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A Biobehavioral Approach to Understanding Obesity and the Development of Obesogenic Illnesses Among Latino Immigrants in the United States

Karen T. D'Alonzo, PhD, RN, APNC¹, Shanda Johnson, RN, MSN¹, and Dany Fanfan, RN, BSN²

¹College of Nursing, Rutgers, The State University of New Jersey, Newark, NJ, USA

²Florida International University, Miami, FL, USA

Abstract

The prevalence of obesity and obesity-related illnesses is higher among Hispanics (Latinos) than other racial and ethnic groups, and rates increase exponentially with the number of years living in the United States. Mounting evidence suggests that the origins of many chronic illnesses among disadvantaged minority groups may lie with cumulative exposure to chronic psychological and physiological stressors through the biobehavioral process of allostatic load (AL). Among immigrant Latinos, acculturation stress may contribute to an increase in AL and thus may be an independent risk factor for the development of obesity and obesogenic illnesses. The purpose of this theoretical article is to present a proposed model of the effects of acculturation stress on AL and obesity among Latino immigrants. Such a model can be useful to guide intervention efforts to decrease obesity among immigrant Latinos by adding education, skill building, and social integration strategies to healthy eating and physical activity to reduce the deleterious impact of acculturation stress.

Keywords

allostatic load; obesity; Latinos; acculturation stress

Over the past 25 years, the prevalence of obesity has reached pandemic proportions, affecting all races, ethnicities, and socioeconomic classes. Obesity is now the second leading cause of preventable death in the United States (Mokdad, Marks, Stroup, & Gerberding, 2004); it has been associated with the development of more than 20 chronic illnesses, from type 2 diabetes mellitus and cardiovascular disease to arthritis, obstructive sleep apnea, and certain cancers (Wyatt, Winters, & Dubbert, 2006). However, the prevalence of obesity and obesity-related illnesses is higher among Hispanics (Latinos)¹ than other racial and ethnic

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Corresponding Author: Karen T. D'Alonzo, PhD, RN, APNC, College of Nursing, Rutgers, The State University of New Jersey, Newark, NJ 07102, USA, kdalonzo@rutgers.edu.

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Note

groups, and rates increase exponentially with the number of years living in the United States (Centers for Disease Control and Prevention [CDC], 2008).

The disproportionately large percentage of Latinos affected by obesity and obesogenic illnesses is a significant public health concern related to racial and ethnic health disparities. Mounting evidence suggests that a key factor in the genesis of chronic illnesses among disadvantaged minority groups may lie with cumulative exposure to chronic psychological and physiological stressors through the biobehavioral process of allostatic load (AL; McEwen, 1998; Shonkoff, Boyce, & McEwen, 2011). AL is conceptualized as the sum of the physiological consequences of exposure to chronic stress (McEwen, 2000). Among immigrant Latinos, acculturation stress may contribute to the development of AL, which increases the risk of obesity (Björntorp, 2001). Sources of acculturation stress include language barriers, racism and discrimination, low socioeconomic status and income inequality, low perceived control over employment, separation from family, and fear of deportation (D'Alonzo, 2012). AL appears to increase dramatically among Latinos following immigration to the United States, concurrent with the onset of acculturation stress (Kaestner, Pearson, Keene, & Geronimus, 2009; Peeke et al., 2010). Immigrants with low levels of education who suffer from frustrated social expectations are more likely to continue to experience chronically high levels of acculturation stress than more highly educated immigrants over an indefinite period of time. According to the model of allostatic load, acculturation stress may therefore be seen, not only as a barrier to health-promoting lifestyles but also as an independent risk factor for the development of obesity and obesogenic illnesses among immigrant Latinos. This link is particularly evident when individuals adopt unhealthy habits such as sedentary behavior and high calorie, low nutrient diets as a means to cope with acculturation stress.

The purpose of this theoretical article is to present a proposed model of the effects of acculturation stress on AL and obesity among Latino immigrants. Such a model can be useful to guide intervention efforts to decrease obesity among immigrant Latinos.

