynnerup, 1998; Murphy, 2002, 2003; Ortner & Frohlich, 2008; Oxenham & Tayles, 2006; Papathanasiou, 2001; Pechenkina & Oxenham, 2013; Pietrusewsky & Douglas, 2002b; Rife, 2012; Roberts & Cox, 2003; Ruff, 2010a; Schepartz et al., 2009; Whittington & Reed, 1997; and many others). Reflecting this increasingly international bioarchaeology are the international, multidisciplinary collaborations around the world, including in Latin America, Europe, Asia, and Africa.

Various points made in the book are addressed by contrasting and comparing data sets from skeletal assemblages representing human populations from different levels of sociopolitical complexity and differing subsistence regimes. Because of the vagaries of dietary reconstruction in the archaeological past, anthropologists usually characterize human groups broadly, using terms such as “foragers” or “farmers.” The reader should recognize that these terms are often overly simplistic and do not convey the underlying complexity of human adaptive systems adequately. Nevertheless, these categories help us to understand broad behavioral and adaptive features of different groups better, and therefore, are the starting points to facilitate yet more specific and contextual reconstructions and interpretations of past lifeways. Of far more importance to the focus of this book is that these contrasts and comparisons add an important dimension to the growing discussion in anthropology oriented toward the understanding of the causes and consequences of adaptive and behavioral shifts in the past and present.

A fundamental barrier to understanding health in today’s populations is the very narrow temporal window in which they have been studied. The prevalence records for osteoarthritis and oral degenerative conditions, for example, are limited largely to the last several decades when large-scale epidemiological studies of living populations were first undertaken (Arden & Nevitt, 2006; Blinkhorn & Davies, 1996; Issa & Sharma, 2006; Jordan et al., 2007; Pilot, 1998; Sreebny, 1982; Woodward & Walker, 1994), representing approximately only the last 0.1% of the history and evolution of our species. Biomedical, experimental, molecular, and behavioral studies of skeletal and oral degenerative conditions have been investigated in great detail in human populations for this 0.1% window of time. However, these studies are limited in scope, focusing primarily on remarkably gross categories of human variation. They are deficient because they underrepresent and mischaracterize human biological variation, reducing the variation to simple dichotomous (or other limited) comparisons having little to do with real biological or social variation. Analysis of the recent biomedical and epidemiological literature characterizes variation according to “race” (e.g., White vs. Black vs. Hispanic), geography (mostly United States and western Europe), sex (men vs. women), diet (e.g., access to refined sugar), and socioeconomic status based on income level (upper-, middle-, and lower-income), in addition to the very narrow temporal window (Allen, 2010; Dominick & Baker, 2004; Jordan et al., 2007; Pilot, 1998). The (mis)characterization of human variation has important implications for understanding an increasingly diverse society in the United States, far more diverse than the racial categories so prevalent in biomedical research would seem to imply. By expanding understanding of diversity, in terms of both broad temporal and geographic perspectives, bioarchaeology as an anthropological subdiscipline provides a more informed understanding of health in the present through a consideration of heath in the past.

Anthropologists, economic historians, and other social scientists have long recognized that humans in the past and present are extraordinarily diverse in their food consumption practices, social habits, workloads, and other behavioral characteristics that collectively characterize health and lifestyle. The biomedical and epidemiological literature on degenerative conditions is known from a limited, if not insufficient record. Moreover, this record is limited to the study of populations that have mitigated some of the conditions that influence the prevalence of degenerative conditions most strongly, namely industrialized societies having access to healthcare, adequate nutrition, and labor-saving technology. For example, prevalence of dental caries in many developed countries has been reduced due to the introduction of fluoride in drinking water, which is certainly the case in the United States (McDonagh et al., 2000). In addition, owing to work-saving technology, workload has greatly declined in developed countries especially. If physical activity is the primary factor in determining prevalence and pattern of osteoarthritis, for example, then one could predict a decline in its prevalence, especially in recent societies. That is, as advances in technology essentially replace what the body used to do in work and activity generally, we should expect to see long-term trends in terms of a decline in osteoarthritis. This hypothesis has not been tested using the kind of systematic approach offered by bioarchaeology.

Bioarchaeology offers a unique opportunity to study a much more diverse sampling of humanity, namely the last 10 000 years of more than seven million years of human evolution, greatly extending the time framework for characterizing the biocultural context surrounding some of the most important changes and developments in the evolutionary history of our species. Arguably, it is this small percentage of our evolution where crucial developments occurred that set the stage for the rise of modern civilization, namely farming, appearance of complex societies, urbanization, and industrialization.

