Biocultural Aspects of Obesity in Young Mexican Schoolchildren

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ABSTRACT Obesity related to over-nutrition is investigated in a sample of 219 Mexican children from affluent families, ages 6–12 years. Defined as weight-for-age at or above the 95th percentile, obesity rates in middle childhood are very high in this population, being 24.2% of children (29.4% of boys and 19.1% of girls). Binary logistic regression shows that children are more likely to be obese if they are boys, from small households with few or no other children, and have more permissive, less authoritarian parents. Diet at school and activity patterns, including television viewing, are not different for boys and girls and so do not explain this gender variation. The value placed on children, especially sons, in smaller middle-class families, can result in indulgent feeding because food treats are a cultural index of parental caring. Parents also value child fatness as a sign of health. These obese Mexican children have no greater social problems (peer rejection or stigma) or psychological problems (anxiety, depression, or low self-esteem) than their non-obese peers. More study specifically focused on feeding practices in the home environment is required to explain very high rates of child obesity. The differences in obesity risk related to specific aspects of children’s developmental microniche emphasize the importance of including a focus on gender as a socio-ecological construct in human biological studies of child growth, development, and nutrition. Am. J. Hum. Biol. 15:446–460, 2003. © 2003 Wiley-Liss, Inc.

INTRODUCTION

A substantial secular trend in human biology is increasing body size of children. While children have been getting taller, they are also getting heavier (de Onis and Blössner, 2000; Stinson, 2000). In many developed and wealthier developing countries, including Mexico, children’s weight now appears to be increasing more than height (Peña Reyes et al., 2002). Associated dramatic increases in child obesity are ultimately related to a global nutritional transition toward diets higher in fat and sugar and lower in fiber and increased sedentism in everyday life, especially in urban settings (Popkin et al., 2001). These increases are tied in complex ways to changing socioeconomic conditions (SECs) (Wang, 2001): before the 1980s obesity was seen mainly as a biological marker of affluence in developing countries (Sokol and Stunkard, 1989), but now it is associated more with poverty (James et al., 2000). Especially, child obesity is now often combined with stunting and others signs of under-nutrition (Popkin et al., 1996; Sawaya et al., 1998). Considerable biological anthropological and human biological research has been directed at understanding more proximate biocultural contexts of child under-nutrition (represented by wasting or stunting) in ecologically diverse settings (e.g., Gillett-Netting and Tobias, 2002; Sellen, 2002; Shell-Duncan and Obiero, 2000; Yamanaka and Ashworth, 2002). There has been little comparable biocultural study of child over-nutrition (represented by obesity or obesity-with-stunting), and what has been done has mainly focused on U.S.-based groups (e.g., Crooks, 2000). The critical period of middle childhood, in which obesity rates are rising rapidly, is particularly under-researched (DuFour, 1997, p 558).

This paper reports a study of biocultural aspects of obesity in a sample of 6- to 12-year-old middle-class Mexican children. These children belong to an economically and socially privileged community with extremely high rates of middle-childhood obesity. For the “well-off” in Latin America, which includes the subjects of this study, secular trends in stature appear to have ended some time ago (Bogin and MacVean,
However, a positive secular trend in weight progresses. Mexico, while in the midst of a nutritional transition (Uauy et al., 2001), is a very diverse country and such secular biological change (increasing stature, weight, weight-for-height, body mass index, and so on) is certainly uneven across communities (Martorell et al., 1992). It is thought to be occurring most rapidly in urban areas and among the more affluent (Uauy et al., 2001). Some increase in obesity rates in even rural and impoverished communities is, however, now apparent (Sanchez-Castillo et al., 2000). Increasing rates of child obesity in Mexico are proposed, as they have been elsewhere, to be related to changes in dietary structure from a traditional diet richer in fiber and grains to higher fat foods and major changes in leisure-time activity patterns (Filozof et al., 2001). However, only very limited research on child obesity in Mexico has been conducted (Peña Reyes et al., 2002).

This study has three main goals. The first is to identify general socio-ecological features that may explain the particularly high rates of middle childhood obesity in a Mexican population characterized by relatively high socio-economic status (SES). Although high SES is associated with lowered risk of obesity in some contexts (Langnase et al., 2002), this has not been observed as the pattern among Latin-American populations, including Mexico (Martorell et al., 1998) and among Mexican-Americans (Crawford et al., 2002). Why this might be so is little understood. Understanding better the basic socioecology of obesity in Mexican children has other practical implications. Mexican-American children are at elevated risk of obesity compared to other ethnic groups in the U.S., and studies explaining this phenomena are few (Crawford et al., 2000; Malina, 1993; Malina et al., 1986; Martorell et al., 1998; Pawson et al., 1991). While most researchers believe environmental factors are crucial in explaining such patterns (Ryan et al., 1990), there is also a possibility that weight gain associated with a lower overall stature, perhaps with an underlying genetic basis, could also be implicated in high rates of child obesity among Mexican-Americans (Ryan et al., 1999).

