

Measurement Challenges for Childhood Obesity Research Within and Between Latin America and the United States

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Abstract

Childhood obesity is a major public health challenge across Latin America and the US. Addressing childhood obesity depends on valid, reliable and culturally sensitive measurements. Such progress within and between countries of the Americas could be enhanced through better measurement across different age groups, different countries and in sending and receiving communities. Additionally, better and more comparable measurement could accelerate cross border collaboration and learning. Here, we present: 1) frameworks that influenced our perspectives on childhood obesity and measurement needs across the Americas; 2) a summary of resources and guidance available concerning measurement and adaptation of measures for childhood obesity research; and 3) three major areas that present challenges and opportunities for measurement advances related to childhood obesity, including parental behavior, acculturation and the potential to incorporate ethnographic methods to identify critical factors related to economics and globalization. Progress to reduce childhood obesity across the Americas could be accelerated by further transnational collaboration aimed at improving measurement for better surveillance, intervention development and evaluation, implementation research, and evaluation of natural experiments. Additionally, there is a need to improve training related to measurement and for improving access to valid and reliable measures in Spanish and other languages common in the Americas.

1. Introduction

Childhood obesity is increasing at alarming rates around the globe, including in Latin America and among Latino populations in the United States (US), which have some of the highest obesity rates in the world^{13,14}. Countries across Latin America and the US have invested in research for understanding, monitoring, and ultimately reducing the prevalence of childhood obesity. To achieve this goal, the research community needs instruments and resulting measurements that are valid, reliable, culturally sensitive, and consider the multilevel factors influencing obesity. We define ‘measures’ broadly to include self-report, geospatial data and measures of policies and programs. Adoption of better measures both within and across countries and efforts at harmonization could promote comparability of research findings in different settings and advance multi-country collaborations. This in turn could help in recognizing what works in childhood obesity prevention and accelerate progress across borders.

To tackle childhood obesity, researchers in the US and many Latin American countries are developing and evaluating innovative interventions. However, the growth of the childhood obesity epidemic is outpacing these efforts, creating a greater need to work together across countries and regions to share approaches and better understand the generalizability of research results for Latino populations in the US and Latin America. To that end, the NIH Fogarty International Center’s Center for Global Health Studies (CGHS) held the *Childhood Obesity Prevention Across Borders: The Promise of US-Latin American Research Collaboration* workshop to catalyze new collaborations between US and Latin American scientists on childhood obesity prevention by sharing research methods, results and lessons learned and identifying common research questions and strategies. The workshop built on a previous CGHS project that brought together researchers, practitioners and policymakers from Latin America around understanding the nutrition status of children, linking research to practice and policy, assessing research capacity, and identifying research needs.¹⁵ The Cross Border workshop also engaged members of the National Collaborative on Childhood Obesity Research to explore measurement needs for cross-border research on obesity as well as participants from multiple NIH institutes and Offices¹⁷.

Specifically, the workshop participants highlighted the importance of developing and selecting measures as a key component to harmonizing research across borders and as a critical foundational step toward understanding and optimizing interventions to improve their impact. Identifying the right measure depends critically on the purpose of the project, the population of interest, the age of the participants, and a wide variety of practical concerns. The type of research also dictates measurement selection, as the research questions for intervention evaluation or surveillance research are inherently different than those for implementation science or an evaluation of natural experiments in the policy and built environment arenas^{18,19}. To enhance progress within and between countries of the Americas through better measurement, this paper describes: 1) a framework for understanding influences on childhood obesity and guiding measurement needs across Latin America and the US, 2) representative resources and guidance available concerning measurement and measures adaptation for childhood obesity research, and 3) three major areas (i.e., parental behavior, acculturation, and globalization) that present challenges and opportunities for advances in measurement related to childhood obesity. Before turning to specific resources and challenges in measurement, we briefly discuss the Kumanyika Community Energy Balance Framework that motivated the overarching conversation at the workshop.

2. Framework for childhood obesity with special reference to Latin America, the US and movement between them.

The current series of papers from the *Childhood Obesity Prevention Across Borders: The Promise of US-Latin American Research Collaboration* workshop draws from the Kumanyika Community-Energy Balance Framework (CEBF)²². This model is helpful in identifying the breadth of domains needed to address obesity prevention in Latinos in the US. However, the CEBF requires further development as a model for obesity in Latin America, distinct from challenges faced by low income and/or immigrant populations living in a high-income pluralistic society such as the US. The CEBF draws from the social ecological framework²³ that posits that individual behaviors, notably diet, physical activity and sedentary time are nested within different environments and that the interactions between the individual and these environments is what ultimately influences behaviors at the individual level. The unique advantage of the CEBF is that it emphasizes how the multiple environments (e.g., the built

environment, physical activity resources, food environments) are in turn influenced by the dynamics of culture(s) and historical migration. The challenge is how researchers can identify what is important to measure and how to measure it within the dynamics of culture and migration processes in each environment.

This paper highlights selected areas of measurement research where there is a need for improved focus on the development and use of valid measures that could advance childhood obesity research in Latin America and US Latino populations. Parenting styles and acculturation represent key examples of the environmental factors in which childhood and subsequent adult behaviors related to obesity develop. The ethnographic approach described below is a methodological approach that could contribute to identifying specific structural, economic and cultural factors important for childhood obesity across the America's. Furthermore, harmonization of measures related to obesity over the life course could further improve understanding of cross-generational transmission of obesity²⁴⁻²⁷, developmental windows of susceptibility to negative effects of obesity^{28,29} and mechanisms for the Hispanic mortality paradox in the United States³⁰. A comprehensive review of measurement needs associated with CEBF and its extension to understanding childhood obesity across the America's was beyond the scope of the workshop and this paper, nevertheless, the themes developed here are highly relevant to progress in addressing obesity in Latinx populations and may also set the stage for comprehensive efforts to improve measurement.

3. The Current Measures Landscape for Childhood Obesity Across Borders

Compiling valid and reliable measures and promoting more harmonization and standardization of such measures is an ongoing effort in the field of childhood obesity. One challenge for summarizing measurement resources for cross border obesity involves how to structure a typology of measures. Past discussions have used a variety of such typologies, including 1) measurement purpose, including surveillance, etiology, evaluation, engagement, or action³¹, 2) level of impact or disciplinary focus, including biological, behavioral, psychosocial, or environmental³², 3) specific behaviors and environments such as diet, physical activity, food environment^{33,34}, or physical activity environment³⁵, 4) by age or stage in the life course: preterm, newborn, infant, toddler, preschool, school age,

adolescent^{36,37}, or 5) by mode of data collection, including self and proxy reporting, device-based assessment, direct observation, data extraction from available datasets, and passive or active instruments³⁸. Additionally, measurement tools and resources could be cataloged by country of origin and language. Across the Americas, this could include one of 55 countries from Antigua to Venezuela, or one of many languages in the region, including Spanish, French, Portuguese, English, Creole, Southern Quechua and hundreds of others, some common, many rare, endangered, or extinct. Space precludes a more complete discussion of these typologies and how they might influence measurement choices, but such typologies can help define specific research and evaluation goals as well as needs for new measurement-related resources.

Despite these challenges, substantial but scattered resources and instruments exist to support measurement needs related to childhood obesity across the America's. Below we present a summary of such resources, drawing on activities of the National Collaborative on Childhood Obesity Research (NCCOR), a recent US National Academy workshop on physical activity surveillance³¹, a recent paper concerning surveillance and the recently updated WHO physical activity guidelines³⁹ as well as publications concerning malnutrition across the Americas⁴⁰ and the INFORMAS project⁴¹. Note, that there was overlap between attendees and invited speakers at the NCCOR and the Cross Borders workshops in an intentional effort to enhance childhood obesity research, evaluation and measurement throughout the Americas⁴².

Surveillance

Scattered but extensive surveillance data are available across the Americas, with more extensive resources available in the US (Supplementary Table 1). Surveillance of childhood obesity and its behavioral, social, and physical environmental determinants is vital for planning, interpreting, and evaluating public health practice⁴³. Nutrition, malnutrition and obesity have been the topics of substantial work across the Americas^{40,41} and Latin American countries have carried out a wide variety of health surveys concerning diet, physical activity and other factors influencing childhood obesity. Much information about the surveillance systems of specific countries in the Americas beyond the US can be difficult to access as they are not always readily available on the Internet or in scientific

publications. Most of the relevant US surveillance systems and health surveys include instruments translated into Spanish, a valuable resource but clearly in need of adaptation to specific countries and often to specific immigrant populations within the US. The US National Heart Lung and Blood Institute lead Study of Latinos (SOL) is a good example of a US based health survey with a large number of measures relevant to obesity for both adults and youth translated into Spanish^{44,45}. These measures are available online⁴⁶ and details of the measures and their development are found in many papers published concerning the study.

The workshop identified three specific areas in need of further work to improve surveillance. First, considerable material addresses obesity and its more proximal determinants—diet and physical activity. Many fewer surveillance resources are available for the social, familial, and structural and environmental determinants of obesity that comprise the outer layers of the CEBF. Second, more work is also needed to adapt methods for extracting information about built and natural environments outside of the US and Canada from archives of images such as Google Street View⁴⁷. Third, there is a pressing need for further review and compilation of available surveillance data and resources across the Americas⁴⁸. Such a compilation could be modelled on the National Collaborative on Childhood Obesity Research Catalog of Surveillance systems³⁵. Additional information and compilation concerning the Pan American Health Organization (PAHO), the World Health Organization (WHO) and other organizations' survey instruments would also be useful; currently, it can be difficult to find such instruments along with details about their development and adaptation for different countries. Hoelscher et al. (2017) summarize the overall set of surveillance systems for obesity prevention in the US and note the need for greater attention to environmental and policy factors⁴⁹. This is certainly true across the whole of the Americas.