Many studies of human remains from archaeological contexts focus on a single population without actively linking the analysis of these remains to the context (climate, diet, time, culture, settlement, and economic system) from which they derive. A central aim of bioarchaeology is to establish a comprehensive record of skeletal and dental conditions in relation to prevalence and pattern to develop an understanding of behavior and the costs and consequences of particular lifestyle circumstances and conditions. Bioarchaeology provides an unmatched record of health and life conditions in the past, thereby extending our understanding of diversity in geography, cultures, and time that is simply not possible with sole reliance on limited health attributes of living populations.

Human skeletal and dental tissues are remarkable records of lives led in the past, what Stanley M. Garn referred to as "a rich storehouse of individual historical events" (1976:454). This book provides a tour of the vast holdings in this storehouse, displaying the knowledge gained about earlier peoples based on the study of their mortal remains.

2 Stress and deprivation during growth and development and adulthood

2.1 Introduction

Physiological disruption resulting from impoverished environmental circumstances – "stress" – is central to the study of health and well-being and the reconstruction and understanding of health, adaptation, and behavior in both earlier and contemporary human societies. Stress involves disruption of homeostasis, or the maintenance of a constancy of conditions that keep the body's internal environment stable. Stress is a product of three key factors, including (1) environmental constraints, (2) cultural systems, and (3) host resistance. Goodman and others (Goodman, 1991; Goodman & Armelagos, 1989; Goodman & Martin, 2002; Goodman, Martin et al., 1984, 1988; Klaus, 2012; Martin et al., 1991) modeled the interaction of these factors at both the individual and population levels (Figure 2.1). This model of health and context emphasizes the role of environment in providing both the resources necessary for survival and the stressors that may affect the health and well-being of a population, yet includes the profound influence of culture in health outcomes. Cultural systems serve as protective buffers from the environment, such as shelter and clothing as buffers against temperature extremes. Cultural systems can be highly effective at mitigating behaviors necessary for extraction of important nutrients and resources from the environment, thus supporting the ability to maintain stability. It appears impossible for the full spectrum of stressors in an environment to be buffered against; some inevitably slip through the filters of the cultural system. In these instances, the individual may exhibit a biological stress response observable at the tissue level (bones and teeth). Importantly, stress, buffering systems, and tissue-level responses are not linked by a simplistic, linear relationship. Instead, they can interact with and influence other variables within other levels of the model. Physiological disruption feeds directly back into environmental constraints and cultural systems. This model makes clear that health is a key variable in the adaptive process.

Biological stress has significant functional consequences for the individual and for the society in which they are living. Elevated stress and associated disruption of homeostasis may lead to a state of functional impairment, resulting in diminished cognitive development and work capacity. The reduction in work capacity can be detrimental if it impedes the acquisition of essential resources (e.g., dietary) for the maintenance of the individual, the population, and the society. If individuals of reproductive age are affected by poor health, then decreased fertility may be the outcome. Ultimately, the success or failure of a population and its individual constituents to mitigate stress has far-reaching implications for behavior and the functioning of society.

Stress and developmental instability in early life, prenatal and postnatal, have important implications for health outcomes in later life. David Barker's research on chronic diseases in middle age reveals that individuals with low birth weight and nutritional deprivation in early

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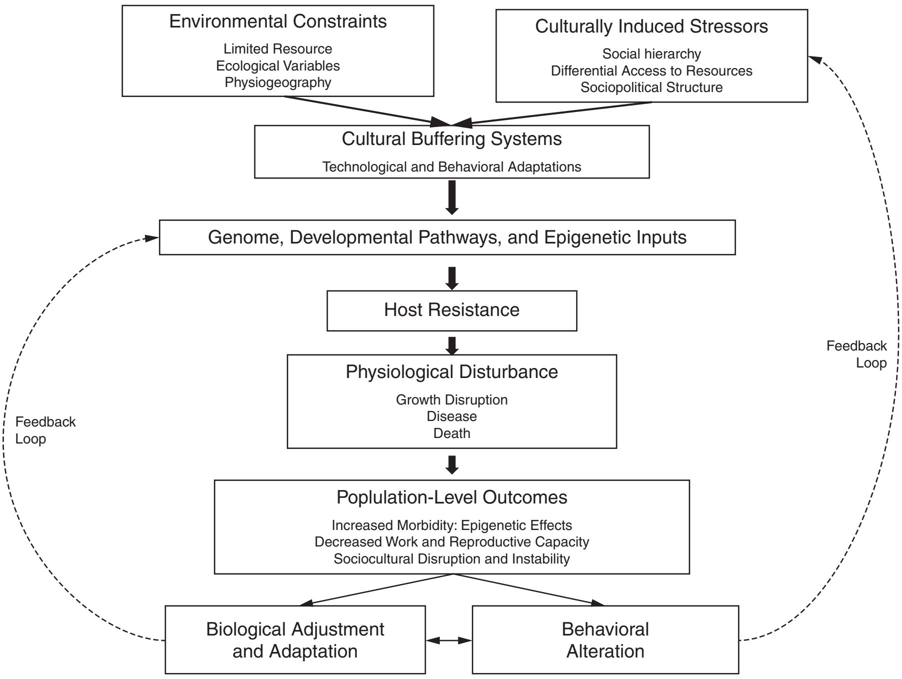

