

# Evolutionary Medicine

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## Key Words

biological anthropology, reproduction, nutrition, diabetes,  
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## Abstract

Biological anthropologists have been contributing to what is now referred to as evolutionary medicine for more than a half century, although the phrase itself began to be widely used only in the early 1990s. Three topics in which anthropological contributions have been especially significant include nutrition, reproductive health, and chronic disease. A major focus in nutrition and reproduction is the health consequences of evolved biology in the context of contemporary diets, lifestyles, and contraceptive practices seen in industrialized nations. Contributions from anthropology include efforts to assess and redefine the concept of “normal” in health indicators, emphasis on developmental processes in addition to proximate and ultimate forces affecting health, and enhancement of understanding of contemporary health disparities. Evolutionary medicine is a highly interdisciplinary field, and anthropologists have played important roles in directing attention not only to evolutionary processes but also to sociocultural and sociopolitical effects on human health.

## INTRODUCTION

Contributors to the field of evolutionary medicine, defined as the application of principles of evolutionary theory to the practice and research of medicine, have come from various disciplines, including psychology, nutrition, psychiatry, exercise physiology, family medicine, oncology, chiropractic, genetics, pediatrics, endocrinology, obstetrics, gynecology, and anthropology. A thorough review of the field would include literature from all these fields, especially biology and medicine, but I limit my review for this volume to a near exclusive focus on contributions from anthropology. Although much of evolutionary medicine proceeds without consideration of sociocultural factors, an important contribution of the anthropological perspective is a focus on the body as the result of evolutionary and developmental processes in specific sociocultural and sociopolitical contexts.

## HISTORICAL OVERVIEW

Most historical overviews of the field of evolutionary medicine cite the works of Williams and Nesse as marking the field's inception (Nesse & Williams 1994, Williams & Nesse 1991). Indeed, one of these early works is entitled "The Dawn of Darwinian Medicine," indicating the authors' perception that they were initiating a new field. A careful review of anthropological research (especially from biological anthropology), however, reveals that many scholars have long been "doing" what is called evolutionary medicine, even if the phrase itself was not used until recently. For example, the "new physical anthropology" initiated by Sherwood Washburn in 1951 highlighted the importance of evolutionary processes and contexts rather than simply the results of these processes. Washburn discussed evolutionary changes in the lower jaw and suggested that understanding how the facial region has evolved in the human lineage and how it develops in the individual will "open the way to...interpretation of abnor-

malities and malocclusion, and may lead to advances in genetics, anatomy, and medicine" (Washburn 1951, p. 304). That same year, Krogman (1951) published a much-cited paper that reviewed the "scars of human evolution," in which he argued that some of the ubiquitous back problems that plague modern humans result from compromises (what he termed "imperfections") in the evolution of bipedalism.

A few years later, Frank Livingstone described the interaction of genes, disease vectors, and culture and proposed that selection for resistance to malaria could partially explain the high frequencies in West Africa of the sickle cell allele that causes a usually fatal form of anemia at young ages (Livingstone 1958). He noted that "this gene is the first known genetic response to a very important event in man's evolution when disease became a major factor determining the direction of that evolution" (p. 557).

Another early approach to evolution and health is seen in the works of Cohen and Armelagos (Armelagos 1991, Cohen 1989, Cohen & Armelagos 1984), who argued that human health has actually declined in many ways in the past 10,000 years (i.e., since the development of agriculture) rather than improved. Related contributions focus on how human health and epidemiological profiles have changed over the course of human evolutionary history (Boyden 1970, Harrison 1973). Finally, Eaton, Konner, and Shostak ushered in new ways of thinking about contemporary health issues with their seminal papers in leading medical journals, suggesting that modern human lifestyles often conflict with our evolved bodies, with negative consequences for health (Eaton et al. 1988a,b; Eaton & Konner 1985). These anthropologists recognized the important role that the evolutionary process has played in human health and can be regarded as the founders of evolutionary medicine in anthropology.

