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This review considers recent scientific evidence with regard to the role of dairy in the diet of women during menopause, focusing on aspects such as bone health, cardiovascular health, weight management and inflammation, and overall menopausal symptomatic relief.

A publication for health professionals

The role of dairy in the diet *of women during menopause*

Menopause, defined as the cessation or 'pausing' of the female menstrual cycle, is a natural phase occurring in a woman's life cycle. It presents with a decline in ovarian hormone production as the ovaries become less responsive to follicle stimulating hormone and lutein hormone, leading to a reduced circulation of oestrogen and progesterone. The drop in these hormone levels leads to a multitude of health challenges for women to navigate during the 'menopause phase'. Although not often considered, dietary interventions and modifications have been postulated to have a significant role in managing menopausal symptoms and promoting overall health in women during this phase. This review considers recent scientific evidence with regard to the role of dairy in the diet of women during menopause, focusing on aspects such as bone health, cardiovascular health, weight management and inflammation, and overall menopausal symptomatic relief.

Introduction

Physiological and psychological changes during the 'menopausal phase' can be a challenge for women. Menopause typically presents between the ages of 45 and 55, with the average age of onset in the United States being 51 years.[1] Physiological changes include a decrease in oestrogen levels, an increased risk of osteoporosis and cardiovascular disease(CVD), and weight gain (particularly around the central abdominal area). Psychological changes manifesting around this time may include depression and anxiety (at varying levels). Given these health concerns in women, lifestyle interventions such as dietary intake and physical activity, particularly to preserve and strengthen muscle mass, are of great interest in attempting to mitigate menopausal symptoms and promote optimal health.

Dairy products include liquid milk, cheese, fermented dairy products such as yoghurt, kefir, maas, buttermilk and doogh (a fermented savoury yoghurt drink), cream and butter. These products vary with regard to their food matrix and nutrient content, including fat, protein and calcium. As a result, the effects of different dairy products on fat absorption, composition of the gut microbiota, gene expression and blood metabolomics vary, influencing lipid metabolism and inflammation.[2] The health benefits of dairy foods are attributed to milk and milk products being rich sources of easily digestible fat and protein, along with an array of fatty acids, bioactive peptides, and vitamins and minerals, all working together as a team in a specific structure. This is referred to as the dairy matrix (for more on the dairy matrix see https://www.rediscoverdairy.co.za/dairy-matrix/). Owing to the high content of nutrients such as calcium, vitamin D (if fortified), phosphorus and protein in dairy products, health practitioners may recommend their intake specifically for bone health.

This review considers recent scientific evidence with regard to the role of dairy in the diet of women during menopause, focusing on aspects such as bone health, cardiovascular health, weight management and inflammation, and overall menopausal symptomatic relief.

Bone health

The SWAN longitudinal study has significantly contributed to our understanding of the alterations in bone health across the menopausal transition phase.[3] The data demonstrate that, for the lumbar spine and femoral neck, bone mineral density (BMD) declines fastest from a year before the final menstrual period and the rate then tapers off over two years after the final menstrual period.[4] One of

the most significant health concerns during menopause is BMD loss, primarily due to decreased oestrogen levels. Oestrogen is crucial for maintaining bone density, and its decline during the menopausal phase increases the risk of bone-related health problems such as osteoporosis and fractures.

Dairy products contain calcium, phosphorus, magnesium, vitamin D (if fortified) and protein, which together promote bone health through an increase in bone mineralisation and formation and a decrease in bone resorption. A large systematic review and meta-analysis reported that daily yoghurt consumption, for example, was associated with a lower risk of hip fractures.[5]

Based on research regarding the risks of bone fractures during menopause, women should be encouraged to adopt a 'bone-friendly' lifestyle, especially during this life stage. This includes optimising vitamin D status and dietary intakes of calcium and protein to support skeletal muscle mass, engaging in adequate physical activity, and avoiding smoking and alcohol consumption.

Calcium and bone health

Calcium is critical for the maintenance of BMD and, consequently, the associated prevention of osteoporosis. Studies show that women who consume dairy daily have higher BMD and a lower rate of bone loss compared with women who do not have dairy often.

