The Maya Project: a mirror for human growth in biocultural perspective

This item was submitted to Loughborough University’s Institutional Repository by the/an author.


Additional Information:

- This is a chapter from the book Human Growth: the Mirror of the Society

Metadata Record: [https://dspace.lboro.ac.uk/2134/20889](https://dspace.lboro.ac.uk/2134/20889)

Version: Published

Publisher: B.R. Publishing Corporation / © The Authors

Rights: This work is made available according to the conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0) licence. Full details of this licence are available at: https://creativecommons.org/licenses/by-nc-nd/4.0/

Please cite the published version.
The Maya Project: A mirror for human growth in biocultural perspective

Barry Bogin†* and Ines Varela-Silva*

Every man carries with him through life a mirror, as unique and impossible to get rid of as his shadow.

From The Dyer’s Hand by W.H. Auden,
Anglo-American poet (1907-1973)

Abstract

Our purpose in this chapter is to explain how human physical growth reflects the biocultural environment in which groups of people live. We do this in the context of our research on the physical growth and health of Maya children and adults. The Maya are one of the native peoples of the Americas. There are an estimated 7-8 million Maya living in Guatemala, the Yucatan Peninsula and a few other areas of southern Mexico, Belize, El Salvador, and western Honduras (Figure 1.1). The majority, about 6.5 million live in the highlands of Guatemala (Bogin, 2012). These demographic statistics make the Maya the most populous Native American ethnic group. To better understand the Maya people we created the Maya Project, a blend of art and science portraying the biocultural realities of the Maya in Mesoamerica. One aspect of the Maya Project is a web site – http://mayaproject.org.uk. We will highlight some aspects of the Maya Project web site in later sections of this chapter. First we offer some explanation of the biocultural perspective of human growth.

† Corresponding author.

* Centre for Global Health and Human Development, School of Sport, Exercise & Health Sciences, Loughborough University, United Kindom.
The theme

J.M. Tanner’s expression ‘Growth as a Mirror’ (1986) sets the title for this book. The full passage of Tanner’s words is worth repeating here:

My thesis – that the growth of children amongst the various groups which make up a contemporary society reflects rather accurately the material and moral conditions of that society – is no less important for being wholly unoriginal.

James M Tanner, paediatrician, auxologist, medical historian (1920–2010)

By ‘wholly unoriginal’ Tanner was referring to his building upon the use of growth data by 19th century social reformers in France and the Britain to establish differences between social classes. The quote from W. H. Auden that opens our essay shows that the use of the mirror metaphor to reflect on the life course is also ‘wholly unoriginal.’ The mirror allegory is known from ancient Greek fables. One of the more popular expressions of ‘life’s mirror’ is the novel The Picture of Dorian Gray by Oscar Wilde (1890). In that story, Mr. Gray sits for a portrait painting that captures his youth and beauty. He expresses a wish that he would sell his soul if only the painting would age and that his body would remain forever young. Some devil accepts this proposition and when Mr. Gray realizes the situation he sets off on a life of remorseless hedonistic pleasure. With each sin the portrait becomes more disfigured and with each year shows signs of aging and decrepitude. Gray locks away the painting but visits with it to see the effect that each depraved act had upon his soul. In the end, Gray kills himself by stabbing at the heart of the painting.

Auden’s and Tanner’s use of the mirror extends the metaphor beyond the acts of an individual to those of the entire society. Society involves how we are treated and how we treat others and this interchange shapes our collective countenance in terms of our material and moral being, that is, in terms of the biology and culture. Tanner’s originality was combining these into a unified biocultural perspective - ‘growth as mirror’ – with growth being the biology and the mirror being the culture.
A biocultural perspective

In the textbook *Human Biology: An Evolutionary and Biocultural Perspective*, Stinson et al. (2012, pp. 12-13) explained the biocultural nature of the human species:

Humans are a peculiar species of mammal: bipedal, omnivorous, relatively hairless, massively encephalized, intensely social, and reliant on complex learned behavior for survival. Individuals communicate by using thousands of different languages, are organized into societies with widely varying structures, and solve environmental problems with myriad technological solutions. Thus, humans are a species with a highly developed capacity for symbolic thought and representation; environmental manipulation; and invention, learning, and appreciation of social facts. In short, humans have culture. Any understanding of human biology requires that we attend to the fact that humans are cultural beings.

