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Ecological Differences in Weight, Length, and Weight for Length of Mexican American Children in the WIC Program

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Abstract

PURPOSE—Examine factors common in the environments of children who obtain services from a WIC program to determine if differences in ecological/environmental factors can be found in the children who differ in weight, length, and weight for length.

DESIGN AND METHODS—Cross-sectional study of 300 children, 100 each who were stunted, normal weight for length, or overweight. Instruments used were NCATS, ARSMA II, 24-hr diet recall, and Baecke Activity Questionnaire.

RESULTS—Significant differences were present in children's diet, parents' BMI, parents' generation in United States, parents' activity levels, and maternal–child relationship.

PRACTICE IMPLICATIONS—Encourage parents to adopt family approaches to encourage normal body size in children.

Search terms

Child overweight; ecological factors; ecological monitoring; Mexican American children; obesity

The length, weight, and weight-for-length ratio of toddlers (children 12–24 months old) have many influences. Prenatal nutrition, early childhood feeding, parents' sizes, and the larger community environment all contribute to a child's size. Even when children live in the same neighborhood, are from families with the same socioeconomic status (SES), and claim the same ethnicity, differences persist in children's weight, length, and weight for length. The purpose of this study was to examine factors common in the environment of children who obtain services from a large metropolitan Supplemental Nutrition Program for Women, Infants, and Children (WIC) to determine if differences in environmental factors can be found in the children who differ in weight, length, and weight-for-length.

Conceptual Framework: Ecological Model of Growth (EMG)

One method to view a child's environment is through an ecological model. The EMG (see Figure 1) is a heuristic model that explains the levels of a child's environment that contribute to a child's growth (Reifsnider, 1995; Reifsnider, Gallagher, & Forgione, 2005).

Traditionally, an ecological model is shown as a Venn diagram with overlapping circles. The EMG can be drawn in that manner, but it is separated here for ease of presentation.

The EMG is a combination of Human Ecology (Bronfenbrenner, 1979) and epidemiology and illustrates influences at the host (child) and agent (food) levels as they interact in the environment (microsystem and mesosystem). The host variables are those that are characteristics of the child, such as a child's anthropometric measurements, or a child's diet and level of activity or inactivity. The agent is viewed as the proximate cause of the problem, in this case nutrition that is not balanced with the child's needs. The ecological environment is conceived as a set of connected structures, each influencing the other structures within the set.

The microsystem is the immediate setting containing the parent and child. In this study, the family, the family's home situation, other children in the family, and the interaction between parent and child, are all considered characteristics of the microsystem. Other levels in the system are the mesosystem, exosystem, and macrosystem. This study did not examine the exosystem or macrosystem. The microsystem and mesosystem are settings that have powerful influences on the parents' parenting practices, and thus affect the child (Bronfenbrenner, 1979).

A mesosystem is composed of a group of microsystems. Whenever a child or parent moves into a new setting or context, a mesosystem is formed or extended. In the mesosystem, a parent is an active participant; therefore, the strength or weakness in the link between the microsystem and mesosystem is important. For this study, the mesosystem was conceived as the parents' cultural backgrounds and cultural practices. The EMG was used as the framework for this study and directed the choice of conceptual and operational variables to measure.

Background

Impact of Childhood Overweight

The National Center for Health Statistics at the Centers for Disease Control and Prevention (CDC) recommends that body mass index (BMI) be used to screen for overweight in children more than 2 years of age (CDC, 2007). Normal BMI in children is a BMI < 85th percentile, at risk for overweight is a BMI > 85th percentile and < 95th percentile, and overweight is > 95th percentile BMI for age and gender. In children younger than 2 years, weight-for-length is the measure that is used to determine body mass. Weight-for-length is interpreted in the same manner, in that a child less than 2 years of age who is above the 95th percentile is considered overweight (CDC). No at-risk-for-overweight category (BMI 85th to 95th percentile) exists for weight-for-length. Stunted growth is length (or height for children more than 2) for age < 5th percentile.

Overweight during childhood is one of the major risk factors for the development of severe obesity and type 2 diabetes mellitus in adulthood, with all of its attendant risks for cardiovascular diseases (Freedman et al., 2005). It is a particular health problem among Hispanic and African American children. The percentage of overweight preschoolers (ages 2–5 years) has doubled in the past two decades, according to the National Health and Nutrition Examination Survey, increasing from 5% to 10% (Hedley et al., 2004). When preschoolers who are between the 85th and 95th percentile BMI (at risk for overweight) are included, the percentage increases to 23%. Type 2 diabetes, previously considered an adult disease, has increased dramatically in children and adolescents. Eighty percent of persons with diabetes will develop cardiovascular disease, and type 2 diabetes characterizes nearly half of new cases of childhood diabetes (Barrett-Connor et al., 2004). Furthermore, obesity has been shown to track from childhood into adulthood (Dietz, 2000). Children who were overweight between the ages of 1 and 6 years have twice the odds for obesity at age 35; children who were overweight at ages 10–14 have 5–10 times the odds for obesity at age 35 (Dietz).