Figure 2.1 Biocultural model for interpreting stress. This model emphasizes the primacy of environmental constraints and cultural influences on outcomes in health and well-being. (Adapted from Klaus, 2012; reproduced with permission of author and University Press of Florida.)

life are more predisposed to earlier death and greater frequency of chronic disease, including cardiovascular disease, hypertension, and type 2 diabetes, than are individuals with normal birth weight and sufficient prenatal and early natal nutrition (Barker, 2001, 2012; Barker et al., 2002; Beltrán-Sánchez et al., 2012; Hales et al., 1991; Harding, 2001; and see Jovanovic, 2000; various in Henry & Ulijaszek, 1996; and others). Similarly, low birth weight infants show lower bone mass as adults than infants with normal birth weight (Antoniades et al., 2003; Cooper et al., 1995; Gluckman et al., 2008). Experimental evidence in laboratory animals suggests that poor prenatal environments are also a risk factor for growth stunting over the life course in general (Dancause et al., 2012). While the prenatal environment does not determine health consequences in adulthood, it appears to have a profound role to play in programing circumstances in later life that promote poor health. A growing record supports Barker's developmental origins hypothesis regarding the profound influence of intrauterine stresses in early life on later health, morbidity, and mortality.

2.2 Measuring stress in human remains

Biological anthropologists employ a variety of skeletal and dental stress indicators that can be measured empirically. Use of multiple indicators gives a comprehensive understanding of stress and adaptation in past populations (Goodman & Martin, 2002). The multiple-indicator approach stems from the recognition that health is a composite of nutrition, disease, and other aspects of life history. Simply, simultaneous study of multiple, but independent, markers of stress provides a more reliable and informed understanding of composite health as documented in a skeletal series. Contrary to medical models of health, stress and disease (see Chapter 3) represent a continuum rather than a presence versus absence phenomenon, with respect to both the population and the individuals that comprise it.

2.3 Growth and development: skeletal

2.3.1 Growth rate

Rate or velocity of growth in humans shows considerable variation in the comparison of different human populations, present and past (Bogin, 1999; Hoppa & FitzGerald, 1999; Ruff et al., 2013; Saunders, 2008). Nevertheless, human growth is punctuated by two intensive periods of activity from birth through adolescence. The first period pertains to a great increase in growth velocity during infancy, falling off soon after the first two years of life. The second involves another marked increase during adolescence, then declines and reduces to zero growth when epiphyseal fusion of the long bones (femur, tibia, fibula, humerus, radius, and ulna) and other skeletal elements is complete, marking full skeletal maturity (Crews & Bogin, 2010). Growth rate is widely recognized as a highly sensitive indicator of health and well-being of a community or population (Bogin, 1999; Eveleth & Tanner, 1990; Foster et al., 2005; Lewis, 2007).

Various factors affect growth, such as genetic influences, growth hormonal deficiencies, and psychological stress (Bogin, 1999; Eveleth & Tanner, 1990; Gray & Wolfe, 1996; Ruff et al., 2013), but the preponderance of evidence underscores stressors that are produced by adverse environments, especially poor nutrition, in shaping growth and development (Foster et al., 2005; Leonard et al., 2000; Moffat & Galloway, 2007). Infectious disease can also contribute to poor growth, such as episodic diarrheal disease and circumstances involving poor sanitation and suboptimal living conditions that ultimately reduce nutrition at the cellular level (Cardoso, 2007; Jenkins, 1982; Martorell et al., 1977; Moffat 2003). Nutrition and disease have a synergistic relationship whereby poorly nourished juveniles are more susceptible to infection, while infectious disease reduces the ability of the body to absorb essential nutrients (Keusch & Farthing, 1986; Scrimshaw, 2003, 2010; Scrimshaw et al., 1968).