Epidemiological studies have shown a proximal relationship between physical activity patterns and risk of childhood obesity (DuFour, 1997). Anthropological studies of such local ecological and behavioral contexts of child obesity are very few (DuFour, 1997). Recently, Crooks (2000) demonstrated higher rates of obesity in boys were associated with more time at television and computer in an impoverished Appalachian community. In this regard, the second goal of the study is to investigate how individual socioecological variation (such as differences in exercise, diet, family, household, parental, and demographic factors) help explain within-population variations in risk of obesity in middle childhood in Mexico. While this study is school-based, consideration of such features as parental strategies and household economics are included because family environment is known to be especially important in mediating relationships between SECs and child health (Flinn, 1999).

A third, related, goal is to consider how secular trends (increasing adiposity of children) associated with such broad scale social change (nutritional transition or urbanism) are mediated through socioecological changes at a more proximate (individual) level. It is increasingly appreciated that the analysis of individual biological differences in local contexts can be linked to broader scale political and economic phenomena, and so better explain patterns of biological variation (e.g., Dressler and Bindon, 1997). The concept of the developmental niche (or microniche) (Super and Harkness, 1986; Worthman, 1994) is useful to this goal. The niche is the variable individual context of each child, and includes the social as well as physical settings in which each child develops. It provides a level of analysis and explanation between the more proximate (physiological) and ultimate (political economic) aspects of biology, and a framework to organize and consider relationships between children’s biology, behavior, socioecological context, and development, and such contextual features as household economy and structure. Gender needs to be considered an important component of each child’s development niche. Differences in how others such as parents treat girls versus boys can influence developmental niches in gendered ways (Beach, 1978; Lancaster, 1994; Worthman 1996, 1993) and so can create gender variation in biological outcomes. In this case, for example, parents gender-specific ethnotheories about appropriate child eating, nutrition,
and activity that may promote or reinforce gender differentiation in micro-niches and thereby influence boys versus girls likelihood of being obese.

Given these goals, the main questions that guide analyses are: what is the overall prevalence and pattern of obesity in this middle-class population? What general socio-ecological features explain the high rates of obesity? What aspects of obese children's developmental microniches best predict whether children are obese or not (such as variation in parental strategies, diet and exercise patterns, household economy, and family structure and dynamics)? Also, what is the role of children's gender in each of these? In some populations, boys are more at risk of obesity, in others girls. In still others, gender differences are not apparent.

Childhood over-nutrition has crucial health implications. It is related to increased pulmonary, gastroenterological, endocrine, neurological, and orthopedic problems in children (de Onis and Blössner, 2000). It also leads to health problems in adulthood, such as increased cardiovascular disease and premature mortality, as obese children often become obese adults. In Western contexts, it has been proposed that obese children are more likely to experience psychological problems, particularly anxiety, depression, and low self-esteem, and social and peer problems such as social stigma and rejection (cf. Erikson et al., 2000; Friedman and Brownell, 1995; Gold, 1976; Sheslow et al., 1993; Strauss, 2000). Few studies have been conducted to date to determine if any psychosocial costs of child obesity are apparent in more diverse settings. Thus, another question addressed in this study is if the health and psycho-social experience of obese children is different than non-obese children in this Mexican population.

METHODS

Study setting and sample

The study population is represented by 219 children (110 girls and 109 boys), ages 6–12 years, attending a single state elementary school. This sample represents approximately half of the total student body of the school, i.e., all children for whom parental consent was obtained. The school is located in central Xalapa (Jalapa), the capital of prosperous Veracruz state in Central-Eastern Mexico. The research in the school was conducted in collaboration with researchers at the teacher's training institution (BENV) to which the school is attached. Research was conducted over a 6-month period in 2001.

Awareness of nutritional issues associated with obesity is low in this community, including among teachers and school administrators. There is no particular nutritional educational component to the school curriculum. Each morning, the entire school body spends ten minutes doing upper-body exercises in unison to music, but this is explained by teachers as a means to increase children's attention in the classroom. Each class has one period of physical education weekly as part of their syllabus. Most children are driven to and from school. Around midday, children have one 30-min recess, during which time they eat a snack (main meal of the day is at home after school) and engage in free play in the schoolyard. Most students purchase these snacks at school with money provided by parents. Snacks are sold on a free-enterprise system where vendors from the community set up stalls in the schoolyard selling those foods and drinks preferred by the children. While one vendor sells vegetable sticks and fruit, the rest offer high fat and high sugar foods such as hamburgers, empañadas, potato chips, and candy.

The sample represents a relatively privileged component of Xalapa society. All parents in the sample described themselves and their children as Mestizo, which is the socially and politically advantaged majority ethnic group in Mexico. They are economically comfortable compared to most other Xalapeños. The modal occupational categories for fathers were, in order, doctor, professor, federal or state employee, and businessman. All fathers were currently employed. Mothers' modal occupations were, in order, homemaker (23.6%), schoolteacher, professor, and federal or state employee. The parents are also very well educated: 94.2% of fathers have at least some post high-school qualification, and 48.9% have at least a bachelor's degree. Of mothers, 90.5% of mothers have at least some post high-school education, and 49.3% have at least a bachelor's degree. Further, and uncommon for Xalapa, none of these children work outside the home. While the parents of these children are generally well educated and professionally employed, they are not, however, an idle wealthy elite. Many parents work extra
jobs to maintain a middle-class lifestyle under Mexico’s current difficult economic circumstances. It is possible to make some SES differentiations within the sample on the basis of current occupation (ranging from chauffeur to surgeon), dwelling type (apartments versus house), and education level of parents (university degree or not). As we have described elsewhere (Brewis and Schmidt, 2003), these parents have characteristically permissive and responsive parenting style compared to the more authoritarian approaches that have been described as typical of Mexico (Frias-Armenta and McCloskey, 1998). In this way they can be considered fairly progressive.

