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Changes in stature, weight, and nutritional status with tourism-based economic development in the Yucatan

Thomas L. Leatherman [a,*], Alan H. Goodman [b], Tobias Stillman [b,c]

[a] Department of Anthropology, University of South Carolina, Columbia, SC, United States
[b] School of Natural Science, Hampshire College, Amherst, MA, United States
[c] UNICEF, United States

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ABSTRACT

Over the past 40 years, tourism-based economic development has transformed social and economic conditions in the Yucatan Peninsula, Mexico. We address how these changes have influenced anthropometric indicators of growth and nutritional status in Yalcoba, a Mayan farming community involved in the circular migration of labor in the tourist economy. Data are presented on stature and weight for children measured in 1938 in the Yucatan Peninsula and from 1987 to 1998 in the Mayan community of Yalcoba. In addition, stature, weight and BMI are presented for adults in Yalcoba based on clinic records. Childhood stature varied little between 1938 and 1987. Between 1987 and 1998 average male child statures increased by 2.6 cm and female child statures increased by 2.7 cm. Yet, 65% of children were short for their ages. Between 1987 and 1998, average child weight increased by 1.8 kg. Child BMIs were similar to US reference values and 13% were considered to be above average for weight. Forty percent of adult males and 64% of females were overweight or obese. The anthropometric data from Yalcoba suggest a pattern of stunted children growing into overweight adults. This pattern is found elsewhere in the Yucatan and in much of the developing world where populations have experienced a nutrition transition toward western diets and reduced physical activity levels.

1. Introduction

Throughout Latin America and much of the developing world, nations are turning to tourism as a path to economic development for generating much needed foreign income and investment. International tourism to Central America expanded dramatically between 1987 and 1991, with growth rates of 11.5% and 16.8%, respectively (Stonich, 1998). Mexico is a leader in Latin American tourism and the Yucatan Peninsula is one of the most important tourism destinations in Mexico. For example, Cancun, the center of tourism-based development, grew from a small fishing village of about 400 inhabitants in the early 1970s to a population of over 400,000 people in the 1990s (Daltabuit and Leatherman, 1998; Pi-Sunyer and Thomas, 1997). Mayan communities have become directly involved in the tourist economy as a source of inexpensive labor for construction and service jobs at tourism centers and as sites of ecotourism and archaeotourism. These changes in regional and local economies have affected the diet, nutrition and health of Mayan populations.

Populations in Mexico, Latin America and much of the world are experiencing a nutrition transition toward western diets and activity patterns associated with an increase in obesity and chronic diseases (Rivera et al., 2004; Popkin, 1998). This nutritional pattern is often manifested in patterns of stunting or low height-for-age values, coupled with obesity in the same population (Popkin et al., 1996). Changes in heights and weights of children and adults in the Yucatan are investigated to

* Corresponding author. Tel.: +1 803 777 7261; fax: +1 803 777 0259.
E-mail address: leatherman@sc.edu (T.L. Leatherman).

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assess whether similar evidence of a nutritional transition exists in rural Mayan communities experiencing tourism-led economic changes. This analysis focuses on the community of Yalcoba in the maize producing region of the peninsula between the late 1980s and late 1990s, where we have collected anthropometric data and information on changing economic activities, food systems and diet.

2. Background

The development of a tourist economy in the Yucatan Peninsula relied on labor from its interior and in the late 1960s and early 1970s the Mexican federal government made public investments in infrastructure, health care and food distribution networks to facilitate an adequate supply of labor to the cities of Merida and Cancun (Gurri et al., 2001). Universal health coverage against diphtheria, whooping cough, tetanus, polio and measles were initiated for infants and children under 5 years old and government run clinics were expanded to provide basic health care for the larger population (Gurri, 1997). Today, Mayan communities are enmeshed in the broader tourism-based economy as construction workers, tour guides and artisans, as well as waiters, maids and gardeners in tourist resorts. The region's subsistence economy has transformed into a mixed economy of wage work (Re Cruz, 1996) coupled with slash and burn milpa agriculture producing corn, beans and squash, and use of important forest resources (Primack et al., 1998).