In the past two decades contributions to evolutionary medicine from biological anthropologists have steadily increased

(Trevathan et al. 1999, 2008), and a thorough review would require far more than a single chapter in this volume. In an effort to stay within the acceptable chapter length, this review focuses on three topical areas in which anthropologists have made substantial contributions: nutrition, reproductive health, and early life effects on chronic disease. Additionally, I discuss concepts, partially derived from anthropology, that have contributed to the maturation of the field of evolutionary medicine.

### ANTHROPOLOGY, EVOLUTIONARY MEDICINE, AND NUTRITION

Contemporary human nutritional needs are the result of coevolutionary processes among human physiology, food acquisition behaviors, and the nutrients consumed over the course of mammalian, primate, and hominin evolution. Most significant for the evolution of nutrient needs in the hominin lineage are the metabolic demands of bipedalism and expanding brain size, whereby a premium was placed on high-quality foods (Aiello & Wells 2002, Aiello & Wheeler 1995, Bogin 1998, Leonard et al. 2003, Leonard & Robertson 1994, Milton 2000). One theme of an evolutionary medicine approach states that human nutritional needs evolved under circumstances dramatically different from contemporary diets and lifestyles, resulting in a “discordance” or “mismatch” between biology and lifestyle. Anthropological contributions to understanding the health consequences of this mismatch have been numerous and focus on many “diseases of civilization” such as heart disease, hypertension, type 2 diabetes, some cancers, and osteoporosis (Cordain et al. 2002a,b; Crews 2003; Crews & Gerber 1994; Crews & James 1991, Eaton et al. 1999, Eaton & Konner 1985, Gerber & Crews 1999, Hockett & Haws 2003, Jackson 1991, Lieberman 2003, McGarvey et al. 1989, Milton 2000). Many of the arguments depend on paleontological and archaeological

**Table 1 Selected nutrients intake for hypothesized ancestral and contemporary populations. Adapted from Eaton et al. (1988b)**

Nutrient	Hypothesized ancestors	Contemporary Americans
% calories from protein	33	12
% calories from fats	21	42
Fiber (g)	100–150	20
Sodium (mg)	690	2300–6900
Calcium (mg)	1500–2000	740

evidence about diets of early humans (Aiello & Wheeler 1995, Danforth 1999, Lee-Thorp et al. 2003, Speth 1989, Teaford & Ungar 2000, Ungar et al. 2006) and ethnographic descriptions of diets of the few remaining foraging populations that serve as very rough proxies for preagricultural hominins (Hill & Hurtado 1989, 1996; Lee 1979; Lee & DeVore 1976; O’Connell et al. 2002).

**Table 1** notes the major differences proposed between diets of people in industrialized nations (in this case, the United States) and in hypothesized ancestral populations (from Eaton et al. 1988). Most significantly, contemporary Western diets tend to be higher in fats, sodium, and simple sugars and lower in complex carbohydrates, fiber, and calcium than are diets of recent foraging populations and, perhaps, ancestral populations. These excesses and deficiencies have been linked with several of the contemporary disorders cited above. Furthermore, cravings for sweets and fats, which once may have been advantageous to foragers (Whitten 1999), are problematic for many people in contemporary industrialized environments in which fatty foods and refined carbohydrates are cheap and easily accessible (Turner et al. 2008). Food sources exploited by humans have changed dramatically in many regions of the world. Ancestral populations derived most of their nutrients from wild plants and animals, whereas modern diets tend to be composed primarily of grains, refined sugars, dairy, and meat from domesticated animals (Eaton et al. 2002). Finally, except in high-end supermarkets in industrialized nations, one consequence of

modernization has been a narrowing of dietary breadth for the omnivorous human whose survival in the past depended on acquiring nutrients from a variety of foodstuffs (Bogin 1998, Turner et al. 2008, Whitten 1999).