The meaning of ‘culture’ is much debated in anthropology and related disciplines. One definition we find useful is that culture is an epiphenomenon arising from the constant interaction between social, technological, and ideological processes. A very large number of biological species are social - even the single-celled paramecium conjugates with others of its kind. A smaller number of species use or create technology, which broadly considered is any use of the natural world for a purpose particular to the technologists. This may be nest building by social insects or converting silicon into smart phones. Very few species have ever created ideology. The American Heritage Dictionary definitions of ‘ideology’ are: 1) The body of ideas reflecting the social needs and aspirations of an individual, group, class, or culture, and 2) A set of doctrines or beliefs that form the basis of a political, economic, or other system. Ideology is all of that and more. The Oxford Dictionary of Archaeology defines ideology as the belief system shared by members of a society. Anthropologists take ideology to signify the sets of symbolic meanings which structure thought, beliefs, and values, and these in turn structure behavior. Symbolic meanings encompass the ethics of ‘right and wrong,’ of
Human Growth: The Mirror of the Society

‘good and bad,’ ‘male and female,’ ‘sacred and profane,’ and all other binary oppositions. Ideology structures language, kinship, marriage and other unique, or at least very special, biosocial features of human affairs. Given present evidence, the only biological species with ideology are living humans (*Homo sapiens*) and, perhaps, extinct ancestral hominin species such as *H. neandertalensis*.

![Map showing the geographic location of the Maya culture area in southern Mexico and Central America.](image)

Figure 1.1 Map showing the geographic location of the Maya culture area in southern Mexico and Central America.

It takes the combination of sociology, technology, and ideology to have human culture. Other apes such as the chimpanzee have the sociology and technology, but seem to lack the ideology. Chimpanzees have a chimpanzee culture, but not a human culture. It also takes a physical world and its energy and matter to sustain a culture. This is depicted in Figure 1.2. Sandwiched between the social, economic, political and cultural environments and the
physical environments are each of the basic elements of human culture. These basic elements are linked in a cycle of interdependence and transfiguration, in the sense of metamorphosis from one element into another. An example of the linked cycle is the ideology of physical science to propose the existence of the Higg’s boson, which lead to the construction of the Large Hadron Collider (technology), one of the most expensive and complex experimental facilities, and the creation of new communities of people to staff the facility (sociology). The Higg’s boson social communities include artists, economists, politicians, as well as scientists (http://news.discovery.com/space/higgs-boson-quest-impires-epic-art-at-the-lhc-120703.htm). Considerable amounts of energy and matter, symbolized as money, buildings, and experimental machinery, were and are channeled into the ideology of the boson.

More to the point of this chapter, a biocultural example of human growth may be seen in the artwork on the home page of our Maya Project website. That artwork is a mural titled *Maya Cultural Mosaic* by the Maya Mexican painter Marcelo Jiménez Santos. We reproduce a portion of the mural here in Figure 1.3. We see the allegory of the creation of the Maya, according to Pre-Columbian ideology. The Maya are ‘people of corn,’ created by Xmucane, the Divine Grandmother of the gods, when she took dried corn kernels (*Zea maize*), ground them on a stone pestle with a cylindrical mortar (technology). She mixed the corn meal with water and fashioned human shapes from which arose the Maya people (sociology). This creation story was written some
time before 250 CE when the Maya people began to practice intensive agriculture (more technology) of corn and other crops to feed a large population, including many non-food producers such as soldiers, artists, architects, politicians, religious leaders and crafts people (more sociology). Corn was the basic matter of life as the kilocalories from the corn people consumed provided the energy to run Maya civilization.