Growth stunting is a complex child health phenomenon that, if not corrected, can contribute to developmental delay, cognitive deficits, and small constitutional size as an adult. Stunted growth, or height for age below the 5th percentile on the NCHS growth grid, is primarily caused by chronic malnutrition. Malnutrition is broadly defined as insufficient, inadequate, or inappropriate macronutrients and micronutrients. Families of children with stunted growth are often chaotic, characterized by poor supervision of the children and a lack of attention paid to the children's physical and emotional needs (Heffer & Kelley, 1994). Little is known about the most effective way to treat stunted growth in a community setting, even though the community has been identified as the best place to manage stunted growth (Wright & Talbot, 1996).

Risk factors for overweight in toddlers and preschoolers have been summarized as race/ethnicity, physical activity/ inactivity, and dietary intake (Nelson, Carpenter, & Chiasson, 2006). Risk factors for stunted growth other than organic causes are largely based on parenting practices, infections and illness, and malnutrition. As these categories roughly match the EMG framework, they will be summarized in the EMG categories below.

Ethnic Differences and Genetic Influences in Overweight Among Children (Host Factors)

A threefold increase in pediatric overweight has occurred in the last two decades (Ritchie, Ivey, Woodward-Lopez, & Crawford, 2003). Even more worrisome, the prevalence of overweight is higher in minority children, particularly Hispanic and African American children, and among children from low-income families (Lavizzo-Mourey, 2007). The prevalence of overweight among Mexican American preschoolers varies from 15.5% (Warner, Harley, Bradman, Vargas, & Eskenazi, 2006) to 26% (Ariza, Chen, Binns, & Christoffel, 2004); and for African American pre-schoolers it varies from 16.2% (Ariza et al. 2004) to 42% (Whitaker & Orzol, 2006), with the variation based on location, income of family, and age sampled. Hu et al. (2007) found that Mexican origin nearly tripled the risk of overweight among Head Start students in Minnesota. Stettler, Elliott, Kallan, Auerbach, and Jumanyika (2005) found the prevalence of overweight to be 22% in a nationally

representative sample of pre-schoolers with no difference based on race/ethnicity, and urban, rural, or suburban clinic location.

The effect of allergies on anthropometrics is unclear. Researchers in Mexico have shown a lower risk for overweight among children with a history of eczema (Violante et al., 2005), while in Germany, an association was found between airway resistance and overweight (du Prel et al., 2006). In Sweden, a high BMI was associated with wheeze but not with hay fever (Mai et al., 2003). Australian researchers have shown that the increase in BMI from ages 5 to 14 years is associated with asthma, while BMI at age 5 by itself is not associated with asthma (Violante et al. 2005). Some researchers have postulated that overweight and asthma are connected through a common pathway of inflammation, while others doubt this association (Plumb, Brawer, & Brisbon, 2007).

Energy Intake and Sedentary Behavior (Agent Factors)

Data collected from 1994 to 1998 indicate that the physical activity of children of all ethnic groups fell short of the *Healthy People 2010* goal for strenuous physical activity (Anderson, Crespo, Bartlett, Cheskin, & Pratt, 1998). Studies investigating the factors influencing overweight among Mexican American children have shown birth weight, mother's BMI, juice intake, TV watching, and sweetened beverage intake as positive correlates to overweight (Ariza et al., 2004; Melgar-Quinonez & Kaiser, 2004). TV exposure increases the odds of overweight by 50% among boys and girls (Fleming-Moran & Thiagarajah, 2005).

Fewer than 20% of U.S. children exercise more than 2 hr of vigorous physical activity weekly, while more than 25% watch more than 4 hr of television daily (Dennison, Erb, & Jenkins, 2002; United States Department of Health and Human Services, 2000). Hernandez et al. (1999) found an average of 4.1 hr of television viewing was reported compared to an average of 2 hr a day of moderate or vigorous activity among children in Mexico City. The risk for obesity was 12% higher for each hour of TV watched and 10% lower for each hour of moderate or vigorous physical activity. Treviño et al. (1999), in a sample from San Antonio, found that Hispanic 9-year-old children were more sedentary at home and watched more television than did non-Hispanic White children.