The National Osteoporosis Foundation recommends an intake of 1200 mg of calcium per day for women over 50, which can be effectively met through daily dairy consumption.[6] (The European Food Safety Authority recommends an intake of 950 mg for women over the age of 25 years.[7]) Adequate vitamin D status, defined as 30 ng/mL or more of serum 25-hydroxy vitamin D (usually achieved with a daily oral intake of at least 400 to 600 IU), is required to achieve the nutritional benefits of calcium.[5] Adequate calcium intake (in the presence of adequate vitamin D status) has been shown to reduce bone loss in peri- and postmenopausal women and reduce fractures in postmenopausal women older than 60 with low calcium intakes.[5] Adequate calcium is considered a key component of any bone-protective therapeutic regimen.

Dairy products are an effective means to meet daily calcium needs, as they provide a readily absorbable form of calcium. Although food is the best source of calcium, high-quality calcium supplements are also an alternative source for those unable to meet dietary calcium requirements. However, some studies warn of possible cardiovascular risks with calcium supplementation, but the evidence is inconclusive. Healthcare practitioners should strongly advise menopausal women to meet their daily calcium needs of 1200 mg for bone health.

Vitamin D and bone health

Vitamin D is critical for calcium absorption. Clinical studies have proven that osteoporosis treatments are effective only with adequate vitamin D supplementation (more than 1000 IU/ day). Without such supplementation, the fracture risk reduction effect of osteoporosis therapies can be 30% lower than expected.[8]

As dairy is not a natural source of vitamin D, milk and milk products are fortified with vitamin D in the United States and Europe. This is, however, not the case in South Africa, as 30–40 minutes of direct sun exposure is considered to be enough to ensure an adequate vitamin D status.

Protein and bone health

Protein in dairy products helps maintain muscle mass and bone density, which are crucial for overall skeletal health, especially around the time sarcopenia starts to set in. Rizzoli et al.[9] found that higher dairy protein intake was linked to greater BMD and muscle mass in older women.

Cardiovascular health

It is well documented that women of reproductive age have a lower cardiovascular risk than males of the same age owing to the protective effect of oestrogen on the cardiovascular system.[10] During perimenopause and menopause, the risk of cardiovascular disease increases, largely owing to the decrease in circulating oestrogen.[11] Through local anti-inflammatory and epigenetic modifying effects, oestradiol contributes to the regulation of the vascular system.[12] It is imperative to note that the greater the decrease in oestradiol levels and the faster the rate of change, the greater the increase in cardiovascular risk.[12]

With the onset of menopause, and the subsequent decrease in oestrogen levels, blood lipid profiles tend to change rapidly. The elasticity of blood vessels starts to decrease and the blood supply to organs dissipate. The possible increase in total serum cholesterol, low-density lipoprotein (LDL) cholesterol and triglycerides during the menopausal

phase can lead to cholesterol values higher than those of men of the same age,[13] therefore putting women at a higher risk for CVD during menopause. Epidemiological studies have shown that central obesity, dyslipidemia, glucose intolerance and hypertension are the most common risk factors for CVD in menopausal women. The occurrence of insulin resistance (metabolic syndrome) has been found to be two to three times higher in postmenopausal women than before they enter the menopausal phase.[14] The risk of high visceral adiposity in menopausal women is five times higher than what is typically observed in women before onset of the menopausal phase.[15]

Dairy products can influence cardiovascular health through the effects of their specific fat content, probiotic profile and other beneficial bioactive components.

Fatty acids in dairy

The fatty acid composition of the diet is more important than the total fat amount. For optimal health, saturated fatty acids should not make up more than 10% of the diet's total energy. The type of fat in dairy products is an important consideration. Although full-fat dairy products contain saturated fats, which have been associated with increased LDL cholesterol levels, recent research suggests that the overall impact of dairy fat on cardiovascular health may be less detrimental than previously thought. A study by Huth and Park[16] found that dairy fat intake was not consistently associated with increased cardiovascular risk and that fermented dairy products may offer additional protective effects.