Methods and data types

The same data sets were collected for each participating child. These were as follows: (1) anthropometric measures of height, weight, triceps skinfold thickness, and upper arm circumference; (2) parent and teacher reports on psychometric scales of anxiety and depression using the Behavior Assessment System for Children ratings (BASC Spanish language version: Reynolds and Kamphaus, 1992; Piñeda et al., 1999); (3) parental interviews including reports of household, family, and parental variables, estimates of child health status, dietary and activity patterns and demographic characteristics, questions regarding their perceptions of their child’s weight, and completion of a 20-item parenting-beliefs rating scale to determine basic parenting strategy; (4) for children over 8 years of age only, child’s self-report of their psychological state (particularly anxiety, social stress, and depression) using the BASC self-report scales; (5) teacher ratings of children’s anxiety, depression, and somatization symptoms using the BASC teacher scales, and teacher nominations of how popular each child is among their peers (see Peery et al., 1979, for method description); (6) social nominations by each child’s classmates, following the method suggested by Eudey et al. (1994), to classify them as socially rejected or isolated or not; and (7) spot observations of what children were eating during noon recess. The spot observations were done by trained observers locating each child on five different occasions and recording exactly what they were doing at the moment they first located them, including what food they were consuming, if any. Interviews took place in a private room at the school and were conducted by student teachers associated with the school who were well known to and trusted by the participating parents. In addition, considerable time was spent in ethnographic observation with parents, teachers, and students in a variety of settings, including playground, classroom, teacher’s lounge, and homes, allowing some contextual understandings of attitudes to bodies, food, and exercise. Written parental and teacher consent and verbal child assent were obtained, and clearance for this research was given by the Institutional Review Board of The University of Georgia. This study was part of a broader project investigating the ecology of child behavior: for more complete descriptions of these methods (Brewis et al., 2000, 2002, 2003; Brewis and Schmidt, 2003; Brewis, 2004).

Anthropometric data collection

Standing height measurements were made to the nearest millimeter using a GPM Anthropological Instruments (Berne, Switzerland) portable stadiometer. Weight was taken with children dressed in a light school uniform and no shoes using a portable scale. Weight in pounds and ounces was converted to metric measures (kilograms). Triceps skinfold measurements were taken in duplicate at the mid-point of the back of the left arm using a Lange caliper and then averaged to provide a single estimate. Mid-upper arm circumferences were taken in duplicate on the left arm at the mid-point of the brachium using a flexible steel tape and then averaged to provide a single measure. All of these measurements were made by one of three field assistants, trained and monitored by the author. Pearson correlations for all the duplicate measures were above 0.95, indicating excellent intra-individual measurement reliability. Body mass index was calculated as weight/height$^2$ (kg/m$^2$). Weight-for-age percentiles and $z$ scores and height-for-age $z$ scores were calculated by the Centers for Disease Control Epi-Info program using the Epi-Nut module (version 1.1.2, CDC 2000), using the CDC 2000 reference standard. (This new standard is an update based on US National Health Examination (NHES) and National Health and Nutrition Examination survey (NHANES) data.)
There are a number of different ways researchers estimate obesity rates in populations, including relative weight-for-age, weight-for-height, and BMI (Dufour, 1997, Table 1). Further, studies apply varied cut-offs for defining obesity with each of these measures, making comparability difficult. A biomedical standard often applied is obesity defined as being at or above the 95th percentile compared to reference standards. In some human biological studies, a cut-point for obesity at the 85th or 90th percentile is used because of the lack of subjects measuring above the 95th percentile (e.g., Tanasescu et al., 2000). Sufficient subjects were available in this study, and children were defined as obese if they presented weight-for-age at or above the 95th percentile compared to gender-specific CDC 2000 references. Weight-for-age was used as the primary index of obesity in this study because it has been the measure most commonly used in recent studies of Latin-American populations. However, BMI data are also given here to allow comparability to human biological studies using that measure to estimate body size and obesity patterns.

Use of weight-for-age percentiles as the criteria for obesity requires accurate aging of participants. Children's ages were collected from parent reports of date-of-birth, cross-checked against school records, and further confirmed by asking each child their age at their last birthday.