Among young Spanish children, the determinants of obesity found in a cross-sectional study of a random national sample (Perez-Rodrigo, Aranceta Bartrina, Serra-Majem, Moreno, & Delgado Rubio, 2006) were absence of breast-feeding; low consumption of fruit and vegetables; high consumption of sweetened breads, soft drinks, and meat; low physical activity, and high physical inactivity (measured by hours spent watching TV). A prospective longitudinal study of Dutch children showed that children who were breast-fed more than 16 weeks had lower BMI at 1 year of age than did children who were not breast-fed (Scholtens et al., 2007). A prospective longitudinal study of 1,739 Black, Hispanic, and White young children in the United States showed that breast-feeding for four or more months (equivalent to 16 weeks) was associated with a decreased risk of overweight as young children (toddlers or preschoolers) or as older, school-age children (Li, Goran, Kaur, Nollen, & Ahluwalia, 2007).

Home Environment, Parental-Family Influence, and Family-Based Interventions (Microsystem Factors)

How parents feed their children has been shown to have a significant effect on childhood overweight. Maternal child feeding practices that offer restricted food choices result in reduced child BMI percentile (Faith et al., 2003). The authors note that there is an interaction between ethnicity and feeding practices; non-Hispanic White parents/guardians report less monitoring of their children's food choices than do Hispanic and African American parents/guardians. Close maternal monitoring and verbal prompting to eat at mealtime has been related to undesirable child eating behaviors (Johnson & Birch, 1994). Children who are compliant with maternal directions to eat tend to have a larger BMI (Faith et al., 2003).

A contribution that parents can make to childhood overweight prevention is modeling of healthy behavior at home. Seibold, Knafl, and Grey (2003) interviewed parents and teens to determine the family context of an intervention to prevent type 2 diabetes in high-risk, overweight teens. They identified four themes: child and family eating patterns, rules and control over eating, perspective on obesity, and perspective on weight control. Parents often did not assist teens with weight loss; eating together as a family occurred inconsistently; physical activity was sporadic; and parents did not provide healthy models of eating. Obesity was not seen as something to be avoided.

Children's weight is significantly and independently associated with high-energy intake of both parents (Mirmiran, Mirbolooki, & Azizi, 2002). Parenting influences health behaviors of children and includes role modeling appropriate behavior and creating the social learning environment wherein the child adopts parental behaviors concerning food and eating. A home environment with low levels of cognitive stimulation, low family income, and maternal obesity results in a twofold increased risk for overweight in children (Strauss & Knight, 1999). Homes with a highly stimulating cognitive environment have the lowest rates of childhood overweight, independent of SES, race, maternal BMI, or marital status. Positive family behaviors, such as eating together and modeling healthy dietary intake, can have an impact on the development and persistence of overweight in childhood (Seibold et al., 2003).

Parental obesity is a major risk factor for child obesity and is the strongest predictor of adult obesity in children before age 3 years (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Children with type 2 diabetes usually have a family history of type 2 diabetes, and those of non-European ancestry have a disproportionate share of multigenerational type 2 diabetes (American Diabetes Association, 2000). The majority of the world's population most likely has genes that allow for survival in times of food scarcity, which would promote obesity in times of abundance (Lobstein, Baur, & Uauy, 2004). Thus, food availability is an example of environmental change that can affect obesity.

Parental modeling of healthy eating and activity behaviors has been associated with less chance for overweight in their children and identified as a useful approach for management of childhood overweight (Ritchie, Welk, Styne, Gerstein, & Crawford, 2005). Polley, Spicer, Knight, and Hartley (2005) demonstrated that African American and Native American

parent/ grandparent TV-watching hours were significantly correlated with child TV-watching hours, and child BMI was significantly associated with TV-watching hours.

Family-based interventions for weight management have been recommended for decades (Mahan, 1987). Parents shape the home environment, which includes the children's toys, play locations, and activities, and they buy the food children consume. Parents' BMIs are highly correlated to their children's BMIs (Fogelholm, Nuutinen, Pasanen, Myohanen, & Saatela, 1999). Parents can take a number of steps to change their home environment so that it promotes a healthy lifestyle and reduces the incidence of childhood overweight (Kirk, Scott, & Daniels, 2005; Ritchie et al., 2005). These steps include dietary changes, activity changes, and parental modeling behaviors.

