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Perimenopausal Obesity

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Abstract

Obesity is recognized as one of the most important underlying risk factors for a wide variety of diseases, including heart disease and diabetes. Women are particularly prone to obesity, and approaches that address life transitions across the life span suggest that a number of factors may converge at passage points, such as menopause, that contribute to weight accumulation in the aging woman. The menopausal phase of a woman's life brings a number of changes that may trigger and maintain weight gain. Although the prevalence of overweight and obesity is attributable to each of these factors, it is most likely the interaction among multiple factors that determines an individual's propensity for excess energy intake, sedentary behavior, patterns of fat distribution, and risk of developing obesity. The problem of weight change and obesity in perimenopausal women is best understood from an ecological perspective that can integrate the analysis of factors across levels, from the culture and built environment of the community to family-related factors to individual factors, such as subjective norms, values, attitudes, and beliefs, and biological/genetic predispositions. This review describes the literature relevant to weight change during perimenopause using a multi-level perspective and recommends future directions for the development of translational weight management research to meet the unique needs of women.

Introduction

OBESITY IS RECOGNIZED as one of the most important underlying risk factors for a wide variety of diseases, including heart disease, diabetes,¹ and cancer, with particularly strong evidence supporting obesity as a risk factor for colorectal and breast cancers.^{2,3} Women are particularly prone to obesity, and approaches that address life transitions across the life span suggest that a number of factors may converge at passage points, such as menopause, that contribute to weight accumulation in the aging woman.

Menopause is a natural developmental process whereby a woman's menses cease to occur between the ages of 45 and 55 (generally), with an average age of 51.⁴ Menopause is the time point in a woman's life indicating the end of the reproductive cycle and may be accompanied by several physiological and psychological symptoms, including vasomotor symptoms (hot flashes), insomnia, fatigue, weight gain, and mood disorders, including depression. The transitional period prior to and ending with menopause is often referred to as peri-

menopause. The numerous physiological changes a woman experiences during the perimenopausal process are due primarily to declining ovarian function.⁵ However, the menopausal phase of a woman's life brings a number of changes, not just hormonal, that may work together to trigger and maintain weight gain. Although many of the pieces of the puzzle that contribute to this problem have been examined, others have not. The multiple factors and levels of influence have not been previously outlined as potentially interactive forces.

Body weight is influenced by many different factors. Environmental factors, including the cheap, plentiful availability of highly palatable, energy-dense foods, and the significant constraints of modern life, including built environments that limit opportunities for physical activity, strongly affect body weight and adiposity. In addition, age, gender, levels of circulating sex steroids, and genetic predisposition also contribute to the regulation of both body fat distribution and adipose tissue metabolism.⁶ The relatively recent explosion in the prevalence of overweight and

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obesity is attributable to each of these factors, but it is most likely the interaction among environmental, social, psychological, and biological/genetic factors that determines an individual's propensity for excess energy intake, sedentary behavior, patterns of fat distribution, and risk of developing obesity. An examination of the contextual effects of events, milestones, and relationships that occur or change during midlife transition might assist in illuminating the complex contributions of weight gain and increasing obesity in mid-life women.⁷

The problem of weight change and obesity in perimenopausal women, then, is best understood from an ecological perspective that can integrate the analysis of factors across levels, from the culture and built environment of the community to family-related factors to individual factors, such as subjective norms, values, attitudes, and beliefs, and biological/genetic predispositions. The purpose of this review is twofold: (1) to provide a descriptive review of literature relevant to weight change during perimenopause using a multilevel perspective and (2) to recommend future directions for the development of translational weight management research to meet the unique needs of perimenopausal women. We focus specifically on the aspects of the menopausal transition that contribute to weight gain during this time.