Selected Extant Resources and Challenges

Progress in research and evaluation related to childhood obesity across borders depends on the availability of valid and reliable measurement tools for the diverse potential influences on childhood obesity and interventions aimed at preventing or reversing obesity. Identifying appropriate measures can be difficult because of rapid growth in the literature and the need for measurement tools from

multiple domains, which can make it hard to judge which measures are appropriate for a particular study. A few compilations of measures, efforts to characterize reliability and validity, and guidance on measures selection are available (Supplementary Table 2). For example, the NCCOR Measures Registry Resource suite⁵⁰ includes a searchable registry of measures of diet, physical activity and their environmental influences, monograph length guides to measurement selection in these areas, and 16 short (5-10 minute) online learning modules. The Measures Registry notes whether included instruments are available in other languages, including Spanish, and if such information was available in the specific validation study abstracted. However, only 5-10% of the studies (~1500) mention Spanish language translation⁵¹.

Device-based measurement of physical activity^{37,38} and environmental data extraction from archives of online images⁴⁷ can help address some of the cultural adaptation challenges alluded to here⁵⁰. The explosion of mobile health (mHealth) applications and devices in this area holds promise for improving both individual and population-level accuracy and reach of assessment in the physical activity area⁵², in addition to other relevant health behaviors, including diet⁵³. However, some of these tools are more expensive, may be less acceptable for certain population subgroups (King et al. 2020 In Press), and typically require significant training for data collection and analysis⁵³.

The dominance of English language measurement resources highlights a pressing need for the collation of measures in other languages, adaptation of existing measures and development of new measures appropriate for different countries, populations, and high-risk groups measures⁵⁴. Methods for adaptation and development of self-report-based instruments such as standardized survey questions are relatively well developed in the survey community and for multinational survey projects. For large scale multinational, multicultural, or multiregional surveys, extensive guidance is available for the entire survey lifecycle encompassing all aspects of survey development from sample design through questionnaire development, translation and adaptation through analysis and dissemination⁵⁵. Specific research or evaluation projects addressing understudied or at-risk populations will often lack the resources required for these large-scale approaches. Nevertheless, attention to adaptation is vital. Adaptation may involve qualitative work including focus groups, key informant interviews or

ethnographic efforts aimed at understanding specific behaviors, foods or attitudes potentially important for obesity⁵⁶. Cognitive interviewing has proved useful in identifying potential problems and gaps in surveys, including instructions, items, and responses⁵⁷⁻⁵⁹.

Recently, an NCCOR workshop on measurement issues for high risk populations^{60,61} resulted in an extensive discussion of measurement needs related to childhood obesity and developed a series of case studies and a decision tree to help guide choices concerning adaptation of measures for at-risk populations⁶². This work highlighted the need to engage the community and carefully consider whether or not an existing measurement tool is suitable for the population of interest. These resources could be useful for investigators addressing childhood obesity in countries with little research history concerning childhood obesity or in thinking about measurement needs for migrant and immigrant populations. Note, the approach developed by NCCOR was specifically designed for high-risk populations in the US; thus, it is only partially relevant to measurement adaptation for countries across Latin America which comprise diverse populations, only some of which are at elevated risk of childhood obesity.

Summary and Future Needs Related to Diet, Physical Activity and their Environmental Influences

A substantial set of tools exist for measurement⁵⁰ and surveillance^{40,41,63,64} of proximal influences on childhood obesity in the US, high-income world and to some extent in low- and middle-income countries including Latin America (Supplementary Tables 1 and 2). Only a fraction of these materials have been translated for Spanish speaking populations. Furthermore, even less effort has been made to explore whether or not adaptation of such instruments to account for different foodways, physical activities and characteristic environments is required. Resources compiling such measurement tools for use across the Americas, comparable to NCCOR efforts, are lacking. Furthermore, the community energy balance model adopted here to address cross border challenges in obesity highlights the potential importance of historical experiences, structural and socio-cultural influences, and other macro-level factors²². These areas lack such extensive development of measurement resources and likely require even greater effort in the US and Latin America to define a valid and reliable set of instruments and measurement approaches. Finally, there are dramatic differences in literacy, access to phone,

smart -phone and internet across the Americas⁶⁵. These differences influence the optimal design and implementation of surveillance related to childhood obesity.

4. Parental Influences on Childhood Obesity

The literature has consistently documented that obesity-associated behaviors among youth are influenced by parenting styles, feeding styles, and parenting practices⁶⁶⁻⁷⁰. These practices and styles influence children's attitudes and beliefs about foods⁷⁰ and physical activity behaviors⁷¹. Nonetheless, the majority of studies were conducted on non-Latino white populations⁷², with more limited and equivocal findings about food⁷³⁻⁷⁵ and physical activity practices⁷⁶⁻⁷⁸ and parenting styles⁷⁹⁻⁸⁵ among Latino and Latin American groups. In the US, some investigators posit Latino parenting styles, practices and feeding styles are sometimes nonconforming with the dominant US culture, emphasizing the need for further research on the familial, sociocultural, psychological, and economic contexts in which parenting practices and styles occur⁷⁴. Furthermore, research is needed to identify how these constructs influence children's and adolescents' eating behaviors in the Latin American countries— a region where the prevalence of combined childhood overweight and obesity ranges from 16.7% to 35%⁸⁶.

Parenting Styles: Parenting styles are a function of parents' attitudes, beliefs, and behaviors, and provide the socio-emotional context in which specific parenting practices are implemented⁸⁷. The cross-cultural application of the Baumrind's⁸⁸ and Maccoby and Martin's⁸⁹ frameworks to diverse populations, including Latinos has been disputed^{60,75}. Parenting behaviors may be reactive to children's characteristics and the cultural and socioeconomic contexts in which families live. Among children from diverse ethnic backgrounds, culturally mediated mechanisms may alter children's interpretations and responses to their parent's parenting styles⁹⁰. Parents also react to the context in which they live, influencing how they parent their child, so neighborhoods with low-income Latinos in the US may influence their parenting behaviors differently than high-income, predominantly white neighborhoods^{76,91}. Additionally, language influences parenting and family dynamics. For example, children with greater English fluency than their parents may lead to role reversal and conflict within the family^{92,93}. In the original frameworks, there were four parenting styles; one of which, 'authoritative', has been associated with overall positive outcomes for children in non-Latino, white American families.

However, results may differ for Latino parents. Some⁹⁴⁻⁹⁸, but not all^{74,99-102}, studies have found Latino parents to employ more authoritarian parenting styles, associated with positive outcomes. A more recent study showed some variability of child outcomes dependent on ethnicity (e.g., Mexican American and Dominican American)¹⁰².

In 2009, Domenech, Rodríguez, Donovan, and Crowley showed the four traditional parenting styles did not capture Latino parenting styles very well⁷⁴. In response, the Parenting Style Observations Rating Scale (P-SOS) was developed with eight parenting styles: authoritative, authoritarian, permissive, neglectful, protective, cold, affiliative, and neglectful II. They found Mexican parents were better described as protective—a parenting style characterized by high levels of warmth and demandingness and low levels of autonomy granting. More research is needed to understand whether one or more of these parenting styles is associated with reduced levels of obesity in Latino children.

Feeding Styles: In contrast to parenting styles, which can be conceived as more distal, higher-order constructs, feeding styles are more proximal determinants of child behavior¹⁰³. Feeding styles are defined as the way parents interact with their children during eating¹⁰⁴, and may be more predictive of child weight status^{80,88}. The Caregiver's Feeding Styles Questionnaire (CFSQ) was developed for low-income Latino and Black populations in the US and has been used extensively to better understand feeding styles in relation to childhood obesity¹⁰⁵. Studies have found young children of indulgent parents were most likely to have a higher weight status in this population and less optimal child eating behaviors¹⁰⁶⁻¹⁰⁸. Nonetheless, to date, no studies using the CFSQ have been conducted in the Latin American population outside the US.

Parenting Practices: Food parenting practices are context specific behaviors parents use to influence their child's eating¹⁰⁹. The Child Feeding Questionnaire (CFQ) is the most commonly used instrument and was designed to assess parents' perceptions and concerns regarding childhood obesity, as well as child-feeding attitudes and practices¹¹⁰. Anderson et al (2005)¹¹¹ validated the CFQ among low-income Latino and Black parents of pre-school children, documenting cross-cultural conceptual problems to the structure of the original seven factors proposed. They proposed a modified CFQ with a five-factor structure: responsibility, concern about weight, restriction, pressure to eat, and monitoring.

Many other instruments to measure food¹¹² and physical activity¹¹³-related parenting practices among infant and preschooler children have been published. Examples include the Comprehensive Feeding Practices Questionnaire Variety¹¹⁴, the Infant Feeding Questionnaire, the Preschooler Feeding Questionnaire¹¹⁵, Parental feeding practices in Mexican American families¹¹⁶, and the Parent Mealtime Action Scale¹¹⁷. Many of these instruments are more comprehensive than the CFQ, but few were specifically developed for Latino parents. The Parental Feeding Styles and Adolescents' Healthy Eating Habits Questionnaire¹¹⁸ was specifically developed for Latin American adolescents with four domains: verbal encouragement of healthy eating behaviors; use of verbal sanctions to indirectly control the intake of healthy food; direct control of access to and intake of food; and use of food to regulate emotions and behavior.

To date, the focus of research on food parenting practices has been predominantly on mothers, while evidence is emerging regarding the importance of engaging fathers in Latino and Latin American cultures¹¹⁹. The absence of fathers in child feeding research results in a gap in the literature and undermines efforts to develop effective family interventions. A common argument for the maternal-centric focus is mothers take primary responsibility for feeding their children or are considered the primary caregiver¹²⁰. However, studies that directly compared mothers' and fathers' feeding practices suggest fathers influence their children differently regarding eating behaviors¹²⁰. Additionally, many studies focus on parental influences on children. Recent work on eating behavior has started examining parent-adolescent dyads and addressing actor-partner interdependence¹²¹. Further work is needed to determine if such approaches could inform understanding of differences in parenting, behavior and obesity across the Americas.