Influence of Acculturation and Community on Overweight (Mesosystem Factors)

In a study of 901 Latino men and women, years lived in the United States was the strongest correlate of obesity (Hubert, Snider, & Winkleby, 2005). Subjects who obtained less exercise, watched TV regularly, and ate fried foods were heavier than subjects with healthier habits. Unger et al. (2004) found in a study of 1,385 Latino and 619 Asian middle-school-age children that acculturation to the United States was positively associated with less physical activity and greater consumption of fast foods. Researchers have demonstrated a fourfold increase in obesity among Latino immigrants to the United States based on length of residence in the United States and shown significant relationships between BMI, fewer hours of physical activity, and years in the United States (Ayala et al., 2004; Himmelgreen et al., 2004; Kaplan, Huguot, Newsom, & McFarland, 2004). They recommend maintaining Mexican cultural practices to reduce obesity among immigrants.

Purpose of Study

In this study, we wanted to determine the differences in weight, length, and weight for length present in the ecological environment of children who participate in a large metropolitan WIC clinic. When the differences are identified, culturally sensitive interventions that model the factors most prevalent in the normal sized children (weight for length or BMI > 5th percentile and < 85th percentile for age and sex) can be developed. The research question driving the study was "What are the differences in the agent, host, microsystem, and mesosystem variables among children who are stunted in growth (below 5th percentile for length), children who are of normal weight and length (between 5th percentile and 85th percentile weight for length), and children who are overweight (above 95th percentile weight for length)?"

Methods

Design and Procedures

This cross-sectional study collected data based on the EMG. The study was approved by the university's institutional review board as well as the human subjects protection review board of the health district and occurred across 3 years. Data were obtained from children's mothers about the children, the mothers, and their families when they were in a WIC clinic

sponsored by a large metropolitan health district. All data collection was done at the WIC clinic in a standard manner by all research team members.

After the children had been weighed and measured by WIC personnel, the mothers were approached by a member of the research team and informed of the study. The research team asked for permission to see the children's anthropometric measurements to determine if they would qualify for the study. The child was then re-measured by the research personnel. If the child qualified based on criteria discussed below, the study was explained to the mothers and informed consent obtained. Mothers were asked to complete a packet of instruments while their children were being certified for WIC nutrition vouchers and waiting for voucher pickup. It took approximately 30 min to complete the packet. The instruments were in English and Spanish, and the mother was approached by a research team member who spoke her language.

After the questionnaire packet was completed, the research team member asked the mother to review the listing of activities that are included in the NCATS and to teach the child that activity. The resulting mother-child interaction was observed by the team member and scored at its completion. At the completion of the instrument packet and measurement of the child and mother for anthropometrics, the mother was given a \$20 gift card to a local retailer as compensation for her time.

Participants

The sample-size goal was 100 children ages 12 to 24 months in each of the three conditions: stunted, normal-size, and overweight, and their mothers ($N = 300$). The WIC program in this health district has an average monthly enrollment of 50,000 women and children, and the clinic where the data collection occurred is its largest site. By virtue of qualifying for WIC, all the families were at 185% of federal poverty level or lower. All children had documented residence in the city. To be included in the study, the children had to fit anthropometric criteria for being stunted, normal-sized, or overweight. In addition, they had to live with a parent or guardian (no foster children), not have any metabolic or major illnesses or any neurological or developmental delays, and not have an organic cause for stunted growth or overweight. No inclusion or exclusion criteria existed for the children's mothers.

Instruments

Anthropometrics—For children, height was measured with a length board to the nearest mm, and weight was measured to the nearest 0.1 kg using a balance beam scale with the child wearing only a dry diaper. For mothers, a wall-mounted stadiometer was used for height and a balance beam scale was used for weight, with the mothers wearing only indoor clothing and shoes of no more than 1" in height. All height and weight measures used for research purposes were obtained by research staff, who achieved inter-rater reliability on the measures before data collection began. These measures were used to calculate weight for length, which was entered on the growth charts provided by the National Center for Health Statistics to determine anthropometric percentiles for children and adults. This determined the categories of stunted, normal, and overweight for children and overweight or obesity for

adults. All anthropometrics were converted to a *z* score to allow group comparison by gender and age in months.

Dietary data—The 24-hr Diet Recall captured all food intake for the 24 hr of measurement for the child only, both food consumed at home and food consumed away from home. The dietary data were then entered into Food Processor II, a computer-based nutrient analysis system, which then converted the data into multiple levels of analysis. The dietary data were analyzed as individual foods, servings from the food pyramid, as well as macronutrients and micronutrients.