Although popular books have invoked some of the arguments about disparities between contemporary diets and hypothesized ancestral diets to make prescriptive recommendations (Cordain 2002, Eaton et al. 1988b), the proposed contrasts have their greatest potential in generating testable hypotheses (Eaton & Eaton 2000). In fact, an important step in the maturation of evolutionary medicine is to move beyond early “just so” stories to test hypotheses and generate data to support or refute them. Although the gold standard of testing medical hypotheses with randomized trials is important for furthering the arguments in favor of an evolutionary medicine approach to human nutrition and preventive health, anthropologists will more likely contribute via work at the population level. Future efforts that will enhance the quality of anthropological contributions to nutrition and evolutionary medicine include ethnographic research on the remaining foraging populations, especially as they undergo modernization with associated changes in diet and activity levels (Eaton et al. 2002). Migrant populations also provide a window into what happens to health, growth, and development when diet and other aspects of daily life change in a short period of time (Lasker 1995, Nuñez-de la Mora & Bentley 2008, Pollard et al. 2006, Pollard & Unwin 2008, Zemel et al. 1993).

Type 2 diabetes is rising globally and at unprecedented rates (Zimmet et al. 2001), presenting a classic example of a disease that results when genetics, evolved biology, and changes in lifestyle (especially diet) collide. Because the epidemic affects people most dramatically in traditional societies undergoing modernization, it has received much attention from anthropologists (Eaton 1977, Joe & Young 1994, McGarvey et al. 1989,

Szathmary et al. 1987), including those who take the evolutionary medicine perspective (Eaton et al. 1988a; Lieberman 2003, 2006). Several decades ago, Neel (Neel 1962, updated in Neel et al. 1998; see also Gerber & Crews 1999) proposed that in populations that historically faced alternating periods of food abundance and scarcity, a “thrifty genotype” with the ability to store excess calories as fat and to mobilize insulin quickly was selectively favored, but that the same genotype in contemporary environments of “constant feast” and low activity levels predispose a person to diabetes (see below for discussion of the “thrifty phenotype” model for type 2 diabetes). Although the hypothesis does not hold in all cases (Ritenbaugh & Goodby 1989), the association between diabetes and rapid dietary change has generally been upheld (Diamond 2003, Lieberman 2003). Diamond proposes a number of hypotheses for testing ideas about how type 2 diabetes evolved (Diamond 2003), including refocusing the discussion on why certain European and European-derived populations are resistant to diabetes compared with migrant and modernizing populations rather than why the latter are more susceptible.

## **EVOLUTIONARY MEDICINE AND REPRODUCTIVE HEALTH**

At its very core, evolution is about reproductive success, so it is not surprising that much work in the field of evolutionary medicine relates to reproductive health. In the past two decades, investigators have developed techniques for assaying reproductive hormones using saliva and blood spots, greatly enhancing the ability of anthropologists and other researchers to obtain information under field conditions more typical of anthropological research and from populations living in conditions that may be more similar to those of most of human evolutionary history (Ellison 1988; Worthman & Stallings 1994, 1997; Worthman et al. 1990). One conclusion from several studies that use these techniques is that

ovarian hormone levels deemed to be normal in Chicago, Boston, and other parts of the developed world are actually at one end of a range of variation (Ellison et al. 1993) and, in fact, may actually be further from the norm (taken as a species average) than what is commonly reported for other populations (**Figure 1**) (Bentley et al. 1998, Ellison 1994, Ellison et al. 1993, Jasienska 2003, Panter-Brick et al. 1993).

Vitzthum and her colleagues, for example, have investigated progesterone profiles of contracepting and noncontracepting women from Chicago and the Bolivian highlands. Their findings illustrate that what is observed in affluent populations is quite different from that observed in less-affluent populations and probably from the ancestral condition (**Figure 2**) (Vitzthum et al. 2004). Because women in both populations are getting pregnant and giving birth to healthy offspring, however, we see that the low levels of progesterone usually associated with infertility in some populations (e.g., the United States and Great Britain) are associated with fertility in others (e.g., Bolivia).

