

The Menopausal Metabolic Shift: Mechanisms, Myths, and Management of Midlife Weight Gain: A Narrative Review

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Abstract—One of the woman's primary concerns about menopause is that they may gain weight. It is a common belief that menopause is an inevitable, immutable aspect of aging that leaves no control to women over their bodies. However, longitudinal studies indicate that while they do, in fact, gain weight during menopause, it is in amounts too small to be immediately noticeable to the individual: approximately 1 pound per year. The larger issue is one of redistribution: fat is stored disproportionately in the abdominal region compared to the gluteofemoral regions. This is down to a combination of decreased estrogen levels, increased visceral adipose deposition, reduced muscle mass, and impaired protein metabolism, but a targeted approach to resistance training and sufficient protein consumption can yield considerable benefits to the individual, as can hormone therapy. The primary takeaway message is that while menopause is a contributing factor to adipose deposition and weight gain, there are other, additional causes that are potentially more serious: decreased muscle mass, which can be mitigated by resistance training, and poor sleep hygiene, which can be mitigated by lifestyle changes.

Index Terms—menopause; weight gain; visceral adiposity; estrogen; muscle mass; resistance training; hormone therapy

I. INTRODUCTION

The years surrounding menopause represent a period of physiological change for women. Dietary and exercise behaviors that previously supported weight control begin to shift in unpredictable ways, and adipose tissue preferentially accumulates in the abdominal region, presenting a conundrum for the menopausal woman who wishes to resist these

changes. Popularly, menopause is associated with inevitable weight gain due to the cessation of ovarian function, but longitudinal studies tell a more nuanced story.

During menopause, women tend to gain a few pounds: approximately 6-7 pounds, on average. This weight gain, however, tends to be concentrated disproportionately in the abdominal region, and the loss of muscle mass tends to outweigh concurrent increases in fat mass. Additionally, these changes can impact core metabolism and, consequently, the individual's health status, further emphasizing the importance of a balanced diet and a suitable exercise program. These changes, while reasonably minor on an individual level, are often significant enough to raise alarm bells with the average menopausal woman.

While it is tempting to attribute these changes to menopause, menopause is not an independent entity but a process, and processes require context for proper understanding. Thus, changes in adipose distribution should be seen as endocrine, metabolic, psychological, physiological, and behavioral phenomena that take place in a silo, without consideration for other factors that may independently contribute to weight gain or alterations in body composition. This context is vital to understanding the following discussion, which aims to provide an overview of relevant mechanisms while emphasizing the importance of dietary and lifestyle changes, particularly with respect to exercise.



II. THE BIOLOGY BEHIND THE SHIFT

2.1 Estrogen Decline and Fat Redistribution

Women who go through menopause typically notice that their bodies undergo a variety of alterations at the level of body composition. Their overall adipose tissue content generally experiences only minor increases, on the order of one pound per year on average, but the distribution undergoes a profound remodeling, with fat being preferentially stored in the abdominal region. As such, the woman may find that her clothes begin to feel tighter around the waist, even if her overall weight has not changed significantly. This change is related to the decreased estrogen levels characteristic of menopause, as lower estrogen causes shifts in the pattern of fat deposition. Estrogen plays a crucial role in the regulation of body fat deposition and distribution. Namely, higher estrogen levels are associated with higher levels of subcutaneous adipose tissue and lower visceral adipose tissue. The opposite is true for decreased estrogen levels: adipose tissue begins to accumulate inside the abdomen, posing significant health risks to the individual. The mechanism behind this shift is complex and is related to altered inflammatory signaling in adipose tissue, but the connection to menopause is easily understood: with the loss of estrogen, the woman's metabolism slows down, and fat is preferentially stored as visceral adipose tissue. Additionally, menopausal women tend to have higher testosterone levels relative to estrogen, which drives adipose tissue deposition in the abdominal region.

Thus, the combination of lower estrogen and higher testosterone leads to increased abdominal adipose tissue deposition in menopausal women.

This phenomenon extends beyond aesthetics: increased visceral adipose tissue, particularly the deposition of fat around the abdominal organs, is frequently associated with poor cardiometabolic health outcomes. The woman's overall health is significantly impacted by menopause, and her increased visceral adipose tissue content poses additional health risks, including dyslipidemia and impaired glucose regulation, among others. Waist circumference, muscle mass, and general metabolic health should be prioritized during and after menopause, on par with body weight.