The biocultural nature of the Maya people is reflected not only in their ‘people of corn’ creation story but also in the physical growth of the people. Analysis of skeletons recovered from Maya graves at the site of Tikal allowed for the estimation of the height of the grave occupants. Tikal was one of several large civil and religious centres noted for their monumental architecture and dating to the Classic Period (250 to 900 CE). During the Early Classic period, skeletons from tomb burials average about 170 cm in total height (Figure 1.4). The tomb burials are those of high status individuals, often Maya royalty. These individuals would have enjoyed the best possible conditions for life that Maya society could have provided. Just for comparison, the average stature of Mexican-American men 18-24 years old, a relatively healthy age, living in the United States was 171.2 cm in 1984. The Classic Maya buried lower ranking people under the floor of their homes. The size of homes is an indication of the wealth and social status of both the occupants and the burials. Individuals buried in small-sized Maya homes averaged 163 cm in stature. The difference between the elites and the lower social class is an indication of a lower quality environment for growth for the general population. Clearly, the elites reserved the best diet, indeed the best of everything, for themselves.
Figure 1.3 The biocultural nature of the Maya people – People of Corn.

(Detail of the mural Maya Cultural Mosaic by Marcelo Jiménez Santos. The Maya people believe they were created from corn, shaped by the hands of the gods. Other images in this detail are the steel swords of the European Conquistadores used to subjugate the Maya and the hands and weapons of the Maya used to defend against the conquerors. The complete painting may be viewed at http://mayaproject.org.uk/maya-cultural-mosaic/).

Figure 1.4 Mean stature of skeletons recovered from tombs, mid-sized houses, or small-sized houses at Tikal during the Early Classic or Late Classic Periods (redrawn from Haviland and Moholy-Nagy, 1992).
By the late Classic Period the quality of life declined for all segments of Maya state society. The mean stature of both tomb and non-tomb burials declined by about 5.0 cm. In late Classic times (~ 700-900 CE) we have comparisons for both mid-size and small-size homes, which show how closely stature follows social rank. The decline in stature occurred during a time of increasing warfare between Maya city-states, increased investment in militarization (larger armies, weapons production, construction of fortifications, etc.), and declines in food production and public building (Bogin 2001). The “material and moral condition of that society” (Tanner, 1986) were directed away from the diet and health factors that would promote growth and toward those factors that would inhibit growth.

Biocultural: old and new

As for the mirror metaphor, the biocultural perspective on human growth is not new. The ancient Greeks, Chinese and Indians wrote of connections between food, emotions, economics, and health. As we mentioned earlier, 19th century European social reformers made connections between the physical growth and health of children and the social conditions under which these children lived. A study of English factory children, 13 to 14 years old measured in the year 1833, noted a height deficit averaging 23 cm less than that of children from wealthier families able to attend school (Bogin 1999, p. 32-33). Early 20th century studies of immigrants to the United States documented the rapid increase in stature of children born in America and exposed to a new culture of child rearing compared with their older siblings born and raised under the culture of the ‘old country’.

By the 1960s, human biologists had an understanding that the biocultural nature of human growth was based on fundamental biological process which could be influenced to a greater or lesser extent by the social and cultural environment. The most fundamental of all biology was ‘the gene.’ The discoveries of the structure of DNA in 1953 and its role in the formation of amino acid polypeptide chains in the 1960’s elevated the ideology of the gene to what seemed to be an unassailable position in biology. This ideology culminated in Francis Crick’s article the ‘Central dogma of molecular biology’ (1970). Crick proposed that all biological information needed for life flowed
either from DNA→DNA when new cells were reproduced, or from DNA→RNA→protein when those proteins are synthesized. This meant that in an ideal environment the genes coded in the linear sequence of DNA bases specified the formation of the phenotype (DNA→phenotype). The maximum phenotype of a person’s adult height, be it 160 cm or 190 cm, was coded in the DNA. Each human being, then, had a ‘genetic potential’ to grow to his or her DNA controlled height. Environmental factors might interfere and retard the expression of ‘the full genetic potential’ for growth in height, but environmental factors could not increase that potential (Schell et al., 2012 review this older perspective and Varela-Silva (2013) adds some more on this rebuttal to DNA determinism in her blog entry (http://scienceitches.com/2013/06/07/genetic-potential-defined-deconstructed-and-put-to-rest/). Crick’s central dogma model was an advance in biological ideology at its time. It just was not the end of the story.