Fermented dairy products

In a large systematic review and meta-analysis, across a total of 291 236 subjects, yoghurt consumption of 200 g per day was significantly associated with a lower CVD risk.[17] Evidence suggests that yoghurt may interfere with cholesterol synthesis. In a systematic review of seven randomised controlled trials, the consumption of yoghurt significantly reduced participants' total cholesterol values, ratio of total cholesterol to high-density lipoprotein (HDL) cholesterol and plasma glucose values.[18]

The positive effects of yoghurt on lipid profiles may be linked to the product's calcium content. Calcium interferes with fat absorption in the intestine, forming calcium soaps with fatty acids and binding bile acids, resulting in increased faecal fat loss. Bioactive peptides have also been shown to lower cholesterol levels.[18] In addition, yoghurt may have a positive effect on weight management. Fermented dairy products such as yoghurt and kefir also contain probiotics that have been shown to influence cardiovascular health positively through improving lipid profiles and reducing hypertension, which offers potential cardiovascular benefits for menopausal women.[19]

Weight management

Weight gain and the accrual of abdominal adiposity are two of the most common frustrations reported by women during the menopause transition. Body composition changes parallel to the decrease in basal metabolic rate and weight gain typically present as an increase in visceral fat mass.[20] Data from the four-year-long Healthy Transitions study, the ongoing SWAN longitudinal study and the eight-year-long Australian Longitudinal Study on Women's Health reveal that detrimental changes in body composition (i.e. increased fat mass, decreased fat-free mass and decreased bone density) occur and exacerbate cardiometabolic risk for menopausal women. These menopause-related changes in body composition seem to coincide with significant declines in physical activity. In addition, owing to hormonal changes, fat-free mass and skeletal muscle mass decrease, which can ultimately lead to osteoporosis and sarcopenia. In summary, the data demonstrate significant lean tissue losses along with more substantial increases in fat mass during the menopause transition phase. According to current World Health Organization data, 44% of women are overweight or obese (BMI >25).[21] The incidence of abdominal obesity in women increases with age, and a rapid increase is observed in middle-aged women. Weight gain is a symptom of menopause, experienced by 60–70% of middle-aged women. Hales et al.[22] postulated that over 43% of menopausal women have obesity and the challenges that promote these staggering rates, and barriers to effective treatment, are multifactorial. Results from the longitudinal observational Healthy Women Study revealed that, on average, women gained 2.25 kg during three years of menopausal transition and 20% of them gained more than 4.5 kg. The SWAN study also showed a 10% increase in fat mass among women transitioning to menopause, together with a shift in body fat distribution, leading to more central abdominal adiposity.[3]

Dairy consumption may influence weight management and body composition through various mechanisms. However, because of their

high saturated fat content, the effects of dairy foods on weight change and weight management remain controversial. It is important to note that not all types of saturated fat have equal effects on health status. Dairy fat contains a higher percentage of short-chain fatty acids, which have been shown to lower the risk of obesity.[23] Despite their fat content, dairy foods are nutrient dense and contribute to the intake of proteins, several vitamins, minerals and other bioactive compounds, which may have an active role in managing weight positively.

Data on the impact of dairy foods on weight change and weight maintenance in menopausal women are inconsistent. A systematic review concluded that there was no statistically significant relation between total dairy consumption and weight change, although there was a 15% lower risk of central obesity and 13% lower risk of being overweight among participants with the highest dairy intake.[23]

The inconsistency of the association between total dairy and weight in some studies could be attributed to the different effects dairy products may illicit. The positive health effects of fermented dairy products are increasingly interesting. Fermented dairy such as yoghurt and kefir has a high probiotic content, which has been demonstrated to modulate gut microbiota favourably and be protective against obesity. Data from the Nurses' Health Study (NHS) and Nurses' Health Study II (NHS II) as well as the Health Professional Follow-up Study found that increasing yoghurt intake was associated with 0.37 kg less weight gain ($p < 0.001$) over four years, whereas no such association was found with the intake of other dairy products, including milk and cheese. The authors of a longitudinal study in which participants' mean age was 54.5 years reported that people who consumed more than three servings of yoghurt per week had 50% less weight gain and a 20% lower increase in waist circumference compared with those who consumed less yoghurt (<1 serving/week) across 13 years of follow-up. No associations were found between weight change and milk and cheese intake.[24] These results suggest that individual dairy foods may have different roles in weight change and body composition.

