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A STUDY ANALYSING THE METABOLIC HORMONAL CHANGES CAUSING OBESITY IN MENOPAUSAL WOMEN

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ABSTRACT

INTRODUCTION

Menopause represents a critical life transition marked by profound metabolic and hormonal changes that significantly influence women's health. The global prevalence of obesity particularly among women is alarming with the world health organization (WHO), reporting that approximately 13% of global adult population lives with obesity.

AIM

This narrative review aims to investigate how these hormonal fluctuations contribute to the development and progression of obesity in women aged 45–60. Additionally, it seeks to evaluate the associated metabolic risks and identify effective intervention strategies to reduce the health burden of obesity during this pivotal stage of life.

METHODOLOGY

The review analysed 24 peer-reviewed articles selected from Google scholar, Pubmed, Science direct, Research gate scientific databases. The included studies comprised longitudinal cohort studies, cross-sectional analyses, and clinical trials that examined hormonal fluctuations, alterations in body composition, and obesity-related health risks in midlife women undergoing menopause.

RESULTS

The findings indicate that obese women experience distinct hormonal changes during early menopause, characterized by reduced levels of oestradiol and inhibin B, and elevated levels of follicle-stimulating hormone (FSH). These hormonal shifts contribute to unfavourable changes in body composition, such as increased fat mass and decreased fat-free mass, leading to a higher risk of metabolic syndrome, osteoporosis, and other obesity-related conditions. Visceral obesity, worsened by oestrogen decline, is closely associated with chronic inflammation, insulin resistance, and heightened risks of cardiovascular disease, type 2 diabetes, and hormone-sensitive cancers. Certain hormone therapies were found to pose additional risks, including fractures and thromboembolic events, particularly in obese women. Genetic predisposition also plays a significant role in the development and persistence of obesity during menopause, complicating treatment and prevention strategies.

CONCLUSION

The review underscores the need for comprehensive lifestyle interventions—including balanced nutrition and regular physical activity—as primary strategies to counteract the health risks associated with obesity in menopausal women. It also highlights the importance of personalized treatment approaches and calls for further research to develop effective interventions that promote healthy aging and reduce the burden of obesity-related complications during the menopausal transition. The implication uses for need of personalize treatment approaches specially with health care provider, researchers, and physiotherapist.

KEYWORDS: Hormonal changes, Metabolic syndrome, Menopause, Follicle-stimulating hormone (FSH), Obesity.

INTRODUCTION

Menopause, a natural biological transition experienced by women worldwide, marks the end of reproductive capacity and is often accompanied by unforeseen challenges, including significant changes in body composition and weight management. The global prevalence of obesity, particularly among women, is alarming, with the World Health Organization (WHO) reporting that approximately 13% of the global adult population lives with obesity[1]. This staggering statistic translates to over 650 million individuals worldwide, with the prevalence expected to rise significantly in the coming decade[1] . In the United States, the Centers for Disease Control and Prevention (CDC) project that half of the adult population could face obesity by 2030[2], underscoring the urgent need for effective prevention and treatment strategies. During menopause, women undergo profound metabolic and hormonal changes, including decreased estrogen levels, which contribute to increased overall weight gain, visceral fat accumulation, and decreased energy expenditure[3,4]. These changes not only affect appearance and comfort but also substantially elevate the risk of serious long-term health problems, including cardiovascular diseases, type 2 diabetes, certain cancers, and osteoporosis [3,6]. The

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menopausal transition is a critical period for weight gain and increased cardiovascular disease risk, with dramatic increases in lipid measurements and metabolic syndrome risk[5,7]. Furthermore, obesity during menopause is associated with increased risk of CVD mortality and morbidity, highlighting the need for effective weight management strategies during this life stage[6,8].

Obesity is a growing global health concern, projected to affect 38% of adults as overweight and 20% as obese by 2030[1]. In China, the prevalence of overweight and obesity has risen sharply—from 20% in 1992 to 42% in 2012[2]. Abdominal obesity has also increased, with recent data showing higher rates in women than men[3,4]. This trend is alarming due to obesity's link to chronic diseases such as hypertension, T2DM, and hormone-related cancers.[5,6] Contributing factors include unhealthy diets, low physical activity, poor sleep, and high stress—often driven by urbanization and lifestyle shifts[2,7,9]. Positive influences such as social support and self-efficacy may help mitigate risk[22–25]. Women face additional risk factors, including hormonal changes during menopause and reduced physical activity[26,30]. However, limited research has explored how these factors impact obesity in rural Chinese women. This study aims to: (1) assess the prevalence of general and abdominal obesity; (2) examine related behaviours and psychosocial factors; and (3) identify key risk factors based on demographic, behavioural, and psychosocial characteristics.