Method

In this article, we review the current literature related to acculturation stress and AL as a framework for explaining the high prevalence of obesity and obesity-related illnesses among Latino immigrants. We performed literature searches using PubMed and CINAHL databases in order to identify peer-reviewed manuscripts that addressed physiological responses to acculturation stress among Latinos and their relationship to obesity. Keywords included *allostasis*, *allostatic load*, *stress response*, *acculturation*, *acculturation stress*, *obesity*, and *Hispanics or Latino immigrants*. We reviewed papers written in English and primarily limited our search to those published within the last 15 years.

¹.To maintain consistency with the terminology used by the U.S. Census Bureau, we use the terms Hispanic and Latino/Latina interchangeably in this article.

Background

Latinos, or people of Hispanic descent, comprise the largest and fastest growing minority group in the United States. According to the 2010 census, close to 50.5 million people in the United States self-identify as Hispanic or Latino, a figure that has increased by 43% since 2000 (U.S. Census Bureau, 2011). The total Hispanic population in the United States can be further divided into (1) native Hispanics (persons born in the country who are of Hispanic ancestry) and (2) foreign-born Hispanics who have immigrated to the United States and who may or may not have acquired U.S. citizenship (Pew Hispanic Center, 2011). Based on estimates from 2008, approximately 47% of Latino adults living in the United States are native born. An estimated 8.8 million foreign-born Latinos living in the United States are undocumented.

Latinos in general account for half of the population growth in the United States since 2000 (U.S. Census Bureau, 2011). Much of this growth has been among foreign-born residents and is best explained by both a rise in immigration and high birth rates. Immigrant Latinos in the United States are a heterogeneous group, representing all of the 21 Spanish-speaking countries of the world. Almost 60% of the Latino immigrant population in the United States is from Mexico, with significant numbers from other Central and South American countries. Of the more than 1 million Dominicans and 1.6 million Cubans living in the United States, 60% are foreign-born. Close to 10% of Latinos in the United States are Puerto Ricans, who are considered citizens at birth.

A decade ago, the Institute of Medicine issued the first major report to address large and persistent gaps in health status among Americans of different racial and ethnic groups (Smedley, Stith, & Nelson, 2002). The report confirmed the presence of long-standing disparities in health status between Blacks, Hispanics, Asian and Pacific Islanders, and Native Americans and Whites. Concurrently, researchers documented the existence of the “Hispanic paradox” (Markides & Coreil, 1986; Taningco, 2007). This phrase refers to the seemingly contradictory finding that Latinos in the United States tend to have better health and mortality outcomes than the general population despite their lower socioeconomic status. Recent studies have concluded that Latinos in the United States generally do have lower mortality rates from chronic illnesses associated with obesity such as heart disease, stroke, and most cancers but that they also have higher morbidity rates from these illnesses as compared with the overall U.S. population (Franzini, Ribble, & Keddle, 2001). Likewise, research has demonstrated that, as the length of residence in the United States increases, so does the prevalence of chronic obesogenic health conditions and functional limitations. For example, rates of cardiovascular disease among Latinos increase with the length of time spent living in the United States (Koya & Egede, 2007). Likewise, National Health and Nutrition Examination Survey III (NHANES III) data demonstrate that a significant positive correlation exists between acculturation and rates of type 2 diabetes mellitus among non-Mexican origin Latinos (Kandula et al., 2008).

Acculturation and Acculturation Stress

Immigration may be viewed as a complex, transitional process (Jones, Zhang, & Meleis, 2003), characterized by a change in geographical locale and profound alterations in lifestyle.

Acculturation has been defined as a normative process that occurs when a person from one culture comes in contact with another culture (Berry, 1989). It has long been acknowledged that acculturative changes occur, not only in the immigrant as she or he adapts from the home to host country but also in those persons who come in contact with the immigrant (Redfield, Linton, & Herskovits, 1936). Acculturation may occur in various ways. Berry (1997) identified four strategies immigrants use during the acculturation process: (1) *Assimilation*—the immigrant rejects the culture of origin and adopts the cultural norms of the host culture; (2) *Separation*—the immigrant rejects the host culture in favor of preserving the culture of origin; (3) *Integration*—the immigrant adopts the cultural norms of the host culture while maintaining the culture of origin; and (4) *Marginalization*—the immigrant rejects both the culture of origin and the host culture. Portes and Rumbaut (2006) refer specifically to one process known as “selective acculturation,” a situation in which the immigrant combines the most advantageous aspects of both the host culture and the home culture. In this model, acculturation occurs at a gradual pace and there is an equal acceptance of both languages and cultures. Selective acculturation (also referred to as selective biculturalism), which may well be the most salutogenic form of adaptation for new immigrants, may also play a significant role in the prevention of obesity-related chronic illnesses among Latinos. For example, individuals who retain healthy eating habits and physical activity behaviors from their home country and combine them with selected health habits learned in the United States are more likely to maintain a near normal weight and therefore prevent the onset of obesogenic illnesses.