Summary and Future Needs related to Parenting and Feeding Styles and Practices

With the exception of the P-SOS and CFSQ, most instruments that assess parenting styles, feeding styles and parenting practices were developed for white American or European populations. Additionally, many of the instruments or methods used to measure feeding practices were initially developed with mothers or were validated in studies in which fathers were underrepresented¹²⁰. The role of fathers has changed in many cultural groups in parallel with shifts in maternal employment. Most of the available

studies in this area have been conducted in the US and some US studies have included Latinos of diverse backgrounds. Culturally relevant and appropriate instruments should be used to assess the variations in the effects of parenting styles, parenting practices, and feeding practices among groups of different backgrounds, because they have serious implications for the design of family interventions. This is of particular relevance in the Latin American context, where there are few studies that assess parenting in Latin American countries which may innately differ socio-culturally from those of migrant Latinos (who are influenced by acculturation) and from those of the US population.

5. Acculturation and Childhood Obesity

Transculturation, Deculturation, Neoculturation

Given the long history of migration from Latin America to the US¹²² and the growing numbers of Latinos born in the US each year¹²³, it is critical to understand how acculturation impacts Latino childhood obesity in the US. Acculturation can be considered one of the processes of transculturalism, or the complex transformation of culture over time. Acculturation is a dynamic process by which the culture of a group or individual is modified as a result of continuous, first-hand contact with a different culture¹²⁴. In addition to acculturation, transculturalism includes deculturation—the loss of original or home culture, and neoculturation—the creation of new culture¹²⁵. Of these concepts, acculturation has received the most attention in relation to Latino childhood obesity. Early conceptual models, especially of Mexican immigrant acculturation in the US, conceived of a one-dimensional process whereby individuals moved in a linear fashion from Mexican culture at one extreme to US culture at the other^{126,127}. However, this conceptualization did not account for processes whereby individuals develop qualities of both cultures. Multidimensional conceptualizations of acculturation describe an orthogonal relationship between two cultures whereby individuals may retain their original culture while also adapting to the new culture¹²⁷. Indeed, the process of acculturation among Latinos in the context of the US mainstream European American culture can take at least four different distinct paths¹²⁸. First, Latinos may end up giving up completely their Hispanic culture and totally assimilating into the European American mainstream culture, i.e., following the “melting pot” social concept popular in the US. Second, Latinos may choose to retain their Hispanic heritage at the same time that they fully integrate into the

mainstream culture, i.e., becoming “integrated” but also “bicultural.” Third, Latinos may choose to retain their Hispanic culture without attempting to integrate into the mainstream culture, i.e., becoming “separated” or “segregated” from society and being pushed to live in ghetto or barrio environments. Fourth, Latinos may end up losing their Hispanic ethnicity without seeking integration into the mainstream society, i.e., becoming “marginalized” or “invisible” with little sense of belonging to any culture (Fig. 1)¹²⁹.ⁱ A major conceptual limitation of most research on acculturation and health is an underlying assumption that this process involves all ethnic cultures acculturating into the mainstream European American culture¹³⁰ when, in fact, the reverse is true in many regions of the country. For instance, Latinos have been in the southwest for hundreds of years. Indeed, in areas of high Latino density (e.g., the U.S. Mexican border), acculturation is expected to also occur to a great extent in the opposite direction (i.e., European Americans becoming acculturated into the Latino culture)¹²⁹.

----- **Insert Figure 1 around here** -----

Additionally, public health researchers have proposed studying dimensions of acculturation relevant to the health outcome under study¹²⁴. For example, dietary acculturation may be important to consider in the study of childhood obesity. Dietary acculturation is defined as “the change in attitudes and beliefs about food, taste preferences, and food purchasing and preparation.”¹³¹. Acculturation has also been associated with changes in physical activity, smoking, alcohol use and other health behaviors^{132,133}.

Transculturalism can result in changes to attitudes, values, customs, beliefs, and behaviors that may have implications for preventing, developing, and/or treating Latino childhood obesity in the US. Early research among adults of Mexican descent in the US generally demonstrated that the risk of obesity increased with increased time spent in the US and with each successive generation^{134,135}. This was due to the fact that recent immigrants or those with low acculturation levels were thought to arrive with healthier behaviors than the mainstream US population but that with increasing time spent in the US, higher acculturation levels led to health behaviors more similar to the US population. Health behaviors similar to the US population would lead to an increased risk for adverse health outcomes, such as obesity. However, later research using multidimensional and/or multiple measures of

acculturation demonstrated that the associations may be more complex. For example, one study examined years in the US and a multidimensional acculturation scale and found the risk of obesity to be higher among adults who had lived in the US 13 years or longer but who had low acculturation scores, compared to adults who had lived in the US less than 13 years but who had higher acculturation scores¹³⁶. Similar to adults, the evidence for the association between acculturation and childhood obesity is mixed. In the earliest study on this topic, Popkin and Udry found that 25% of Hispanic adolescents born outside the US were overweight, which was significantly less than the 32% of Hispanic adolescents born to immigrants and the 31% of native Hispanic adolescents who were classified as overweight using the National Longitudinal Study of Adolescent Health¹³⁷. Subsequent literature for adolescents, school-age children, and preschoolers has been mixed, with some studies showing a positive association, some a negative association, and others no association¹³⁸. The mixed findings are likely due to two main challenges: first, the association between acculturation and obesity is likely shaped by diet and physical activity patterns in the community of origin and the destination community, which can vary within countries and over time. Second, as discussed in the following section, measurement of acculturation varies widely across studies, including parental nativity, parental language proficiency, parental scores on various acculturation scales, and children/adolescent's scores on acculturation scales. In addition, this literature does not take account of other cultural transformations, including deculturation and neoculturation, which may have different implications for childhood obesity.

Existing Measures/Approaches – Unidimensional, Bidimensional and Castro's life trajectory approach

As indicated in the previous section, acculturation is a complex phenomenon that is difficult to quantify¹³⁹. The construct of acculturation is not only multidirectional, but it is also multidimensional. Its several dimensions include behaviors, attitudes, norms, and values. The level of acculturation for an individual goes well beyond language use and preference, may not be constant across dimensions, and may differ across settings (e.g., home, work, and social environments). This process can only be well understood by understanding the life trajectories and places of origin (e.g., urban or rural) of the immigrant populations being studied. Unfortunately, this approach for measuring acculturation among

Latinos has not yet been used widely and greater efforts are needed to explore how acculturation processes manifest themselves at different levels of the Community Energy Balance Model. Furthermore, the vast majority of the acculturation literature has focused on immigrants moving from Latin America to the United States. Future work could profitably examine the growing number of immigrants moving among different Latin American countries and from remote rural and indigenous communities to urban settings¹⁴⁰.

In spite of the dynamic and multi-dimensional nature of the acculturation construct, researchers commonly use simple static proxy indicators such as birthplace, language use, dietary behaviors, and number of years spent in the U.S.¹⁴¹. Other common measures include unidimensional scales such as the Acculturation Rating Scale for Mexican Americans (ARMSA)¹⁴² and the Short Acculturation Scale for Hispanics (SASH)¹⁴³. These unidimensional measures include domains such as language use, ethnic interactions, and media preferences and provide a single continuous measure of acculturation that can be used in analyses. Bidimensional and multidimensional measures such as the Bidimensional Acculturation Scale¹⁴⁴, the ARMSA II¹⁴⁵, and the Hazuda Scale¹⁴⁶ can provide additional summary measures that capture the multidimensional nature of acculturation. The advantages of these scales are that they provide additional information on the acculturation process than the simple proxy indicators, and they tend to be easy to administer with the number of items ranging from 12 for the SASH to 48 for the ARMSA II. A major disadvantage of these measures is that they were primarily developed and validated with Mexican Americans, thus limiting their use with other Latino groups and they may still fail to capture the specific acculturation processes relevant for research on childhood obesity. In addition, the majority of measures were designed for adults, which may be inappropriate for younger children. Scales specifically for children and adolescents include the Short Acculturation scale for Hispanic Youth¹⁴³ and the Acculturation, Habits, and Interests Multicultural Scale for Adolescents¹⁴⁷. Several systematic reviews have summarized the existing measures for acculturation^{141,148,149}. Nevertheless, none of these scales account of the “life history” or trajectories of individuals that are so important for understanding acculturation.

Progress in understanding associations between acculturation and childhood obesity could be accelerated by considering life history trajectories of acculturation for parents and children. Such efforts might also contribute to the design of more targeted interventions. Castro et al. (2010) developed a measurement approach¹⁵⁰ that takes into account events over the life course based on the construct of lifetime segmented assimilation trajectories in the context of eco-developmental theory. Segmented assimilation has been defined as “diverse patterns of adaptation whereby immigrant groups differentially adopt the attitudes, beliefs, and behaviors of divergent cultural groups in the United States.”¹²⁴ (p. 1344). Hence, segmented assimilation helps understand how successful the process of cultural and economic integration into a “mainstream” society is. Segmented assimilation theory has identified three processes of social integration: (1) upward assimilation; acculturation change toward mainstream white American culture coupled with upward socioeconomic mobility; (2) downward assimilation acculturation; change and downward socioeconomic mobility into an underclass; and (3) resistance to forced assimilation; resistance to acculturation and to assimilation into the mainstream society¹⁵⁰.

A person, family, or group (immigrant or native) initiates a “life journey” from an initial sociocultural position—low, moderate, or high—with the potential for moving upward or downward. Under this eco-developmental framework, both minority persons and persons from the mainstream culture can undergo segmented assimilation. For example, along the US–Mexico border, non-Hispanic white Americans can move culturally from their native white American culture toward Latino/Mexican culture (acculturation toward a Latino/Mexican culture) by learning to speak Spanish, making friends with Latinos, moving from a predominantly white neighborhood into a Latino neighborhood, or by intermarriage¹⁵¹. Similarly, Latinos can move toward mainstream white American culture (conventional acculturation) by learning English, making friends with White Americans, moving into a white, nonminority neighborhood, and marriage or romantic partnership. Hence, segmented assimilation trajectories indicate that segmented assimilation is a bidirectional process. While downward assimilation trajectories are expected to lead to negative health and wellbeing outcomes; upward assimilation in the direction of upper socioeconomic strata is expected to be linked to positive health and wellbeing.