Epidemiology of Obesity and Menopause

Overweight and obesity are associated with significant health problems, are estimated to be responsible for almost 300,000 deaths each year, and contribute to annual healthcare costs of \$117 billion in the United States.^{8–10} Overweight and obesity are caused by an imbalance between energy intake and energy expenditure.¹¹ Whereas genetics and aging may increase the risk of being overweight, individual, social, and environmental factors may promote unfavorable dietary patterns and sedentary behavior.¹¹ Low socioeconomic status (SES), low educational attainment, unemployment, and poverty have also been associated with overweight and obesity among members of specific ethnic groups.¹²

Healthy People 2010 aims to reduce the proportion of obese adults from 23% to <15% by the year 2010¹³ and eliminate racial/ethnic health disparities.¹⁴ However, data from the National Health and Nutrition Examination Survey (NHANES)¹⁵ suggest that adult age-adjusted obesity rates have increased from 23% in 1988–1994¹⁵ to 30% in 1999–2000¹⁶ and are highest among Hispanics, African Americans, and groups with low SES.^{17,18}

Although the epidemiological data do not conclusively tie obesity to menopause, it is notable that cross-sectional examination of overweight data shows higher rates during the perimenopausal years. For example, data from the 2003–2004 NHANES show that non-Hispanic black and Mexican American women aged 40–59 have the highest rates, with 88% (non-Hispanic black) and 79.7% (Mexican American) who are overweight or obese, inclusively, whereas 65.3% of non-Hispanic white women are in the overweight or obese category.¹⁹ For all women participating in this survey, increases from the previous age category (20–39) at 51.7% to 68.1% in the perimenopausal age range (40–59) who are overweight or obese are the largest leap across the life span. Rates remain relatively stable past this phase (68.9% for

women ≥ 69 years). Thus, there appears to be a profound period of weight gain not linearly related to aging but specifically increasing during the perimenopausal years.

Changes in body fat distribution and composition during menopause

A significant proportion of women gain weight during the menopausal transition, although it has not been clear if this change in body weight is related to the aging process in general, the hormonal modification attendant with menopause, or a combination of the two effects. An improved understanding of the biologically related menopausal contribution to weight gain and body fat distribution is critical because the changes that accompany this period in a woman's life can significantly increase her risk of major metabolic disorders, including type 2 diabetes mellitus and cardiovascular disease (CVD).

It has been demonstrated that women specifically gain visceral fat when they go through menopause.²⁰ This change in fat accumulation coincides with the expected decrease in serum estradiol and an unexpected decrease in energy expenditure. The increase in visceral body fat during menopause, along with other related metabolic changes, has been implicated as a cause of the increase in CVD seen in postmenopausal women.²¹

As women go through menopause, levels of estrogen and energy expenditure decrease, and visceral fat, glucose, and insulin increase, leading to an increase in metabolic syndrome.²² The hormone changes of menopause appear to be intimately linked to many metabolic processes in the body. The question has been posed of whether replacing ovarian estrogen with exogenous estrogen can reverse or halt this metabolic process, including abdominal obesity gain, but the results have been mixed and may differ depending on hormone formula and route of administration.^{23–25} It appears that simply replacing estrogen and progesterone with currently available hormone preparations does not consistently stop weight gain and the associated metabolic and cardiac risk factors from accruing.

In addition to changes in estrogen, other moderating hormonal factors may be at play during the menopausal transition. Janssen et al.²⁶ found that the risk of developing cardiometabolic syndrome increases as testosterone increases after estrogenic decline, which may contribute to an enhanced risk for CVD. Kimura et al.²⁷ found that altered metabolic activity resulting from this transition is associated with increased adiposity in postmenopausal women and that suppression of the autonomic nervous system (ANS) not only is associated with weight gain factors in these women but also may contribute to a wide range of medical pathologies.