Although acculturation is sometimes used as a proxy for acculturation stress (Caplan, 2007), empirical evidence suggests that it is not the acculturation process itself but the stress of adapting to life in a new country that has the greatest impact on the physical and emotional health of Latino immigrants. Berry (1970) defined acculturation stress as a struggle to reconcile the culture of origin with the host culture that often manifests in anxiety, depression, and other forms of mental and physical distress. In a study among Hispanic psychiatric patients, Thoman and Suris (2004) reported that acculturation stress was predictive of psychological distress and quality of life with regard to mental health, while acculturation level was not predictive of any of the dependent variables. D'Alonzo and Smith (2012) found that the level of acculturation stress, not acculturation, was the strongest predictor of participation in a physical activity intervention among immigrant Latinas. Acculturation stress has been well documented among immigrant Latinos (Arbona et al., 2010; Leuck & Wilson, 2007), particularly as a predictor of mental health and substance abuse issues (Finch & Vega, 2003; Hovey, 2000). The types of stressors immigrants experience may include instrumental and environmental stressors (including financial stressors, language barriers, lack of access to health care, unsafe neighborhoods, unemployment, exploitation, and dangerous working conditions), social and interpersonal stressors (such as loss of social networks, social status, family support, and the presence of intergenerational and gender-related conflicts), and societal stressors (specifically ethnic and racial discrimination and fear of deportation; Caplan, 2007).

Acculturation stress can be an intense and enduring process. In a phenomenological study among adolescent female Mexican immigrants (Skuza, 2007), participants described the process of acculturation stress as a “fatiguing experience requiring a constant stream of

bodily energy.” The assumption that acculturation stress should decrease with length of time in the host country does not appear to hold true. Desjarlais, Eisenberg, Good, and Kleinman (1995) identified four specific circumstances in which immigrants are most likely to experience acculturation stress: (1) undesirable pre-immigration experiences that led to relocation; (2) unpleasant experiences encountered during the passage to a new country; (3) negative postmigration experiences seeking housing, work, or education; and (4) negative postmigration experiences involving unemployment, poor social support, or racial or ethnic discrimination. The intensity and duration of levels of acculturation stress are highly dependent upon additional factors such as race (Dawson & Panchanadeswaran, 2010), education and socioeconomic level (Leuck & Wilson, 2007), age at time of immigration (Mui & Kang, 2006), stress coping (Miranda & Matheny, 2000), social support (Finch & Vega, 2003), and the degree to which the immigrants are content with their decision to live in the United States (Hovey & Magaña, 2000). Marin (1993) noted that some immigrants may appear more eager to become acculturated, not because of personal interest or inclination but due to political, social, or economic pressure to do so. In general, young children experience less acculturation stress than do teenagers and adults because they have yet to develop a strong cultural identity and have had limited cultural experiences in their home country (Kurtz-Costes & Pungello, 2001; Mena, Padilla, & Maldonado, 1987). In summary, these findings suggest that immigrants with lower levels of education who do not attain higher levels of socioeconomic success through immigration or who experience chronic negative social evaluation are more likely to continue to experience high levels of acculturation stress over a longer period of time.

Among some immigrant Latinos, there are unique stressors related to documentation status. According to Sullivan and Rehm (2005), undocumented Mexican immigrants are (1) more likely to have experienced a traumatic event, (2) more vulnerable to exploitation, (3) less likely to have adequate economic and social resources, and (4) more marginalized than legal immigrants. Arbona et al. (2010) found that about one third of the undocumented Latino immigrants in their study reported avoiding activities such as walking in the street or requesting services from government agencies for fear of deportation. Given that more than 60% of adult illegal immigrants have lived in the United States for at least 10 years and nearly half have minor children, acculturation stress can become a long-term problem among the undocumented.