Castro et al. empirically tested the segmented assimilation model with data from the Corazón Life Journeys study conducted in Phoenix Arizona¹⁵⁰. Consistent with the concept of segmented assimilation, latent class analysis findings indicated that assimilation is a product of two interrelated factors: socioeconomic mobility (upward or downward) and acculturative integration into a host society (i.e., toward or away from American “mainstream” culture). The following four groups were identified based on the combination of acculturation and socio-economic patterns across the life course (a) Extreme Upward Assimilation, (b) Extreme Downward Assimilation, (c) Moderate Upward Assimilation, (d) Moderate Downward Assimilation.

----- **Insert Figure 2 around here** -----

Findings showed that, as predicted, the extreme upward assimilation group had better dietary and health outcomes. For example, this group had a lower frequency of unhealthy food consumption relative to the extreme downward assimilation group and the moderate upward assimilation group. This study indicates that the relationship between acculturation and health outcomes needs to be interpreted in the context of socioeconomic change across the life course.

Summary and Future Needs related to Acculturation

The acculturation process is complex and various measures and scales have been used among different studies examining the influence of acculturation on diverse health behaviors and outcomes among Latinos. These measures and scales have used a variety of indicators including nativity, language preferences, time of residence in “new” country, social networks, and multi-indicator scales. As has been documented over more than a decade, this may partially explain the inconsistency across studies, and even within the same study using different acculturation indicators¹⁵², aimed at addressing the influence of acculturation on nutrition, obesity and related physical and mental health outcomes¹²⁹. Additionally, most acculturation scales or indicators used thus far with Latinos fail to capture individuals who are bicultural. This is a major knowledge gap because individuals who can function well in both the Latino and the European American worlds are perhaps the most likely to have positive economic and health outcomes. Another major limitation in the area of acculturation, nutrition, and health research

among Latinos is the lack of longitudinal or lifetime trajectory studies that actually consider the life experiences of immigrants before moving to the US, taking into account important changes socioeconomic, demographic, and biocultural confounders across the life course¹⁵³. Moving forward, it is important to reach consensus on a standard definition of acculturation and its corresponding dimensions, to be able to develop and pre-test multi-indicator scales that clearly identify the different acculturation pathways followed by migrants over time. The vast majority of research studies identified were cross sectional or retrospective, and the majority of the research in the field has mainly focused on acculturation from Latin America to the “mainstream” white US culture, as opposed to acculturation between Latin American countries, or among Latino or other ethnicity/racial sub-groups within the US. Prospective studies are needed to further elucidate how the process of acculturation happens and how the different pathways followed affect diet, physical activity, obesity and related to non-communicable disease outcomes across the life-course.

6. Ethnography: A Promising Tool for Measuring Childhood Obesity

Measuring childhood obesity in Latin America should ideally involve measuring 1) diet and physical activity within the context in which children live and 2) as well as the contexts themselves. The CEBF framework does a good job of highlighting many potentially relevant features of context including social, environmental, policy and economic factors. By allowing us to understand childhood obesity more comprehensively, these measurements can provide population-based strategies to reduce and prevent it. As discussed above, public health researchers have a suite of measurement tools for individual dietary intake including versions for Latin American populations¹⁵⁴ and where and when people carry out physical activity. However, while broad measures of contextual factors are available and used to examine their relationship with obesity¹⁵⁵, we have less robust means to examine the specific causal mechanisms that link such measures to obesity-related behaviors beyond broad hypothesized pathways.

This section discusses a specific qualitative tool, ethnography, for enhancing measurement and testing of causal mechanisms. Several authors of this paper (Roberts, Sanchez, Tellez-Rojo) have been developing the use of this approach in Mexico and other settings. Ethnography involves non-hypothesis

driven, long-term, open-ended observations of research participants within their everyday lives, serving to illuminate context more comprehensively than other mixed methods^{100,156}. Often ethnographers reside temporarily with or near the people they are studying. While motivated by a broad question, e.g., obesity, ethnographic research entails a wider aperture than focus groups or interviews, because the ethnographer does not predetermine a list of ‘standardized’ questions in advance, instead allowing their observations of everyday life to help them understand the practices and processes that shape research participants’ lives and health-related behaviors^{157,158}. This heightened understanding of context can enhance measurement design and testing of causal mechanisms, because it can aid in generating hypotheses that are more context-specific and can produce improved survey questions for traditional epidemiologic studies. Thus, we are advocating a mixed-methods approach, that highlights ethnography.

Case Study of Ethnographic Research on Diet in Mexico

We briefly describe our collaborative ethnographic research about diet in Mexico City (Box 1.) with twenty-five working class families, which has provided new insights about how and why (not if) food purchasing/procurement has been shaped by broader economic processes^{159,160}. Ultimately, mixed methods involving ethnography could direct us towards measuring “the how and the why”; in other words, what most meaningfully shapes diet and physical activity within a specific context.

Box 1: Ethnographic observations over the long-term illuminate the person- and household-level casual processes—the how and why—behind the dramatic changes in diet in Mexico after the profound market deregulation brought about from North American Free Trade Agreement (NAFTA). Retail inventory data show that NAFTA inundated the food landscape with cheap, mass-marketed goods¹⁻⁵, and other quantitative data demonstrate how, following NAFTA, the Mexican population registered increases in caloric intake, particularly for low income households^{2,6}. Ethnographic observations demonstrate how and why this occurred: in the context of NAFTA-induced economic precarity⁷⁻⁹, sugary foods are used as a demonstration of maternal love and are highly valued despite peoples’ knowledge of their potential health risk¹⁰. The powerful sentiments and actions that motivate maternal food provisioning, also highlighted above in our discussion of parenting, are in part fueled by unregulated food marketing. Advertisements where a woman is portrayed as actively supporting the wellbeing and happiness of her family by serving cheap processed foods, especially soda^{11,12}, demonstrate the food industries’ profound understanding of the importance of expressing love to family members in precarious economic times¹⁶. Campaigns like these target women, who tend to be the family caregivers and key gatekeepers for food procurement in Mexico and in Latin America (as well as the US) more generally^{20,21}, thus specifically targeting their traditional role within the family and sense of duty.

The study described in Box 1 showed how and why food marketing is so powerful in resource poor contexts. We observed that in working class communities in Mexico City, tap water is intermittent and unreliable. Additionally, government subsidies in the form of tax incentives, sugar subsidies and water rights have made soda nearly as cheap as purchased water¹⁶¹⁻¹⁶³. Hence, serving water makes little sense in this context when the advertising, ubiquity, reliability, and palatability of soda make it a much more powerful means to care for children than water. Our findings suggest that health education campaigns may have little relevance in people’s choices about their children’s diet when trade agreements have made ultra-processed foods cheaper, widely available and advertised everywhere. We have witnessed women underreporting soda consumption on surveys because they know soda is considered unhealthy by those administering the survey. We have also observed that after sugar-sweetened beverages were banned from schools, women hid soda in their children’s lunches by putting clear soda in single-use water bottles^{10,164}. In sum, our long-term ethnographic observations within working class households found that the ubiquity and convenience of soda and the need to demonstrate love outweighed health education messages about the harms of soda, even though these messages

have appeared on television immediately after/before soda advertisements. These results could not have been obtained through surveys, interviews or focus groups, during which research subjects typically have good reason to underreport their consumption habits. Our ethnographic findings are produced from a small sample size (e.g., typically 6-10 households), however, so they must be tested in statistically robust ways. Nevertheless, these ethnographic findings can help to guide the development of context-specific hypotheses and decide what to measure in order to test them. Narrowing research questions in advance, without first ground truthing what actually occurs in participants' everyday lives, may lead to missing the larger context producing the phenomena under question, in this case childhood obesity.

The ethnographic observations demonstrating the complexity of diet can be further explored both through mixed methods using other qualitative methods like focus groups and via new items in health surveys. For instance, to develop questions that go beyond "how much soda did your child consume last week?", subsequent to ethnographic observation, focus groups could explore the relationship of soda consumption to water availability, and the pleasure soda provides in the context of economic precarity. The validity of survey items also could be explored through cross-referencing responses to survey items with ethnographic observations of daily life practices of a sample of study participants. Such cross-referencing, not unlike the use of cognitive interviewing techniques, could also be used to further refine and extend survey instruments. These more comprehensive data can then be used to quantitatively examine these more complex pathways—i.e., the why and the how discovered through ethnographic observations.

7. Conclusions

Progress in reducing the prevalence of childhood obesity across Latin America and the US could be accelerated by further transnational collaborations aimed at improving measurement for better surveillance, intervention development, dissemination and implementation research³⁴ as well as evaluation of natural experiments. The 2019 workshop and preparation of this paper highlighted needs for 1) improving access to valid and reliable measures for specific populations and languages, 2) working further on understanding and measuring parental behavior and practices related to diet, physical

activity and other relevant influences on childhood obesity such the role of fathers, 3) improving guidance concerning measurement of acculturation and its behavioral correlates, and 4) identifying further measurement needs related to major social and economic factors using novel approaches such as ethnography. Workshop participants frequently pointed to challenges related to regional and inter-country mobility. At-risk populations involve residents of specific countries, but immigrants and families or children who move back and forth between different places, within and between countries¹⁶⁵. Such movements create challenges in measuring environments, attitudes, behaviors and how they interact in different settings. Additional dialogue, more work and conceivably further workshops are needed to establish a consistent body of practice to address these mobile populations.

The suggestions above are not small tasks and may require considerable additional efforts, including workshops, investment in online resources and the development of training materials. At present, there are diverse resources available to support measurement related to childhood obesity, but these resources are incomplete— they are largely in English and they often require significant expertise to actually select appropriate measures from the many available in the research literature. One potential solution to this problem involves the creation of a repository of measures in Spanish and other languages commonly used in the Americas.

Additionally, many of the measures available have been developed largely to serve the interests of the research community. Greater efforts to engage the public in identifying critical factors influencing behavior and designing measures for relevant constructs also are needed. Among potential approaches for doing this are community-based participatory research and community-engaged citizen science methods, which have shown promise in addressing obesity-relevant behaviors in under-resourced communities in Latin America as well as the US¹⁶⁶. Continued investment in developing and promoting the use of valid, reliable, and culturally sensitive measurements that consider the multilevel factors influencing obesity is needed to support and improve results obtained from ongoing efforts to address childhood obesity across Latin America and the US. A next step in these efforts could be a workshop devoted to measurement needs for childhood obesity across the Americas, including those associated with the Community Energy Balance model that motivates much of the thinking shared in this special

issue and the potential for creating a curated repository of relevant measures, instruments and protocols.