Several cross-sectional studies have shown a progressive increase in fat mass and a corresponding decrease in lean mass in postmenopausal women compared with premenopausal women. For example, using dual-energy x-ray absorptiometry (DXA), Ley et al.²⁸ found a greater fat mass and higher proportion of upper body fat distribution in postmenopausal compared with premenopausal women. Likewise, in a study of 1075 women, Gambacciani et al.⁶ found that body weight and body mass index (BMI) were higher in perimenopausal and postmenopausal women than in

premenopausal women. In addition, the authors found that mean total body fat and percentage of fat with respect to soft tissue, as measured by DXA, were significantly higher in the perimenopausal and postmenopausal groups relative to the premenopausal women, whereas total body and leg lean tissue was significantly less in the postmenopausal group relative to the perimenopausal and premenopausal women. In this study, body weight and BMI were positively correlated with age in the premenopausal women only, and not in the other groups, suggesting that climacteric changes and not the aging process *per se* underlie modifications in body weight and fat distribution in perimenopausal and postmenopausal women.

Results from recent longitudinal studies support a role for menopause in mediating changes in body fat accumulation and distribution. In a study of 543 premenopausal or early perimenopausal women, Sowers et al.²⁹ found absolute cumulative increases in fat mass and waist circumference and a decrease in skeletal muscle mass over a 6-year period. In these women, changes in fat mass, lean mass, skeletal muscle mass, and waist circumference were also correlated with follicle-stimulating hormone (FSH) levels, and these changes were attributed to both chronological and ovarian aging. Likewise, Lovejoy et al.²⁰ found that during a 4-year study of 156 initially premenopausal women, body fat and weight increased significantly only in those women who became menopausal by the end of the study and that whereas all the participants gained subcutaneous abdominal fat, only those who became menopausal showed a significant increase in visceral adipose tissue. The authors also found that although 24-hour and sleeping energy expenditures decreased significantly with age in all women, sleeping energy expenditure decreased 1.5-fold more in women who underwent menopause during the study period compared with women who remained premenopausal. In addition, fat oxidation increased substantially in women who became menopausal compared with those who did not.

The preponderance of evidence suggests that the transition to menopause is accompanied by shifts toward increased central adiposity and a more atherogenic lipid profile, as well as alterations in glucose metabolism. It is widely recognized that CVD risk increases sharply in women after menopause, although debate continues as to whether menopause contributes to this risk independent of aging. Certainly, the substantial metabolic changes that occur during the premenopausal to postmenopausal transition promote physiological conditions conducive to the development of CVD, but delineating the individual contributions of normal aging, associated behavioral changes, and the hormonal milieu of menopause is difficult in both cross-sectional and longitudinal studies. For example, menopause is associated with increased abdominal fat distribution and reduced lean body mass, but lower levels of physical activity in postmenopausal women may be a contributing factor.³⁰

Individual Factors that Occur during Menopause Associated with Weight Gain

Genetic influence

Obesity is known to have strong genetic determinants. To date, no studies have examined genetic determinants of weight gain or body fat distribution distinctly associated

with the menopausal transition. However, several genetic variants have been identified that contribute to common forms of obesity in the general population (for review, see Walley et al.³¹), and it is possible that these and other variants may also contribute to increased adiposity attributed to menopause. Some variants may contribute to perimenopausal and menopausal obesity, which may only become manifest against the hormonal backdrop of menopause. Such variants may possibly affect fat redistribution, energy expenditure, nutrient partitioning, or changes in eating behavior.

Mutations in specific genes underlying monogenic forms of obesity have been identified and primarily include defects in genes within the leptin-melanocortin signaling pathway.^{32–37} Variants in the melanocortin 4 receptor (*MC4R*), deficiency of which underlies a relatively substantial portion of childhood obesity cases,³⁸ appear to have consistently strong effects on body weight in the general population over the life span.^{39,40} O'Rahilly and Farooqi⁴¹ have postulated that common variants in the *MC4R* gene will likely have effects on food intake and appetite that are similar to those of the rare variants underlying monogenic forms of obesity, differing only in degree. The recent application of genome-wide association studies to the investigation of obesity has also led to identification of the fat mass and obesity-associated gene, *FTO*, which encodes a member of the 2-oxoglutarate-dependent dioxygenase family.⁴² Individuals homozygous for the high-risk A allele weigh approximately 3 kg more than individuals with no copies of this allele. Interestingly, *FTO* is expressed most abundantly in the arcuate nucleus of the hypothalamus, where its expression is modulated by feeding and fasting.⁴² In the near future, many other variants with effects on energy metabolism, appetite and satiety mechanisms, and energy expenditure are expected to be identified.