Natural selection has shaped a reproductive system that is sensitive to environmental and individual contextual conditions (e.g., socioeconomic) with flexible responsiveness (Vitzthum 2001) rather than one that is invariant and predictable. From an evolutionary perspective, human reproduction is an extremely costly investment for women, and conditions arise under which conception would result in less viable offspring and thus lower long-term reproductive success. In such cases, ovarian hormones may be dampened to prevent ovulation and/or implantation (Jasienska 2001, 2003), or early pregnancy loss may occur (Peacock 1991). Early pregnancy loss is an example of a phenomenon that may be seen as adaptive from the view of evolutionary medicine but as pathological by physicians and parents who work hard to ensure a “successful” pregnancy no matter what the circumstances (Peacock 1990).

Furthermore, as Ellison (1999) notes, too often clinicians try to treat the symptom (e.g., amenorrhea or low steroid levels) rather than addressing the cause of the excess energy expenditure or insufficient energy intake that lowers fecundity. This does not mean, of course, that some levels of reproductive hormones are not abnormally low or high but that the range is broader than most medical textbooks imply, and focusing on causes rather than on symptoms may be more fruitful for improving health and pregnancy outcomes in such cases.

Until recently, the normal and expected state of women between menarche and menopause was believed to be menstrual cycling. In fact, early birth control pills were designed to mirror the perceived “normal” hormonal profile of affluent women with 12–13 cycles per year. They thus contained high levels of estrogen, doses that later proved to threaten health (Tyler 1999) until they were lowered significantly. An appreciation for the range of variation provided by the anthropological and evolutionary perspectives may have avoided these early mistakes. As noted above, the hormonal profiles of cycling and pregnant affluent women may be one extreme range of the variation seen in the world today, and to design contraceptives on these bases may be ill advised.

On the basis of studies of contemporary foraging women (again, an imperfect proxy), anthropologists have argued that for most of their reproductive years, ancestral women were pregnant or breastfeeding, and their ovarian hormones reflected these states. Investigators have estimated that foraging women had as few as 160 menstrual cycles in their lifetimes before effective means of birth control were developed. In contrast, a woman who uses contraception today may have as many as 450 cycles during her reproductive years (see **Table 2**). A reasonable conclusion finds that women’s bodies did not evolve to be exposed to 400 or more monthly rises and falls in estrogen, with the associated effects on cell turnover rates, so these regular, frequent

**Table 2 Comparative reproductive variables for foraging populations and Americans (from Eaton et al. 1994)**

	Foraging populations	Americans
Age at menarche	16.1	12.5
Age at first birth	19.5	24.0
Years between menarche and first birth	3.4	11.5
Years of lactation per birth	2.9	0.25
Completed family size	5.9	1.8
Total years of lactation (approx)	17	0.5
Age at menopause	47	50.5
Estimated total lifetime ovulations	160	450

surges in estrogen have likely had an impact on women's health. The most probable impact, as proposed by several scholars (Eaton et al. 1994, Eaton & Eaton 1999, Ellison 1999, Strassmann 1999), is on estrogen-related cancers of the breast, uterus, and ovaries.

Although comparative rates are difficult to obtain, one study estimates that the rate of breast cancer for industrialized nations, where birth control is practiced and childbearing is limited and deferred, is as high as 100 times the rate for women who are not using contraception and are spending the bulk of their reproductive lives pregnant or nursing in patterns that result in lactational amenorrhea (Eaton et al. 1994). For these women, the hormonal milieu to which they are most commonly exposed is high progesterone rather than high estrogen. Eaton and his colleagues suggest that hormonal interventions (not unlike those with oral contraceptives) that delay menarche or reduce the number of menstrual cycles may provide protection against the reproductive cancers described above (Eaton et al. 2002). Indeed, pharmaceutical companies are developing birth control pills that reduce the number of menstrual cycles to 4 per year (e.g., Seasonale<sup>TM</sup> from Barr Pharmaceuticals) (Kaunitz 2000). Whether this advances women's health remains to be seen (Sievert 2008), but it illustrates the impact that evolutionary thinking has had on drug development.

Other aspects of reproductive health that have been examined through the lens of evolutionary medicine include menopause (Leidy 1999, Sievert 2006), childbirth (Rosenberg & Trevathan 2002; Trevathan 1987, 1999), preterm delivery (Pike 2005), preeclampsia (Robillard et al. 2002, 2003), and nausea of pregnancy (Fessler 2002, Profet 1992; but see Pike 2000).