With the growth of the tourist economy, households and communities in the Yucatan have become increasingly dependent on the large urban centers for income (Daltabuit and Pi-Sunyer, 1990; Kintz, 1980) and we have observed that the reliance on milpa agriculture and home-gardens has declined (Daltabuit and Leatherman, 1998; Leatherman and Goodman, 2005). This increased reliance on non-local foods is exaccerbated by communally owned lands in Yalcoba, the ejido, that are limited in size and overworked, reflected in decreased productivity. Few families grow enough corn to last a year and more foods of all sorts must be purchased, especially during summer months.

As household production declined and the role of markets increased, Yalcoba residents increasingly consumed foods produced out of the area, an example of dietary delocalization (Pelto and Pelto, 1983; Leatherman and Goodman, 2005). By the mid-1980s, there was a shift from locally produced food toward commercial foodstuffs, where sodas and snack foods became key elements (Daltabuit, 1988). Current diets illustrate a trend toward increased consumption of high-calorie, low-nutrient snack foods (Leatherman and Goodman, 2005). Mexico rivals the US as the highest per capita consumer of soft drinks in the world (Coca-Cola Company, 1999) and rural residents consume an average of one soda per day. Many school children likely obtain 20% or more of their daily caloric intake from sodas and other high-calorie snack foods (Leatherman and Goodman, 2005).

Although shifts from locally produced to commercialized foods are associated with increased dietary diversity and improved levels of nutrition in industrialized nations, such shifts often have a negative impact on nutrition in poorer countries, communities and families who cannot afford to purchase a variety of foods at market prices (Pelto and Pelto, 1983). Decreased subsistence production combined with an inability to purchase market foods reduces dietary diversity and nutritient intakes (Dewey, 1989). Despite adequate caloric intake, several micronutrients (e.g., Vitamins A, B2, B12 and zinc) and protein quality are notably lacking in Yalcoba diets, especially among households without steady sources of cash income (Leatherman and Goodman, 2005).

3. Methods

In order to assess the effects of social and economic change on nutrition and health, height and weight data from three time periods are presented. The three data sets include stature of 215 children from 1938 reported by Steggerda (1941), stature and weight data from 288 school children in Yalcoba from 1987 (Daltabuit, 1988) and new stature and weight data from a sample of 470 Yalcoba school children in 1998. The newly reported data from 1998 were collected using standard techniques (Frisancho, 1990) from children attending primary and secondary schools in Yalcoba. The study was conducted in collaboration with the school administration and teachers, and participation was voluntary; fewer than 3% of the children chose not to participate. According to a government census of the locale, the sample represents approximately 85% of the total population between the ages of 6 and 16 (Government of Mexico, 1996). The results, therefore, should be fairly representative of the community as a whole. Child height-for-age and weight-for-height *Z*-scores from 1998 were calculated using the CDC software package EpiInfo (US Centers for Disease Control and Prevention, 1998), and children were classified by height-for-age using the Waterlow (1984) classification system and weight-for-height using Frisancho (1990). In addition, we collected adult heights and weights from local clinic records, obtaining a sample of 78 adult males and 199 females. The most recently recorded weight for recorded height is used to calculate body mass index (BMI) values.

4. Results

Height, weight and BMI means and standard deviations of children measured in 1998 are presented in Table 1. Fig. 1 provides a comparison of Yucatec Mayan children's heights in 1938, 1987 and 1998. Between 1938 and 1987, there was an average increase in stature of about 1 cm for boys and an average decrease in stature of about .5 cm for girls between ages 7 and 13. Between 1987 and 1998, statures increased in boys aged 7–13 by 2.6 cm, and by 2.7 cm in girls. The stature increase between 1987 and 1998 is significant for boys ages 8, 10, 12 and 13, and girls ages 9, 10 and 11. This suggests a measureable but rather small increase in stature associated with regional socio-economic and infrastructural development. Yalcoba children remain short for their ages compared to NCHS

Table 1
Stature, weight and BMI of boys and girls (7–17 years) from Yalcoba.