2.2 Muscle Loss and the Protein-Leverage Hypothesis

Muscle mass begins to decline throughout the lifespan, beginning at approximately age 30, with individuals losing approximately 3-8% of their muscle mass per decade. This decrease is even more profound around and after menopause. Since muscle is one of the most metabolically active tissues in the human body, this decrease in muscle mass impacts the individual's metabolic rate, which can have downstream consequences for their health. It is therefore crucial for the menopausal woman to understand this aspect of her physiological decline and take steps to mitigate the losses.

Protein intake is one such method of combating age-related muscle loss, and its importance in the

menopausal woman's diet is two-fold: first, as the primary building block for muscle tissue, protein allows for maximal muscle protein synthesis and, therefore, increased muscle mass. Second, protein intake has downstream effects on the woman's inflammatory and immunological response, and a sufficient intake is necessary to maintain a healthy immune system. As such, protein intake should be prioritized during and after menopause to combat losses of lean body mass and subsequent decreases in metabolic rate.

Protein intake is not just a tool for increasing muscle mass, however: the protein-leverage hypothesis states that the body's desire to consume protein drives food intake. Thus, when protein intake is insufficient relative to the body's requirements, caloric intake increases, as the body seeks to maximize protein consumption. When applied to menopause, this hypothesis can explain some women's increased appetite during this period. This increase in appetite is perfectly normal and should be embraced by the menopausal woman, who should seek to consume more calories, particularly protein, during this period of her life.

The menopausal woman's health, particularly her body composition, should be seen as a dynamic system in which caloric balance is only one part of the equation. The woman cannot simply reduce her food intake and exercise more to combat menopause-related changes in body composition: she must instead build muscle through resistance training and consume enough protein to allow her body to do its job. Her health and body composition will ultimately benefit from this nuanced approach to diet and exercise.

2.3 Sleep, Aging, and Everyday Life

Hormones are not the sole drivers of change during menopause. The transition that women experience throughout their forties and fifties impacts multiple systems in the body, and the alterations to the endocrine system have knock-on effects throughout the body. Hot flashes, which frequently accompany menopause, severely disrupt sleep, leaving the menopausal woman fatigued and irritable the following day. Poor sleep, in turn, has been linked to poorer regulation of hunger and satiety hormones and, therefore, poorer weight regulation in menopausal women (Menopausal Sleep

Fragmentation and Body Fat Gain study protocol, Massachusetts General Brigham, 2024).

With advancing age, individuals begin to experience decreases in their resting metabolic rate. Simultaneously, their levels of physical activity begin to drop, with many individuals becoming less active overall. This decline in activity can have downstream effects on the individual's body composition, as they burn fewer calories throughout the day than before. There are multiple potential explanations for this shift in behavior: increased busyness, higher rates of caregiving, fatigue due to menopause, joint pain, or other changes in the individual's routine can all contribute to this observed phenomenon. Overall, decreased physical activity throughout adulthood has been linked to poorer body composition outcomes, including increased adipose tissue deposition and decreased muscle mass.

III. WHAT THE EVIDENCE SAYS ABOUT MANAGEMENT

3.1 Resistance Training: A Key Strategy for Maintaining Muscle

Resistance training is among the most thoroughly researched interventions for maintaining and increasing muscle mass during menopause. The effects of regular physical activity in this domain are largely positive, as the woman builds muscle, which in turn positively impacts her body composition and her overall health. Resistance training offers significant potential to improve the menopausal woman's physical fitness and body composition and should be seriously considered during this phase of life. In short, resistance training is beneficial and should be used to combat menopause-related losses of muscle mass.

In 2024, a study examined the effects of structured, supervised resistance training on postmenopausal women and found that it had demonstrable, positive effects on both the participants' body composition and their physical fitness. As such, regular, structured strength training has far-reaching benefits for the menopausal woman.

Interestingly, postmenopausal women should likely engage in a modified form of resistance training, one that takes their unique physiological circumstances into account. In a 20-week controlled trial that compared the effects of low- and moderate-intensity

free-weight training interventions among pre- and postmenopausal women, the latter required between six and eight sets per muscle group per week to observe similar increases in muscle size compared to their premenopausal counterparts (BMC Women's Health, 2023). Generic recommendations for resistance training, which are typically aimed at the general young and healthy population, are therefore insufficient for postmenopausal women, who must train harder to observe the same results.