## EARLY LIFE EFFECTS ON CHRONIC DISEASE

In addition to ultimate and proximate causes of disease and poor health that are common foci of evolutionary medicine, investigators have shown an enormous and lifelong health impact of more immediate factors that occur during individual development (ontogeny). As Chisholm (1993) and Worthman (1999) have noted, it is in the growing and living human being that evolved biology and sociocultural and environmental context meet. One example of an early life component of development considered within the framework of evolutionary medicine is birth weight, which has been linked to subsequent child and adult health. Low birth weight (defined as less than 2500 g) is known to elevate the risk of developing hypertension, diabetes, and high cholesterol (Barker 1998). In this view, a form of fetal programming occurs in utero in response to nutritional stress that prepares the individual for lifelong deprivation. In the case of food shortage, a sort of triage effect occurs by which the size of liver, muscle tissue, and other organs is reduced to maintain sufficient nutrients for the developing brain. This often results in vulnerabilities to later-life chronic diseases and disorders, especially if the postnatal environment happens to provide excess calories, as often occurs in populations undergoing transition associated with globalization.

Selection does not operate on chronic diseases of middle and old age that have their impact after reproductive years have passed, so it is not likely that adaptations to these

diseases will emerge. Worthman and her colleagues (Worthman & Kohrt 2005, Worthman & Kuzara 2005) refer to these consequences as “deferred costs,” the price an individual pays to survive birth and the early years up to and including reproductive years. As the age of onset of one chronic disease, type 2 diabetes, continues to decrease, however, adaptation to this disease may be occurring (Diamond 2003), although a better (and quicker!) way to defeat diabetes and other chronic diseases may be to alter the conditions of gestation that predispose individuals to lifelong health challenges.

A seemingly obvious way to decrease these risks is to provide maternal nutritional supplementation to increase birth weights. Unfortunately, supplementation during pregnancy has turned out to be only modestly effective in increasing birth weights. Presumably natural selection has favored the ability of the fetus to predict postnatal conditions and to adjust metabolic needs accordingly, but when conditions after birth turn out not to be what is predicted, a mismatch of expectations and reality occurs that leads to chronic disease in adulthood (Kuzawa 2005). The assumption that the fetus makes is that the current environment in utero is predictive of the future environment, and it adjusts its growth accordingly by being prepared for lower nutritional needs after birth if nutrition during pregnancy is restricted. Why, then, is growth in utero still compromised if the mother is provided with nutritional support during pregnancy? Adopting an evolutionary perspective for understanding this failure, Kuzawa (2005) proposes the “intergenerational phenotypic inertia” hypothesis, whereby the fetus is obtaining cues not just from the mother, but from her entire matrilineage. This idea suggests that adaptations that have been successful for generations (i.e., buffering from pregnancy insult due to poor nutrition) may not be amenable to short-term fixes. Because the effects are apparently transgenerational, the implication is that public health measures to improve infant birth weight should begin long before preg-

nancy and should not be judged as successes or failures on the basis of one generation’s data. In fact, the proposed intergenerational linkage to physiology may characterize a number of chronic diseases and disorders that seem to be related to early life events, reinforcing the importance of the developmental in addition to the proximate and ultimate explanations of health (Ellison 2005).

## CONCEPTUAL CONTRIBUTIONS FROM ANTHROPOLOGY

### Redefining the “Normal”

A fundamental concept at the core of evolution and anthropology is variability. Evolution would not occur without variability, and the human species is nothing if it is not variable in all of its cultural and biological manifestations. Medicine, however, tends to focus on what is perceived as “normal,” often regarding variation from the norm as something that needs to be treated. Unfortunately, the medical “normal” is often based on Western concepts and on health characteristics of people who are born, grow up, and live under relatively affluent conditions. Use of this narrow population raises concerns that treatment regimes and drugs that are developed on the basis of these “normal” humans may not be appropriate for people growing up and living under other conditions. An important contribution from evolutionary medicine as it is cast in anthropology is expanding and even redefining the concept of normal, as noted above with regard to ovarian hormones. Parenting is another topic that anthropologists have addressed regarding what is normal—see sidebar on Evolutionary Medicine and Parenting.