Today, there exist newer, expanded, and more sophisticated models of the place of DNA in biology. Some of these newer models are biocultural and are generating hypotheses to better understand how culture shaped the human genome (Laland et al., 2010). Many of these newer models recognize that DNA is only a part of the genome. The genome concept, which did not exist in 1970, has almost done away with the idea of ‘the gene’ as understood by the central dogma model. The genome of the 21st century is viewed as a read-write storage system, to use the informatics model of Shapiro (2011). Rather than being fixed in DNA content from cell-to-cell and across generations of parent-to-offspring, except for random mutations, the genome is now known to change in response to non-random adaptive mutations of DNA bases as well as sequence inversions and translocation, epigenetic modifications, transposable elements, novel insertions, and the duplication of repeated segments of DNA. All of these have influences on genome regulation. James Shapiro, who discovered transposable elements in bacteria which confirmed that the genome has been subject to natural genetic engineering for more than three billion years, reviews the current genome model in his book (2011). None of this new knowledge is “wholly original,” as Jacques Monod discovered the lac operon in 1961, which is a DNA regulation system in which certain enzymes are expressed from the genome
of the bacterium *E. coli* only in the presence of lactose and the absence of glucose. The lac operon is an example of a type of genome regulation called nutrient sensing, which is an active area of research today. Even before Monod’s research, Barbara McClintock discovered in 1951 the first transposable genetic elements; two genetic loci in the maize plant, Activator (Ac) and Dissociator (Ds), which could interact to influence the phenotype of color formation of maize seeds. Perhaps such interactions in the People of Corn give rise to the great variety of Maya phenotypes! While that last sentence is an attempt at humor, the early work of Nobel Laureates McClintock and Monod has blossomed into huge industry within biology.

The old central dogma of DNA has given way to models of recurring interactions between the biological substrates for human growth, in terms of the genome and the phenome - the totality of all phenotypic traits of a cell, tissue, organ, organism, or species. Human biology interacts with human cultural (sociology, technology, ideology). Not only does culture influence biology, it also creates biology at every level from the organization of the human genome, to the phenome of the individual person, and to the community networks in which people live their lives. The linear and unidirectional flow of information of the central dogma model is now modified to a series of cyclical and overlapping flows of information, energy, and material. We model two of these flows in Figure 1.5.

![Diagram of cyclical and overlapping flows of information, energy and material between genome and phenome and biology and culture.](image)

*Figure 1.5. Cyclical and overlapping flows of information, energy and material between genome and phenome and biology and culture. The grey area indicates that the two cyclical flows are interrelated and connect the individual person, the family, the community, and the species.*
It is now understood that forces and factors from the physical and cultural environments acting in prenatal and early post-natal life regulate the expression of DNA. These factors include exposure to toxins, infection, nutrient deficiencies and excesses, physical abuse, and psychosocial stress. These forces act to pattern the methylation of DNA and to modify DNA histones to the extent that groups of people with highly similar DNA sequences may have highly different growth process (Szyf, 2012). We recommend that interested readers consult the growing body of recent literature in the field of epigenetics and development for more background information and examples. A book on the epigenetics of growth and development edited by Hallgrímsson and Hall (2011) is one good resource.