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References

1. Bankman J. Mexico: Public Health, Rising Obesity and the NAFTA Effect. <https://civileats.com/2013/07/17/mexico-public-health-rising-obesity-and-the-nafta-effect/>. Published 2013. Accessed 7/3/2020.
2. Clark SE, Hawkes C, Murphy SM, Hansen-Kuhn KA, Wallinga D. Exporting obesity: US farm and trade policy and the transformation of the Mexican consumer food environment. *Int J Occup Environ Health*. 2012;18(1):53-65.
3. Kennedy G, Nantel G, Shetty P. Globalization of food systems in developing countries: impact on food security and nutrition. *FAO Food Nutr Pap*. 2004;83:1-300.
4. Bridle-Fitzpatrick S. Food deserts or food swamps?: A mixed-methods study of local food environments in a Mexican city. *Soc Sci Med*. 2015;142:202-213.
5. Mendoza A, Pérez AE, Aggarwal A, Drewnowski A. Energy density of foods and diets in Mexico and their monetary cost by socioeconomic strata: analyses of ENSANUT data 2012. *J Epidemiol Community Health*. 2017;71(7):713-721.
6. Bonvecchio A, Safdie M, Monterrubio EA, Gust T, Villalpando S, Rivera JA. Overweight and obesity trends in Mexican children 2 to 18 years of age from 1988 to 2006. *Salud Publica Mex*. 2009;51 Suppl 4:S586-594.
7. Alyshia Gl. Eating NAFTA : trade, food policies, and the destruction of Mexico. In: Oakland, California: University of California Press;; 2018.
8. NAFTA. Publication of a mission report on the effects on human rights of the NAFTA. https://www.fidh.org/spip.php?page=article&id_article=3304. Published 2006. Accessed 7/6/2020.
9. Villareal MA. NAFTA and the Mexican Economy. <https://fas.org/sgp/crs/row/RL34733.pdf>. Published 2010. Accessed 7/6/2020.
10. Roberts E. Food is love: And so, what then? *BioSocieties*. 2015;10:247-252.
11. Yates-Doerr E. *The weight of obesity : hunger and global health in postwar Guatemala*. Oakland, California: University of California Press; 2015.
12. Sanabria EaY-D, E. Alimentary Uncertainties: From Contested Evidence to Policy. *Biosocietes*. 2015;10:117-124.
13. Hales CM, Fryar CD, Carroll MD, Freedman DS, Ogden CL. Trends in Obesity and Severe Obesity Prevalence in US Youth and Adults by Sex and Age, 2007-2008 to 2015-2016. *Jama*. 2018;319(16):1723-1725.
14. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. *Lancet*. 2017;390(10113):2627-2642.
15. Caballero B, Vorkoper S, Anand N, Rivera JA. Preventing childhood obesity in Latin America: an agenda for regional research and strategic partnerships. *Obes Rev*. 2017;18 Suppl 2(Suppl 2):3-6.
16. Chemas-Velez MM, Gómez LF, Velasquez A, Mora-Plazas M, Parra DC. Scoping review of studies on food marketing in Latin America: Summary of existing evidence and research gaps. *Rev Saude Publica*. 2020;53:107.

17. Vorkoper S, Arteaga S, Berrigan D, et al. Childhood Obesity Prevention Across Borders NIH Commentary. *Obesity Reviews*. 2021.
18. Tumilowicz A, Ruel MT, Pelto G, et al. Implementation Science in Nutrition: Concepts and Frameworks for an Emerging Field of Science and Practice. *Curr Dev Nutr*. 2019;3(3):nzy080.
19. Ogilvie D, Adams J, Bauman A, et al. Using natural experimental studies to guide public health action: turning the evidence-based medicine paradigm on its head. *J Epidemiol Community Health*. 2020;74(2):203-208.
20. Fielding-Singh P. A Taste of Inequality: Food's Symbolic Value Across the Socioeconomic System. *Sociological Science*. 2017;4:424-448.
21. Guthman J. *Weighing in : obesity, food justice, and the limits of capitalism*. Berkeley: University of California Press; 2011.
22. Kumanyika S, Taylor WC, Grier SA, et al. Community energy balance: a framework for contextualizing cultural influences on high risk of obesity in ethnic minority populations. *Prev Med*. 2012;55(5):371-381.
23. Bronfenbrenner U. Toward an experimental ecology of human development. *American Psychologist*. 1977;32(7):513-531.
24. Adair LS. Child and adolescent obesity: epidemiology and developmental perspectives. *Physiol Behav*. 2008;94(1):8-16.
25. Li L, Law C, Lo Conte R, Power C. Intergenerational influences on childhood body mass index: the effect of parental body mass index trajectories. *Am J Clin Nutr*. 2009;89(2):551-557.
26. Pérez-Escamilla R, Kac G. Childhood obesity prevention: a life-course framework. *Int J Obes Suppl*. 2013;3(Suppl 1):S3-s5.
27. Perez-Escamilla R, Bermudez O, Buccini GS, et al. Nutrition disparities and the global burden of malnutrition. *Bmj*. 2018;361:k2252.
28. Fordyce L, Berrigan D, Srinivasan S. Social Determinants of Health and the Environmental Exposures: A Promising Partnership. In: *Translational Toxicology and Therapeutics: Windows of Developmental Susceptibility in Reproduction and Cancer*. CL Wiley; 2017:395-414.
29. Jia P, Lakerveld J, Wu J, et al. Top 10 Research Priorities in Spatial Lifecourse Epidemiology. *Environ Health Perspect*. 2019;127(7):74501.
30. Ruiz JM, Steffen P, Smith TB. Hispanic mortality paradox: a systematic review and meta-analysis of the longitudinal literature. *Am J Public Health*. 2013;103(3):e52-60.
31. Dunton GF, Berrigan D, Young DR, et al. Strategies to Improve Physical Activity Surveillance among Youth in the United States. *J Pediatr*. 2019;210:226-231.
32. MacLean PS, Rothman AJ, Nicastro HL, et al. The Accumulating Data to Optimally Predict Obesity Treatment (ADOPT) Core Measures Project: Rationale and Approach. *Obesity (Silver Spring)*. 2018;26 Suppl 2(Suppl 2):S6-s15.
33. Duran A, Batis C, Corvalan C, et al. Food Environment Issues and Solutions for Childhood Obesity Prevention in Latin American and among Latinxs living in the United States. . *Obesity Reviews*. 2021.
34. Pérez-Escamilla R, Vilar-Compte M, Rhodes E, et al. Implementation Science in the Prevention and Control of Childhood Obesity: Implications for Intervention Research in the US and Latin America. . *Obesity Reviews*. 2021.

35. McKinnon RA, Reedy J, Berrigan D, Krebs-Smith SM. The National Collaborative on Childhood Obesity Research catalogue of surveillance systems and measures registry: new tools to spur innovation and increase productivity in childhood obesity research. *Am J Prev Med*. 2012;42(4):433-435.
36. Hawkins SS, Oken E., Gillman M.W. . Early in the Life Course: Time for Obesity Prevention. In: Halfon N. FC, Lerner R., Faustman E, ed. *Handbook of Life Course Health Development*. Cham (CH): Springer; 2018:169-196.
37. Saint-Maurice PFS, S.; Welk, G.; Matthews, C.E.; Berrigan, D. Report-based Measures of Physical Activity: Features, Challenges, Applications, and Resources. In: Brusseau TAF, S.; Luban, D.R, ed. *The Routledge Handbook of Youth and Physical Activity*. Milton Park: Routledge; 2020.
38. Spruijt-Metz D, Berrigan D, Kelly LA, et al. Measures of physical activity and exercise. In: Allison DB, ed. *Handbook of assessment methods for eating behaviors and weight-related problems: Measures, theory, and research*. Sage Publications; 2009.
39. Troiano RP, Stamatakis E, Bull FC. How can global physical activity surveillance adapt to evolving physical activity guidelines? Needs, challenges and future directions. *Br J Sports Med*. 2020;54(24):1468-1473.
40. Batis C, Mazariegos M, Martorell R, Gil A, Rivera JA. Malnutrition in all its forms by wealth, education and ethnicity in Latin America: who are more affected? *Public Health Nutr*. 2020;23(S1):s1-s12.
41. Brinsden H, Lobstein T, Landon J, et al. Monitoring policy and actions on food environments: rationale and outline of the INFORMAS policy engagement and communication strategies. *Obes Rev*. 2013;14 Suppl 1:13-23.
42. Center F. Childhood Obesity Prevention Across Borders: The Promise of US-Latin American Research Collaboration. <https://www.fic.nih.gov/About/center-global-health-studies/Pages/childhood-obesity-prevention-across-borders.aspx>. Published 2019. Accessed 7/3/2020.
43. Teutsch SM, Thacker SB. Planning a public health surveillance system. *Epidemiol Bull*. 1995;16(1):1-6.
44. Sorlie PD, Avilés-Santa LM, Wassertheil-Smoller S, et al. Design and implementation of the Hispanic Community Health Study/Study of Latinos. *Ann Epidemiol*. 2010;20(8):629-641.
45. Isasi CR, Carnethon MR, Ayala GX, et al. The Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth): design, objectives, and procedures. *Ann Epidemiol*. 2014;24(1):29-35.
46. SOL. <https://sites.csc.unc.edu/hchs/manuals-forms>. Published 2020. Accessed 11-23-2020.
47. Carlson JA, Hipp JA, Kerr J, Horowitz TS, Berrigan D. Unique Views on Obesity-Related Behaviors and Environments: Research Using Still and Video Images. *J Meas Phys Behav*. 2018;1(3):143-154.
48. Kinyoki DK, Ross, J.M., Lazzar-Atwood, A. et al. Mapping local patterns of childhood overweight and wasting in low- and middle-income countries between 2000 and 2017. *Nat Med*. 2020;26(5):750-759.
49. Hoelscher DM, Ranjit N, Pérez A. Surveillance Systems to Track and Evaluate Obesity Prevention Efforts. *Annu Rev Public Health*. 2017;38:187-214.