Demographic data—Demographic data consists of personal and family characteristics for each child, his/her parents, and the family situation. It includes items such as income, educational level of parents, parental employment, number and relation of people in the household, receipt of food stamps and monthly amount, receipt of free or reduced lunches for any siblings in the family, length of residence in current house, generation of residence in United States, ethnicity, and language spoken at home.

Acculturation—Acculturation of Hispanic families was measured by the *Acculturation Rating Scale for Mexican Americans-II (ARSMA-II)* (Cuéllar, Arnold, & Maldonado, 1995). *ARSMA-II* is a 30-item Likert-type scale that measures acculturation along three primary factors: language, ethnic identity, and ethnic interaction. Higher total scores indicate that subjects are acculturated into Anglo-American culture. The authors (Cuéllar et al., 1995) report reliability of $\alpha = .88$ and demonstrate validity with lessening ethnic identity (a related but separate process) as acculturation increases (Cuéllar, Nyberg, Maldonado, & Roberts, 1997). Sherman, Alexander, Dean, and Kim (1995) used the ARSMA in a study of obesity in Mexican American children and employed total scores as a predictor of obesity.

Parent-child interaction—The variable of parent-child interaction was measured by the Nursing Child Assessment Teaching Scale (NCATS) (Barnard, 1978). The scale consists of 73 items organized into four subscales that measure the parent's responsibility to the interaction: sensitivity to cues, response to distress, social-emotional growth fostering, cognitive growth fostering; and the scale consists of two subscales that measure the child's responsibility to the interaction: clarity of cues and responsiveness to caregiver. It is appropriate for children from birth to 36 months. Cronbach's α for the NCATS is reported at .83 for the entire scale, with the parent subscale α of .83 and the child subscale α of .84 (Barnard et al., 1989). Test-retest reliability is reported as 0.85. Validity was measured by correlation with the HOME of $r = .48$, and $R = .48$ with the 24-month Bayley Scale (Barnard et al., 1989). All members of the research team were trained in the use of the scale and obtained inter-rater reliability exceeding .90 before collecting data.

Baecke Questionnaire of habitual physical activity—The Baecke Questionnaire is designed to measure three aspects of an adult's daily activities: work, leisure, and sports (Baecke & Frijters, 1982). The authors have demonstrated that the questionnaire captures the three types of habitual physical activity, and reliably differentiates between the three types. To demonstrate validity, Florindo and Dias de Oliveira Latorre (2003) compared 21 adult subjects on aerobic fitness, an annual index of physical activity, a weekly walking log, and

the Baecke Questionnaire. The subjects who were measured as most fit according to the Baecke Questionnaire also demonstrated fitness on a 12-min aerobic run/walk and were shown to be most active according to a weekly log of physical activity. Six-week test-retest scores on the Baecke Questionnaire demonstrated a significant intraclass correlation of 0.77. The Baecke Questionnaire (available in English and Spanish) was used to measure the mother's daily habitual physical activities.

Data Analysis

Univariate and multivariate normality were reviewed statistically prior to further data analysis. Statistical analyses were conducted using ANOVA with *post hoc* tests using Bonferroni correction. Significance was set at $p < .05$. In a one-way ANOVA study, sample sizes of 100, 100, and 100 are obtained from the three groups whose means are to be compared. The total sample of 300 subjects achieves 100% power to detect differences among the means versus the alternative of equal means using an *F* test with a .05 significance level (Hintze, 2001). The size of the variation in the means is represented by their standard deviation, which is 1.41. The common standard deviation within a group is assumed to be 0.63.

Results

The genders and ages of the stunted and the normal groups were significantly different. There were no significant differences between the groups for maternal education or employment, or the percentage of mothers who preferred to speak Spanish for data collection. See Table 1 for a description of the sample.

Host Differences

As expected, there were significant differences in the heights, weights, and weight for length of the three groups of children. Of interest is the mean height and weight of the normal sized children was below 0 (*z*-score), so less than the 50th percentile on the growth grid. The mean height for overweight children was 0 (*z*-score), which means they were at the 50th percentile on the height growth grid; but at 1.9 *z*-score mean for weight, they were nearly 2 SD above the mean for weight. For weight for length, no groups were below the mean, but the normal group was closest, followed by the stunted group. The overweight group, as expected, had a *z*-score of 2.5, indicating they were 2.5 SD above the mean for weight for length. The finding of a significant difference in occurrence of allergies (to environmental sources, as reported by mothers) was not expected (see Table 2).