AL

Sterling and Eyer (1988) proposed the concept of allostasis to describe a short-term, physiological “fight or flight response” to a perceived challenge to body functioning. Although the terms allostasis and homeostasis are often used interchangeably, allostasis is really an extension of the concept of homeostasis, a dynamic process of adaptation that involves the production of stress hormones that act to restore homeostasis (McEwen, 2002). Allostasis is thus a normative process; it is the bodily mechanism by which humans and other organisms cope with short-term physiological and psychological stress. Primary mediators of allostasis include the hormones of the hypothalamic–pituitary–adrenal (HPA) axis, catecholamines, and cytokines (McEwen & Wingfield, 2003). Following an encounter with a stressful stimulus, the locus ceruleus in the brain stem responds by increasing

norepinephrine secretion, which in turn activates the HPA axis and increases the sympathetic discharge. The release of norepinephrine also stimulates the secretion of corticotropin-releasing factor (CRF) from the hypothalamus, which induces adrenocorticotrophic hormone release from the pituitary and production of cortisol in the adrenal glands (Chrousos & Gold, 1992). Although stressful stimuli may trigger a cascade of various neurotransmitters and hormones, the catecholamines and cortisol have received particular attention in the allostatic stress response. In the event of a short-term stressful situation, the allostatic stress response is no longer needed once the stressor has been resolved and bio-chemical mediator activity subsides (Sapolsky, Romero, & Munck, 2000).

There is, however, some disagreement regarding the processes of biochemical adaptation in the presence of long-term stressors. Most authors have hypothesized that chronic stress may trigger the metabolic syndrome and obesogenic diseases through a sustained increase in the output of cortisol, leading to tissue damage and dysregulation of biological systems. This line of thinking is derived from Selye's (1956) original work in stress theory and is supported by McEwen (1998) and others (Sapolsky, Romero, & Munck, 2000; Sterling & Eyer, 1988). However, according to the attenuation hypothesis (Susman, 2006), chronic stress may actually trigger a decline in cortisol production and a flattening of the expected daily rhythm (Gunnar & Vasquez, 2001; Heim, Ellert, & Helhammer, 2000; Yehuda, 2000), resulting in hypocortisolism. Miller, Chen, and Zhou (2007) support the attenuation hypothesis, suggesting that factors such as length of exposure to the stressor, nature of the threat, emotions elicited by stress, controllability of the stressor, and individual psychiatric sequelae may play a role in increasing or decreasing HPA-axis activity. For example, with long-term stress, the HPA-axis negative feedback mechanism may inhibit production of CRF and adrenocorticotrophic hormone (ACTH) by acting on glucocorticoid receptors in the hippocampus, hypothalamus, and pituitary. Hypocortisolism may have its own deleterious effects on the body. McEwen (2002) notes that in animal models, low cortisol levels are associated with diseases thought to be caused by hyperactivity of the immune system. In addition, several features of the metabolic syndrome are associated with a pro-inflammatory state, which has in turn been associated with an increased risk for cardiovascular disease (Das, 2002; Grundy, 2002).

In contemporary society, the perceived stressor is most often psychological in nature and is frequently long standing or repetitive. Examples of such stressors include social conflicts, low socioeconomic status, domestic abuse, unemployment, or employment in so-called dead-end jobs where there is little or no chance of recognition or promotion. In the Whitehall II Study conducted among low-level civil service workers in London, employees with chronic work stress were significantly more likely to suffer from metabolic syndrome than those without stress (Chandola, Brunner, & Marmot, 2006). The stressor may also simply represent a potential threat to the individual's functioning, demonstrating how powerful an effect perception, thought, and emotion have in the stress response. McEwen and Lasley (2002, p. 34) noted that humans appear to be the only organisms that can "become stressed from things that exist in idea only."

AL is the collective term used to refer to damage incurred by the body as it adapts to such psychosocial or physical stressors. Increased AL reflects a situation where (1) the stress

itself goes on for an extended period, (2) the body does not recognize the stressor as having been resolved, or (3) the body's mechanisms for shutting off the stressor are not functioning (McEwen, 2000). Repeated exposure to long-term psychosocial or physical stressors is accompanied by a release of catecholamines and cortisol, resulting in increases in blood pressure, the deposition of fat in the abdomen and atherosclerosis (McEwen, 1998). These physiological processes set the stage for weight gain and obesogenic illnesses such as type 2 diabetes mellitus and cardiovascular disease, which are characteristic of the metabolic syndrome. Figure 1 illustrates the biopsychosocial processes that contribute to increased AL.