Studies aimed at identifying such variants would be critical in developing better strategies for preventing or treating obesity in perimenopausal women, but at this point, the contribution of these more general genetic influences on obesity are not identified as relating to the specific shifts during menopause. Although it will be important to assess the relative contribution of these variants to weight gain and body fat distribution in menopause, approaches to identify specific molecular mechanisms unique to the changes in adiposity associated with this life transition will be crucial for developing targeted therapeutic strategies for treating obesity in perimenopausal and postmenopausal women.

Individual Variation in Hormonal Patterns during the Menopausal Transition

As noted previously, there is a strong association between hormonal changes of menopause and the consequent shifts in metabolism and fat distribution. With the focus of much research on defining trends in the overall population of women going through the menopausal transition, and less on the individual variation, it is not clear what the range and differences are among women in hormonal patterns and sequelae. There is evidence, however, that there is wide variation, for example, in the symptoms often associated with hormonal change (e.g., more or less hot flashes). Such variation in hormonal levels and patterns among individuals could

partially explain why some women are more prone to perimenopausal weight gain than others. Although we do not fully understand the interaction of hormones, psychological effects, and genetic determinants of the individual's experience, it would be important to learn more about these individual variations and interactions.

The psychology of weight

Research on the relationship among menopause, psychological factors, and obesity is extensive. Studies of midlife women reveal significant psychologically related contributors to weight gain after the menopausal transition, but the factors examined are often so closely interrelated that it is difficult to sift through the data to determine causal relationships. For example, psychological symptoms, such as depression and anxiety, as well as factors that interact with psychological states, such as smoking cessation, childhood abuse, and ethnicity, have been found to contribute to weight gain in later life.^{43,44} These relationships may well be directly related to the variables being studied, with less clear ties to the menopausal transition, as findings are similar to those from studies of younger women.⁴⁵ Further, among menopausal women, depression has been linked to obesity through the complex interaction of reduced physical activity and occupation (e.g., Latina women in service roles show higher physical activity levels than women in other roles and fewer depressive symptoms,⁴⁶ again, dynamics that are difficult to separate out for causal determination).

Disagreement even exists about whether depression is more prevalent during and after the perimenopausal period compared with the premenopausal period⁴⁷⁻⁵⁰ and to what extent depression may contribute to women's risk for obesity vs. weight loss at any time in life. For example, there has been some level of support linking heavier weight with better mood states,⁵¹ but this is based on correlational research, not examining trajectories of weight change during the time of menopause.

One significant pathway of exploration involves increasing our understanding of the critical role of gender in the risks, course, and treatment of depression.⁵² Gender differences become apparent at the menopausal transition. Although most perimenopausal women do not experience depression, the prevalence of women's depression remains twice that observed among men of similar ages. Women respond better than men to serotonin-modulating substances until menopause, when this effect is reversed.⁵³ Women also experience weight gain as a side effect of antidepressant use more often than men.⁵³ The cause of these gender differences is not known but may be a result of an imbalance in testosterone and estrogen levels.⁵⁴ At this point, the research literature does not point to menopausal depression or antidepressant use being related to weight loss, but it seems more fruitful to explore mood states and changes in weight directly to begin to better understand what interventions might be preventive.

As with many of the factors associated with the perimenopausal time of life, it is not clear what the impact is for each, but it is likely that the multiple influences may converge more pathologically for some women than others to produce a pattern of unhealthy negative experiences, behaviors, and weight gain.