Agent Differences

The agent variables that showed significant differences were dietary intake, as well as length of time breast-fed and daily ingestion of fluoride. The normal group was breast-fed the longest and the overweight group the shortest length of time. The stunted group received fluoride more often than did either of the other two groups. The overweight group had significantly higher daily intakes of Mexican rice, Kool-Aid, and showed a trend to significance for water and bread, while the normal group had the highest daily intake of American cheese, raw apple with peel, pancakes, and showed a trend to significance for

vitamin C. The stunted group showed a trend to significance for the highest daily intake of vegetables (Table 3).

Microsystem Differences

The microsystem differences were analyzed according to the three components of the microsystem: home environment, maternal–child (MC) relationship, and parental factors. There were no significant differences in home environment, but two variables showed a trend to significance, those of sitting with the child at mealtime and a crowded home. For the MC relationship, the total NCATS scale, the child and caregiver subscales, and the subscales of child's response to distress, mother's cognitive growth fostering, and child's response to caregiver showed significant differences by group. The stunted group was significantly higher in child's response to distress but was the lowest in the other scales and subscales. The normal group was significantly higher in the overall NCATS, caregiver subscale, and tied in the response to caregiver subscale. The overweight group was highest in the cognitive growth fostering and child subscale, and tied with the normal group in response to caregiver.

The maternal and paternal BMIs for the overweight group were significantly higher than for the normal group and the stunted group. The mean parental heights were significantly lower for the stunted group, while they were the same for the normal and overweight groups. The mothers in the overweight group were significantly less likely to sweat during leisure time activity than were the mothers in the stunted group (see Table 4).

Mesosystem Differences

The mesosystem differences show a clear and consistent significant increase in the percentage of mothers, maternal grandmothers, and maternal grandfathers who were born in the United States (as opposed to being born in Mexico) from the stunted group to the overweight group. There were no significant differences in fathers, paternal grandmothers, or paternal grandfathers' places of birth by group (see Table 5).

Discussion

This study supports previous research that shows differences in various factors that contribute to overweight. This study contributes to the fields of child growth and childhood overweight by emphasizing the holistic view that many factors in the child's environment have an impact on a child's size and that those differences can be examined through an ecological lens, rather than as a random group of factors.

The cause of the differences in the proportion of boys and girls among the three groups is unknown. The stunted group is significantly different from the normal, with more boys than girls represented in the stunted group. The reason for this disproportion may be due to the significant difference between the stunted and normal groups' mean ages, with the stunted group being 1.5 months older, or it may be unknown. The mean educational level of the mothers (10th grade) among the children shows no difference between groups, similar to the finding of approximately one third or fewer of the mothers in each group being employed outside the home. The percentage who preferred Spanish is also not significantly different, which was a surprising finding given the significant difference in the percentage of mothers

who were born in the United States. However, there were a sizable percentage of mothers in each group who were born in Mexico, and it could be that some of those mothers preferred to complete the instruments in Spanish.

The host differences in weight, length, and weight for length were expected given that those measurements were the inclusion criteria for the study. However, the finding that the mean height and weight for the normal group were below the 50th percentile shows that the children in this population were shorter and lighter than the children in the NCHS growth sample. This may reflect their low-income status because height is associated with better nutrition in a population. Only the overweight group achieved the mean 50th percentile in height, but as increased height is associated with increased weight, this is expected (Dewey et al., 2005). The finding of more reported allergies among the normal group is statistically significant, but its clinical significance is unknown.

The agent differences indicate the length of time breast-fed does contribute to normal growth. This finding was supported by a systematic review by Dewey (2003), who found that the preponderance of studies on breast-feeding show that breast-feeding may influence an infant's self-regulation of energy intake and metabolic programming in early life. The higher intake of fluoride in the stunted group could indicate supplemental fluoride as the water supply was not fluoridated in this city at this time, so all fluoride the children received was through supplementation given as drops.

The food intake is harder to interpret, but it does indicate that diets featuring dairy protein (American cheese) and fruit (apple with peel and vitamin C) are a characteristic of the normal sized group, while diets featuring starches (Mexican rice, breads) and sweetened beverages (Kool-Aid®) are characteristic of the overweight group. Dairy consumption has been inversely associated with components of the metabolic syndrome in adults in several studies (Pfeuffer & Schrezenmeir, 2007). Zemel (2005), in a review on the role of dairy foods in weight management, postulates that high calcium diets reduce fat accumulation and play an important role in maintenance of normal weight and management of overweight. Ariza et al. (2004) found that overweight Hispanic children (ages 5–6 years) were more likely to consume sweetened beverages (including Kool-Aid®) daily. Vegetables are generally low in calories, and the finding that the stunted group ate the most vegetables could indicate their lower caloric intake. The diet differences are only suggestive at this time but do lend support to advising mothers to provide dairy protein and fresh fruit to encourage normal growth and discouraging intake of many servings of starches and sweetened beverages to prevent overweight.