Statistical methods and study variables

Statistical analyses were performed using SPSS version 11.0 (SPSS, Inc., 1989–2001). Independent sample t-tests were used to identify statistically significant gender variation in mean anthropometric values. Differences were considered statistically significant at the $P = 0.05$ level. Binary logistic regression is well suited for describing and testing hypotheses between two categoric outcomes (in this case, obese versus not obese) and multiple continuous or categoric predictor variables where sample size exceeds one hundred (Peng et al., 2002) and so was used here. A logistic model was fitted to the data to test the relationship between various aspects of children's micro-niches (predictor variables) and whether a child is obese or not (dependent variable). Predictor variables included in the logistic regression model were as follows: demographic features (gender [with males coded as 1 and females coded as 2], age, birthweight categorized as low [$\leq 2,500 \text{ g}$], or normal, infant and child feeding practices [reported age at weaning, parent and child reports of number of soda drinks consumed in the preceding 7 days, whether they were ever empirically observed using spot observation to be eating sweet snacks during recess]), parental factors (mother's and father's age at birth, mother's and father's education level, whether mother is currently working or at home)

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>N</th>
<th>Height (cm)</th>
<th>Weight (kg)</th>
<th>BMI</th>
<th>Triceps skinfold (mm)</th>
<th>Upper arm circumference (mm)</th>
</tr>
</thead>
<tbody>
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<td>Boy children</td>
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<tr>
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<td>14</td>
<td>122.67 (5.28)</td>
<td>26.55 (5.94)</td>
<td>17.54 (2.90)</td>
<td>11.04 (3.77)</td>
<td>20.52 (5.39)</td>
</tr>
<tr>
<td>7</td>
<td>23</td>
<td>122.80 (11.99)</td>
<td>29.19 (5.64)</td>
<td>19.70 (4.94)</td>
<td>11.54 (4.18)</td>
<td>20.96 (5.42)</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>127.71 (4.45)</td>
<td>27.99 (5.42)</td>
<td>17.02 (3.60)</td>
<td>11.00 (5.62)</td>
<td>19.54 (2.85)</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
<td>140.03 (5.99)</td>
<td>39.50 (10.17)</td>
<td>19.96 (3.77)</td>
<td>14.71 (4.80)</td>
<td>22.98 (3.64)</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>143.57 (7.66)</td>
<td>42.78 (11.96)</td>
<td>20.05 (4.67)</td>
<td>16.00 (5.50)</td>
<td>23.32 (4.47)</td>
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<td>147.58 (7.04)</td>
<td>44.04 (11.31)</td>
<td>20.04 (4.04)</td>
<td>15.19 (5.45)</td>
<td>23.47 (3.48)</td>
</tr>
<tr>
<td>12</td>
<td>11</td>
<td>148.17 (3.90)</td>
<td>45.71 (8.34)</td>
<td>20.74 (3.15)</td>
<td>16.32 (5.69)</td>
<td>24.80 (2.92)</td>
</tr>
<tr>
<td>Total</td>
<td>109</td>
<td>136.40 (13.50)</td>
<td>36.87 (11.71)</td>
<td>19.47 (4.10)</td>
<td>13.68 (5.3)</td>
<td>22.30 (4.45)</td>
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<tr>
<td>Girl children</td>
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<td>6</td>
<td>19</td>
<td>119.78 (10.49)</td>
<td>24.37 (5.03)</td>
<td>17.00 (2.66)</td>
<td>10.34 (2.91)</td>
<td>19.22 (3.51)</td>
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<td>14</td>
<td>124.45 (4.38)</td>
<td>24.83 (5.74)</td>
<td>15.91 (2.74)</td>
<td>10.29 (3.35)</td>
<td>19.00 (2.46)</td>
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<td>18</td>
<td>129.00 (6.35)</td>
<td>27.50 (6.42)</td>
<td>16.36 (2.49)</td>
<td>11.39 (2.73)</td>
<td>19.27 (2.83)</td>
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<td>9</td>
<td>15</td>
<td>138.5 (7.30)</td>
<td>38.36 (9.13)</td>
<td>19.76 (3.42)</td>
<td>17.49 (6.55)</td>
<td>22.94 (2.93)</td>
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<td>10</td>
<td>19</td>
<td>143.7 (6.66)</td>
<td>38.57 (8.95)</td>
<td>18.52 (3.19)</td>
<td>14.11 (4.70)</td>
<td>22.51 (3.19)</td>
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<td>14</td>
<td>153.79 (4.86)</td>
<td>49.47 (10.32)</td>
<td>20.89 (4.07)</td>
<td>16.36 (6.02)</td>
<td>24.21 (3.54)</td>
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<td>150.36 (5.35)</td>
<td>45.91 (9.87)</td>
<td>20.29 (4.33)</td>
<td>15.00 (3.52)</td>
<td>24.81 (3.51)</td>
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<tr>
<td>Total</td>
<td>110</td>
<td>135.95 (13.79)</td>
<td>34.65 (12.04)</td>
<td>18.22 (3.62)</td>
<td>13.35 (5.05)</td>
<td>21.46 (3.80)</td>
</tr>
</tbody>
</table>
full time, parent’s score on a 0–10 point disciplinary attitudes scale); biobehavioral factors (number of hours of television viewing, computer use, pleasure reading, and vigorous exercise in the last 7 days and a “typical week”, according to parent reports), and family and household variables (household size and membership, birth order, household SES [on a 6-point scale based on lower, medium, or higher income, higher or lower status profession of parents, and whether the family lived in an apartment or house and had more bedrooms than household members or not]). Variables were selected if they associated at a value of \( P < 0.020 \). A Homer–Lemeshow goodness-of-fit test was used to help determine if the model was fit to the data well.