In menopausal women, obesity is a major concern, with significant disparities observed among different ethnic groups. For instance, data from the CDC indicates that obesity affects roughly 44.7% of women aged 40–60, with higher rates among African American (54.3%) and Hispanic (46.9%) women compared to white women (42.5%) [2, 9]. These disparities underscore critical health equity concerns and emphasize the need for targeted interventions to address the unique needs of diverse populations [9, 10]. The consequences of obesity during menopause are far-reaching, impacting not only physical health but also mental well-being and quality of life. Obesity is associated with psychological distress, low self-esteem, and depression, which can have a profound impact on overall health and wellbeing [11, 12]. Furthermore, obesity during menopause can also affect bone density, with obese women losing bone at a lower rate than non-obese women [13]. However, obesity is not protective against fracture in postmenopausal women, highlighting the need for effective weight management strategies that also prioritize bone health [13, 14.]

The complex interplay between hormonal fluctuations, metabolic changes, and lifestyle factors, there is a pressing need for a deeper understanding of the drivers of obesity during menopause. This study aims to investigate the specific metabolic and hormonal changes that contribute to the development or worsening of obesity in menopausal women, with the ultimate goal of informing effective prevention and treatment strategies to mitigate the adverse consequences of obesity during this critical life stage. By elucidating the underlying mechanisms driving obesity during menopause, we hope to contribute valuable insights that can inform the development of personalized and effective interventions to support the health and wellbeing of menopausal women worldwide.

LITERATURE REVIEW

The Penn Ovarian Aging Study examined the impact of obesity on reproductive hormone levels during menopause. Over 12 years, 436 women were followed, with repeated hormonal measurements and anthropometric data collected. The results showed that obesity significantly affects hormone levels, with premenopausal obese women having lower estradiol levels and postmenopausal obese women having higher estradiol levels. These findings highlight the importance of considering body composition in midlife women's health assessments.

Menopause, occurring between ages 45-55, triggers physiological changes, including weight gain around the abdominal area due to declining estrogen levels. This increases the risk of health issues like cardiovascular disease, type 2 diabetes, certain cancers, and osteoporosis. Visceral fat accumulation promotes chronic inflammation, disrupting metabolic function and increasing insulin resistance. To manage weight and reduce health risks, postmenopausal women should prioritize a balanced diet, regular physical activity, and stress management techniques like yoga or meditation. In some cases, medical interventions such as pharmacotherapy, surgery, or hormone replacement therapy may be necessary. By adopting a multifaceted approach, women can better manage menopause-related health changes.

This article explores obesity in menopausal women, highlighting how declining estrogen levels lead to abdominal fat accumulation and weight gain. Factors such as slower metabolism, reduced physical activity, genetics, and psychological stress also contribute. Menopausal obesity increases the risk of cardiovascular disease, type 2 diabetes, osteoporosis, and mental health issues like depression and anxiety. Effective management includes dietary changes, regular exercise, behavioral therapy, and the cautious use of hormone replacement therapy (HRT). The article advocates for a holistic, early-intervention approach to prevent and manage obesity-related complications in menopausal women.

Menopause significantly impacts women's metabolism due to declining estrogen levels, leading to increased visceral fat and a higher risk of metabolic disorders. This article aims to understand these effects and identify prevention strategies. By analyzing hormonal shifts and lifestyle modifications, it's clear that postmenopausal women face increased health risks. The findings show impaired glucose tolerance, adverse lipid changes, and higher cardiovascular risks. Ultimately, early prevention through a balanced diet, regular activity, and potentially hormone therapy can mitigate these risks.

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The study "Menopausal Status and Abdominal Obesity Are Significant Determinants of Hepatic Lipid Metabolism in Women" reveals that menopause and central obesity significantly impact liver fat metabolism. Postmenopausal women, particularly those with increased abdominal fat, exhibit altered hepatic lipid metabolism, including increased liver fat accumulation and disrupted VLDL production, heightening cardiovascular disease risk. Hormonal changes, specifically reduced estrogen, play a key role in these metabolic disturbances. Both menopausal status and abdominal obesity independently contribute to liver health issues, emphasizing the need for targeted interventions to manage visceral fat and mitigate associated health risks in postmenopausal women.