Age group		Stature (cm)		Weight (kg)		BMI	
Years	*N*	Mean	SD	Mean	SD	Mean	SD
Boys							
7	26	108.7	5.0	18.4	1.6	15.6	1.1
8	21	115.9	3.5	21.5	2.5	16.0	1.2
9	34	120.4	5.8	23.7	3.2	16.3	1.3
10	33	125.8	9.4	26.8	7.4	16.7	2.4
11	23	128.6	3.9	27.8	4.3	16.7	2.5
12	23	133.3	6.8	32.1	7.5	17.9	2.2
13	27	140.0	6.9	37.8	8.8	19.1	2.9
14	23	145.8	6.1	41.2	6.7	19.3	2.1
15	19	150.6	5.2	45.6	4.4	20.1	1.3
16	15	153.0	4.9	49.6	6.4	21.2	2.1
17	5	149.2	8.6	49.6	3.3	22.4	1.7
Girls							
7	24	109.8	5.0	18.6	2.1	15.4	1.3
8	31	112.7	4.6	19.6	3.1	15.4	1.6
9	16	121.5	6.0	23.0	2.9	15.5	1.4
10	31	124.8	4.7	25.5	3.8	16.3	1.5
11	26	127.8	5.9	28.9	7.1	17.5	3
12	17	134.0	4.9	31.6	5.6	17.6	2.7
13	27	139.4	4.1	40.5	5.7	20.8	2.3
14	6	140.1	3.4	43.3	6.9	22.0	2.8
15	14	140.2	3.7	45.0	7.3	22.8	2.8
16	10	140.6	5.1	46.5	7.3	23.5	3.6
17	2	139.7	5.7	46.3	1.1	23.8	1.4

standards (US Department of Health and Human Services, 1987). Over 45% of Yalcoba children in 1998 were stunted (*Z*-score ≤ -2.0) and 20% were very stunted (*Z*-score ≤ -3.0) (Table 2). Thus, while child stature increased in the 1990s, there is ample evidence of chronic undernutrition among children in Yalcoba.

Table 2
Height-for-age *Z*-scores of Yalcoba children (6–18 years) in 1998 ($N = 456$).

Z-score	*N*	%
Normal ($Z > -2.0$)	157	34.4
Stunted ($Z < -2.0$ and > -3.0)	208	45.6
Very stunted ($Z < -3.0$)	91	20.0

Between 1987 and 1998, weight increased an average of 2.0 kg for boys and 1.8 kg for girls aged 7–13 (Fig. 2). Weight gains between 1987 and 1998 were significant for boys at ages 10, 12 and 13 and ages 7, 10 and 13 for girls. There is relatively little difference in mean BMIs between 1987 and 1998 for both boys and girls except for age 12 in boys and age 13 in girls (Fig. 3). Boys and girls in 1987 and 1998 were relatively close to the median for the NCHS standard. For boys, the 1987 sample had slightly lower BMIs up to age 13 and the 1998 sample closely paralleled the NCHS reference standard across all age groups. Girls in both 1987 and 1998 had slightly lower BMIs until age 13, when 1987 girls converged with the reference standard and 1998 girls surpassed it. Between ages 13 and 17, Yalcoba girls in 1998 had BMIs larger than the NCHS reference norm (average of 22.6 BMI vs. 20.5 BMI for ages 13–17). Based on weight-for-height classifications (Frisancho, 1990), only 5.8% of girls and boys (ages 6–11) in