The Maya people in biocultural perspective

The remainder of this chapter reviews recent progress in the application of some current biocultural approaches toward human growth using the Maya people as an example. The living Maya are the biological and cultural descendants of people inhabiting the same culture area prior to European contact in the year 1520 CE. Archaeology of the region indicates that hunter-gatherers and small-scale farmers existed in the region for thousands of years. It is not certain from which of these groups the Maya originated and dates for the earliest evidence of Maya artifacts range from 2600-1500 BCE (Gómez-Casado et al., 2003). By about 250 CE a Maya cultural identity was well established and the people were organized in several state-level societies, ruled by priest-kings and an elite class of political-religious leaders. Each Maya state maintained armies, full-time craft specialists, and a workforce of peasants who supplied labor to build monumental architecture and produced food using a mosaic agricultural system including rainfall dependent fields, raised wetland fields, hydroponic gardens for plants, fish and other animals, terraced hillsides, home ‘kitchen’ gardens, and managed forests. Maya plant and animal husbandry cultivated a diversity of species to provide food, medicinal plants, wild animals for protein food and honey, firewood and building materials (Bogin, 2012).

The Maya people alive today may be defined by several biological and cultural characteristics. Analysis of HLA allele frequencies of several
Mesoamerican populations indicates that the Maya are a single, biologically well-defined group of people across their entire culture area (Gómez-Casado et al., 2003). An analysis of Y chromosome haplogroups and Y-STR haplotypes of living Maya people from Yucatan, Mexico and from the Guatemalan Highlands finds that both groups display only haplotypes M3 and L54 and that there are no significant differences in the frequency of these two haplotypes. This suggests a single male founding population of the Maya (Regueiro et al., 2013). This study also found a relatively high level of diversity in Y-STR profiles within the Maya compared with other Amerindian populations. The authors propose that this is due to rapid demographic growth during the Pre-Classic, Classic and Post-Classic periods (250-900 CE). This population expansion was most likely supported by technologies for intensive agricultural production and extensive trade networks of the Maya during the peak period of their empire. This is another example of cultural practices creating new biological profiles.

As the Maya empire expanded it likely incorporated a variety of previously independent peoples in what is now the Maya culture area. Some evidence for this exists in the 22 or so Maya languages still spoken today. Each language is associated with a specific Maya group such as the Yucatec Maya of southern Mexico and the K’iche (Quiche), Mam, Q’eqchi (Qekchi), and Q’anjob’al (Kanjobal) of Guatemala. Maya orthography has changed over time. The spellings in parentheses are an older orthography. Some of the Maya languages are similar enough to each-to be mutually intelligible, while others are as different as French is from Italian or German is from Swedish. The use of Spanish as a vehicular language (a ‘lingua franca’) is common. Despite the linguistic variation, many other features of Maya life are shared by all groups. These include a history of rural agrarian lifestyle, the kinship and marriage systems, religion, philosophy, and a brutal history of subjugation, persecution, and disenfranchisement since the European Conquest of the Americas. History binds all Maya together into a shared cultural identity.
Maya Project research on biocultural health and nutritional status

We have no need of other worlds. We need mirrors. We don’t know what to do with other worlds. A single world, our own, suffices us; but we can’t accept it for what it is.

From Solaris by Stanislaw Lem (1921-2006), writer, philosopher, satirist

The Maya Project is a window to a biocultural world that is different in many ways from the world of relative comfort and safety that many people in the wealthy nations (for example, of Western Europe, North America, Japan) experience. The Maya world is, in a way, a mirror image – an inversion – which reflects and contrasts wealth/poverty, safety/danger, health/illness. The Maya Project web site provides some images of these reflections and contrasts, organized into five themes: Living conditions, Migration, Health and nutrition, Faith and spirituality, and Women’s roles. Our direct research focuses primarily on health and nutrition. We use physical growth and development variables, such a height and weight, as our indicators of health and nutritional status, which is a long-established practice in anthropology, epidemiology, and medicine (Tanner, 1986; Bogin, 1999). Some members of the Maya Project have been working with the Maya and publishing about the Maya since the 1980s. In this chapter we limit our discussion to research on health and nutritional status conducted since 2000.