Sociocultural Influences on Weight in the Menopausal Transition

Associations among SES, ethnicity, and overweight

SES is an important consideration in racial and ethnic differences for attitudes about overweight, risk factors for weight gain, and patterns of overweight.⁵⁵⁻⁵⁷ With a high association of lower SES and ethnicity, especially among Hispanic and black women, these interacting factors are difficult to separate for causal patterns, so we discuss them together.

As noted earlier, ethnicity and cultural norms shape attitudes about weight. Women of lower SES, especially Hispanic and black women of lower SES, have been generally shown to hold more positive attitudes toward overweight and obesity than women of higher SES.⁵⁷ Another study found no differences in body dissatisfaction, self-esteem, or discrepancies between ideal and actual body weight among African American women of middle to high SES,⁵⁸ suggesting that attitudes often ascribed to race are as much about SES as race or ethnicity.

Also notable is the fairly consistent relationship found between the risk factors for obesity (including smoking, high energy intake, lower levels of exercise) and ethnicity, especially Hispanic (with the exception of tobacco use) and black vs. non-Hispanic white women,^{16,59} and the higher prevalence of obesity among women of these ethnic groups.⁶⁰ The specific relationship of ethnicity and weight gain and maintenance during the perimenopausal phase has not been clearly established, but some evidence is accruing to support disparate effects even during this time of life that challenge women in general. For example, a sample of perimenopausal African American women showed lower sleep energy expenditure (an indication of lower basal metabolism) and higher intakes of certain dietary fats compared with white women.⁶¹

Sociocultural differences in perception of weight

Women's attitudes and perception of weight and weight management might be influential on weight gain during menopause. For some women, the stigma of overweight contributes to negative body images, and research shows that overweight and obese women have higher rates of subsequent depression and anxiety.⁶² Further, the negative self-image reported in both black and Hispanic women regarding their weight is associated with reduced physical activity.⁶³

There seem to be paradoxical attitudes about weight and body image for black and Hispanic women, however, with stigma and stress associated with overweight, yet greater acceptance, both of which probably do not serve to shift women toward healthier behaviors. For black women, differences in attitudes toward overweight and obesity are, in part, based in cultural norms that prescribe greater acceptance and appreciation for increased body size. Several studies have documented attitudes toward weight and body image among black women that differ from those of white women.^{56,57,64-68} For example, black women reported greater satisfaction with body size and a more realistic body image compared with white women.⁶⁹ Recent qualitative studies examining body image disparity and cultural factors affecting weight found that African American women's ideas about how race affects their health stem mostly from unhealthy food preparation/selection, lack of exercise, stress, increased risk of chronic disease, and the costs associated with them. By comparison,

white women in the study reported distorted expectations of perfect body type, the relationship of success to thinness and beauty, social pressures, media, and men's preferences as the driving forces of weight for them.^{70,71}

Cultural and social acceptance of overweight is also found among Hispanic groups, particularly Mexican Americans.⁷² Comparing Hispanic and black women on body image concerns and weight, Hrabosky and Grilo⁷³ found no difference between the two cultural groups. Hispanic overweight women, however, reported more disordered eating than black women. Among some Hispanic women, a contradiction exists with body image; whereas there is some social pressure to be thin, there is a strong preference among Latinas for curves or curvier body types.^{63,74} Thus, the perceptions of self and other's body size and acceptability might influence energy intake and expenditure lifestyle patterns through the menopause transition in these vulnerable populations of women. This research has focused mostly on the more general patterns of cultural attitudes about weight without addressing differences in the life phases, but these cultural patterns would be important to explore specifically for the menopausal transition.