### Adding Development to the Picture

McDade & Worthman (1999) have argued that understanding the developmental processes that affect immune function can be greatly enhanced by adding evolutionary

## EVOLUTIONARY MEDICINE AND PARENTING

An early and enduring success of evolutionary medicine is widening the understanding of normal infant care, particularly regarding where babies should sleep. Notions that infants should sleep alone in a darkened room away from the sights and sounds of others, that they should sleep through the night even at very young ages, and that they do not need to breastfeed during the night are at one end of a continuum of appropriate caretaking, but they have been the dominant paradigm in Western child care for several decades (Ball 2003, McKenna 2000). Moreover, clinical understanding of normal infant sleep physiology is based on studies of bottle-fed and solitary-sleeping infants (Ball 2003, McKenna & McDade 2005). Drawing from primate and ethnographic studies, evolutionary medicine critiques of this paradigm argue that cosleeping, nighttime breastfeeding, and transient awakenings (in contrast with deep sleep) have been the norm for most of human evolutionary history (and for most traditional cultures today) and contributed to infant survival in the past (McKenna et al. 1999). Furthermore, beyond the idea that mother-infant cosleeping is at minimum appropriate and, at optimum, beneficial, evidence increasingly shows that it may be protective against sudden infant death syndrome (SIDS), particularly when coupled with breastfeeding (McKenna & McDade 2005).

processes to the picture. One important first step in immune function development comes with the inheritance of acquired antibody characteristics (Lamarckian evolution) from the mother via the placenta and breast milk. These transferred immunoglobulins give infants a head start after which their own, naturally selected (Darwinian evolution) immune capabilities kick in. Not surprisingly, up to a point, breastfed infants have lower morbidity and mortality, but, as McDade & Worthman note, "Breast-feeding is a culturally contingent behavior" (p. 714) and cultural norms often have a great impact on immune function development. In healthful, low-pathogenic environments, breast feeding may not have much impact on infant health, but in impoverished, high-pathogen environments, breast-

feeding may provide immune protection that improves lifelong health.

### Evolutionary Medicine as a Tool for Understanding Health Disparities

One especially promising potential contribution of evolutionary medicine to global health is revealing underlying causes of disparities in chronic disease incidence and outcome. Consider that with globalization, individuals in populations that have been subjected to deprivation for generations are suddenly confronted with an overabundance of easily available and easily absorbed nutrients, resulting in increased risk for cardiovascular and other chronic diseases. As Kuzawa (2008) notes, infants in these populations are often responding to cues from previous generations, whereas adults are faced with cheap calories that compromise their health. Here the mismatch is not between the evolved body of the foraging past and the contemporary environment, but between the environment expected in utero based on poor maternal diet and the reality of high-fat, high-carbohydrate foods readily and cheaply available to growing children. Children are living lives different from their ancestors and different from what their gestational environments led them to expect. The result is that what may have been an asset, had the postnatal environment better matched the prenatal environment, is now a liability that leads to the development of diabetes and other chronic diseases. Kuzawa (2008) suggests that black-white differences in the United States in birth weight, diabetes, hypertension, and cardiovascular disease (all of which are worse for blacks compared with whites) may be based not only on current inequalities, but also on generations of gestational environments that have been affected differentially by sociocultural factors including racism, discrimination, and stress.