Stunting

Any consideration of Maya health and nutrition must begin with an understanding that Maya adults are the shortest people in the contemporary world. This statement excludes the Central African Pygmies and Philippine Pygmies, whose short average stature is due some combination of genome mutations, hormonal insufficiencies, missing carrier proteins for hormones, and other neuroendocrine pathology. None of these causes for short stature are known to afflict the Maya. In our most recent study of Maya women living in Merida, Mexico the mean height of 109 women was 147.91 cm (SD = 4.84). The mean age of these women was 32.75 years (SD = 5.67), so all height growth had been completed and age-associated declines in stature were not present (Azcorra et al., 2013). We did not measure men in this study. Across the Americas, and across samples of different environments,
men average between 11-13 cm taller than women (Bogin and Keep, 1999) which would mean that Maya men in Merida should average 159-161 cm. This estimate accords well with measured heights of Maya men reported by Siniarska and Wolanski (1999) of 160 cm (they reported 148 cm for women). The mean height of adult Maya men from the Western Highland region of Guatemala, measured in 1991, was 160.7 cm. The mean height for all Maya women from Guatemala reported by the National Institute of Statistics in 2001 was 145.3 cm (Rios and Bogin, 2010). The heights estimated for the Maya skeletons from the tombs at Tikal were of men averaged 170 cm and even that mean stature likely was reduced by exposure to infection, parasites, and other growth limiting factors. Previous research indicates that Maya stature decreased 10-12 cm on average in the past 18 centuries (McCullough, 1982).

An adult mean height of women less than 150 cm is considered to be evidence of childhood stunting, that is, a childhood height that was 2.0 standard deviation scores (SDS) less than the median height of the reference value for healthy, adequately nourished children. In our most recent study, a sample of 109 Maya women of Merida, with a mean age of 32.75 years, had an average height of -2.01 SDS. Children aged 6.0-8.99 years old of these same women averaged -0.66 SDS (Azcorra et al., 2013). Other research we have carried out in Mexico and Guatemala indicates that as Maya children age they continue to decrease in height SDS. Our interpretation of this pattern is assisted by our biocultural model shown in Figure 1.2. The Maya live between environments and physical environments that persistently deny them sufficient energy, matter, sociology, and technology for healthy growth throughout their lives. The Maya have a rich tradition of ideology, but that is not sufficient for healthy growth.

Nutrition surveys carried out in Mexico and Guatemala between the 1960s and 1990s found that Maya consume only 75-80% of the total food energy needed for adequate physical growth (Bogin, 2012). The most recent Mexican survey found outright deficiencies for several essential nutrients, including vitamin A, folate, iron, zinc, and calcium. A deficiency in any one of these essential nutrients will stunt growth. The single most powerful cause
of this chronic undernutrition is poverty. The Maya families of our most recent study had an average income of US$8.91/day. With median family size of 6 people, this equates to US$1.49/day/person – which is well below the official Mexican poverty line of at least US$4.00/day/person.