The microsystem is viewed as three components: the home environment, the MC relationship, and the variables pertinent to the parents. Overweight children came from the least crowded homes (five people or fewer in the home) and were least likely to eat by themselves. Both of these findings were only trends so can only provide suggestions, but it may be that in this population, the overweight children receive more attention, and that attention is provided through food. This finding can be interpreted in light of the MC relationship, in that the MC relationship shows that the normal sized and the overweight children have more positive relationships with their mothers on many measures, except for

response to distress. In terms of supportive home environments, the stunted children are at a disadvantage compared to normal sized or overweight children. In this population, the structure of home environments and MC relationships that provided individual attention and support may have protected against poor child growth (stunting) but not overweight.

The differences in the parent variables, regarding size of parents, are consistent with previous findings. The BMI of the parents of the overweight children was significantly larger than the BMI of the parents of the normal sized children. Of note is the finding that the mean BMI for all the parents, both mothers and fathers, is in the range considered overweight (BMI > 25), and the BMI of the mothers of the overweight children is in the obese range (BMI > 30). The finding that the mother's participation in activity during leisure time decreases as the children's BMI increases has not been previously reported. The finding that more leisure time physical activity is associated with a lower BMI was expected because Mouton, Calmbach, Dhanda, Espino, and Hazuda (2000) have shown that leisure time physical activity is inversely associated with obesity among repeated samples of Mexican American adults from family practice clinics in South Texas. Increasing a mother's leisure time physical activity could be one way to promote normal child size and decrease risk of overweight in children (Fogelholm et al., 1999).

The increase in percentage of mothers and maternal grandparents born in the United States as the children's BMI increases mirrors the finding of Duerksen et al. (2007) that parental overweight is associated with eating at American restaurants, while child and parental BMI were lowest in families that predominately ate at Mexican restaurants. However, Ariza et al. (2004) found no association between children's overweight and the mother's score on the acculturation scale in their study of 250 kindergarten children who were primarily Mexican American. The effect of acculturation and generation in the United States on health and weight gain is complex, and it calls for models that examine the patterns of health and disease outcomes for distinct ethnic and cultural subgroups, according to Castro (2007).

Limitations

The findings from this study are limited to similar populations of low-income, Hispanic (mostly Mexican American) children who participate in the WIC program. It is unknown if children from other Hispanic populations (Puerto Rican, Central American, etc.) or from other ethnicities/races have similar home environments or growth patterns. As this was a cross-sectional study, no conclusions can be drawn about the antecedents for the children's patterns. Only associations between ecological factors and the size of the children when they were toddlers can be known from this study.

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How Do I Apply This Information to Nursing Practice?

The EMG can be used as a “pathway” by a nurse working with a family that includes a young child who has altered growth patterns, either overweight or stunted growth. The EMG will help the nurse systematically analyze the factors that are contributing to the child’s growth and recommend solutions that are consistent with the family’s culture and background. First the nurse can examine the host contribution by taking careful measurements of the child’s height and weight and graphing them on the appropriate scale. Then consider how many hours of TV the child watches and how many hours the child is physically active. To examine the agent contribution, determine the child’s 24-hr diet intake, whether the child is getting five fruits and vegetables per day and sufficient protein, and inquire about the family’s favorite foods. Is the child getting too many calories or not enough? The microsystem examination will yield information about the number of people in the home, the family’s meal patterns, how the mother responds to the child’s mealtime behaviors, and the parents’ BMI. Then an examination of the family’s cultural background will give meaning about the family’s view of food and child-rearing, type of preferred child activity, and interaction patterns. When the nurse has a systematic view of all the influences surrounding the child that reinforce or discourage childhood growth, the nurse can create a plan that is unique for that child and family and will be more likely to be effective. The EMG is “elastic” in that it will provide a systematic examination of child growth no matter what size the child happens to be.

When teaching the parents of a stunted or overweight child about ways to help the child “grow into” the normal weight category, the nurse can discuss foods that support normal growth, such as dairy and fruits and vegetables, and those that encourage overweight, such as sweetened drinks and low-fiber starches. Foods that encourage growth in height contain complete protein, with sufficient calories to maintain accelerated growth. If the nurse is counseling expectant parents, the finding that length of time of breast-feeding is associated with normal growth can provide support for encouraging the expectant parents to choose breast-feeding.