50. NCCOR. Measures Registry Users Suite. <https://www.nccor.org/nccor-tools/mrresourcesuite/>. Published 2020. Accessed 7/3/2020.
51. Foti KE, Perez CL, Knapp EA, et al. Identification of Measurement Needs to Prevent Childhood Obesity in High-Risk Populations and Environments. *Am J Prev Med*. 2020.
52. Brusseau TA, Fairclough SJ, Lubans DR. The Routledge handbook on pediatric physical activity. In: New York, NY: Routledge,; 2020.
53. Spruijt-Metz D, Wen CKF, Bell BM, Intille S, Huang JS, Baranowski T. Advances and Controversies in Diet and Physical Activity Measurement in Youth. *Am J Prev Med*. 2018;55(4):e81-e91.
54. McGuire S. Institute of Medicine. 2013. Evaluating obesity prevention efforts: a plan for measuring progress. Washington, DC: The National Academies Press, 2013. *Adv Nutr*. 2014;5(2):191-192.
55. SRC SRC. Guidelines for Best Practice in Cross-Cultural Surveys. <http://www.ccsgr.umich.edu>. Published 2016. Accessed 6/19/2020, 2020.
56. Arredondo EM, Mendelson T, Holub C, Espinoza N, Marshall S. Cultural adaptation of physical activity self-report instruments. *J Phys Act Health*. 2012;9 Suppl 1(Suppl 1):S37-43.
57. Willis GB, M. Stapleton Kudela, K. Levin, A. Norberg, D. S. Stark, B. H. Forsyth, P. Dean Brick, D. Berrigan, F. E. Thompson, D. Lawrence, A. Hartman. Evaluation of a Multi-Step Survey Translation Process. In: J.A. Harkness MB, B. Edwards, T. P. Johnson, L. Lyberg, P. Ph. Mohler, B.-Ellen Pennell, T. W. Smith, ed. *Survey Methods in Multinational, Multiregional, and Multicultural Contexts*. Wiley; 2010.
58. Willis G. *Cognitive Interviewing: A Tool for Improving Questionnaire Design*. Thousand Oaks, CA: Sage Publications; 2005.
59. Ramírez AS, Willis G, Rutten LF. Understanding Spanish-Language Response in a National Health Communication Survey: Implications for Health Communication Research. *J Health Commun*. 2017;22(5):442-450.
60. NCCOR. White Papers on Measurement Needs. <https://www.nccor.org/measurement-workshop-series/>. Published 2021. Accessed 7/5/2020.
61. Ballard RSSA, David Berrigan, Heather Devlin, Deborah A Galuska, Heather Hamner, Laura Kettel Khan, Latetia Freeman Moore, TusaRebecca Pannucci, Jill Reedy*, Amanda S. Sharfman. Challenges and Opportunities for Advancing Measurement to Address Childhood Obesity: Results of Three Workshops *American Journal Of Preventive Medicine*. 2021;Submitted.
62. NCCOR. <https://www.nccor.org/2020/10/28/new-from-nccor-measurement-for-children-at-high-risk-for-obesity-choosing-whether-to-apply-adapt-or-develop-a-measure/>. Published 2020. Accessed 11-3-2020.
63. Corvalán C, Garmendia ML, Jones-Smith J, et al. Nutrition status of children in Latin America. *Obes Rev*. 2017;18 Suppl 2(Suppl 2):7-18.
64. Aguilar-Farias N, Martino-Fuentealba P, Carcamo-Oyarzun J, et al. A regional vision of physical activity, sedentary behaviour and physical education in adolescents from Latin America and the Caribbean: results from 26 countries. *Int J Epidemiol*. 2018;47(3):976-986.
65. Center PR. *Smartphone Ownership and Internet Usage Continues to Climb in Emerging Economies*. 2016.

66. Vereecken CA, Keukelier E, Maes L. Influence of mother's educational level on food parenting practices and food habits of young children. *Appetite*. 2004;43(1):93-103.
67. Vereecken C, Rovner A, Maes L. Associations of parenting styles, parental feeding practices and child characteristics with young children's fruit and vegetable consumption. *Appetite*. 2010;55(3):589-596.
68. Sleddens EF, Gerards SM, Thijs C, de Vries NK, Kremers SP. General parenting, childhood overweight and obesity-inducing behaviors: a review. *Int J Pediatr Obes*. 2011;6(2-2):e12-27.
69. Larsen JK, Hermans RC, Sleddens EF, Engels RC, Fisher JO, Kremers SP. How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence? *Appetite*. 2015;89:246-257.
70. Gevers DW, Kremers SP, de Vries NK, van Assema P. Patterns of Food Parenting Practices and Children's Intake of Energy-Dense Snack Foods. *Nutrients*. 2015;7(6):4093-4106.
71. Xu H, Wen LM, Rissel C. Associations of parental influences with physical activity and screen time among young children: a systematic review. *J Obes*. 2015;2015:546925.
72. Gicevic S, Aftosmes-Tobio A, Manganello JA, et al. Parenting and childhood obesity research: a quantitative content analysis of published research 2009-2015. *Obes Rev*. 2016;17(8):724-734.
73. Roche K, M. Ensminger, and A. Cherlin. Variations in parenting and adolescent outcomes among African American and Latino families living in low-income, urban areas. *Journal of Family Issues*. 2007;28(7):882-909.
74. Domenech Rodríguez MM, Donovan MR, Crowley SL. Parenting styles in a cultural context: observations of "protective parenting" in first-generation Latinos. *Fam Process*. 2009;48(2):195-210.
75. Tschann JM, Martinez SM, Penilla C, et al. Parental feeding practices and child weight status in Mexican American families: a longitudinal analysis. *Int J Behav Nutr Phys Act*. 2015;12:66.
76. O'Connor TM, Cerin E, Lee RE, et al. Environmental and cultural correlates of physical activity parenting practices among Latino parents with preschool-aged children: Niños Activos. *BMC Public Health*. 2014;14:707.
77. Cerin E, Baranowski T, Barnett A, et al. Places where preschoolers are (in)active: an observational study on Latino preschoolers and their parents using objective measures. *Int J Behav Nutr Phys Act*. 2016;13:29.
78. Hartson KR, Gance-Cleveland B, Amura CR, Schmiede S. Correlates of Physical Activity and Sedentary Behaviors Among Overweight Hispanic School-aged Children. *J Pediatr Nurs*. 2018;40:1-6.
79. Hughes SO, Power TG, Orlet Fisher J, Mueller S, Nicklas TA. Revisiting a neglected construct: parenting styles in a child-feeding context. *Appetite*. 2005;44(1):83-92.
80. Hughes SO, Anderson CB, Power TG, Micheli N, Jaramillo S, Nicklas TA. Measuring feeding in low-income African-American and Hispanic parents. *Appetite*. 2006;46(2):215-223.
81. Larios SE, Ayala GX, Arredondo EM, Baquero B, Elder JP. Development and validation of a scale to measure Latino parenting strategies related to children's obesigenic behaviors. The parenting strategies for eating and activity scale (PEAS). *Appetite*. 2009;52(1):166-172.
82. Olvera N, Power TG. Brief report: parenting styles and obesity in Mexican American children: a longitudinal study. *J Pediatr Psychol*. 2010;35(3):243-249.

83. Tovar A, Hennessy E, Pirie A, et al. Feeding styles and child weight status among recent immigrant mother-child dyads. *Int J Behav Nutr Phys Act.* 2012;9:62.
84. Hughes SO, Power TG, O'Connor TM, Orlet Fisher J, Chen TA. Maternal Feeding Styles and Food Parenting Practices as Predictors of Longitudinal Changes in Weight Status in Hispanic Preschoolers from Low-Income Families. *J Obes.* 2016;2016:7201082.
85. Arlinghaus KR, Vollrath K, Hernandez DC, et al. Authoritative parent feeding style is associated with better child dietary quality at dinner among low-income minority families. *Am J Clin Nutr.* 2018;108(4):730-736.
86. Rivera J, de Cossío TG, Pedraza LS, Aburto TC, Sánchez TG, Martorell R. Childhood and adolescent overweight and obesity in Latin America: a systematic review. *Lancet Diabetes Endocrinol.* 2014;2(4):321-332.
87. Lopez NV, Schembre S, Belcher BR, et al. Parenting styles, food-related parenting practices, and children's healthy eating: A mediation analysis to examine relationships between parenting and child diet. *Appetite.* 2018;128:205-213.
88. Baumrind D. Current patterns of parental authority. *Developmental Psychology.* 1971;4(1):1-103.
89. Maccoby EE, Martin, J. . Socialization in the context of the family: Parent-child interaction. In: Mussen P, ed. *Handbook of child psychology.* Vol 3. 4th ed. New York: Wiley; 1983.
90. Arredondo EM, Elder JP, Ayala GX, Campbell N, Baquero B, Duerksen S. Is parenting style related to children's healthy eating and physical activity in Latino families? *Health Educ Res.* 2006;21(6):862-871.
91. van Bakergem M, Sommer EC, Heerman WJ, Hipp JA, Barkin SL. Objective reports versus subjective perceptions of crime and their relationships to accelerometer-measured physical activity in Hispanic caretaker-child dyads. *Prev Med.* 2017;95 Suppl:S68-s74.
92. Portes A RR. *Immigrant America: A portrait.* Los Angeles CA: UNiversity of California Press; 1996.
93. Schofield T, Beaumont K, Widaman K, Jochem R, Robins R, Conger R. Parent and child fluency in a common language: implications for the parent-child relationship and later academic success in Mexican American families. *J Fam Psychol.* 2012;26(6):869-879.
94. García-Preto N. *Ethnicity and family therapy* 2nd ed. New York: Guildford Press; 1996.
95. Falicov CJ. *Latino families in therapy: A guide to multicultural practice.* New York: Guilford Press; 1998.
96. Finkelstein JAS, Donenberg, G. R., & Martinovich, Z. Maternal control and adolescent depression: Ethnic differences among clinically referred girls. *Journal of Youth and Adolescence.* 2001;30:155-171.
97. Calzada EJ, Huang KY, Anicama C, Fernandez Y, Brotman LM. Test of a cultural framework of parenting with Latino families of young children. *Cultur Divers Ethnic Minor Psychol.* 2012;18(3):285-296.
98. Henry CS, Sheffield Morris, A., & Harrist, A. W. Family resilience: Moving into the third wave. *Family Relations.* 2015;64(1):22-43.
99. Jabaghourian JJ, Sorkhabi, N., Quach, W., & Strage, A. . Parenting styles and practices of Latino parents and Latino fifth graders' academic, cognitive, social, and behavioral outcomes. *Hispanic Journal of Behavioral Sciences.* 2014;36(2):175-194.

