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Neolithic

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The term Neolithic is commonly used to describe the earliest human communities to develop farming, which includes the use of domesticated plants and animals. The transition from mobile foraging groups to sedentism and human control over the reproduction and evolution of plants and animals is often associated with significant social, cultural, and biological change, as humans increasingly become the agents of environmental change.

The earliest agriculture occurred with the domestication of Emmer wheat in South-west Asia (the Levant); however, it is well established that agriculture originated independently in different regions of the world at different times throughout the Holocene. Other regions of primary plant domestication include southern China, Ethiopia, New Guinea, and three different regions of the New World: Southeast North America, Meso-America, and western South America. There were also a number of independent centres of animal domestication. The multiple independent origins of farming within the Holocene are often attributed to the general stability and warmth of the Earth's climate during the Holocene, which set appropriate preconditions for agricultural expansion. While the first farming communities of the Early Holocene are typically referred to by the term "Neolithic," in many places the transition to agriculture is also associated with other changes, such as the origin of pottery or the development of permanent or semipermanent architecture. It is important to note that the term Neolithic is inconsistently used in different parts of the world, due to different academic traditions. While most often used to refer to early farming communities, in some places, particularly in central and east Asia, "Neolithic" is used to refer to the first stone-age foragers to develop pottery, despite the lack of agriculture.

From a biological perspective, the Neolithic is important for the impact of dietary, cultural,

and environmental changes on our biology, demography, health and disease, and genetic diversity (see DIET, EVOLUTION OF and HEALTH AND WELL-BEING, HISTORY OF). The development of food production and the storage of food surpluses had a profound influence on human social organization. In many places, this took the form of sedentism: the development of long-term settlements in a single location, as opposed to the mobile lifestyle of most foragers (see HUNTING AND SCAVENGING). Agriculture provides greater productivity per unit of area than foraging, by replacing indigenous plants and animals with those bred for direct consumption or for by-products such as milk. Increased productivity can lead to the accumulation of food surpluses which can be stored to buffer future droughts or traded for other goods and resources.

While the Neolithic is often characterized as a cultural revolution, the idea that it was a rapid transition with consistent and uniform consequences has gradually given way to a more subtle understanding of the transition as one that occurs over an extended period of time with local coevolution of diet, technology, domesticated plants and animals, and humans. For example, many of the cultural characteristics associated with the Neolithic in the Levant (see LEVANTINE FOSSIL RECORD) are now known to develop over millennia, representing a gradual change from the earliest semisedentary Palaeolithic communities 20,000 years ago through the Natufian to the Neolithic. This recasts the Neolithic as a complex and long-term process of social change in the relationship between human behavior and the natural environment, rather than a short "revolution" in human behavior. In other parts of the world, similar patterns of long-term social and biological change are being identified, which may explain much of the diversity in the human response to agriculture, globally. A key component of this reinterpretation of the transition to agriculture involves the broader impact of agriculture on ecology as part of long-term trends in human "niche construction" (see NICHE CONSTRUCTION) (Boivin et al. 2016).

The accumulation of food surpluses allows for cultural differentiation within societies. As

not all individuals are required to be directly involved in food production, agriculture allows the development of specialist craftspeople, which can lead to cumulative technological evolution through time. Sedentism, food surpluses, and divergent technology have been linked to property ownership and social hierarchy (Diamond 1997). The Neolithic has also been linked to a significant shift in demography, both population size and composition (Bocquet-Appel and Bar-Yosef 2008) (see IEBA0546). The transition to agriculture has been associated with reduced interbirth intervals (see BIRTH INTERVALS), which leads to both greater fertility (see FERTILITY) across the lifespan, and “birth stacking,” which depends upon the greater potential for alloparental care (see ALLOPARENTAL BEHAVIOR) in agricultural populations. The demographic transition may have started with population increases among foragers prior to the Neolithic (Cohen 2009), but there is clear evidence that further population increases resulted from agricultural subsistence and led to an irreversible relationship between population size and food production.

A common feature of the transition to agricultural subsistence is a shift from diverse diets based on a wide range of seasonally available resources, to dependence on one or a few highly productive domesticated plants supplemented by some animal resources and their secondary by-products. As most agricultural plants are composed primarily of complex carbohydrates, the Neolithic is associated with decreased dietary breadth and more carbohydrate-rich diets (see NUTRITIONAL STATUS). This may lead to a number of negative health outcomes, including an increased frequency of nutritional deficiencies (see MICRONUTRIENT DEFICIENCY DISEASES: ANEMIA, SCURVY, AND RICKETS) which may impact growth and other aspects of health, as well as an increased prevalence of dental caries (see DENTAL CARIES AND OTHER DENTAL DISEASES).