Culture, acculturation, and menopause

The research literature shows significant findings of cultural differences in perceived menopausal symptoms among women from diverse cultures, ethnicity, and racial backgrounds.⁷⁵⁻⁷⁷ The majority of these reports reflect responses to and management of symptoms, however, rather than illuminating differing cultural contexts that impact health behaviors related to weight managing lifestyles.⁷⁵ For example, Longworth⁷⁸ showed that Mexican American women were comfortable discussing "el cambio de vida" but preferred homeopathic remedies for symptom management. Dillaway et al.⁷⁹ determined that the menopausal experience was positive among African American and Hispanic women compared with Caucasian women, with women of color seeking support from same sex, same race friends. Remenick⁸⁰ showed that Israeli women, who appeared to medicalize menopause, became more aware of health promoting options during postmenopause but did little about it. Further, Israeli women did not particularly dramatize menopause. Little is offered in these excellent reports to guide investigators in determining how cultural influences at midlife might impact weight accumulation and changes in relationships that might impact eating and exercise behaviors that contribute to weight changes in midlife women.

Acculturation, defined as the process of psychosocial change that occurs when groups or individuals acquire values, language, and norms of the dominant society, may play an important part in the health behavior of minority women. Acculturation is a long-term process during which individuals simultaneously learn about and modify certain aspects of a new culture and their culture of origin.⁸¹ Among Hispanics, the effects of acculturation on health-related behaviors is complex and not clearly tied to the menopausal phase of life. As Hispanics become more acculturated, they may be at greater risk for selected adverse health outcomes and engage in less physical activity.⁸² Conversely, there is some evidence that resistance to acculturation may confer protective benefits from dietary patterns. A recent meta-analysis of studies that

report acculturation factors and diet indicate that less acculturated Hispanics maintain a diet rich in fruits, beans, and rice and with less sugar and sugar-sweetened beverages, although total energy and fat intake appear to be unrelated to acculturation.⁸³

Level of acculturation may be related to increasing weight among Hispanic women, although interpretations are equivocal depending on the proxy measure of acculturation. For example, length of residence and acquisition of Western lifestyles (increasing sedentary behavior and poor nutrition) have been associated with increasing obesity, but SES, neighborhood residence, and education level confound the interpretation of the findings.

The relationship is further clouded by the notion that travel between residence of origin and the United States is frequent and consistent, and selective acculturation, the individual choice whether or not to adopt Western lifestyles related to energy intake and expenditure behavior, becomes an opportunity for intervention among foreign-born ethnic groups during the menopause transition.^{74,84} For immigrant populations in general, acculturation to U.S. norms can lead to the adoption of a more sedentary lifestyle as well as poor dietary habits.⁸⁵ As with many of the other factors considered relative to weight gain, the current state of our research simply does not address how these behaviors may relate to the menopausal phase of life specifically.

Co-occurring life transitions often associated with midlife: Suspected covariates of weight gain

Life events that occur during the life transition of menopause might be salient in influencing women's health behaviors related to weight gain or management. For example, marriages or partnerships might dissolve around menopause, or women might experience loss because of a partner death. These sometimes abrupt changes are often associated with loss of income and unexpected role changes.⁸⁶

Departing children

One of the most interesting factors that might influence a woman's selection of healthy behaviors related to weight management during midlife is the departure of children from the home, or the empty nest. For some authors,⁸⁷ the departure of children was explored within the context of loneliness and associated with a poorer quality of life, but this was moderated by good physical and mental health and level of social supports. For some women, the departure of children is perceived as an opportunity to pursue their own interests. Some women are faced with the paradox of children leaving home, then returning, often with their own children.⁸⁶ An individual's attachment style is related to how well she deals with anticipated life events, such as the departure of children, likely because the empty-nest transition is a planned, anticipatory change.⁸⁸ Dillaway⁸⁹ discusses menopausal transition adjustment in terms of the continuum of Motherwork, that motherhood is a lifelong endeavor, and its importance is sustained throughout menopause.