To test whether obese children have different health and well-being experiences than non-obese children, independent sample \( t \)-tests (continuous variables) and chi-square goodness of fit tests (categoric variables), with alpha set at 0.05, were used to detect any significant differences in mean values of mental and physical health measures of obese versus non-obese children. The continuous health variables were: scalar measures of depression, anxiety, and somatization reported by parents on the BASC, scalar measures of anxiety, depression, and self-esteem based on children’s own reports on the BASC, and parent’s estimates of how many school days the child had missed due to illness in the previous week, month, and year. Categoric variables were: parent reports of whether the child suffers from allergies or asthma, is regularly absent from school or not, how often they see a doctor (seldom, sometimes, often), parental and teacher reports of how popular with peers and happy children are, and categorization based on classmates’ social nominations as socially rejected or isolated or not.

**RESULTS**

**Anthropometric characteristics of the sample**

Table 1 describes some basic anthropometric characteristics of the sample, allowing comparability to data presented in other studies using different measures, being height, weight, body mass index calculated from height and weight, triceps skinfold, and mid-upper arm circumference differentiated by age and gender. Girls and boys mean values of weight-for-age \( z \) scores and weight-for-age percentiles are presented by age in Table 2. Both genders in this sample are heavier on average at any given age than the CDC 2000 reference samples: \( z \) scores of weight-for-age differ positively from zero in each age group and weight-for-age percentiles exceed the 50th percentile of weight for age reference samples at all ages and for both genders. While BMI increases with age (Fig. 1), high weight-for-age \( z \) scores and percentiles are evident at all ages. There is a tendency for boys’ \( z \) scores to be further from zero and percentiles to be higher than girls, indicating that boys are even heavier than male reference samples than are the girls in this study compared to female reference samples. Only one child had height-for-age greater than two standard deviations below the mean of the CDC 2000 reference samples (HAZ < 2), indicating a prevalence of stunting in this population of 0.5%.

**TABLE 2. Means and standard deviations (in parentheses) of weight-for-age \( z \) scores and weight-for-age percentiles (using CDC 2000 reference) by age and gender**

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>N</th>
<th>Weight-for-age ( z ) scores</th>
<th>Weight-for-age percentiles</th>
<th>WAZ</th>
<th>WAP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male (Female)</td>
<td>Male (Female)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>33</td>
<td>1.35 (1.07)</td>
<td>0.901 (0.94)</td>
<td>82.24 (18.45)</td>
<td>74.50 (23.85)</td>
</tr>
<tr>
<td>7</td>
<td>37</td>
<td>1.15 (1.18)</td>
<td>0.27 (1.03)</td>
<td>79.22 (28.08)</td>
<td>55.69 (28.68)</td>
</tr>
<tr>
<td>8</td>
<td>27</td>
<td>0.191 (1.25)</td>
<td>0.015 (1.06)</td>
<td>51.18 (31.00)</td>
<td>51.86 (29.94)</td>
</tr>
<tr>
<td>9</td>
<td>27</td>
<td>1.35 (0.89)</td>
<td>1.07 (1.16)</td>
<td>84.42 (16.95)</td>
<td>77.38 (27.9)</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>1.03 (1.29)</td>
<td>0.55 (1.05)</td>
<td>74.82 (30.61)</td>
<td>65.47 (28.9)</td>
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<tr>
<td>11</td>
<td>43</td>
<td>0.732 (0.98)</td>
<td>1.127 (0.821)</td>
<td>69.08 (25.6)</td>
<td>81.25 (20.52)</td>
</tr>
<tr>
<td>12</td>
<td>22</td>
<td>0.457 (0.871)</td>
<td>0.289 (1.00)</td>
<td>69.24 (26.7)</td>
<td>58.32 (31.75)</td>
</tr>
<tr>
<td>All ages</td>
<td>219</td>
<td>0.926 (1.11)</td>
<td>0.630 (1.05)</td>
<td>73.20 (26.7)</td>
<td>66.48 (28.7)</td>
</tr>
</tbody>
</table>

*Indicates a significant gender difference according to \( t \)-test \((P < 0.05)\).
Classification of obesity

According to the more conservative definition of obesity (≥95th percentile), 24.2% of all children in this sample are obese (29.4% of boys and 19.1% of girls). Figure 2 provides obesity estimates for this sample based on differing anthropometric definitions. Regardless of the classification used, boys in this sample present much higher rates of obesity than do girls according to the chi square test (all $P < 0.05$). There is no apparent age-related increase in propositions of children classified as obese.

Parents of these obese children classified them as having a weight problem (pasado de peso) only 58.9% of the time (63.6% of the time for boys and 52.9% of the time for girls). Just under 18% of all parents classified their children as having a weight problem.