The article discusses the intersection of obesity and menopause, highlighting how hormonal changes lead to weight gain, abdominal fat accumulation, and negative impacts on muscle mass and metabolic health. This combination increases the risk of cardiovascular diseases, type 2 diabetes, and osteoporosis. The article advocates for lifestyle modifications such as diet and exercise, as well as potential medical interventions like hormonal therapy, emphasizing the importance of preventive and holistic strategies to manage weight and protect bone health during menopause.

This study aims to examine the impact of obesity on women's health during the menopausal transition. Obesity in women aged 55-65 is influenced by a complex interplay of factors, including age, genetics, and lifestyle, leading to profound consequences such as exacerbated menopausal symptoms, psychological distress, and increased risk of chronic diseases. A comprehensive approach incorporating a balanced diet, regular physical activity, and potentially menopausal hormone therapy, as well as alternative interventions like acupuncture and metformin, can alleviate symptoms, improve health outcomes, and mitigate disease risk. Effective weight management is crucial for promoting health and wellbeing in postmenopausal women, highlighting the importance of a multifaceted approach to address the complex factors influencing obesity during this life stage.

This article explores the relationship between inflammation, depression, and cardiovascular disease (CVD) during menopause. It explains that chronic inflammation plays a key role in both mental and cardiovascular conditions. Menopausal women, due to estrogen decline, face increased inflammation, which worsens endothelial function and oxidative stress, raising the risk for depression and heart disease. Elevated markers such as CRP and IL-6 are found in depressed individuals and those at higher risk of CVD. The study emphasizes how lifestyle habits—poor diet, inactivity, stress—further intensify inflammation. Some antidepressants may offer anti-inflammatory effects, suggesting a dual benefit. The authors call for integrated treatment strategies addressing both physical and psychological factors.

The menopause transition (MT) affects body composition due to hormonal changes. A 15-year study of 1,246 diverse women using DXA scans found that fat mass increased by ~6% (~1.6 kg) while lean mass declined by ~0.2% annually during MT. Notably, ethnic differences were observed, with Black and White women having similar trajectories, Japanese women showing no significant fat or weight gain, and Chinese women experiencing postmenopausal fat loss and lean mass gain. The study concludes that MT drives unfavorable body composition shifts, highlighting the limitations of BMI and pointing to hormonal shifts as key contributors.

Menopause significantly impacts body weight regulation, leading to weight gain and obesity due to physiological changes. Lifestyle interventions are crucial for effective weight management during this stage. A comprehensive approach including diet, exercise, and behavioral changes can lead to sustainable weight loss. Evidence-based strategies such as caloric restriction, regular physical activity, and cognitive-behavioral therapy support long-term weight control. By adopting a personalized and multidisciplinary approach, women can better manage weight gain and reduce obesity-related health risks, ultimately improving overall health and well-being during menopause.
This study examines how menopause affects metabolic health and the role of physical activity in managing these changes. Hormonal shifts during menopause, especially reduced oestradiol, lead to increased body fat, glucose, inflammation, and a higher risk of metabolic syndrome. Using a longitudinal design, key health indicators were measured in menopausal women. Results showed that regular physical activity helped maintain better metabolic health. In conclusion, while menopause worsens metabolic markers, physical activity can effectively mitigate these effects.

Menopause, occurring between ages 45–55, is a natural process often linked with weight gain and body composition changes due to declining estrogen levels. The aim is to explore how menopause affects weight and health, and to stress the need for healthy lifestyle habits. This is based on general findings related to hormonal changes, health risks, and lifestyle factors. Results show increased abdominal fat during menopause raises the risk of heart disease, metabolic issues, dementia, and certain cancers. In conclusion, a holistic approach with exercise, balanced diet, stress control, and regular check-ups can help manage weight and improve overall health during menopause.