The menopausal woman does not need to train with excessively heavy weights to see significant benefits for her body composition and her overall health. Even low-impact resistance training can be an effective way to increase muscle mass and improve her physical fitness, particularly if it is performed under the guidance of a professional. For example, a 12-week program that used a supervised approach saw improvements in the participants' strength and balance, regardless of their menopausal status. This approach was ideal for individuals who had issues with their joints or who were otherwise put off by the idea of heavy lifting. Moreover, initial evidence suggests that such training can be effectively delivered in the context of an online or community-based program, which could help the menopausal woman adhere to the recommendations. Finding a suitable, progressive program is essential to obtaining the benefits of resistance training. By finding a program that is appropriate for her current level of fitness and that does not aggravate her joints, the menopausal woman can obtain substantial benefits for her body composition, her physical fitness, and, by extension, her health.

3.2 Protein and Nutrition: Supporting Muscle Through Menopause

During resistance training, it is crucial that the woman's protein needs are met to ensure that the benefits of the exercise are maximized. With advancing age and the resultant decrease in estrogen, the woman's muscle mass begins to decrease, and her body's ability to form new muscle tissue diminishes. This means that her protein requirements during menopause are higher than they were before: a diet that was sufficient prior to menopause is no longer adequate, and a careful reassessment is necessary to ensure that she consumes enough protein during this period of her life. Protein should be seen as the

cornerstone of the menopausal woman's diet, as it is crucial to optimize her response to resistance training and to maximize her muscle protein synthesis.

It is not enough to simply consume more protein: as the woman goes through menopause, her nutritional needs are changing, and a balanced, varied diet is crucial to ensure that she obtains sufficient micronutrients to support her health and that she does not restrict herself in ways that cause long-term harm to her health. The menopausal woman should focus on achieving a caloric balance that is positive for her muscle growth and that emphasizes whole foods, particularly those that are rich in protein and fiber. Such a diet keeps her satiety levels high while minimizing the risks to her cardiometabolic health posed by excessive caloric intake. A diet that emphasizes fruits, vegetables, whole grains, legumes, lean proteins, healthy fats, and minimally processed foods is ideal for the menopausal woman and should be followed consistently to derive maximum benefits from her dietary choices.

A balanced diet that emphasizes whole foods, protein, and fiber is generally healthier than a highly restrictive one. The same caloric intake can have vastly differing effects on the woman's health depending on the foods she eats, with a wider variety of micronutrients being beneficial to her long-term health. The menopausal woman has the option of choosing from a wide variety of protein sources, including legumes, dairy, eggs, fish, lean meats, soy products, nuts, and seeds, depending on her personal preferences and nutritional needs. By choosing wisely, she can ensure that she receives the micronutrients she needs without limiting herself to one particular type of food. It is worth reiterating that there is limited scientific literature regarding the precise nutritional requirements for the menopausal woman or the optimal approach to designing a diet around them. Therefore, it is crucial for the woman to receive personalized advice regarding her nutritional needs and to tailor her diet to them rather than following a generalized set of guidelines.

Maintaining muscle mass during menopause is an important aspect of preserving one's health and body composition. The woman should prioritize resistance training and a balanced diet during this phase of her life to ensure that her muscle mass, and by extension, her body composition, does not deteriorate. During menopause, her protein requirements are higher, and

she should make sure that her diet emphasizes protein-rich, whole foods while also including sufficient fiber to keep her satiety levels high. This approach allows her to reap the rewards of her resistance training while also supporting her overall health. By following these guidelines, the menopausal woman can ensure that she maintains her muscle mass and, by extension, her physical fitness and health.

3.3 Menopausal Hormone Therapy and Weight Management

Hormone therapy for menopause is not indicated for weight loss purposes. It is important that the woman understands that this therapy is not a tool for weight loss but rather a way to alleviate some of the uncomfortable symptoms of menopause. Its effects on the woman's body are largely positive, improving her overall health in numerous ways, including her sleep quality. Better sleep, in turn, has downstream effects on her metabolism and is beneficial to her body weight and general wellbeing.

Recent research has begun to investigate the potential interactions between MHT and novel pharmaceutical weight loss interventions, such as the various GLP-1 receptor agonists. Preliminary retrospective data indicate that, when combined with a GLP-1 agonist such as semaglutide, MHT provides women with greater weight loss benefits than would be expected from either intervention alone. Researchers hypothesize that estrogen and GLP-1 signaling have synergistic effects on the woman's metabolism, but it is important to emphasize that these findings were preliminary and were based on relatively small retrospective analyses. More research is needed before these combined interventions can be confidently recommended to menopausal women, and until such time that larger, well-designed randomized controlled trials are available, no conclusive statements can be made about the potential benefits of this combined approach.