Other characteristics of the sample

With reference to the first goal of this study, being to identify socio-ecological features of this population with high rates of child obesity, basic characteristics of the sample were estimated. The average household size of children in this sample is 4.59 people (standard deviation [SD] is ±1.3, mode = 4, median = 4). The average number of children in the household, including the participating child, is 2.18 (SD = 0.79, mode = 2, median = 2), and mean number of siblings is 1.28 (SD = 0.76, mode and median = 1). Just over 11% of homes have only children, and in 17.6% of cases the subject child is the only one currently living in the home. Some 9% of children are being raised by a sole parent, 59.4% are being raised in a nuclear family of father and mother, and 30.6% have
additional adults in the house, most usually a grandmother. Children contribute to the household with an estimated average of 5 hr of housework per week (SD = 4.98, mode = 7, median = 4) and do an average of 8.48 hr of homework per week (SD = 4.01, mode = 10, median = 8). Parental expectations of these children are upwardly mobile: the majority of parents (96.3%) anticipate their children will receive a university degree. When asked what occupation they expected their child to choose, the modal answer is "doctor."

In terms of basic activity patterns, children spent an estimated average of 11.48 hr per week watching television (SD = 6.5, median and mode = 10), 2.76 hr on computers outside of school (SD = 3.2, mode = 0, median = 2), and 2.52 hr reading for pleasure (SD = 2.9, mode = 0, median = 2). Parents estimated children had an average of 5.88 hr of vigorous exercise each week (SD = 5.7, mode = 0, median = 5). There was no gender difference in the average amount of time children used computers, watched television, read books for pleasure, or engaged in vigorous exercise each week (all P > 0.05). Although girls spent more hours each week helping around the house than did boys (5.64 vs. 4.39 hr on average), this also proved not to be statistically significant according to t-test (P > 0.05). As to diet, as can be seen in Figure 3, spot observations identified the most commonly consumed foods during recess were high fat and high sugar. Candy was the most common. The majority of children were breast-fed (84.6%). Mean age at weaning was 7.74 months (SD = 6.8). Although boys were weaned slightly later than girls, this difference proved to have no statistical significance.

Results of logistic regression predicting obesity based on aspects of children’s developmental microniche

According to the model produced by logistic regression (see “Statistical methods and study variables” above), three predictors explained children’s classification as obese or non-obese. These were children’s gender, number of other children in the household, and parental strictness in disciplinary strategy. Data relevant to the model are presented in Table 3. According to the model, the log of the odds of a child being obese is negatively related to more children in the household (P < 0.05), negatively related to
gender ($P < 0.05$), and negatively related to the degree of strictness in the parental disciplinary strategy ($P < 0.05$). In other words, children are more likely to be obese if they are male, in homes with fewer other children, and where parents have less authoritarian approaches to parenting. In the model, the odds of a boy being obese are $2.33$ times ($e^{0.847}$) greater than the odds of a girl being obese. The data fit the model well, according to overall model evaluation ($\chi^2 = 18.886, df = 3, P = 0.000$). The goodness-of-fit test produced an insignificant $P$ value, also suggesting the model was fit to the data well. Figure 4 shows clearly in graphic terms how larger family sizes are related to lower rates of obesity in this sample.

**Psychological, health, and social well-being in obese versus non-obese children**

Obese children showed no differences in social, mental, or physical aspects of well-being than their non-obese peers (all $P < 0.05$ according to $t$-tests on continuous variables and chi-square test on categoric variables). They showed no statistically significant difference in parent, teacher, or self-reports of their mean level of anxiety or depression, or self-reports of self-esteem.

### TABLE 3. Logistic regression analysis of predictors of 219 children’s status as obese; child’s gender was coded as boys = 1 and girls = 2*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$\beta$</th>
<th>SE $\beta$</th>
<th>Wald’s $\chi^2$</th>
<th>$P$</th>
<th>Odds ratio ($e^\beta$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-1.925</td>
<td>0.794</td>
<td>5.875</td>
<td>0.015</td>
<td>0.146</td>
</tr>
<tr>
<td>Gender</td>
<td>0.847</td>
<td>0.347</td>
<td>5.951</td>
<td>0.015</td>
<td>2.333</td>
</tr>
<tr>
<td>No. of children in household</td>
<td>0.565</td>
<td>0.234</td>
<td>5.841</td>
<td>0.016</td>
<td>1.759</td>
</tr>
<tr>
<td>Parents disciplinary strategy</td>
<td>0.064</td>
<td>0.025</td>
<td>6.387</td>
<td>0.011</td>
<td>1.066</td>
</tr>
</tbody>
</table>

*Parents disciplinary strategy was estimated on a 0–10 scale, with higher scores representing a more authoritarian, strict disciplinary strategy, and lower scores representing more permissive attitudes to parenting (in the Hosner and Lemeshow test, $P = 0.994$).
Obese children were no more likely to be socially rejected or isolated than their peers, as classified by the social nominations of other children in their class. Obese children, when compared to their non-obese peers, did not complain of illness more than non-obese peers, based on t-tests of mean parent and teacher ratings of number of somatization symptoms. Obese children were no more likely to suffer from chronic allergies or asthma, had no more absences from school, and were not more likely to be absent from school due to illness. They also did not visit with a doctor more often.