Although a cup of yoghurt has a similar amount of calcium as one cup of milk, the acidity of yoghurt is believed to improve the bioavailability of calcium, which may account for the specific weight-reducing effects of yoghurt. Research has not shown similar weight-reducing effects specific to milk and cheese.

Dairy and satiety

The protein and fat in dairy products can enhance satiety, potentially leading to reduced overall energy intake. Dairy consumption has been associated with lower body fat and improved body composition in postmenopausal women, which may be attributed to the high protein content and the impact of dairy on appetite regulation.

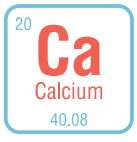
Calcium and weight management

There is ongoing debate about the role of calcium in weight management. Calcium has been postulated to have a role in fat metabolism. Increased calcium intake is reported to inhibit lipogenesis, stimulate lipolysis, promote lipid oxidation and increase the excretion of faecal fat. Increased calcium intake has been shown to accelerate weight and fat loss. A review found that higher calcium intake from dairy products was associated with lower body fat percentage overall and decreased waist circumferences in menopausal women.[25] However, the evidence is mixed, and further research is needed to confirm these effects.

Protein and weight management

Protein requirements increase during the menopause transition owing to tissue protein breakdown. Increased protein breakdown is coupled with protein-specific appetite by a mechanism based on production of fibroblast growth factor [21] or other muscle- or liver-derived hormones. The increase in protein appetite drives either a shift to foods with higher protein content or increased total energy intake. Failing to change the composition of the diet by introducing additional protein intake and decreasing that of carbohydrates and fat results in increased energy intake and storage, and consequently weight gain. Increasing dietary protein concentration can help to ameliorate or prevent weight gain and adiposity.

Studies postulate that to maintain or increase fat-free body weight and skeletal muscle mass, the daily protein intake should be 1.0–1.2 g/kg ideal body weight/day (at least 20% of total energy), coupled with regular physical activity with free weights or against some form of resistance. Diets with a high protein content (at least 20% of total energy) result in weight loss only if the total energy content is low. At the same time, the suggested protein requirement (1.0–1.2g/kg ideal body weight/day) is also essential for increasing and maintaining skeletal muscle mass.



Inflammation

Inflammation is a biological process that occurs when the body activates an immune response to protect itself from environmental stimuli such as dietary triggers, pathogens or toxins. If the inflammatory response presents more persistently, it leaves the body in a state of distress (chronic low-grade inflammation), which can trigger disease and illness. The anti-inflammatory benefits of oestrogen decrease during menopause owing to reduced hormone secretion.

Components in the foods we consume can have either an anti- or a pro-inflammatory effect. In recent years, dairy has increasingly received interest regarding its presumably pro-inflammatory effect on inflammation, often exacerbated by social media claims. However, the nutritional composition of dairy, such as its lipid profile, relative leucine content or fermentation status, can affect its inflammatory potential.

Fermented dairy products may modulate the inflammatory and immune response through several mechanisms. These include effects due to the bacteria in fermented products, palmitic acid (16:0 saturated fatty acid) via toll-like receptors, and short-chain fatty acids produced after consumption of fermented dairy, which may reduce the secretion of pro-inflammatory cytokines and chemokines. Fermented dairy also contains unique trans and other odd-chain fatty acids (15:0 and 17:0), which may be associated with reduced cardiometabolic risk.[2] The composition of the gut microbiota may be altered by the intake of fermented dairy and the dairy matrix may modify the interactions between nutrients, which could explain differences in health effects from the intake of different dairy products.

In a randomised controlled trial, Dugan et al.[40] assessed the effect of the consumption of low-fat dairy on systemic inflammation in 37 participants with metabolic syndrome.[26] The researchers found that the female participants expressed significantly lower levels of tumour necrosis factor alpha (TNF-α) and monochemo-attractant protein[1] (MCP-1), a key chemokine that regulates migration and infiltration of monocytes and macrophages, after six weeks of consuming three servings of low-fat dairy per day (300 ml 1% milk; 180 g fat-free yoghurt; 120 g 2% cheese) compared with the control group, who consumed a 45 g granola bar and 360 ml pure fruit juice every day.