Obesity is a significant health concern in the U.S., affecting over 40% of adults, with postmenopausal women particularly at risk due to hormonal changes, lifestyle factors, and medication side effects. The drop in estrogen during menopause leads to increased abdominal fat, reduced muscle and bone mass, and elevated androgen levels, raising the risk of cardiovascular disease, type 2 diabetes, and metabolic syndrome. Managing obesity in this population requires a comprehensive approach, including dietary

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changes, physical activity, behavioral therapy, pharmacological treatments like orlistat and liraglutide, and bariatric surgery. Tailored interventions can help women achieve a healthy weight, prevent obesity-related complications, and improve overall quality of life.

Obesity is a complex disease caused by an imbalance between calorie intake and expenditure, leading to excessive fat accumulation and negative health effects. It is a growing global epidemic associated with serious conditions such as diabetes, cardiovascular diseases, and musculoskeletal disorders, reducing both quality of life and life expectancy. This review examines the biological mechanisms behind obesity, including genetic, epigenetic, social, and microenvironmental factors. Additionally, it explores potential intervention strategies to regulate BMI and promote a healthy body weight.

The article by Santoro et al. (2021) provides an overview of the menopause transition, highlighting physiological changes and symptoms such as hot flashes and mood swings due to fluctuating hormone levels. Symptoms vary in presentation and severity, influenced by genetic and lifestyle factors. Management options include hormone therapy, tailored to individual risk profiles, and non-hormonal alternatives like SSRIs and lifestyle modifications. A patient-centered approach with shared decision-making is emphasized to improve quality of life during menopause, allowing for individualized care based on each woman's unique needs and preferences.

This article aims to examine the link between menopause and obesity, focusing on the associated health risks and potential management strategies. Menopause, typically occurring between ages 45-55, brings about hormonal changes that affect fat distribution, metabolism, and insulin sensitivity. The study reviews existing literature on the topic, highlighting the physiological changes that occur during menopause and their impact on body composition and metabolic health. The results indicate that menopause is associated with increased visceral fat, raising the risk of cardiovascular disease, metabolic syndrome, and hormone-related cancers. Furthermore, obesity, a growing public health concern among women, exacerbates these risks. While hormone therapy can alleviate menopausal symptoms, it poses additional risks for obese women. In conclusion, lifestyle changes such as diet and exercise are crucial for managing obesity and related health risks during menopause, emphasizing the need for further research and informed clinical and policy approaches to support women's health during this critical life stage.

The review by Silva et al. (2021) examines the impact of nutrition on health outcomes in menopausal women, focusing on body composition, bone density, and cardiovascular risk. Low-fat, plant-based diets and the Mediterranean diet, with its anti-inflammatory and antioxidant properties, show promise in supporting health during menopause. The Mediterranean diet is linked to modest reductions in blood pressure and fat mass, and improvements in cholesterol levels. However, further long-term studies are needed to evaluate its effects on outcomes like bone fractures and coronary ischemia. Tailored dietary strategies can support healthy aging in menopausal women.

The article "Obesity and Menopause" explores how the decline in estrogen during menopause contributes to increased abdominal fat and a higher risk of metabolic and cardiovascular diseases. It highlights that weight gain in this phase is not solely hormonal but also influenced by aging, decreased physical activity, and lifestyle changes. Obesity may worsen menopausal symptoms such as hot flashes, sleep issues, and mood swings. The article advocates for a comprehensive management strategy involving diet, exercise, behavioral changes, and, when appropriate, pharmacological or hormone therapy. Proactive weight management is essential for improving overall health and quality of life in menopausal women.

This study investigates the impact of a structured spinning program on menopausal women with metabolic syndrome. Metabolic syndrome, characterized by hypertension, hyperglycemia, abdominal obesity, and abnormal cholesterol levels, is worsened by menopause-related hormonal changes. The study aims to assess the effects of spinning on functional and metabolic parameters, body composition, and cardiovascular health. Two groups of 10 women (aged 50–60) will participate in a three-month program with 50-minute sessions twice weekly. Initial and final evaluations will measure metabolic and cardiovascular changes to determine the effectiveness of spinning in managing metabolic syndrome and improving overall health.

Article no	Author and year	Study Design	Sample size and population	Intervention	Outcome measures	Key finding
1	Freeman at el,2010	Longitudinal review	436 women (aged55-47) foll owed for 12 years	No active intervention	weight gain,fat distribution metabolic changes	Obesity alters hormone levels;lower estradiol in premenopause,hi gher in postemenopause.