**DISCUSSION**

Obesity rates are extremely high in this population, being a quarter of all children. When using less conservative definitions of obesity (>85th percentile), over half of all boys and a third of all girls can be classified as obese. A similar gender difference, with prevalence of obesity in boys markedly exceeding that of girls, has been reported for other recent studies of Mexican children at similar ages (Peña Reyes et al., 2002). Although a relationship between age and increasing rates of obesity has been observed in many populations, with children not acquiring very high rates of obesity before middle childhood, this is not apparent in this sample. These children become obese early in their lives, before they enter school and well before the end of middle childhood. The aspects of children’s microniches included in the model that predicted within-population variation in risk of obesity are being male, being one of fewer or the only child in a home, and having parents with more permissive and less authoritarian parenting strategies.

These rates of obesity are very high compared to other populations, including in the region. Within Mexico, they are some of the highest ever reported. They exceed those reported for middle and lower class children of the same ages in nearby Veracruz City in 1993, where 22.7% of boys and 15.4% of girls were obese, studies of middle-income children in Mexico City (age 9–16 years), where 24% were obese (Hernández et al., 1999), and previous studies on samples of children in Durango and Monterrey (Peña Reyes et al., 2002). They greatly exceed estimates of national Mexican rates, being around 4–5% in 1987 (Martorell et al., 1998). It is estimated rates of obesity tend to be higher in the north and center of the country (Hernández et al., 1996), which qualifies Xalapa. The rates reported here are also much higher than those reported for relatively affluent populations in other parts of
Latin America (de Onis and Blössner, 2000; Martorell et al., 1998), including Chile (Kain et al., 2002) and Puerto Rico (Tanasescu et al., 2000). Taking into account differing criteria for the definition of obesity, these population rates for obesity are also higher than those reported for children of similar ages in various ethnic groups in urban U.S. under conditions of both poverty and affluence (see Crooks, 2000, and Malina, 1993, for summaries of studies), including rates for Mexican Americans (Martorell et al., 1998).

What generally explains high rates of obesity in this population?

Such high rates of obesity in this population are, as would be expected, associated with intake of high fat and high sugar foods, at least as evidenced by the observations of what children eat during school recess. Similar eating patterns, of high-fat snacks and soft drinks being commonly consumed at school, has also been reported for Mexican children in Baja California (Jiménez Cruz et al., 2002). It is also proposed that the general diet in Veracruz state maybe particularly high in fat compared to other regions in Mexico, and this may be associated with higher risk of obesity at all ages (Peña Reyes et al., 2002). A basic cultural attitude that helps explain high rates of child obesity in Xalapa is the idea that chubby children are healthy children. This cultural belief is reinforced by the immediate contexts of parents’ lives. One of the most impoverished neighborhoods in Xalapa is within a mile of the school. Many of the parents are teachers, social workers, and doctors who interact on a daily basis with thin, hungry children against which the chubbiness of their own children compares well. Thus, for both cultural and local reasons, parents see fat as a sign of health in their children and to be a good thing. Half of all parents of obese children did not identify their children as having any weight problem. Another contributing idea is that feeding a child, including with food treats, is an act of loving and caring. There is little understanding of the health costs of obesity among either teachers or parents to offset these positive connotations of obesity. At the level of children’s developmental microniche, this could well translate into overfeeding at home and so over-nutrition and obesity. As this was a school-based study, there are no behavioral or attitudinal data of parents in the home environment to support this proposition. Such studies are suggested as a high priority to better understanding high rates of obesity in middle-class Mexican children.

Based on other research in a wide variety of populations, lower levels of activity and higher rates of television viewing and computer use appear to contribute often to increasing child obesity. However, this does not appear to be necessarily so in this Mexican case, at least according to parental reports of such activity. The logistic regression model indicated that within-population variation in diet at school and reported activity patterns these does not predict well if individual children are obese. Interestingly, hours of television viewing are less than half the 28.7 hr a week average reported for middle-class children in Mexico City (Hernández et al., 1999), and hours of vigorous activity each week are similar to those reported for these Mexico City children. But rates of obesity in this population are higher. One possibility is that the parental reports of television and video use are biased downwards, and the activity estimates are biased upwards. This seems unlikely, but this finding needs to be confirmed by the more direct study of activity patterns in the home environment, such as through activity monitoring by accelerometry or direct observation.

Do Mexican children have health and social problems associated with obesity?

Obese children in this sample are reported to be no more likely than their non-obese peers to have health or social problems. Two features of the Mexican case might explain this. First, while many children in this sample can be classified as obese, there are no “super-obese” children in this population. This possibility of a truncation in the upper limits of size of obese children in this population is indicated by the highest BMI being only 31.45, and only 1.5% of children being above a BMI of 30. Thus, although many children qualify for the cut-point for classification as obese, they do not have extreme degrees of obesity. Second, at least based on ethnographic observation at the school and in some children’s homes during the course of this project, there appears no particular stigma applied to obese children. In many hours at this school including
on the playground, I never once heard any derogatory comments about any child by another a peer or a teacher related to being fat. Large body size appeared, on the basis of ethnographic observation, socially irrelevant and did not have particular stigma attached. As Massara (1989) has described for Puerto Ricans, the concept of fatness (gordo/gorda) in Mexico does not have particular negative connotations.