The excess production of cortisol further results in leptin-resistant obesity, possibly due to an imbalance in the brain's supply of leptin and neuropeptide Y (NPY), favoring the latter (McEwen & Lasley, 2002). Sleep deprivation, which often accompanies stressful situations, may also contribute to the relative decrease in leptin (Gangwisch, Malaspina, Boden-Albala, & Heymsfield, 2005). In these scenarios, the excess NPY promotes "stress eating" (McEwen & Lasley, 2002), the consumption of high fat, high calorie foods, which further exacerbates weight gain. This cascade of biochemical mediator-induced damage continues in other ways as well. With repeated exposure to chronic stress and elevated cortisol levels, the amygdala (the area of the brain responsible for storage of long-term memories of adverse events) becomes unable to distinguish between a genuinely stressful situation and a relatively harmless one, further increasing stress levels.

Precise measurement of allostasis and AL requires an understanding of the differences between the two concepts. Measurement of allostasis refers to an assessment of the response profiles of the primary mediators of the stress response such as catecholamines, glucocorticoids, and some cytokines. Alternatively, measurement of AL focuses on the tissues and organs that show the effects of overexposure to the mediators of allostasis and is most often expressed as a composite biomeasure of selected cardiovascular, metabolic, inflammatory, and stress hormone parameters. Examples of these biomarkers include body mass index (BMI), systolic and diastolic blood pressure, glycosylated hemoglobin, triglycerides, total cholesterol, C-reactive protein, and homocysteine.

The selection of specific biomarkers for an assessment of AL depends upon the intensity and duration of the stressors under investigation and/or the disease process under study. Blood pressure, heart rate, and pulse are commonly measured indicators of cardiovascular functioning. Cholesterol and triglycerides along with fasting glucose and glycosylated hemoglobin provide information on metabolic processes and are commonly used to evaluate the risk of coronary heart disease. Interleukin-6 and C-reactive protein, measures of the inflammatory response, may also be assessed because of their role in the development of obesity and the metabolic syndrome. Body measurements such as weight, BMI, and waist-to-hip ratio serve as indicators of obesity, chronic metabolic disorders, and atherosclerosis. Increasingly, it appears that AL is most likely characterized by dysregulation of multiple biological regulatory systems rather than by a single biological parameter (Seeman et al., 2010). For this reason, there are a number of algorithms in use (Szanton, Gill, & Allen, 2005), most of which sum up the scores obtained on various individual measures of AL to give a composite score.

Implicit in an appreciation of the effects of AL on the brain and on human behavior is an understanding of neuroplasticity. The term refers to the ability of the brain and nervous system to change structurally and functionally to meet the demand of environmental stressors (Shaw & McEachern, 2001). Adaptive changes in the brain occur in response to short-term stressors, but these changes become maladaptive in the presence of long-term stressors. In animal models, for example, researchers have demonstrated that chronic stress causes plastic remodeling of the hippocampus, resulting in an impaired ability to process information and make decisions about new stressors and increasing HPA activity, which further exacerbates the actions of adrenal steroids (McEwen, 2007). Wood, Norris, Waters, Stoldt, and McEwen (2008) found that chronic stress increased aggression among animals living in the same cage, likely because of hyperactivity of the amygdala. From studies in humans, there is emerging evidence that chronic stress can result in structural changes to the hippocampus (Gianaros et al., 2007) as well as the amygdala and prefrontal cortex (Ganzel, Kim, Glover, & Temple, 2008). In research among individuals in the United States who reported low social standing (which is a feature of acculturation stress), neuroimaging studies demonstrated reduced gray matter in the prefrontal cortex, presumably due to chronic stress (Gianaros et al., 2007). Research among human subjects has begun to link these stress-induced structural and functional changes to diseases such as atherosclerosis that are associated with obesity and increased AL (Gianaros et al., 2009). The good news is that numerous studies have supported the idea that, although neuroplasticity is the cause of such diseases, it may also serve as a mechanism of functional recovery (Pascual-Leone et al., 1998); that is, individuals can learn to rewire the stress response and promote self-directed neuroplasticity (Mitrovic, Fish de Peña, Frassetto, & Mellin, 2011). Similarly, Brunner et al. (2002) reported that the neuroendocrine changes associated with the metabolic syndrome may also be reversible.