More recently, a systematic review by Zhang et al.[41] showed that a higher milk intake was related to a reduced risk of type 2 diabetes, metabolic syndrome and obesity.[27] A dose–response analysis suggested that a 193 ml increment of milk intake per day was related to a 13% lower risk of metabolic syndrome and a 16% lower risk of obesity. Obesity presenting in menopause is characterised as a chronic, low-grade systemic inflammatory state that predisposes the body to develop other chronic conditions such as metabolic syndrome or type 2 diabetes.

Rundblad et al.[42] demonstrated that a high-fat meal composed of fermented dairy products, and specifically cheese, had a weaker pro-inflammatory effect than intake of non-fermented high-fat dairy products, including butter and whipped cream.[28] The high protein and calcium content of cheese may explain some of these differences. Of interest, cell adhesion was also investigated, and between the four meal types studied the researchers demonstrated that only the non-fermented dairy products that included dairy fats (e.g. butter and whipped cream) increased circulating concentrations of adhesion molecules.

Pei et al.[29] found that in premenopausal women daily consumption of 339 g low-fat yoghurt over nine weeks resulted in reduced concentrations of inflammatory biomarkers compared with intake of a non-dairy control food (soy pudding).

In a randomised controlled cross-over study by Rundblad et al.,[28] 47 healthy participants were randomly selected to consume one of four different high-fat meals that included butter, cheese, whipped cream or sour cream. All the meals, rich in saturated fat, induced a postprandial inflammatory response. However, no increase in postprandial C-reactive protein concentrations was observed. The mechanism may involve an inflammatory response through liposaccharide toll-like receptor 4 binding, which likely activates nuclear factor kappa B and the expression of inflammation-related genes or altering the gut microbiota to overproduce liposaccharides, hence worsening the inflammatory response of a high-fat meal.

Meals containing cheese or sour cream (fermented dairy products) induced a weaker pro-inflammatory response than those containing butter and whipped cream, despite having the same amount of fat and the same fatty acid composition. The response after cheese intake differed the most from that of the non-fermented products. Cheese contains more protein than the other three products, and plasma concentrations of amino acids were shown to have

increased after intake of cheese compared with consumption of the other products. Cheese is also rich in calcium, which has been shown to suppress the inflammatory response by contributing to a more anti-inflammatory gene expression response by peripheral blood mononuclear cells.[28]

Reviewing 11 randomised controlled trials, which included a total of 663 adult participants, Moosavian et al.[30] found that, compared with low or no dairy intake, high consumption of dairy products resulted in a decrease in CRP, TNF-α, interleukin 6 (IL-6) and MCP concentrations and increased adiponectin levels. These findings support the possible anti-inflammatory properties associated with dairy products. However, it must be kept in mind that between-study heterogeneity was considerable for these biomarkers, and moderate for leptin. Subgroup analysis showed that dairy consumption appeared to have no effect on inflammatory biomarkers and no differences were observed in these trials. The authors concluded that dairy products high in saturated fat, in the long term, do not promote inflammation because none of the studies reported an increase in circulating inflammatory markers in participants who received dairy.

The authors also postulated that the high concentration of the amino acid leucine in dairy contributes to anti-inflammatory properties.[30] Leucine appears to increase secretion of anti-inflammatory adiponectin and decrease secretion of pro-inflammatory cytokines. In addition, leucine reduces oxidative and inflammatory stress by stimulating mitochondrial biogenesis, which increases oxygen consumption and fatty acid oxidation in adipocytes and skeletal muscle cells, and by inducing protein synthesis and suppressing protein degradation.

Oestrogen has a key influence on immune and inflammatory processes, and it is well documented that the paucity of ovarian steroidal hormones enhances the inflammatory process, predisposing menopausal women to immune inflammatory disorders. Post-menopausal women experience increased inflammatory responses to infection and a higher rate of autoimmune diseases than men, which may be linked to lower circulating oestrogen levels and also the variation of chronic inflammatory disease activity. Therefore, any food type that can lower the risk of chronic low-grade inflammation would be beneficial during the menopausal transition phase.