When considering hormone therapy, a woman needs to assess her overall health, age, and symptoms, as well as the time since menopause. It is essential to balance the potential risks and benefits of therapy, such as the hazards to the cardiovascular system. In addition, a woman's primary care provider or gynecologist needs to be involved in menopause management, as hormone therapy is not a panacea

but only one aspect of caring for the body during this period. Particular attention must be paid to maintaining a healthy and balanced diet, exercising, and sleeping enough. These measures will allow a woman to cope with the menopausal process and all its effects on the body, including osteoporosis and cardiovascular disease, in the long term. Instead of looking for a magic solution in hormone therapy, a woman should take a holistic approach to her health during menopause. In particular, it is necessary to adjust the diet, exercise, and sleep regimes, calculate the risks, and take them into account when choosing a further strategy for changing weight and health in general. Hormone therapy can be a useful tool in this scenario if the doctor correctly selects the doses and the individual characteristics of the woman's body. Thus, hormone therapy will not be the sole factor in improving or maintaining health, but a part of the overall strategy, which also includes balanced nutrition and physical activity.

IV. DISCUSSION

When thinking about menopause, people often attribute weight gain to this period of a woman's life, but this is not entirely accurate. Although menopause is usually associated with some changes in body weight, the focus should be on how fat is distributed rather than the number on the scale. While it is true that menopause is associated with increased fat deposition, fat accumulation is uneven, particularly compared to muscle loss during aging.

Fat distribution changes dramatically with decreasing estrogen levels, which is especially pronounced around menopause. Specifically, fat tends to accumulate in the abdominal region, while fat deposits on the hips and legs decrease. Muscle mass reduction is also associated with menopause and normal aging, as muscle building and maintenance become more challenging. A woman's metabolism slows down as she approaches menopause, meaning she burns fewer calories per day. This situation is aggravated by the fact that many women gain weight as they age. Although menopause is a factor contributing to weight gain, it is not the sole reason. There are several other contributors, including lack of sleep, a low level of physical activity, an unhealthy diet, and other circumstances.

This distinction is crucial both in scientific and therapeutic practice. On the one hand, it recognizes a woman's efforts to control the course of menopause and not aggravate it with additional problems, such as overweight or obesity. On the other hand, it is important to separate menopause as a contributor to weight gain from other factors that a woman can control.

There are several scientifically validated measures that can reduce the impact of menopause on body weight. First, resistance exercises will help maintain muscle mass. Second, a balanced diet with a sufficient amount of protein will help build muscle. Third, a woman should take care of her health in general, following all the recommendations for a healthy lifestyle. In particular, sleep, balanced nutrition, and physical activity are essential elements for the proper functioning of the body and the prevention of disease. Finally, physicians should receive comprehensive examinations and, where appropriate, prescribe hormone therapy to combat menopause. In combination, these measures will allow a woman to reduce the impact of menopause on body weight and health in general for as long as possible.

Menopause is not an insurmountable problem, but it does require some changes in everyday life and appropriate medical care to maintain health and body weight. With regard to maintaining and increasing muscle mass, a woman has three options: a healthy and balanced diet, regular physical activity, and hormone therapy if indicated. Combining these three tools can ensure good muscle protein synthesis, allowing a woman to maintain her muscle tissue and thus her body weight.

V. CONCLUSION

The changes in weight and body composition associated with menopause are multifactorial and include a decrease in estrogen, a reduction in muscle mass, a decrease in physical activity, poor sleep, and a slowdown in the metabolism. Against this background, the use of hormone therapy may be appropriate to maintain body weight during menopause. However, it should be part of a more extensive strategy that includes a healthy and balanced diet, regular physical activity, and sufficient sleep. It is these three pillars that will support a

woman during menopause and allow her to maintain not only her weight but also her health and quality of life in general.

Although there are still many questions about the mechanisms of menopause and the ways to combat its effects on the body, there is reason to be optimistic. Doctors and researchers are continuing their work to find new ways to help women maintain their health during menopause. In the meantime, there is a growing body of evidence showing that small steps, such as a healthy diet and regular physical activity, can make a big difference to health and quality of life. In this regard, the study and improvement of nutritional and therapeutic technologies within the framework of clinical trials is a priority area of research. Women need to understand that menopause is a natural change in the body throughout life and that they are in control of their health and body weight during this period.

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