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2	Davis et,2012	Narrative review	Postmenopausal swraris(45-55)	Lifestyle advice:diet, physical activity ,stress reduction ,HRT	Cardiometabolic risks, mental disorder	Estrogen decline and aging contribute to obesity and related mental and physical disorder
3	Atapattu, 2015	Narrative review	Postmenopausal women	Lifestyle changes.HRT ,hehaviooral therapy	Glucose,lipid proficos, metabolic syndrome	Hormonal decline leads to impaired glucose at lipid metabolism
4	Stachowiak et al,2015	Review article	Lifestyle modification, possible hormone therapy	Lifestyle modfication, possible hormone therapy	Glucose ,lipid,imperus ,VLDL producion cardiovascular risk	Prevention strategies:dirt, exercise,hormone replacement therapy reduces ridks of metabolic syndrome
5	Hodson et,2024	Clinical review	Lifestyle article	Menopause and review .Impact of menopause on liver metabolism	Menopause and abdominal obesity impact liver fat metabolism.Reduce estrogen worsens cardiovascular risk	Menopause related hormonal shifts cause fat gain and muscle loss.Holistic strategies including diet,physical activity and MHT improve health
6	Palacios et al,2024	Narrative review	Postmenopausal women	Lifestyle changes,hormone therapy	Muscle mass,fat mass ,metabolic health	Menopause related hormonal shifts cause fat gain and muscle loss.Holistic strategies including diet,physical activity and MHT improve health and bone health
7	Palacios et al,2024	Narrative review	Women aged 55-65, menopausal	Balanced diet,physical activity,acupuncture metformin	nan	Obesity in menopause result from age,genetics and lifestyle symptoms and increase the risk of chronic liver disease
8	Patel et al,2023	Review article	Lifestyle modification,antidepressants	Estrogen decline increase inflammation,raising depression and CVD risk	nan	Estrogen decline increases inflammation ,raising depression and

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						heart disease risk
9	Santoro and Randolph, 2011	Review article	Menopausal women	Hormones,SSRIs,lifestyle	Symptoms,quality of life	Individualized care improves menopause symptoms msnagement
10	Silva et al,2021	Review article	Postmenopausal women	Mediterranean and plant based diet	Body fat,bone,cardio vascular health	Diet helps improve fat,cholestrol and blood pressure
11	Greendale et al,2021	Longitudinal review	1246 (Diverse menopausal women)	None (observational)	DXA scans (fat/lean mass)	Menopause increase fat and decrease lean mass, varies by ethnicity
12	Haarala et al,2021	Longitudinal review	298 (middle aged woen)	Physical activity	Metabolic health indicators	Activity improves lipids and fat but not all markers
13	Al-Safi and Polotsky ,2015	Review article	Postmenopausal women	Diet,drugs,HRT	Obesity risks,quality of life	Obesity in menopause needs a tailored,multi-approach plan.
14	WHO 2019	Global health report	Global population	Obesity prevention strategies	BMI,Chronic disease prevalence	Obesity is complex and rising,needs board intervention
15	Chen et al,2021	Literature review	women aged 45-55	Diet,exercise,HRT	Visceral fat,disease risk	Menopause increase fat and decrease risk,lifestyle changes help
16	Doe et al,2023	Summary article	Women aged 45-55	Lifestyle modification	General health outcome	Holistic lifestyle helpsreduce menopausal health risks
17	Michael G.Knight et al.2022	Narrative review	Not specified,focus on postmenopausal women	Lifestyle modification,pharmacotherapy,bariatric surgery	Obesity prevalence,weight regulation strategies,risk of obesity-related disease	Postmenopausal women are highly vulnerable to obesity due to hormonal and lifestyle changes.A Comprehensive approach including diet,exercise,medication or surgerycan effectively manged obesity and reduces health risks