Obesity

BMI has been commonly accepted as a crude indication of body fat mass among adults. Normal weight is classified as a BMI of 18.5–24.9 kg/m². A BMI of 25.0–29.9 kg/m² is considered overweight and a value of 30.0 kg/m² or greater is regarded as obese. Obesity has been further subdivided into three classes: Class I (BMI 30–34.9 kg/m²), Class II (35.0–39.9 kg/m²), and Class III (>40 kg/m²; National Institutes of Health/National Heart, Lung, and Blood Institute [NIH/NHLBI], 1998).

Traditionally, approaches to controlling obesity have emphasized the need to balance energy intake and energy output, which basically translates into decreasing the number of calories consumed and increasing the amount of physical activity expended. However, contemporary approaches to address obesity go beyond this representation to emphasize the presence of genetic, physiological, environmental, cultural, and behavioral causative factors that function on an individual, community, national, and global level.

Contemporary models view obesity as a disease in itself, as well as a disorder that leads to many comorbidities, particularly cardiovascular disease, stroke, and type 2 diabetes mellitus. Researchers believe that the excess adipose tissue assumes the role of a new endocrine organ and is the cause of obesity-related illness, not the excess weight, itself (Prentice & Jebb,

2001). In particular, increases in body weight are strongly associated with increased insulin resistance at the cellular level, which may be a fundamental mechanism driving many disease processes. These changes in insulin resistance augment the cortisol-driven responses to stress seen in increased AL, further escalating dysregulated glucocorticosteroid secretion, increased food consumption, insulin resistance, and increased deposition of abdominal fat. Thus, obese individuals are physiologically primed to continue gaining weight.

Obesity Among Latinos

Unfortunately, overweight and obesity have become a way of life for the majority of adults in the United States, setting the stage for an epidemic of chronic diseases related to overnutrition. Nowhere is this more obvious than in the Hispanic community. NHANES data (2007–2008) indicate that the age-adjusted estimated prevalence of overweight and obesity among Latino adults was 76.9%, as compared with 73.7% for non-Hispanic Blacks and 67.5% for non-Hispanic Whites (CDC, n.d.). Approximately 27% of Latino boys and 17% of girls are considered obese, and Latino children are 1.4 times more likely to be overweight or obese than non-Hispanic White children. Unless measures are taken to reverse these trends, it is estimated that 90% of all Mexican Americans (the largest and most widely studied Latino subgroup in the United States) will be overweight or obese by the year 2030, and a similar fate awaits other subgroups of Latinos (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). The risk of overweight and obesity among Latinos increases exponentially with number of years living in the United States (Gordon-Larsen, Adair, & Popkin, 2002; Popkin & Udry, 1998). Kaplan, Huguette, Newsom, and McFarland (2004) reported nearly a 4-fold increase in the risk of obesity for Hispanic immigrants who had lived in the United States for more than 15 years as compared to recent immigrants. It appears that the cardioprotective mechanisms researchers have noted in Latino immigrants, often referred to as components of the “Hispanic paradox” (Markides & Coreil, 1986), largely disappear by the second and third generations so that the risk of cardiovascular diseases and type 2 diabetes among these groups meets or exceeds that of U.S.-born non-Hispanics.

Investigators have advanced various hypotheses to explain the exacerbation of obesity among Latino immigrants. Low-income urban-dwelling Latino immigrants are often faced with a limited availability of and access to nutritious foods, coupled with a relatively plentiful supply of inexpensive high-calorie foods. Nutrition transition, defined as the change from a pattern of low calories and low fat consumption in poor areas to high calorie and high fat intake, has been linked with increases in obesity in Latin America (Popkin, 2001), so that recent Latino immigrants are likely arriving in the United States heavier than previous cohorts of immigrants. In Mexico, for example, the country of origin for the largest percentage of U.S. immigrants, 70% of the population is overweight and 30% is obese (Organization for Economic Cooperation and Development [OECD], 2010). In what has been termed the “mismatch theory” (Popkin, 2001; Popkin & Drenowski, 1997), it is postulated that in countries undergoing nutrition transition, changing social and economic conditions foster rapid weight gain (also referred to as catch up weight) among infants and young children who experienced nutritional deficits earlier in life. These same children are felt to be at increased risk of obesity and the metabolic syndrome as they progress into