**Fatness**

Our studies of Maya growth carried out during the 1970s to 1990 found that children and adults were both short in stature and had low body weight. Compared to international growth references the height and weight reduction of the Maya was proportional, meaning that Maya were both short and thin. In 1992 we measured the children of Maya families from Guatemala then living in Los Angeles, California and Indiantown, Florida in the United States. Maya began to migrate to the United States around 1980 due to the civil war in Guatemala (Bogin, 2012). That war dates from 1960 to 1996, but in the late 1970s the Guatemalan army began a systematic series of attacks and massacres in Maya villages. Maya fled to Mexico and then to the United States. The Maya children, aged 5 to 12 years old (n=240), measured in 1992 in Los Angeles and Indiantown were, on average, 5.5 cm taller and 4.7 kg heavier than same aged Maya children in Guatemala villages. Those children were born in Guatemala, Mexico, and the United States. In height they were still short, but they were now almost at the median weight of long-term residents of the US. We again measured Maya children (n=296) of the same ages in Los Angeles and Indiantown in 1999 and 2000. By that time the height difference compared with Guatemala Maya increased to 10.24 cm and the weight difference to 11.72 kg. Almost all these children were born and grew up in the US. Converting Maya height and weight to percentiles of the United States growth references resulted in the Maya being at the 25th percentile for height and the 65th percentile for weight. When we calculated the body mass index (BMI = [weight/height²]) of these Maya-American boys and girls they averaged the 85th percentile. BMIs above the 85th percentile are considered overweight and by that criterion 48.6% of these Maya-American boys and girls were overweight. Using the 95% of BMI as the cut-off for obesity found that 25.3% of all these children were obese (Smith et al., 2002).
These Maya-American children had transformed from a very short and thin phenotype to a moderately short and very fat phenotype in one generation. Both the rapidity and the magnitude of the change were unusual. The United States of the 1990s was an obesogenic environment for all people, but these Maya children seemed to be especially susceptible. Other immigrants from Latin America, especially Mexican-Americans, were also showing rapid increases in overweight and obesity (OW/OB). Researchers and public health workers began to search for the reasons and the causes behind this alarming rise in OW/OB. In addition, OW/OB was shown to be rising in Mexico and other Latin American countries. It was not known if this trend extended to Maya of Mexico. Our studies in Merida found that indeed the trend was well established among the Maya. Using World Health Organization cut-offs for OW/OB we found that 91.4% of the adult women we measured were overweight and 39.7% were obese. Using the International Obesity Task Force cut-offs for childhood OW/OB we found that 17.2% of 7 to 9 years old boys and girls were overweight and 10.3% were obese. Using the -2.0 SDS cut-off for height we found that 15.5% of the children were stunted. More worrisome, 2.4% of the children were both stunted and overweight (Varela-Silva et al., 2012). In principle it should be virtually impossible for 7-9 years old children to be simultaneously stunted and overweight as the energy to grow fat should also provide for growth in height.

**A new biocultural reality**

“A writer should not run around with a mirror for his countrymen; he should tell his society and his times things no one ever thought before.” – Lem

Maya families in Merida are now characterized by the nutritional dual-burden. This dual-burden is defined as a combination of stunting and overweight in the same person, the same family, or the community. The Maya are not unique in terms of the nutritional dual-burden, but they are an extreme example. Twenty years ago the term ‘nutritional dual-burden’ did not exist. Not even science fiction writers such as Lem considered the possibility. How have biocultural environments changed so quickly to produce the new reality simultaneous stunting and overweight?
We offer one possibility. We explained earlier that the Maya of Mexico and Guatemala lack several essential nutrients and this retards their skeletal growth. This is due to a transition from diets based largely on locally grown foods to globalized foods. The traditional Maya diet was based corn, in the form of tortillas and other foods made from masa. Traditionally, masa is made from dried corn, which is ground to a meal, mixed with water and calcium carbonate and the boiled to form a dough. This dough can be shaped into a variety of forms- Xmucane formed the masa into the first Maya. Tortillas were eaten with beans, a variety of vegetables and fruits supplemented with small amounts of animal foods. Plant fiber was abundant and sugar and fat was relatively low. Surveys in rural Guatemala in the 1960s found that at least 108 different kinds of food items were consumed by the Maya. This traditional diet was not unhealthy per se, but Maya families could not afford to eat enough food and were, consequently, short and thin (Bogin, 2012).

The new globalized diet of the Maya is based on highly processed, industrialized foods, such as pasta, breads, and cakes, along with bottled, boxed, and canned foods. Food frequency surveys in Yucatan carried out since the year 2000 found that tortillas and beans remain staples of the diet, but are now purchased as industrially prepared products. Store bought tortillas may have a lower content of vitamins and minerals, such as calcium. In fact, the 2006 national food survey of Mexico found that Maya of the Yucatan are deficient in calcium. One member of the Maya Project team (Dra. M.T. Castillo Burgette) was part of a study of food consumption patterns in two rural Maya villages (Izquierdo et al., 2012). That study found that 65% of households were medium consumers of industrialized foods (up to 33% of all foods consumed) and 11% of families were heavy consumers (up to 53% of all foods eaten were industrialized). It is likely that in the city of Merida the Maya families consume and even higher proportion of industrialized foods, as there is less opportunity to grow traditional foods.