Changing relationships

For some midlife women, role changes, such as changing relationships with parents, children, or partners, are disruptive

to well-being during midlife. Women change their investment in their public lives during menopause, such as preparing for retirement, or changing their volunteering patterns, and this can cause distress that impacts health behavior.⁹⁰ Women at midlife would like to invest in themselves and their partners during this transition, but other role obligations might interfere.⁹⁰

For many women, lifestyle changes occur in a context of friends, family members, and social contextual settings that contribute to the behavior change process.⁹¹ Integration in a social network has been shown to provide a sense of purpose, recognition of self-worth, ability to meet expectations, motivation for self-care, and identification and use of resources.^{91,92} Social support systems are consistent with both cultural factors and social norms linked to health behavior change.⁹³ Baturka et al.,⁹⁴ in a study of rural African American women, found that acceptance by others was important in influencing women's perceptions of size and shape. Significant male partners, close family members, and close friends were accepting of women's weight. They were sometimes ambivalent and sometimes complimentary but supportive in that they rarely complained about their weight. Further, this may be less of a concern for mature women who have a greater level of self-acceptance.^{95,96}

The effects of marital quality on a midlife woman's psychosocial well-being may contribute to both disordered eating and reduced physical activity, contributing to weight gain. Papini et al.⁹⁷ surveyed 169 married couples about their attitudes toward menopause and found that both the wife's attitude and husband's attitude toward menopause were negatively associated with number of menopausal symptoms and behaviors. As with many of the other areas of research exploring correlates of the menopausal transition, there are many potentially negative life events and resulting stressors associated with this time of life, but explanatory models that account for interacting influences that may contribute to weight gain are missing.

Community-Environmental Influences

The environment is frequently singled out as a primary cause of the obesity epidemic,^{98,99} but it is nearly impossible to select features that uniquely influence body weight.¹⁰⁰ Although it is acknowledged that individual-level motivational factors might influence healthy eating and physical activity, there is no question that neighborhood environments contribute to structure and context that influence health behavior.¹⁰¹ Cubbin et al.¹⁰² showed that material deprivation was associated with higher BMI and low levels of physical activity; for blacks, residential racial segregation was associated with greater odds of being overweight.¹⁰³

Length of residence has been shown to be related to increasing weight and obesity. Several possible explanations are evident for this association with various populations. Some authors suggest that Hispanic immigrants have on average lower educational attainment and are less likely to speak English, in turn reducing upward social mobility and constraining life opportunities, including making it less likely that they would move to better neighborhoods.¹⁷ These authors have further suggested that a higher BMI may be due to cumulative exposures to neighborhood social and physical environments that lack access to nutritious food, lack access to

physical activity, and promote consumption of high-density diets. Increased availability of neighborhood supermarkets has been associated with greater consumption of fruits and vegetables, controlling for individual SES and availability of grocery stores, fast food, and full service restaurants.¹⁰⁴ Other authors have shown that the built environment is associated with neighborhood-level SES, obesity/BMI, and related behaviors.¹⁰⁵ Built environment neighborhood factors that contribute to healthy behaviors, such as healthy eating and physical activity, include safety, lighted streets, curbs, neighborhood food purchase accessibility, and crime. Neighborhood food purchase access has shown significant relationships to fruit and vegetable intake.¹⁰⁶ Hispanics have been shown to be more socioeconomically limited in their ability to live in or move to better neighborhoods than other groups,¹⁷ and living in more disadvantaged neighborhoods increases BMI.¹⁰¹

Birthplace and length of residence in the United States are associated with BMI and obesity among immigrants.^{107–111} The increased susceptibility to higher BMI with U.S. length of residence among women compared with men could be due to gendered patterned roles. For example, immigrant women may remain unemployed compared with men; unemployment may trigger isolation and depression, leading to overconsumption of food and higher BMI. It is also possible that living in poor neighborhoods where crime rates are higher than in more affluent neighborhoods may contribute to weight management issues surrounding seeking food and exercising.¹⁷ Neighborhood crime has been found to be positively associated with higher BMI among women,¹¹² perhaps because these neighborhoods are perceived to be unsafe for walking.