adulthood, often as immigrants to the United States. A similar phenomenon related to intrauterine growth restriction results in “stunting,” or short stature, of offspring, which has also been correlated with an increased risk of adult obesity (Fernald & Neufeld, 2007). In both cases, “catch up” weight gain in these children can be exacerbated by the high-calorie, high-fat dietary consumption patterns seen in much of contemporary U.S. society. Finally, researchers have given much attention to the role of maternal obesity as a risk factor for childhood and consequently adult obesity (Fall, 2011). Given the relatively high birthrates among immigrant Hispanic women (Pew Hispanic Center, 2011), the risk of obesity is perpetuated in each successive generation of Hispanic Americans.

The pattern of migration from a rural area of the home country, where fresh fruits, vegetables and whole grains are plentiful, to an urban locale in the host country where such foods are scarce and expensive, tends to intensify weight gain. This pattern is one of the most common demographic trends among immigrants to the United States (Bodvarsson & Van den Berg, 2009). In addition, Hispanic immigrants to the United States are fairly young; approximately 60% of all Hispanic American children in the United States are first- or second-generation immigrants. Over time, immigrant children tend to adopt American behavioral norms for health status and risk (Zhou, 1997), so that new immigrants may find that their children favor high-calorie “fast foods” in larger portions over healthier traditional fare. Cultural beliefs about the value of food may also play a role in the marked increase in rates of obesity among the poor. Candib (2007) notes that, among immigrants from countries where food may be in short supply and where malnutrition has been common, overweight may be valued as a desirable sign of relative health and wealth.

Similarly, there are various factors associated with a decrease in physical activity among Latino immigrants. As immigrant Latinos adapt to their new home, they may tend to take on the sedentary habits of persons in the United States: for example, riding in automobiles or taxis rather than walking. Deprived of the social support of extended family members, concerned about urban crime and faced with a language barrier, many Hispanic women in particular report feelings of isolation (D'Alonzo, 2012) and are reluctant to make use of places in the community where they can partake in physical activity. Others have cited socioeconomic pressures and the need to work multiple jobs as the major factors limiting the availability of leisure time for exercise (Juniu, 2000). In an ethnographic Photovoice study, D'Alonzo and Sharma (2010) reported that a combination of *marianismo* beliefs and socioeconomic pressures (which resulted in sleep deprivation, among other issues) appeared to negatively influence women's ability to participate in physical activity. *Marianismo* is a gender-related construct seen in traditional Hispanic culture, in which females are socialized into placing family needs above their own throughout their lives (Comas-Diaz, 1988; Gil & Vasquez, 1996; Stevens, 1973). Thus women with strong *marianismo* beliefs (*marianistas*) are likely to view exercise more as a selfish indulgence than a healthy lifestyle behavior. Among immigrant Hispanic women, attempts to maintain *marianismo* and other traditional values while acculturating into mainstream American society often result in cultural conflict, which can be a significant source of acculturation stress (D'Alonzo, 2012) and can lead to increased AL in this population. All of these issues may serve as barriers to participation in healthy physical activity and may contribute either directly or indirectly to the development of obesity.

Acculturation Stress and AL

There is substantial data linking acculturation stress and selected factors that have come to be associated with increased AL. For example, N. Malan (1996) and L. Malan (2006) both reported differences in the cardiovascular responses of urban versus rural Black South Africans, which they attributed to the effects of acculturation. More recently, in a meta-analysis of 125 relevant research manuscripts, Steffen, Smith, Larson, and Butler (2006) found that acculturation to Western society was associated with higher blood pressure, and acculturation stress appeared to be a more influential factor in the genesis of hypertension than differences in diet or physical activity. This finding is important, as previously noted, because abdominal obesity has been linked to hypertension due to the parallel mechanisms of increased cortisol secretions and ineffective coping (Björntorp, 2001). Few researchers to date have linked acculturation stress and obesity through the process of AL. Reiman et al. (2012) demonstrated that Black South Africans (who traditionally have low social support and experience high levels of discrimination) showed greater neurohormonal stress reactivity compared to White South Africans on cold pressor and color–word conflict tests. Likewise, Korenblum et al. (2007) observed that first-generation Russian Jewish immigrants in Germany had significantly higher cortisol levels and higher rates of diabetes than did Russian German immigrants and native Germans. These findings suggest that the presence of negative social evaluation and discrimination and the absence of social supports can induce obesogenic illnesses such as diabetes through chronic hyperactivity of the HPA axis and persistent activation of the endogenous glucocorticoid system.