Menopausal symptoms

The quality of the diet is a determining element of an individual's overall health at every stage of life. Healthy dietary intake and regular physical activity have been shown to counteract the symptoms of perimenopause and menopause, although concrete data – especially with regard to the effect of a single food type – appear limited. Most women transitioning through menopause will experience symptoms such as hot flushes, night sweats, sleep disturbances, mood disturbances and muscle aches, as well as physiological changes such as genital atrophy and loss of urogenital support. In many women, these symptoms are severe enough to adversely affect their quality of life, work performance and personal relationships. Current available treatments to help address these menopause-related symptoms, such as hormone therapy, antidepressants and anticonvulsants, may have significant side effects and adverse long-term consequences, forcing women to seek alternative therapies to help combat symptoms experienced during the menopause transition phase.

Some data suggest that low dietary calcium intake and poor consumption of dairy products could contribute to severe menopausal symptoms,[31] which could lead to the assumption that dairy foods may have some implications for the relief of menopause-related symptoms, although evidence of direct effects is inconclusive.

Although findings are inconclusive, nutrients in dairy may contribute to alleviating symptoms in the ways as described by the points that follow.

Micronutrients and sleep quality

Foods containing melatonin can directly affect sleep. Intake of adequate amounts of the amino acid tryptophan, a precursor of melatonin, has been shown to have a positive effect on sleep. Vitamins and trace elements participating as cofactors in melatonin synthesis include folic acid, vitamins B6 and B12, magnesium and zinc. Dairy foods are rich sources of protein (providing essential amino acids, such as tryptophan), calcium, phosphorus, magnesium, zinc and B vitamins.

Micronutrients and hot flushes

Calcium intake has been investigated for its potential role in reducing menopausal symptoms and it has been suggested that women with higher calcium intake reported fewer and less severe episodes of hot flushes. The mechanism may involve calcium's role in neurotransmitter regulation and hormonal balance.

Vitamin D may improve menopausal symptoms through several mechanisms. Oestrogen increases the activity of the enzyme responsible for activating vitamin D. Vitamin D supplementation can improve mood and muscle aches in non-menopausal populations, but its effects on a menopausal population have not been well studied.

Vitamin D and mood

Vitamin D deficiency has been linked to mood disorders and depression. A recent study found that higher vitamin D levels were associated with improved mood and reduced depressive symptoms in menopausal women.[32] As fortified dairy products are a good source of vitamin D, their consumption may have an impact on mood and overall well-being. However, fresh milk is not fortified with vitamin D in South Africa as natural sun exposure of 30–40 minutes a day is deemed sufficient to ensure adequate vitamin D levels.

Conclusion

Dairy products have a notable role in the diet of menopausal women, contributing to bone health, cardiovascular health and weight management, and potentially alleviating some menopausal symptoms. Current evidence supports the inclusion of dairy in the diet, particularly for its calcium and vitamin D content, which are crucial nutrients for bone health and overall well-being. However, considerations regarding lactose intolerance, fat content and the type of dairy consumed are important concepts to consider.

Despite the numerous health benefits of dairy, healthcare practitioners should also be aware of potential limitations. Lactose intolerance is prevalent among the African population and can affect daily dairy consumption. Women who are lactose intolerant may experience gastrointestinal discomfort following dairy intake. Lactose-free or dairy products with a reduced lactose content, such as yoghurt and hard cheese can be used to ensure adequate nutrient intake. Moreover, the bioavailability of nutrients in dairy products can be influenced by dietary habits and individual metabolic differences. Ensuring a balanced diet and considering individual nutritional needs are therefore important when recommending dairy consumption.

Research should explore the effects and benefits of different types of dairy product, including that of fermented versus non-fermented dairy, and their impact on various health outcomes, particularly in the menopausal phase. Understanding how different dairy products influence health can inform more personalised dietary recommendations. Longitudinal studies are needed to assess the long-term effects of dairy consumption on menopausal health outcomes. These studies can help clarify the impact of dairy on bone density, cardiovascular health and weight management over time.

Future studies should also investigate individual variability in response to dairy consumption. Factors such as genetic predisposition, metabolic rate and existing health conditions may influence the benefits experienced from dairy intake, highlighting the need for personalised dietary advice.

Healthcare practitioners should provide individualised dietary recommendations based on the latest research and consider potential limitations. Continued research is essential to further elucidate the role of dairy in menopausal health and refine dietary guidelines for optimal overall health.elines for optimal overall health.

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