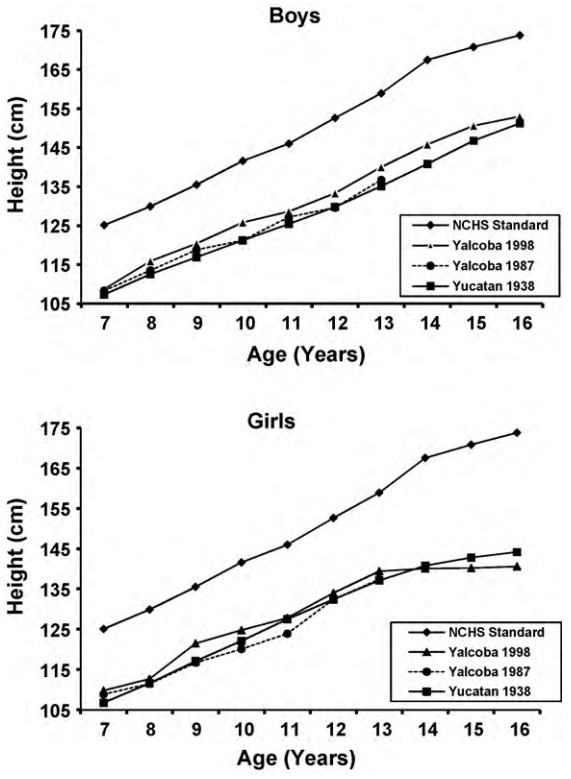

Fig. 1. Stature in boys and girls from Yalcoba (1987 and 1998) and the Yucatan (1938).

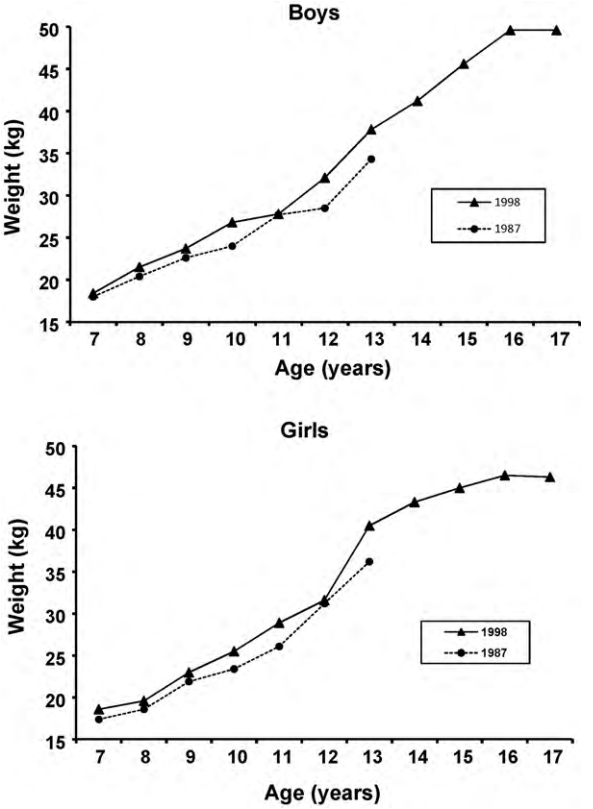

Fig. 2. Weight in boys and girls from Yalcoba in 1987 and 1998.

