

INTRODUCTION

Menopause is a normal part of a woman life and is not considered a disease or a disorder. It is a process through which a woman ceases to be fertile or menstruate. Despite being a natural process in the body for every woman, menopause can cause drastic alterations that trigger some profound changes in a woman’s body (Nordqvist, 2017). Changes to the menstrual pattern due to a reduction in estrogen levels are the first noticeable symptoms of menopause. Lower fertility, vaginal dryness, hot flashes, night sweats, disturbed sleep, urinary complications, emotional disturbances, and problems occur on focusing and learning, are the symptoms occur during menopause. Some other symptoms of menopause include a buildup of fat in the abdomen, sometimes leading to overweight and obesity, hair loss and thinning hair, breast shrinkage (Nordqvist, 2017; Monteleone et al. 2018). There are four stages of menopause, stage 1 is premenopause, and what most women call “menopause” is actually perimenopause i.e. stage 2. After perimenopause, menopause is stage 3, followed by the final stage, postmenopause. Premenopause is broadly defined as the whole of a woman’s life before the menopause when she is able to bear children, and sex hormones like estrogen and progesterone retain a relatively stable balance. Perimenopause can begin 8 to 10 years before menopause when ovulation and fertility slow down due to decline in hormonal levels. Menopause is defined as the point when a woman has missed her menses for 12 consecutive months. It tends to occur in a woman’s late 40s to early 50s and the average age of menopause is 51 years. Postmenopausal years are all of those years after the menopause. However, as a result of a lower level of estrogen, postmenopausal women are at increased risk for a number of health
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conditions, such as osteoporosis, metabolic syndrome (MS), cardiovascular disease (CVD) and Type 2 Diabetes mellitus (T2DM). The experience of menopause is different for every woman, based on how her body uniquely adapts to her process of aging (Stewart, 2017). Vitamin D (Vit-D) deficiency is often associated with postmenopausal women because age is one of the factors for the cutaneous synthesis of Vit-D. Aging affects multiple steps of Vit-D metabolism in elderly women, as the aging of skin led to reducing the efficiency to synthesize Vit-D upon exposure to the sun (Boucher, 2012; Gallagher, 2013; Meehan and Penckofer, 2014; Dawoud et al. 2016). Vit-D deficiency has become a major health problem all over the Indian subcontinent, with a prevalence of 50-90% in general population (Harinarayan et al. 2004). High prevalence of Vit-D deficiency has been reported from northern to southern and western to eastern India. Vit-D levels decline earlier in women than in men as age progresses due to hormonal alteration, low estrogen and high androgen during the menopausal transition contribute more to the changes in the body metabolism (Dasgupta et al. 2012). Joshi H et al reported that 80% postmenopausal women had Vit-D deficiency residing in Jammu and Kashmir (Joshi et al. 2013). The prevalence of Vit-D deficiency among postmenopausal women in south India had also a similar trend (Harinarayan et al. 2011). Another study conducted in Haryana reports that 52.37% postmenopausal women had Vit-D deficiency (Kalra et al. 2011). Since postmenopausal women were more susceptible to having Vit-D deficiency that is related to numerous health outcomes like MS, CVD, T2DM (Masoni et al. 2014).

Vitamin D is a sunshine vitamin which is vital and indispensable for all human beings. Its major circulating form is 25-hydroxycholecalciferol (25 (OH) D) or 25 HCC or calcidiol whereas 1, 25-dihydroxycholecalciferol (1, 25(OH)₂ D) or 1, 25 DHCC or calcitriol is the
biologically active form of Vit-D, which is formed when 25(OH) D is hydroxylated by the enzyme 1α-hydroxylase (CYP27B1) in kidney (Holick et al. 2008). It is not only a fat-soluble vitamin but also a hormone necessary for maintaining calcium, phosphorous homeostasis (Holick et al. 2007; Rosen et al. 2011) and safeguarding skeletal integrity for overall health and wellbeing. It plays an important role in bone metabolism beyond that seems to have an anti-inflammatory and immune-modulating properties with respect to cytokine expression and production. Studies indicate that Vit-D is a key modulator of immune function and inflammation. The active metabolite of Vit-D has an anti-inflammatory effect on the inflammatory profile of monocytes down-regulating the expression and production of several pro-inflammatory cytokines like tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6) (Pilz et al. 2013; Giulietti-Molero et al. 2013; Calton et al. 2015). The immune-modulatory effect of Vit-D and its inverse link with inflammation draws more attention to its possible role in MS (Vita et al. 2014). Recently serum 25(OH) D levels have been linked with obesity-related conditions such as insulin resistance (IR), diabetes, and CVD (Jablonski et al. 2011; Guarner et al. 2015). Obesity also induces low-grade inflammation which disrupts the proper functioning of the immune and metabolic state. It promotes a pro-inflammatory state by increasing circulating inflammatory cytokines, IL-6 is positively correlated with increased adiposity and believed to have pivotal roles in the development of MS (Guarner et al. 2015, Lumeng et al. 2011). Vozarova and colleagues reported the relationship between insulin resistance, T2DM and plasma levels of IL-6, is a predictor of MS (Vozarova et al. 2003).

Metabolic syndrome is a clinical term used to describe a compendium of interrelated biochemical, clinical, and metabolic factors which heightens the risk of CVD, T2DM and
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all-cause mortality (Kaur, 2014). It’s a complex web of metabolic factors that are associated with a 2-fold risk of CVD and a 5-fold risk of diabetes (Madan and Narsaria, 2016). Various organizations have proposed different definitions, using varying terminologies for the diagnostic criteria of MS. An updated version for defining MS was given by the National Cholesterol Education Program’s Adult Treatment Panel III (NCEP-ATP III) for Asian Indian (Misra et al. 2009; Ranasinghe et al. 2017). ATP III identified 6 components of the metabolic syndrome that are related to CVD including underlying and emerging risk factors. Underlying risk factors for CVD are obesity, physical inactivity, and an atherogenic diet; the major risk factors are cigarette smoking, hypertension, elevated low density lipoprotein-cholesterol (LDL-C), increased high-density lipoprotein-cholesterol (HDL-C), family history of CVD and aging; and the emerging risk factors include elevated triglycerides, small dense LDL particles, insulin resistance, impaired fasting glucose, proinflammatory state and the prothrombotic state (Grundy et al. 2004). The prevalence of MS is known to increase during menopause (Sharma et al. 2012). An increased risk of occurrence of MS in postmenopausal women varies from 11% to 63% has been suggested by Gupta et al. 2004; Pandey et al. 2010; Shah, 2010; Sinha et al. 2013; Chhabra et al. 2014; Sharma et al. 2016. Menopause marks an important health transition in women life. The transition from pre- to postmenopausal is associated with the emergence of many features of the MS (Carr and Brunzell, 2003). Hormonal changes with declining estrogen and alteration of its ratio with testosterone have been implicated as a causal factor for the emergence of MS at menopausal transition (Janssen et al. 2008).

With lifestyle transitions in the last 20 years, Vit-D deficiency and metabolic syndrome have become the most widespread health problems among elderly women in India. The
importance of serum vitamin D, not only in maintaining skeletal integrity but its role as an anti-inflammatory marker has been recognized nowadays, which in postmenopausal women is responsible for the metabolic syndrome. Therefore, the present study has been focused on postmenopausal women who are more susceptible to a metabolic syndrome associated with Vit-D deficiency.