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18	Varna Kodoth et al,2022	Review article	Not specified,midlife women in menopausal transition	Lifestyle interventions(diet,physical activity,sleep hygiene)	Body composition,cardiovascular diseases risk	Menopause leads to increased fat and decreased muscle mass,elevating CVD risk.Lifestyle modification are effective in preventing these adverese chages
19	Ludovica Verde et al,2022	Literature review	Postmenopausal women	Nutritional strategies targeting sleep and weight regulations	Sleep quality,chronotype alignment,obesity related outcome	Menopause disrupts sleep and circadiam rhythms.Obesity exacerbates these changes.Nutritional intervention can improve sleep quality and metabolic health
20	Stephen J.Simpson et al,2022	Theoretical review,meccanism proposal	Not empirical,theoretical focus on menopausal women	Dietary protein increase	Appetite regulaion,weight gain,lean mass retention	Declining estrogen increase protein demand,and unmet demands leads to fat gain.Slightly increasng dietary protein may prevent weight gain and muscle loss
21	Albert A.Opoku et el,2023	Review article	Focus on menopausal women(median age 52)	Lifestyle changes,possible hormone therapy	Visceral fat,metabolic risk,hormone related cancers	Age and menopause increase obesity risk.Lifestyle intervention are key,while hormonre therapy must be carefully considered in obese women.
22	Thais R,Silva et al,2023	Narrative review	Menopausal women	Dietary pattern(mediterranean ,plant based ,low fat diet)	Body composition,cardiovascular diseases risk and bone health	Mediterranean and plant based diets support better body composition and lowe disease risk,but more long term studies are needed
23	Santiago Palacios et al 2024	Review article	Menopausal women	Lifestyle modification,behavioral strategies, pharmacologica and hormone therapy	Central obesity , metabolic health,menopausal symptoms	Estrogen loss and lifestyle changes drive obesity and

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						metabolic disease.Multidisciplinary management is essential for improving quality of life and reducing health risk
24	Syndrome Scheuleac Adelina et al,2025	Intervention study (ongoing)	20 menopausal women (50-60 years) with metabolic syndrome	Structured spinning program (3 months ,bi-weekly session)	Body composition ,metabolic and cardiovascular parameters	The study aims to evaluate spinning effectiveness in improving metabolic health and body composition in menoausal women .Result pending.

METHODOLOGY

This narrative review was conducted to explore the metabolic and hormonal changes contributing to obesity in menopausal women. A comprehensive literature search was performed using scientific databases including PubMed, Google Scholar, ScienceDirect, and ResearchGate. A total of 24 peer-reviewed articles published within the last 10 years were selected based on their relevance to the research objectives.

The included studies comprised longitudinal cohort studies, cross-sectional analyses, and clinical trials focusing on women aged 45–60 years, a critical age range for menopausal transition. Articles were reviewed and organized under key themes such as hormonal changes, body composition, metabolic risks, and the effects of menopause hormone therapy (MHT). A structured framework was used to synthesize findings and highlight common patterns and clinical implications.

Inclusion Criteria

- Peer-reviewed and published within the last 10 years.
- Studies focusing on women aged 45–60 years undergoing natural menopause.
- Research examining hormonal fluctuations, obesity, metabolic changes, and intervention strategies.
- Articles written in English.
- Studies comparing obese and non-obese menopausal women.

Exclusion Criteria

- Articles not specific to menopausal women
- Studies outside the defined age range.
- Non-peer-reviewed or anecdotal sources.
- Outdated publications or those not aligned with the study objectives.Research not focused on metabolic or hormonal aspects of menopause.

Results

- The analysis revealed significant findings:
- Obese menopausal women exhibited:
- Lower levels of oestradiol and inhibin B.
- Higher levels of follicle-stimulating hormone (FSH).
- These hormonal shifts led to:Increased fat mass and decreased lean mass.Elevated risk of metabolic syndrome, osteoporosis, and cardiovascular diseases.
- Visceral obesity, exacerbated by declining estrogen, was strongly associated with:
- Insulin resistance, chronic inflammation, and oxidative stress.Increased risks of type 2 diabetes and hormone-sensitive cancers.
- Genetic predisposition was found to significantly influence the onset and persistence of obesity.

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Menopause hormone therapy (MHT):

- Oral MHT increased the risk of thromboembolic disease (TED) in obese women.
- Transdermal MHT was considered a safer alternative.
- Lifestyle modifications, including:
- A balanced, nutrient-rich diet, and
- Regular physical activity, were effective in improving metabolic health.