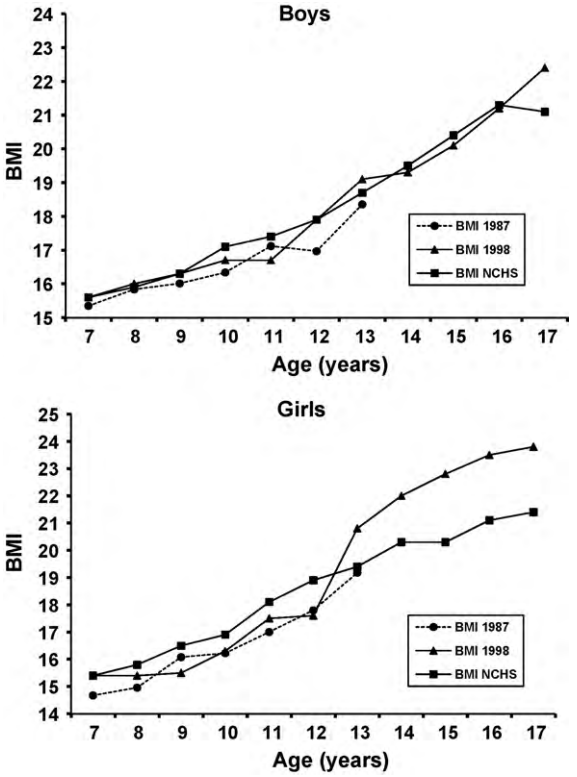

Fig. 3. BMI (body mass index) in boys and girls from Yalcoba in 1987 and 1998.

1998 were below average and 1.3% were low weight-for-height (Table 3). However, 7.1% were above average weight and 5.8% were heavy weight (Table 3).

Male and female adult height, weight and BMI values are reported in Table 4. Adult males in 1998 were about 1.6 cm shorter and .9 kg lighter than males (35+ years) measured by Daltabuit (1988) in 1987 and were 4.1 cm shorter but 2.3 kg heavier than adult males measured in the 1930s by Steggerda (1941). Adult females were 1.7 cm taller and 1 kg lighter than females measured by Daltabuit (1988) in 1987, and .9 cm taller and 7.4 kg heavier than adult females measured by Steggerda (1941). Given the gender and age bias, and unknown measurement error associated with the adult sample, the most reasonable conclusion is there was no adult height secular increase over the past 60 years. However, there was a significant increase in adult male and female weights by the late 1980s ($p < .01$, t-test; 1987 and 1998 male and female

Table 3
Weight-for-height Z-scores of Yalcoba children (6–11 years) in 1998 ($N = 225$)[a].

Z-score	N	%
Low weight ($Z < -1.650$)	3	1.3
Below average ($-1.645 < Z < -1.040$)	13	5.8
Normal ($-1.036 < Z < +1.030$)	180	80.0
Above average ($+1.036 < Z < +1.640$)	16	7.1
Heavy weight ($Z > +1.645$)	13	5.8

[a] Based on classification standards of Frisancho (1990).

Table 4
Heights, weights and BMIs of Yalcoba adults.

	Males ($N = 78$)		Females ($N = 199$)	
	Mean	SD	Mean	SD
Age	55.0	15.6	61.0	14.0
Height	151.3	6.0	142.9	4.9
Weight	56.5	9.2	54.9	9.4
BMI	24.7	3.7	26.9	4.4
Under weight (BMI < 19.0)	6.4$%		2.0%	
Normal (BMI ≥ 19–<25)	51.3%		32.7%	
Overweight (BMI ≥ 25–<30)	32.1%		44.7%	
Obese (BMI ≥ 30)	10.3%		20.6%	

samples relative to the1938 samples). In 1998, 32.1% of adult males and 44.7% of adult females were overweight ($25 \leq \text{BMI} < 30$), and 10.3% of males and 20.6% of females were obese ($\text{BMI} > 30$). While these levels of adult overweight and obesity fall short of the rates reported from urban centers in the Yucatan, they are greater than estimates from Mexico City (Arroyo et al., 1999).