Predictions from life history theory can also illuminate health disparities related to early reproduction. Two ends of a continuum of reproductive strategies are those that

maximize quantity of offspring (“mating effort”) and those that maximize quality (“parenting effort”) (Chisholm 1993). A general prediction is that in unstable environments, maximizing quantity would be most successful in the short term, whereas in stable environments, quality maximization would have the greatest payoff in the long term. Noting that psychosocial stress is associated with early menarche, early onset of sexual activity, and early pregnancy, Coall & Chisholm (2003) suggest that adolescent pregnancy may be an example of a short-term reproductive strategy in unstable environments (see Belsky et al. 1991). Unfortunately, early menarche is also linked with low birth weight, setting a trajectory toward poor childhood and adult health (Coall & Chisholm 2003). Unequal access to resources and medical care is unarguably a major contributor to psychosocial stresses and life course instabilities. As long as medical intervention strategies focus on the specific illnesses and health concerns for which there are disparities (e.g., low birth weight, adolescent pregnancy, diabetes, cardiovascular diseases, hypertension), success at reducing the disparities will be limited because the underlying causes, i.e., socioeconomic disparities, are not fully considered. A public health paradigm (what Coall & Chisholm call “evolutionary public health”) that targets reduction in social inequalities will potentially have more salient and long-lasting impacts on the health of children, adults, and future generations (Armstrong et al. 2005, Barrett et al. 1998, Nguyen & Peschard 2003).

## CONCLUSION

Several years ago studies estimated that 70% of the illness burden borne by Americans was preventable (Fries et al. 1993), but as Eaton and his colleagues note, health promotion efforts have been notably unsuccessful (Eaton et al. 2002). Scholars whose work has been reviewed here are among those who propose that an evolutionary understanding of contemporary health problems may help

to reduce that illness burden, not only for Americans, but for the rest of the world, as well. Eaton et al. (1988b) originally proposed a “Paleolithic prescription” for dealing with many contemporary ills, and more recently, a number of popular books have appeared that present to the general public ways in which adopting lifestyles more like those of our ancestors may improve our health (Cordain 2002, Somer 2001). The success of these books indicates ways in which concepts of evolutionary medicine have resonated with the general public, and despite a wide range in quality, they open the door for public health messages and programs based on evolutionary medicine.

As noted in this review, refining understanding of what is a normal range of variation in reproductive and other aspects of health may avoid unnecessary medical interventions that themselves lead to compromised health. Targeting pregnancy and other developmental phases for improved diet and lifestyle modifications may not only improve childhood growth and subsequent adult health, but also may reduce health disparities across populations. “Interventional endocrinology” could be used to reduce breast cancer rates by mimicking reproductive hormonal profiles of our ancestors (Eaton et al. 1994, 2002), although it remains to be seen if this would actually improve health (Sievert 2008).

Medical practice typically focuses on individuals, but most of what has been reviewed above involves populations or, in some cases, the entire human species. The latter is more typically the domain of anthropologists, and most of the recommendations that derive from an anthropological subfield of evolutionary medicine would more appropriately be called “evolutionary public health” (Coall & Chisholm 2003, Maziak 2002). This broader perspective is, indeed, what anthropologists bring to the interdisciplinary field of evolutionary medicine, especially by focusing on human beings embedded in socio-cultural, sociopolitical, global, and ecological contexts.

## SUMMARY POINTS

1. Biological anthropologists have been working on topics related to evolutionary medicine decades before the phrase was coined and the field established.
2. A topic that has engaged anthropologists working in the field of evolutionary medicine is the impact on health of changing diets from the foraging baseline under which nutritional needs evolved to the high-fat and simple carbohydrate diets of the twenty-first century.
3. The hormonal profiles of medical textbook understanding of reproductive health in women may represent the extreme end of the range of healthy ovarian function.
4. Highly frequent menstrual cycling such as seen in contracepting populations today is not only a deviation from the hypothesized ancestral pattern but may partially account for the increased rates of ovarian, uterine, and breast cancer seen in industrialized nations.
5. Whether genetic susceptibilities to late-onset chronic diseases have the expected effects depends to a great extent on the conditions of development, particularly during gestation and early infancy.
6. The anthropological perspective helps to redefine medicine's concept of "normal" by highlighting the range of healthy variability in, for example, reproductive hormones and infant care.
7. One important contribution to evolutionary medicine from biological anthropologists highlights the significance of not only proximate and ultimate causes of good and ill health, but also developmental causes and constraints as well.
8. Adding development to the picture of human health also helps to identify early causes of health disparities, particularly inequality in access to resources during pregnancy and infancy.