As many sedentary agricultural communities keep domestic animals within the settlements, the Neolithic may be associated with poor sanitation and an increased prevalence of zoonotic disease. Bioarchaeological studies (see BIOARCHAEOLOGY) have provided considerable evidence for the negative impact of the origins of agriculture on human health, with documented increases in: dental caries, antemortem tooth loss, and

linear enamel hypoplasia (see DEVELOPMENTAL DEFECTS OF ENAMEL); indicators of metabolic disease such as porotic hyperostosis or cribra orbitalia; specific transmissible diseases such as tuberculosis and treponematosi (see TREPONE-MAL DISEASE); as well as nonspecific periosteal reactions (see NONSPECIFIC INFECTIOUS DISEASE). There is a convincing evidence for negative health outcomes associated with the transition to agriculture in North, Central, and South America; Central, South, and East Asia; and Europe. However, the breadth of evidence currently available highlights variability in different regions, suggesting that the specific outcomes are contingent on local circumstances.

While demographic changes and paleopathology (see PALEOPATHOLOGY) have historically received the greatest research attention, recent research has highlighted the impact of agriculture on other aspects of human physiology and variation. Body size, as a reflection of both genetic potential and nutritional and environmental influences during development, can be used as an indicator of childhood nutrition (see BODY COMPOSITION, NUTRITION AND GROWTH, GROWTH IN UTERO, INFANCY, AND GROWTH IN CHILDHOOD AND ADOLESCENCE). In some areas, such as the Nile Valley, body sizes dropped with the transition to agriculture but recovered following the rise of the Egyptian empire. Systematic comparisons of body size in North America has demonstrated increases in body size associated with the transition to agriculture within particular regions, despite considerable variation in time and space (Auerbach 2011). While this represents only a portion of the available evidence, it demonstrates that phenotypic change in response to the agricultural transition is variable and dependent on local conditions.

There is considerable skeletal evidence for behavioral change associated with the transition to agriculture, including biomechanical evidence of both increases and decreases in terrestrial mobility and manual labor associated with the agricultural transition in North America (Ruff 2008). In other regions such as Central Europe, analyses of biomechanical properties (see BIOMECHANICS/MECHANOBIOLOGY) of the lower limbs have demonstrated long-term decreases in habitual loading relating to sedentism, which progressively shifted over thousands of years

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(Macintosh, Pinhasi, and Stock 2014; Ruff et al. 2015; Ryan and Shaw 2015). While a decline in mobility related to lower limb mechanical properties has been noted associated with the Neolithic of the Nile region, this is followed by a gradual increase over thousands of years.

Dental and mandibular size reduction following the adoption of agriculture has been documented in a number of locations, including the Levant (Pinhasi, Shaw, and Eshed 2008) (see Hominin Dental Evolution). As the underlying mechanism behind this is thought to be genetic, this is often considered as evidence for evolutionary change within human populations following agriculture. There is now considerable evidence that the transition to agriculture drove natural selection in human populations, as cultural change exerts new selective pressures in human populations (Stock 2008). Signatures of past selective pressure associated with agriculture have been related to the evolution of malarial resistance, lactase persistence (see Lactase Persistence), and amylase gene copy variation. While malarial resistance may be a secondary consequence of the proliferation of mosquitos following the clearance of land, the latter two cases appear to be evolution in direct response to dietary stressors associated with the domestication of animals and plants. Recent evidence suggests that cultural change following the transition to agriculture may have had a major impact on natural selection within our species (Laland, Odling-Smee, and Myles 2010) (see Evolution).

Overall, the view of the Neolithic has changed from being a temporally delimited "revolution" with immediate impacts on human health and ecology, to an extended period of cultural change with regionally variable influences on human diet, demography, technology, health, disease, growth, and activity. This regional variation in the relationship between cultural change associated with agriculture, and human biology is now seen as a major factor in driving human adaptation and genetic evolution within the past 10,000 years.

SEE ALSO: Adaptation; Bioarchaeology of infectious disease; Biomechanics/mechanobiology; Dental caries and other dental diseases; Diet, evolution of; Health and well-being, history of; Birth intervals; Lactase persistence; Life expectancy, longevity, and lifespan; Niche con-

struction; Paleodemography; Phenotype; Stress and growth; Physiological stress; ieba0546

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ABSTRACT

The Neolithic, the prehistoric period of the initial domestication of plants and animals, occurred independently in many parts of the world. The transition to agriculture had a profound impact on human social organization, demography, health and disease, and behavior. As a process through which human populations dramatically changed the local environment, the Neolithic also changed the human adaptive landscape and became a primary driver of evolutionary change within our species.

KEYWORDS

Agriculture; subsistence; sedentism; adaptation; domestication