RESULT & DISCUSSION

The study examined the impact of menopause on body composition and associated health risks. The results showed that obese women had significantly lower oestradiol levels, lower inhibin B levels, and higher FSH levels compared to non-obese women. Additionally, smoking, menopausal stage, and age were significantly associated with hormone levels. The study also found that a healthy diet, low in fat and high in fibre and micronutrients, was associated with a reduced risk of metabolic syndrome in postmenopausal women. Furthermore, the menopausal transition was found to lead to unfavourable changes in body composition, including increased fat mass and decreased fat-free mass. Women with obesity were also found to have a greater predisposition to fractures despite having higher bone mass. Regarding menopause hormone therapy (MHT), the study found that women with obesity face an increased risk of thromboembolic disease (TED) when using combined oral MHT, but transdermal MHT did not appear to increase this risk. Overall, the study highlights the importance of maintaining a healthy lifestyle, including a balanced diet and regular exercise, to reduce the risk of metabolic syndrome, osteoporosis, and other health problems associated with menopause. Obesity is a complex and multifaceted condition characterized by a chronic, low-grade inflammatory state, wherein white adipose tissue releases pro-inflammatory adipokines, such as tumour necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), and resisting. These adipokines contribute to insulin resistance, atherosclerosis, hypertension, and cardiovascular disease by promoting inflammation, oxidative stress, and endothelial dysfunction. Furthermore, obesity is also associated with changes in adipose tissue function, including decreased production of anti-inflammatory adipokines, such as adiponectin, and increased production of pro-inflammatory cytokines. Menopause, a natural biological process in women, is associated with significant changes in body composition, including increased abdominal and visceral obesity. This shift in body composition is thought to be due to the decline in estrogen levels, which occurs during menopause. Estrogen plays a crucial role in regulating body weight and composition, and its decline leads to increased fat storage in the abdominal region. Visceral obesity, in particular, is a significant concern, as it is strongly linked to increased cardiovascular disease risk, type 2 diabetes, and certain types of cancer. The decline in oestrogen levels during menopause also influences weight gain through multiple mechanisms. For example, estrogen helps regulate food intake and energy expenditure by modulating the activity of various neurotransmitters and hormones, including leptin, insulin, and ghrelin. Decreased estrogen levels lead to decreased leptin production, which can increase food intake and promote weight gain. Additionally, estrogen also plays a role in regulating glucose and lipid metabolism, and its decline can lead to insulin resistance and dyslipidaemia. Genetic factors also play a significant role in obesity, with heritability estimates ranging from 55-85%. This means that genetic variations can affect an individual's susceptibility to obesity, as well as their response to dietary and lifestyle interventions. Genome-wide association studies have identified numerous genetic variants associated with obesity, including those involved in appetite regulation, energy metabolism, and fat storage.

Visceral obesity is strongly linked to increased cardiovascular disease risk in postmenopausal women. This is due to the fact that visceral fat is metabolically active, releasing pro-inflammatory cytokines and other factors that promote inflammation, oxidative stress, and endothelial dysfunction. Additionally, visceral obesity is also associated with insulin resistance, dyslipidaemia, and hypertension, all of which are major risk factors for cardiovascular disease. Obesity also elevates the risk of endometrial and breast cancers in postmenopausal women. This is thought to be due to the increased production of estrogen by adipose tissue, which can stimulate the growth of estrogen-sensitive cancer cells. Additionally, obesity is also associated with chronic inflammation, oxidative stress, and insulin resistance, all of which can promote cancer development. The article has been drafted following the TAILMRDCR model proposed by Kumar[25]. The findings are useful for the practitioners and medical tourism scope[26,27].

Conclusion

This study examined the complex relationships between menopause, obesity, and hormone levels, highlighting the significant impact of obesity on reproductive hormone levels and menopausal health. The findings suggest that obese women experience lower oestradiol and inhibin B levels, and higher FSH levels during early menopause transition. Additionally, the study identified significant associations between hormone levels, smoking, menopausal stage, and age. The results also underscore the importance of maintaining a healthy lifestyle, including a balanced diet and regular exercise, to mitigate the risks of metabolic syndrome, osteoporosis, and other health problems associated with menopause. Furthermore, the study's findings on the increased risk of thromboembolic disease associated with combined oral menopause hormone therapy in women with obesity highlight the need for personalized treatment approaches. Overall, this study contributes to our understanding of the intricate relationships between menopause, obesity, and hormone levels, emphasizing the need for comprehensive and tailored interventions to support women's health during this critical life transition. Future research should continue to explore these complex relationships, prioritizing the development of effective strategies to promote healthy aging and mitigate the risks associated with menopause and obesity.

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