It is important for the nurse to understand the cultural background of the child’s parents, as many more traditional (less Americanized) diets feature more fruits and vegetables and fewer sweets than do contemporary fast-food American diets. Encouraging parents to maintain such cultural diets (if appropriate) can promote normal size growth in an immigrant population. Promoting a nurturing mother–child relationship through teaching a mother how to engage in positive, supportive interactions with her child can also promote normal growth and discourage growth stunting. It is important to teach parenting skills so that parents know how to handle children who throw tantrums if they do not get the sweets they desire. Parents who are physically active during leisure activities can promote a healthy model for their children, and they may involve their children in such activities, promoting normal growth for their children.

This study supports the holistic nursing view that a child’s size is influenced by ecological factors present in the family’s environment. Parents’ exercise patterns, cultural

backgrounds, provision of food, and relationships with their children all affect their children's sizes.

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Figure 1.
Ecological Model of Growth (EMG)

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Table 1

Demographics of Sample

Demographic	Stunted	Normal	Overweight	F	p
Number	100	100	100		
Sex (M/F)	63%M 37%F	47%M 53%F	56%M 44%F	3.4	.037
Age (months)	18	16.5	17	5.1	.006
Maternal education	10.6	10.5	10.7	0.24	NS
Maternal employment (%)	32	29	33	0.14	NS
Preferred Spanish (%)	17	25	19	1.23	NS

Table 2

Host Differences

Host variables	Measure	Stunted	Normal	Overweight	F	p
Height	Z score	-2.0	-0.7	0	257.6	.00
Weight	Z score	-1.0	-0.4	1.9	372.2	.00
BMI (weight/height)	Z score	0.25	0.05	2.5	227.5	.00
Allergies	% Yes	8%	19%	10%	3.7	.03

Table 3

Agent Differences

Agent variables	Measure	Stunted	Normal	Overweight	F	p
Time breast-fed	Weeks	6.4	6.7	3.5	4.8	.01
Fluoride	% Yes	42%	21%	28%	3.2	.04
Mexican rice	Number of servings/day	0.10	0.11	0.22	5.5	.00
American cheese	Number of servings/day	0.38	0.52	0.16	4.4	.01
Apple with peel	Number of servings/day	0.11	0.19	0.06	3.4	.04
Kool-Aid	Number of servings/day	0.07	0.02	0.13	3.1	.04
Pancakes	Number of servings/day	0.04	0.10	0.01	3.2	.04
Vegetables	Number of servings/day	1.2	0.78	0.88	2.8	.06
Water/day	Oz./day	10	9.9	13	2.4	.09
Breads	Number of serving/day	3.1	3.5	3.8	2.4	.09
Vitamin C	Mg./day	89	113	109	2.9	.09

Table 4**Microsystem Differences**

Microsystem variables	Measure	Stunted	Normal	Overweight	F	p
Home environment						
Sit with child at meals	% Yes	92%	95%	100%	2.8	.06
Crowded home	# in residence	5.2	4.8	4.6	2.6	.07
Maternal-child relationship						
Response to distress	NCATS	10.5	10.2	9.6	11.9	.00
Cognitive growth fostering	NCATS	10.4	11.3	11.4	5.3	.01
Response to caregiver	NCATS	5.4	6.1	6.1	3.9	.02
Caregiver total	NCATS	36.5	37.8	37.0	4.9	.01
Child total	NCATS	12.3	13.4	13.6	4.4	.01
Total scale	NCATS	48.8	51.2	50.5	3.7	.02
Parent variables						
Maternal BMI	kg/m ²	29	29.2	32.4	7.7	.00
Paternal BMI	kg/m ²	27.3	26.4	28.9	4.4	.01
Mean parental height	Both parents' height (inches)/2	64"	64.8"	64.8"	3.2	.04
Mom's physical activity	Seldom/never sweat during leisure	42%	53%	73%	3.5	.03

Table 5

Mesosystem

Mesosystem variables	Measure	Stunted	Normal	Overweight	F	p
Mo. origin	Born in U.S.	58%	68%	77%	3.4	.03
MGM origin	Born in U.S.	47%	62%	69%	2.9	.05
MGF origin	Born in U.S.	36%	54%	63%	4.7	.01

Mo. origin = mother's origin; MGM origin = maternal grandmother's origin; MGF = maternal grandfather's origin.