## FUTURE ISSUES

1. An impediment to public understanding of evolutionary medicine is rejection of the theory of evolution itself by many, especially in the United States.
2. It is difficult to test most of the proposals that derive from evolutionary thinking about health and illness; but if they are not subjected to scientific scrutiny through experimentation and careful observation, most of the thinking will remain "just so" stories.
3. Anthropologists can contribute to the development of theory and hypothesis testing by studying health changes in populations undergoing modernization to see if they are similar to changes proposed by evolutionary medicine for the transition from foraging to agriculture in human evolutionary history.

## DISCLOSURE STATEMENT

The author is not aware of any biases that might be perceived as affecting the objectivity of this review.

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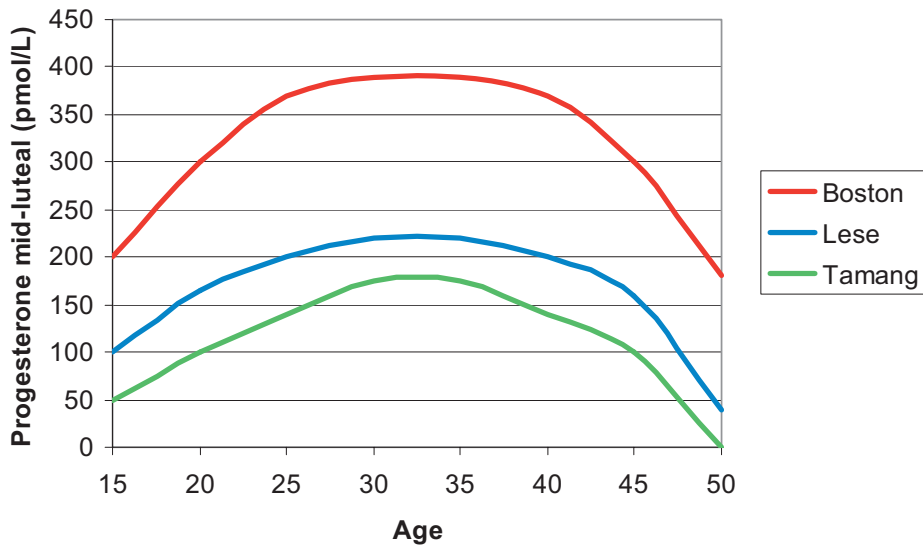
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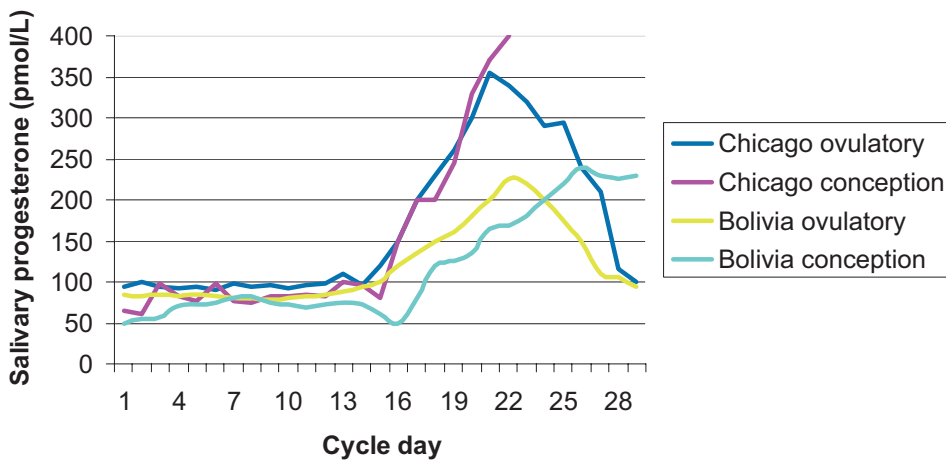
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**Figure 1**

Hormonal variation in three populations. Redrawn from Ellison (1994).



**Figure 2**

Salivary progesterone averages for conception and nonconception cycles of women in Chicago and Bolivia, conception occurring on approximately day 14. From Vitzthum et al. (2004).



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## Errata

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