Researchers have begun to link acculturation stress directly with assessments of AL. Kaestner, Pearson, Keene, and Geronimus (2009) and Peeke et al. (2010) found that U.S.-born Mexican Americans displayed higher AL scores than Mexican immigrants and that immigrants who had resided in the United States for longer periods had higher scores than new immigrants. Gallo, Jiménez, Shivpuri, Espinosa de los Monteros, and Mills (2011) noted that Mexican American women with a combination of chronic work-related, caregiving and financial stressors were significantly more likely to have higher AL scores than Mexican American women without these stressors. Mattei, Demissie, Falcon, Ordovas, and Tucker (2010) found a significant association among Puerto Ricans between increased AL scores and abdominal obesity, but they did not assess acculturation stress. It appears that in the presence of long-standing, emotionally charged psychosocial stressors such as perceived racial and ethnic discrimination, economic insecurity and fear of deportation, acculturation-related stressors may drive the development of obesity and obesity-related illnesses. Future research needs to be conducted exploring links among AL, obesity and increased acculturation stress among Latino immigrants.

Discussion

The articles we have cited here are part of a growing body of evidence that supports the biobehavioral concept of AL as a theoretical framework researchers can use to explore the connection between chronic stressors and health disparities. Using allostasis as a framework with which to address the genesis of obesity, we may see acculturation stress as an independent risk factor for the development of obesity and obesogenic illnesses among

immigrant Latinos. It is apparent that, for many immigrant Latinos, it is the combination of acculturation stress and unhealthy behavioral responses to this stress that results in weight gain and increased AL.

To date, theory-based interventions to address obesity among Latino immigrants have focused solely on improving healthy lifestyle behaviors with no attention directed at education, skill building, and social integration strategies that could assist immigrants to cope with sources of acculturation stress. Such approaches have the potential to help immigrants cope with chronic stressors by helping them build self-esteem, physical wellness, and a sense of commitment to the community around them, while emphasizing aspects of selective acculturation (Portes & Rumbalt, 2006). Cognitive behavioral theory (CBT) may also provide a useful framework for future interventions. A basic premise of CBT is that an individual's emotions and behaviors are in large part determined by his or her cognitive appraisal of a situation (Beck, Rush, Shaw, & Emery, 1979). Individuals who have negative or distorted beliefs about a specific situation tend to have similarly negative emotions and tend to behave in negative ways. In other words, an immigrant who perceives that he or she is powerless to change his or her socioeconomic status has low perceived control over employment opportunities and feels that he or she is being singled out because of a language barrier tends to feel more emotionally stressed when he or she experiences situations that confirm his or her negative perceptions and is more likely to respond with unhealthy behaviors such as overeating. When the individual lacks the skills to develop salutogenic responses to acculturation stress, such negative emotions and behaviors may contribute further to AL. Thus, in addition to emphasizing healthy eating and promoting physical activity, approaches to decrease AL and obesity must utilize techniques to teach immigrants healthy strategies for integrating into the surrounding community, neutralizing sources of acculturation stress, and discovering effective methods to manage feelings of anxiety and depression associated with stress.

Conclusion

As the Latino population of the United States continues to grow, the high prevalence of obesity and obesogenic illnesses such as diabetes mellitus and cardiovascular disease among Latinos will become a serious national public health issue. The concept of AL provides a useful framework with which to view health disparities, particularly those associated with the Hispanic paradox. Acculturation stress is likely to be a major contributor to increased AL among Latino immigrants. Approaches to prevent and decrease obesity in this population must address the need to identify and manage acculturation stress throughout the immigration experience.

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Figure 1.

The stress response and development of allostatic load. Note. Adapted from McEwen (1998), and Israel and Schurman (1990). Adapted with permission from Massachusetts Medical Society, © 1998, and from Jossey-Bass, respectively.