Children raised in impoverished environments in developing nations or in stressed settings in developed nations generally are small in size for their age (Bhargava, 1999; Bogin, 1999; Crooks, 1999; Eveleth & Tanner, 1990; Foster et al., 2005). Among the best-documented populations are the Mayan Indians of Mesoamerica, who show retarded growth in comparison with reference populations from less adverse settings (Crooks, 1994). In Guatemala City, Guatemala, well-fed upper-class children are taller than poorly nourished lower-class children (Bogin & MacVean, 1978, 1981, 1983; Johnston et al., 1975, 1976). Additionally, unlike the markedly slower growth in lower-class children, upper-class children have comparable growth to Europeans. The cumulative differences between Mayan and European children are especially pronounced for the period preceding adolescence, suggesting that growth during the early years of childhood is the most sensitive to environmental disruption in comparison with other life periods (Bogin, 1999). During adolescence, genetic influence on growth is more strongly expressed than in childhood (Bogin, 1999; Bogin & Loucky, 1997).

Juveniles have been growing taller over much of the twentieth century in industrialized countries and in some developing nations. This secular trend in growth is related to a variety of environmental and cultural changes, including improvement in food availability and nutrition, sanitation, reduction of infectious disease, and increased access to Western healthcare. As the environment improves, growth increases. On the other hand, declines in growth velocity are well documented, especially during periods of dietary deprivation in wartime settings, famines, and economic crises (Eveleth & Tanner, 1990; Himes, 1979; Komlos 1994). This link between growth status and environment is well documented via analysis of historical data. Comparisons of heights of British school children from various regions and economic circumstances for the period of 1908 to 1950 show that children were generally shorter in areas experiencing high unemployment (e.g., Glasgow, Scotland) than in other regions with more robust economies (Harris, 1994). These differences were especially pronounced during the severe economic depression in the late 1920s when nutritional and general health of children of unemployed parents declined. Similarly, growth velocity and attainment per age increased in post-World War II following the amelioration of negative socioeconomic conditions (Cardoso & Gomes, 2009; Malina et al., 2010; Tanner et al., 1982). In post-1945 Poland, relatively greater increases in growth were documented in higher socioeconomic groups (Bielicki & Welon, 1982).

Beginning with Francis Johnston's pioneering work on childhood growth based on the study of archaeological skeletons (Johnston, 1962, 1969), a range of studies have extended our understanding of growth rates in past societies. That is, the general pattern of juvenile growth in archaeological populations is broadly similar to that in living populations (Armelagos et al., 1972; Boldsen, 1995; Edynak, 1976; Hillson et al., 2013; Hoppa, 1992; Huss-Ashmore, 1981; Johnston, 1962; Lewis, 2002; Mays, 1999; Merchant & Ubelaker, 1977; Molleson, 1995; Ribot & Roberts, 1996; Ruff et al., 2013; Ryan, 1976; Saunders, 2008; Sciulli & Oberly, 2002; Storey, 1992a, 1992b; Sundick, 1978; Walimbe & Gambhir, 1994; Walker, 1969; and see later). The congruence of growth in past and living groups suggests that there has not been a change in the general pattern of growth in recent human evolution (Saunders, 2008). That is, patterns and processes of growth in known human populations appear to have been present for at least the last 10 000 years of our evolutionary history, and likely longer.

Some populations appear shorter for age than others. Analysis of juvenile long bones from prehistoric North America reveals evidence of growth retardation in agricultural and mixed subsistence economies versus foragers. In children younger than six years of age in the prehistoric lower Illinois River valley, matching of femur length to dental age reveals growth suppression in late prehistoric (Late Woodland period) maize agriculturalists in comparison with earlier foragers (Middle Woodland period) (Cook, 1979, 1984). Cook (1984) concluded that the decline in growth was due to a decrease in nutritional status with the shift to a protein-poor maize diet. Children short for their age during the later prehistoric period tend to express a higher frequency of stress indicators (e.g., porotic hyperostosis, enamel defects) than children who are tall for their age, lending further support for nutritional deficiency as a prime factor contributing to growth retardation.

Lallo (1973; and see Goodman, Lallo et al., 1984) found, in addition, a decrease in the growth of femur, tibia, and humerus diaphysis lengths and circumferences during the