Do et al.¹⁰¹ explored the extent that segregation and the concentration of disadvantage across neighborhoods helped explain ethnic disparities in BMI. Using data geocoded at the census tract-level and linked with individual-level data from the Third National Health and Examination Survey in the United States, significant variation in BMI across U.S. neighborhoods was found. In addition, neighborhood characteristics had a significant association with body mass and partially explain ethnic disparities in BMI. Ethnic segregation was not advantageous for the BMI Hispanics, a relationship counter to what has been documented for other health outcomes.¹⁰¹

Environmental factors, such as built environments, conducive to physical activity and neighborhoods with accessible healthy food options are the larger frame from within which weight gain may be understood, but the applicability to menopause is not clear. With the differences shown for socioeconomic mobility effects on weight, it would be important to explore the intersection of the menopausal life transition, empty nest, and the ability (or not) to move to neighborhoods that support healthy lifestyles. Such clarifications would help build a better understanding of how socioeconomic factors may affect weight via environmental factors during this phase of life.

Recommendations

The multiple levels of influence on the weight that is gained and redistributed during and after menopause reflect increasing risk to women in terms adverse cardiovascular and metabolic risks. From an ecological perspective, the

individual, sociocultural, and environmental influences on weight accumulation create a scenario that, coupled with metabolic changes during the menopause, places women squarely at risk for emotional and behavioral responses that influence obesogenic behaviors. For some women, a response to the complex stressors occurring during this transition includes comfort eating, which has been shown to be increased in obese women,¹¹³ a direct response to stress,¹¹⁴ and accompanies the so-called inevitable weight gain of midlife.¹¹⁵ For other women, midlife is associated with contentment, a letting oneself go, contributing to obesity.¹¹⁵

Considering the multifaceted variables that impinge on women as they proceed through midlife changes, investigators and clinicians need to be vigilant in designing interventions for weight management that address the individual and often emotional components that impact weight control. Acknowledgment of partner and cultural attitudes toward weight, emotional coping strategies in response to menopause symptomatology, enhancing positive attitudes during transitions, and strategizing access to healthy nutrition and physical activity opportunities and choices within diverse neighborhoods might address some of the individual influences on unfavorable weight changes during menopause. Because attitude and positive coping are enhanced during life change events if they are planned or prepared for, anticipating contextual changes that accompany physiological changes during the menopause transition might increase the success of positive weight maintenance behaviors.

Social support, social networks, and life partners are influential in weight management, the perception of desirable weight, and the management of menopausal symptoms. Strategies that include families, partners, and enduring supports are desirable when designing weight intervention programs. Interventions designed to assist women in health promoting behaviors during the menopause transition that include anticipatory adjustment to social role changes, such as relationship changes, and preparation for public life decline in retirement might be fruitful factors.

Investigators and clinicians should consider the powerful effects of environment on women in relationship to their weight, particularly women in transition to menopause. For example, neighborhood access to safe outdoor activity and healthy food purchase outlets becomes increasingly important for women as they plan for later years and during a time when social resources are changing. Women who may have relied on spouses, partners, children, or neighbors for transportation and protection might be faced with changing supports during and after this transition period.

The context of multiple levels of influence on weight change during the menopause transition guides investigators and clinicians in interventions to meet the needs of midlife women. The research to date has variably addressed small numbers of relationships among factors at one level of influence or another, but little has been done to piece together a larger picture of how influences at the various levels may be interacting specifically during this time of life. One strategy for building a better understanding of these factors would be to develop and explore more complex, multilevel models to examine effects beyond the inevitable genetic and biological influences on weight. Another strategy that could prove even more fruitful would be to examine the exceptions to the rule and learn from women who have transitioned through this

phase of life successfully, finding their way to transcend the biological predisposition for weight gain, and develop a model of menopausal well-being. Identifying compelling descriptions of healthy physical and psychological approaches to menopause, even in the face of unsupportive neighborhoods, life events, or high-risk sociocultural contexts, could help us begin to promote a constellation of factors that protect rather than create vulnerability for weight gain during this life transition.

Disclosure Statement

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