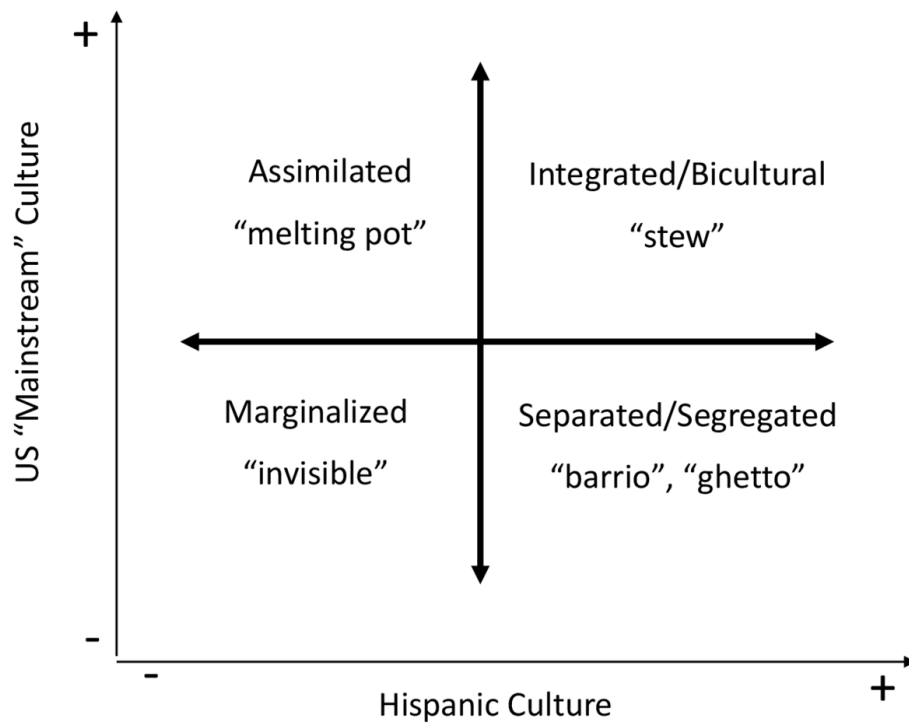
100. Davis AN, Carlo G, Knight GP. Perceived Maternal Parenting Styles, Cultural Values, and Prosocial Tendencies Among Mexican American Youth. *J Genet Psychol.* 2015;176(3-4):235-252.
101. Carlo G, White RMB, Streit C, Knight GP, Zeiders KH. Longitudinal Relations Among Parenting Styles, Prosocial Behaviors, and Academic Outcomes in U.S. Mexican Adolescents. *Child Dev.* 2018;89(2):577-592.
102. Kim Y, Calzada, E. J., Barajas-Gonzalez, R. G., Huang, K. Y., Brotman, L. M., Castro, A., & Pichardo, C. . The role of authoritative and authoritarian parenting in the early academic achievement of Latino students. *Journal of Educational Psychology.* 2018;110(1):119-132.
103. Gerards SM, Kremers SP. The Role of Food Parenting Skills and the Home Food Environment in Children's Weight Gain and Obesity. *Curr Obes Rep.* 2015;4(1):30-36.
104. Inhulsen MM, Mérelle SY, Renders CM. Parental feeding styles, young children's fruit, vegetable, water and sugar-sweetened beverage consumption, and the moderating role of maternal education and ethnic background. *Public Health Nutr.* 2017;20(12):2124-2133.
105. Hughes SO, Cross MB, Hennessy E, Tovar A, Economos CD, Power TG. Caregiver's Feeding Styles Questionnaire. Establishing cutoff points. *Appetite.* 2012;58(1):393-395.
106. Hughes SO, Shewchuk RM, Baskin ML, Nicklas TA, Qu H. Indulgent feeding style and children's weight status in preschool. *J Dev Behav Pediatr.* 2008;29(5):403-410.
107. Hennessy E, Hughes SO, Goldberg JP, Hyatt RR, Economos CD. Parent behavior and child weight status among a diverse group of underserved rural families. *Appetite.* 2010;54(2):369-377.
108. Johnson BA H, Lopez BA, B., & Garcia, R. A review of the Caregiver's Feeding Style Questionnaire (CFSQ): Differences in parent-child feeding styles across geographic location, caregiver roles, and Head Start samples. <https://digitalcommons.unf.edu/cgi/viewcontent.cgi?article=1080&context=soars>. Published 2020. Accessed 6/19/2020.
109. Darling N, Steinberg, L. . Parenting style as context: An integrative model. *Psychological bulletin.* 1993;113(3):487-496.
110. Birch LL, Fisher JO, Grimm-Thomas K, Markey CN, Sawyer R, Johnson SL. Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite.* 2001;36(3):201-210.
111. Anderson CB, Hughes SO, Fisher JO, Nicklas TA. Cross-cultural equivalence of feeding beliefs and practices: the psychometric properties of the child feeding questionnaire among Blacks and Hispanics. *Prev Med.* 2005;41(2):521-531.
112. O'Connor TM, Pham T, Watts AW, et al. Development of an item bank for food parenting practices based on published instruments and reports from Canadian and US parents. *Appetite.* 2016;103:386-395.
113. Mâsse LC, O'Connor TM, Tu AW, et al. Are the Physical Activity Parenting Practices Reported by US and Canadian Parents Captured in Currently Published Instruments? *J Phys Act Health.* 2016;13(10):1070-1078.
114. Musher-Eizenman D, Holub S. Comprehensive Feeding Practices Questionnaire: validation of a new measure of parental feeding practices. *J Pediatr Psychol.* 2007;32(8):960-972.
115. Baughcum AE, Powers SW, Johnson SB, et al. Maternal feeding practices and beliefs and their relationships to overweight in early childhood. *J Dev Behav Pediatr.* 2001;22(6):391-408.

116. Tschann JM, Gregorich SE, Penilla C, et al. Parental feeding practices in Mexican American families: initial test of an expanded measure. *Int J Behav Nutr Phys Act*. 2013;10:6.
117. Hendy HM, Williams KE, Camise TS, Eckman N, Hedemann A. The Parent Mealtime Action Scale (PMAS). Development and association with children's diet and weight. *Appetite*. 2009;52(2):328-339.
118. Monge-Rojas R, Smith-Castro V, Colon-Ramos U, Garita-Arce C, Sánchez-López M, Chinnock A. Parental feeding styles and adolescents' healthy eating habits. Structure and correlates of a Costa Rican questionnaire. *Appetite*. 2010;55(2):253-262.
119. O'Connor T, Perez O, Garcia IC, Gallagher M. Engaging Latino Fathers in Children's Eating and Other Obesity-Related Behaviors: a Review. *Curr Nutr Rep*. 2018;7(2):29-38.
120. Khandpur N, Blaine RE, Fisher JO, Davison KK. Fathers' child feeding practices: a review of the evidence. *Appetite*. 2014;78:110-121.
121. Ferrer RA, Green PA, Oh AY, Hennessy E, Dwyer LA. Emotion suppression, emotional eating, and eating behavior among parent-adolescent dyads. *Emotion*. 2017;17(7):1052-1065.
122. Portes A. Migration in the contemporary history of Latin America: An overview of recent trends." *LASA Forum*. 2017;48(2):12-14.
123. Flores A. How the U.S. Hispanic population is changing. In. Vol 20202017.
124. Abraído-Lanza AF, Armbrister AN, Flórez KR, Aguirre AN. Toward a theory-driven model of acculturation in public health research. *Am J Public Health*. 2006;96(8):1342-1346.
125. Culley L. Transcending transculturalism? Race, ethnicity and health-care. *Nurs Inq*. 2006;13(2):144-153.
126. Park RE. HUMAN MIGRATION AND THE MARGINAL MAN. *American Journal of Sociology*. 1928;33(6):881-893.
127. Cuellar I, Arnold B, Maldonado R. ACCULTURATION RATING-SCALE FOR MEXICAN-AMERICANS II - A REVISION OF THE ORIGINAL ARSMA SCALE. *Hispanic Journal of Behavioral Sciences*. 1995;17(3):275-304.
128. Beck CT. Acculturation: implications for perinatal research. *MCN Am J Matern Child Nurs*. 2006;31(2):114-120.
129. Pérez-Escamilla R, Putnik P. The role of acculturation in nutrition, lifestyle, and incidence of type 2 diabetes among Latinos. *J Nutr*. 2007;137(4):860-870.
130. Zane NaM, W. Major approaches to the measurement of acculturation among ethnic minority populations: a content analysis and an alternative empirical strategy. In: Chun KM BOP, Marín G, , ed. *Acculturation: advances in theory, measurement and applied research.*: American Psychological Association; 2003:39-60.
131. Satia-Abouta J, Patterson RE, Neuhouser ML, Elder J. Dietary acculturation: applications to nutrition research and dietetics. *J Am Diet Assoc*. 2002;102(8):1105-1118.
132. Berrigan D, Dodd K, Troiano RP, Reeve BB, Ballard-Barbash R. Physical activity and acculturation among adult Hispanics in the United States. *Res Q Exerc Sport*. 2006;77(2):147-157.
133. Oh A, Dodd K, Ballard-Barbash R, Perna FM, Berrigan D. Language use and adherence to multiple cancer preventive health behaviors among Hispanics. *J Immigr Minor Health*. 2011;13(5):849-859.