Highly processed factory foods have less fiber, but more added sugars and fats to make them more palatable and to allow them to be stored for long periods and transported long distances. Intensive processing removes many essential nutrients, such as minerals and vitamins. The globalized foods are
Human Growth: The Mirror of the Society

relatively inexpensive compared with fresh vegetables, fruit, and animal foods. Carbonated sugary drinks are often less expensive, or more available, than clean drinking water. The ubiquity and very high intake of sugary drinks lead one research team to proclaim that the Yucatan of Mexico has been ‘coca-colonized’ (Leatherman and Goodman, 2005). Even chicken eggs, which have been a staple of the Maya diet, are now too expensive for many families. During our measurement sessions we gave the children an apple and a carton of milk. These foods were consumed immediately, with no refusals. Many children could not tell us when they last ate fresh fruit or milk.

The globalized foods fill stomachs but leave people hungry for the missing nutrients. The result is a persistence of short stature and an excess of energy intake. The excess is likely due to the fact that retarded skeletal growth greatly reduces the need for energy consumption, but the globalized foods have little more than energy and the surplus of energy intake is converted into fat. Our direct measures of body composition, including skinfolds and bio-electric impedance, showed that these children do have excess body fat.

Another possible reason for a gain in body fat is lack of energy expenditure. We measured the energy expenditure in a sample of 37 Maya children in Merida, aged 7-9 years old. We used the Actiheart®, a combined heart rate monitor and accelerometer, which each child wore for one week (Wilson et al., 2012). The variation between individual children in time spent at moderate-to-vigorous physical activity (MVPA) was high, with a range of 20–312 min per day. At least 60 minutes per day of MVPA is recommended for children aged 7-9 years old. Overall, our sample of children was highly active, spending an average of 120 minutes per day in MVPA. Stunted children were significantly less active than the non-stunted, but even the stunted averaged more than 60 minutes of MVPA/day. Lack of physical activity, among this small group of Maya children, does not seem to be a cause of OW/OB for these Maya children.

An unhappy ending

From a biocultural perspective, there are significant implications from our Maya research. Human phenotypes, represented as growth in height,
weight, body proportions, and body composition, are sensitive indicators of the physical, social, economic, political, and cultural environments. The new wave of anthropological research is concentrating on interactions between these environments and their effects on human biology. Our studies of Maya children and adults are part of this new wave.

With few exceptions, the Maya of Mexico and Guatemala live in poverty. There is little evidence to suppose that this will change soon. The Maya suffer from both extremes of malnutrition – stunting and overweight. In children and adults this terrible combination is known to elevate risks for many diseases and lead to an earlier age at death.

The next stages of our research with the Maya will be focused on discovery of the specific biocultural features that are most amenable to improvement. Interested readers may join us via the Maya Project web site. Our combined efforts may lead to some hope for future generations of Maya. We end this chapter with one final quote which offers encouragement and optimism. In a review of Tanner’s ‘Growth is a mirror’ concept, Lawrence Schell and colleagues (2012) wrote, “Growth is a mirror but it is also a summary of the environment; only analysis of specific features will reveal what growth is mirroring.”

Acknowledgements

Many people are part of the Maya Project team. We especially acknowledge Dr. Federico Dickinson, Dr. Maria Teresa Castillo-Burgette, Dr. Hannah Wilson, Maria Luisa Avila-Escalante. Financial support for the Maya Project comes from The Wenner-Gren Foundation for Anthropological Research, Santander Universities, Loughborough University, and CINVESTAV-Medida.

References