Why are more permissive parenting strategies associated with elevated risk of obesity?

In this population, the children of less authoritarian parents are more likely to be obese. This relationship between permissive parenting and over-nutrition is probably very context-specific. For example, by contrast in Copenhagen parental restrictiveness is childhood is associated with increased obesity (Lissau and Sorensen, 1994). Ethnographically and contextually, it is easy to describe how this might happen in middle-class Mexican families. One way these Xalapeño parents indulge their children is with a fairly constant flow of sweet treats and high fat snacks. Based on informal ethnographic observation, I would suggest this is most pronounced among working mothers. Although the mother’s employment (whether a mother was working versus staying at home) was found not to predict obesity in the logistic regression model, it did show a trend to significance ($P = 0.023$). This might be practically important even if it is not statistically important: working mothers may particularly indulge their children this way. Many times I observed working mothers collecting children, showering them with candy as well as cuddles at the end of the day.

Why are children with fewer siblings or other children in the house and boys at particular risk for obesity?

Mexican family size is currently declining, and this is evident from the small family sizes in this sample. This high ratio of adults to children probably also contributes to child over-nutrition. The smaller the family, the more attention each child receives, especially in Mexico where food in an index of caring attention. The findings that only children, especially boys, are most likely to be overweight make absolute ethnographic sense. While Mexican parents treasure and desire both daughters and sons, there is a special primacy given to male children, especially the firstborn. This was confirmed in many of the informal conversations I had with Mexican colleagues, friends, as well as the study parents in this community (during much of the field season I was pregnant with a daughter: this was a prompt for many such conversations). Where parents express concern and love by feeding children, as they do here, it is explicable that only children and especially boys are overnourished by doting parents. There are other findings of significance in regard to boys’ versus girls’ risk of obesity. Based on observations, boys did not eat significantly different foods at school than girls. Also, boys’ and girls’ reported activity levels do not explain this gender difference in risk of obesity. A number of studies have found that boys are more at risk of obesity because they watch more television and/or play more video games and so are more inactive (e.g., Crooks, 2000), but in this population they are not reported to be spending more time in these activities than girls. Gender differences in eating patterns at home probably best explain this difference. Olvera-Ezzell et al. (1990) found in a study of Mexican-American mothers that they encouraged their sons to eat more than did mothers of girls. Such a simple cultural mechanism, especially if it was particularly heightened in firstborn or only sons, would be sufficient to explain the gender variation we observed in risk for obesity in this sample. Because this study was mostly school-based, we were unable to directly observe household behaviors of parents in any systematic manner, although the ethnographic observations we did make certainly support this as a reasonable suggestion.

CONCLUSION

In many developed and developing nation contexts, obesity is increasingly seen as a disease of poverty. This is most clearly seen biologically in children being simultaneously stunted and obese (Popkin et al., 1996). There is no evidence of any stunting in this group of children, nor any other anthropometric indication of other forms of undernutrition: The stunting rate of 0.5% in this sample compares to one of 25.6% of all children entering school in Veracruz state
(Peña Reyes et al., 2002). Thus, in the case of these Mexican children from upwardly mobile families, obesity is clearly and definitely representing a biology of affluence, not poverty. So, one general feature that explains overall high rate of obesity in this particular population is the relatively good SECs they collectively represent. It has been observed in some parts of Latin America that high income does not predict the decline in obesity that might be expected, even for women (Martorell et al., 1998). Certainly, very high rates of obesity in these affluent children are consistent with this finding. This raises the question of why high income may not always result in lower risk for obesity in some Mexico or Latin American populations. In this case, I can propose from ethnographic experience with the parents at this school that the very high rates of obesity in a relatively affluent population are likely tied to the particular context of these parents lives and their place in broader Mexican society and economy. These include smaller families with more attention paid to each child as a result, the idea that chubby children are healthy children which is reinforced by parents everyday experiences with hungry, smaller, children, a lack of awareness about nutritional issues including the health implications of obesity, and a lack of negative social meaning applied to obesity.

The findings of this study allow some recognition of how large-scale secular trends in body size are mediated at the individual level. These include changes in household composition, sibship size, and changing (“modernizing”) parental ethnotheories and parenting strategies that all affect dietary intake and energy output. While other studies have shown that ecological changes in diet and exercise as part of the microniche are crucial in mediating secular trends, this study shows that cultural changes, such as parenting strategies becoming much more permissive, can also provide other important contextual explanations of why obesity might rise or fall with increasing SES. The case of parental models favoring more indulgence in children, especially boys in smaller families, is one example of how changes in cultural models might act as a mediating influence in how large scale secular trends are translated (after Lock and Kaufert, 2001) into local biologies. Gender is a crucial aspect of this dynamic according to the findings of this study. However, more generally we know little of the role of gender in these process because it is rarely a focus in analyses. The findings of this study—that there are crucial microniche dynamics underlying gender differences in obesity risk—indicate the importance (as Crook (1999) previously argued) of including a focus on gender as a socioecological construct in human biological studies of child growth, development, and nutrition.

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LITERATURE CITED