5. Discussion and conclusions

The results for child and adult changes in height in Yalcoba between 1938, 1987 and 1998 are consistent with results reported by Gurri (1997) for the maize zone of the Yucatan peninsula. Gurri found similar stature increases for boys and girls up to ages 16–18 and no differences in adult height in the 1980s and 1990s compared to 1938. In agreement with Gurri et al. (2001), we interpret our findings as an indication of improved well-being for rural Mayans that were a by-product of regional economic development during the previous 20 years. However, results reported here are similar to those in impoverished Mayan Guatemalan children (Bogin et al., 2002) and illustrate relatively small increases in stature compared to Mayan urban children of Merida (Siniarska and Wolanski, 1999) and the US (Bogin et al., 2002). The stature increase at age 10 of approximately 2.6 cm between 1987 and 1998 in Yalcoba were less than one-half the increase among Mayan children in the US compared to their early 1990s Guatemalan counterparts (5.5 cm, Bogin and Loucky, 1997), and less than one-quarter of the height increase observed in current Mayan-American samples (11.5 cm, Bogin et al., 2002). Similarly, Siniarska and Wolanski (1999) find Mayan boys in Merida to be an average of 10 cm taller than those measured in 1938 by Steggerda (1941). They note that rural boys in the Yucatan Peninsula were shorter than urban boys, and that boys from the maize region were among the shortest in the Yucatan. Thus, while stature increased slightly in the 1990s, stunting levels indicate that chronic, mild-to-moderate malnutrition remained high. This may especially be the case for households with neither sufficient milpa production nor wage income to meet basic needs (Leatherman and Goodman, 2005).

Yalcoba weight and BMI patterns suggest that caloric intakes were adequate for most and even in excess for

some children and many adults. Our findings are similar to Daltabuit (1988) who reported that 13% of Yalcoba boys and girls between ages 7 and 18 were overweight in 1986–1987. Azcorra et al. (2009:399) reports that among 4–6 years aged children living in the poor areas of Merida, only 6% were underweight (<2 SD weight-for-age), but more were overweight (21% > 2 SD weight-for-age; 32% > 2 SD BMI), illustrating a tendency toward obesity. While these levels of overweight children are not as high as those found in many western nations, they suggest a shift toward heavier weights and BMI values, a trend that becomes more pronounced in adulthood.

Our results for adult BMIs are roughly similar to previous reports from Yalcoba (Daltabuit, 1988) and somewhat smaller than urban populations in the Yucatan (Dickinson et al., 1993; Arroyo et al., 1999). Daltabuit (1988) reports that 25% of adult men and 75% of adult women measured in Yalcoba in 1986–1987 were overweight, while Dickinson et al. (1993) find that 86% of urban women are overweight and about 50% are obese. Arroyo et al. (1999) conclude that 45% of urban Yucatec men and 73% of women were overweight or near obesity and 2% of men and 12% of women were severely obese (BMI 35+). These overweight and obesity rates in the Yucatan are higher than in Mexico City or for Mexican-Americans in San Antonio, TX (Arroyo et al., 1999).

The overall pattern for child and adult growth and nutritional status in Yalcoba suggests a trend toward undernourished and stunted children growing up to be obese adults. This is a pattern reflected elsewhere in the Yucatan (Dickinson et al., 1993) and in many countries throughout the world in similar stages of a nutrition transition (Popkin et al., 1996) toward diets high in saturated fats, sugar and processed foods, and lifestyles of reduced physical activity and energy expenditure (Popkin, 1998, 2006). A key global concern is how these dietary changes and reduced activity levels are linked to increased obesity and then lead to diseases such as diabetes mellitus, hypertension and coronary artery disease.

The major social, economic and cultural change in the past 40 years in the Yucatan has been the growth of the tourism industry. Questions raised in this paper are concerned with how tourism-led development has affected regional infrastructures, Mayan food systems and diets, and ultimately, child and adult growth and nutritional status. We suggest that regional political–economic changes are up-stream causes of both a small secular increase in height and continuing mild-to-moderate malnutrition, associated with infrastructural changes that have improved health (Gurri et al., 2001) and the commoditization and dietary delocalization of food systems that leads to increased caloric intakes, but low dietary diversity and low protein and/or micronutrient intakes (Leatherman and Goodman, 2005). This commoditization of food systems and the inability to purchase nutrient dense and diverse foods has led to a greater consumption of low cost, low micronutrient dense foods and contributes to increased weights and BMIs.

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