134. Goel MS, McCarthy EP, Phillips RS, Wee CC. Obesity among US immigrant subgroups by duration of residence. *Jama*. 2004;292(23):2860-2867.
135. Barcenas CH, Wilkinson AV, Strom SS, et al. Birthplace, years of residence in the United States, and obesity among Mexican-American adults. *Obesity (Silver Spring)*. 2007;15(4):1043-1052.
136. Ayala GX, Elder JP, Campbell NR, et al. Correlates of body mass index and waist-to-hip ratio among Mexican women in the United States: implications for intervention development. *Womens Health Issues*. 2004;14(5):155-164.
137. Popkin BM, Udry JR. Adolescent obesity increases significantly in second and third generation U.S. immigrants: the National Longitudinal Study of Adolescent Health. *J Nutr*. 1998;128(4):701-706.
138. McLeod DL, Buscemi J, Bohnert AM. Becoming American, becoming obese? A systematic review of acculturation and weight among Latino youth. *Obes Rev*. 2016;17(11):1040-1049.
139. Schwartz SJ, Unger JB, Zamboanga BL, Szapocznik J. Rethinking the concept of acculturation: implications for theory and research. *Am Psychol*. 2010;65(4):237-251.
140. Vilar-Compte M, Macinko J, Weitzman BC, Avendaño-Villela CM. Short relative leg length is associated with overweight and obesity in Mexican immigrant women. *Int J Equity Health*. 2019;18(1):103.
141. Wallace PM, Pomery EA, Latimer AE, Martinez JL, Salovey P. A Review of Acculturation Measures and Their Utility in Studies Promoting Latino Health. *Hisp J Behav Sci*. 2010;32(1):37-54.
142. Cuéllar I HL, Jasso R. An acculturation scale for Mexican American and clinical populations. *Hispanic Journal of Behavioral Sciences*. 1980;2:199-217.
143. Marín G SF, Marín B, Otero-Sabogal R, Perez-Stable E. Development of a short acculturation scale for Hispanics. *Hispanic Journal of Behavioral Sciences*. 1987;9:183-205.
144. Marín G GT. A new measurement of acculturation for Hispanics: The Bidimensional Acculturation Scale for Hispanics (BAS). *Hispanic Journal of Behavioral Sciences*. 1996;18:297-316.
145. Cuéllar I AB, González G. Cognitive referents of acculturation: Assessment of cultural constructs in Mexican Americans. *Journal of Community Psychology*. 1995;23:339-355.
146. Hazuda HP, Haffner SM, Stern MP, Eifler CW. Effects of acculturation and socioeconomic status on obesity and diabetes in Mexican Americans. The San Antonio Heart Study. *Am J Epidemiol*. 1988;128(6):1289-1301.
147. Unger J GP, Shakib S, Ritt-Olson A, Palmer P, Johnson C. A new measure of acculturation for adolescents in a multicultural society. *Journal of Early Adolescence*. 2002;22:225-251.
148. Thomson MD, Hoffman-Goetz L. Defining and measuring acculturation: a systematic review of public health studies with Hispanic populations in the United States. *Soc Sci Med*. 2009;69(7):983-991.
149. Carter-Pokras O, Bethune L. Defining and measuring acculturation: a systematic review of public health studies with Hispanic populations in the United States. A commentary on Thomson and Hoffman-Goetz. *Soc Sci Med*. 2009;69(7):992-995; discussion 999-1001.
150. Castro FG, Marsiglia FF, Kulis S, Kellison JG. Lifetime segmented assimilation trajectories and health outcomes in Latino and other community residents. *Am J Public Health*. 2010;100(4):669-676.

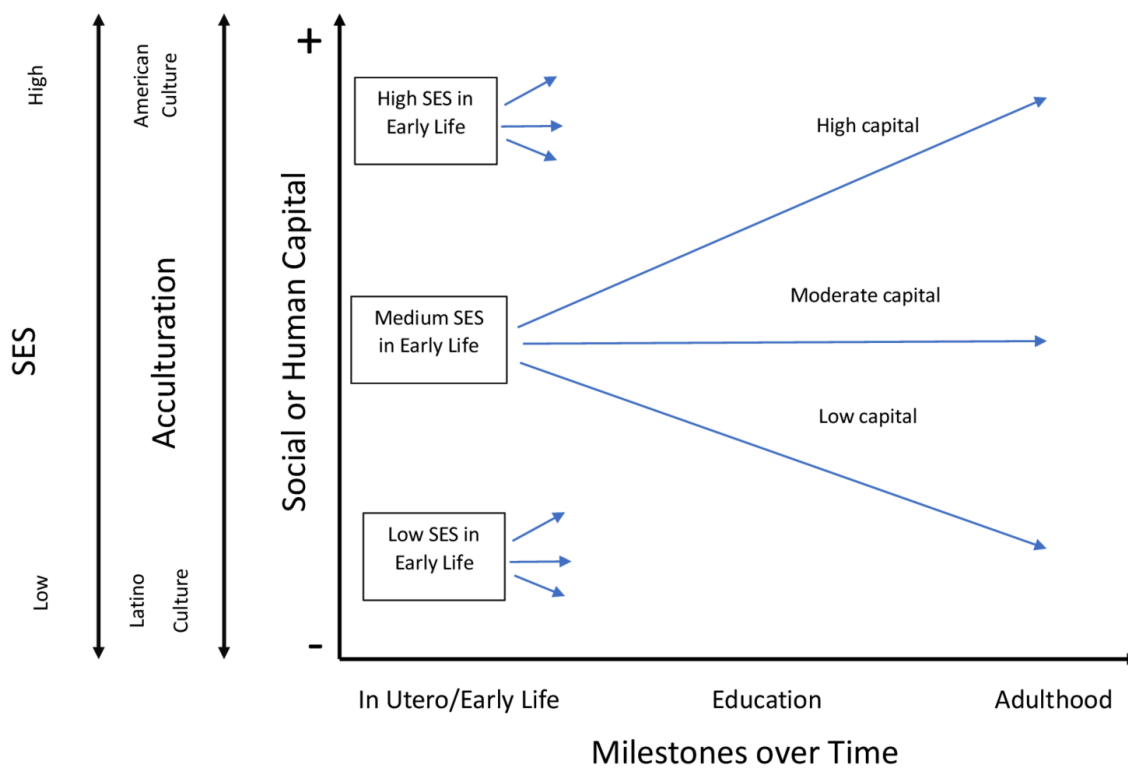
151. 2017 P. <https://www.pewsocialtrends.org/2017/05/18/1-trends-and-patterns-in-intermarriage/>. Published 2017. Accessed 7/6/2020.
152. Norman S, Castro C, Albright C, King A. Comparing acculturation models in evaluating dietary habits among low-income Hispanic women. *Ethn Dis*. 2004;14(3):399-404.
153. Hunt LM, Schneider S, Comer B. Should "acculturation" be a variable in health research? A critical review of research on US Hispanics. *Soc Sci Med*. 2004;59(5):973-986.
154. Zaragoza-Martí A, Cabañero-Martínez MJ, Hurtado-Sánchez JA, Laguna-Pérez A, Ferrer-Cascales R. Evaluation of Mediterranean diet adherence scores: a systematic review. *BMJ Open*. 2018;8(2):e019033.
155. Oliver M, Badland H, Mavoa S, Duncan MJ, Duncan S. Combining GPS, GIS, and accelerometry: methodological issues in the assessment of location and intensity of travel behaviors. *J Phys Act Health*. 2010;7(1):102-108.
156. Hammersley MaA, Paul. *Ethnography: Principles in Practice*. London: Routledge; 2019.
157. Dransart P, ed *Andean art : visual expression and its relation to Andean beliefs and values*. Brookfield, USA: Avebury; 1995. Worlwide Archaeology Series; No. 13.
158. Davis Dn-A, Craven C. Feminist ethnography : thinking through methodologies, challenges, and possibilities. In: Lanham, MD: Rowman & Littlefield,; 2016.
159. Jansen EC, Marcovitch H, Wolfson JA, et al. Exploring dietary patterns in a Mexican adolescent population: A mixed methods approach. *Appetite*. 2020;147:104542.
160. Téllez-Rojo MM, Trejo-Valdivia B, Roberts E, et al. Influence of post-partum BMI change on childhood obesity and energy intake. *PLoS One*. 2019;14(12):e0224830.
161. Freudenberg N. *Lethal but legal : corporations, consumption, and protecting public health*. Oxford ; New York: Oxford University Press; 2014.
162. Zazueta M. De Coca-Cola a Vampi-Cola: políticas, negocios, y el consumo de refrescos y azúcar en México *Apuntes CECYP*. 2012;22:35-55.
163. Smart B. *Consumer society : critical issues and environmental consequences*. Los Angeles: SAGE; 2010.
164. Roberts EFS. What Gets Inside: Violent Entanglements and Toxic Boundaries in Mexico City. *Cultural Anthropology*. 2017;32(4):592-619.
165. Vilar-Compte M, Bustamante A, López-Olmedo N, et al. Migration as a Determinant of Childhood Obesity in the US and Latin America. . *Obesity Reviews*. 2021.
166. King AC, Winter SJ, Sheats JL, et al. Leveraging Citizen Science and Information Technology for Population Physical Activity Promotion. *Transl J Am Coll Sports Med*. 2016;1(4):30-44.

Figure 1. Multidirectional conceptual model depicting four distinct acculturation pathways among Latinos migrating to the US. Latinos can acculturate into the mainstream European American culture retaining or not their cultural roots and assimilating or not to mainstream culture in “new” country. Adapted from Beck (2006) and Perez Escamilla and Putnick (2007).



OBR_13242_Measurement.Cross Border.Measurement. Figure 1.tiff

Figure 2. A developmental field model of segmented assimilation trajectories highlighting potential differences in trajectories related to SES, wealth and diverse measures of acculturation associated with different baseline levels sociocultural position and different outcomes in a new setting. Individuals differ in SES and acculturations and develop different levels of human or social capital over time (Castro et. al. 2010).



OBR_13242_Measurement.Cross Border.Measurement. Figure 2.tiff