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Analysis Of Sleep Pattern In Postmenopausal Women With Knee Osteoarthritis.

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ABSTRACT
Introduction- Osteoarthritis is type of degenerative disease, which is described by incremental loss in articular cartilage and peripheral bony changes which results into joint pain, swelling and osteophyte formation particularly in weight bearing joint. Additionally, adequate sleep duration for young adult recommendation is 7 ≤ 9 hours, while for elder adults it is 7 to 8 hours. As per reports, it is concluded that inflammatory factors plays important role in progression of osteoarthritis and are also interlinked with hormonal levels in postmenopausal women. Hormonal changes are the one of the reason for sleep problems in postmenopausal women and has essential role in maintaining bone metabolism. This analysis aims to investigate the sleep patterns in postmenopausal women with knee osteoarthritis, exploring the relationship between sleep quality, osteoarthritis and postmenopausal women. Methodology This cross-sectional study was conducted at D .Y. Patil Medical College Hospital and Research Institute, Kolhapur over 1.5 years. 93 postmenopausal women with knee osteoarthritis were recruited using convenience sampling. Participants were evaluated using Pittsburgh Sleep Quality Index and Lequesne Scale. Results Analysis of sleep pattern in postmenopausal women with diagnosed knee osteoarthritis is done by using SPSS software. Total 93 participants were included for this observational study out of which about 64.52% were having moderate sleep quality, 25.81% mild type sleep quality and severe sleep quality was seen in 9.68%. In terms of Knee Osteoarthritis (OA) severity about 47.31% has severe. Conclusion This study concludes that poor sleep quality is predominantly observed in postmenopausal women with knee osteoarthritis. Also the relationship between knee osteoarthritis, sleep pattern and postmenopausal women**.**

Keywords: *Knee Osteoarthritis, Sleep Pattern, Postmenopausal Women, Sleep Duration, Sleep Quality, Quality of Life.*

1. INTRODUCTION

The knee joint plays a crucial role in our daily activities, by carrying large part of our body weight, also permits wide range of motion of flexion, extension and external and internal rotation. The knee joint is synovial type of hinge joint. Knee joint kinematics involves rolling, gliding and rotation. Knee joint gives six degrees of freedom range of motion. [1] The knee joint is made up of three joint compartments which includes: the lateral tibio-femoral compartment, the medial tibio- femoral compartment, and the Patellofemoral compartment. Patellofemoral joint is the most frequent origin of pain in osteoarthritis compared to these three compartments. Other sources of

pain probably to be bone, synovitis, bursitis and stretched joint capsule filled with fluid. As there are no nociceptive fibers present in hyaline articular cartilage it is unlikely to be source of pain. [2]

osteoarthritis is a degenerative bone disease, characterized by gradual loss of articular cartilage and secondary bony changes which leads to joint pain, swelling and osteophyte formation particularly in weight bearing joints. [3] it commonly involves hips, knees and joints of hands and feet and it has more prevalence ratio in middle and old age population. [4] prevalence of knee osteoarthritis boosts with age and is more predominant in women than in men. there is need for further research on causes behind any variation in progression and dissertation of knee osteoarthritis in women relative to men. eventually, the reasons for development of knee osteoarthritis in women may be multifactorial such as, differences in anatomical structures,

any past history of trauma, genetic and hormonal problems. kinematic variations in addition with anatomical differences may also play important role in growth of knee osteoarthritis. hormonal variations between men and women has significant impact on progression of knee osteoarthritis. [5] in postmenopausal women, there is significant decrease in oestrogen level which primarily heightened the risk for developing the knee osteoarthritis. anatomically, women have narrower femurs and thinner patellae, larger quadriceps angles, and variation of size in tibial condyles compared to men. distinction in volume of knee articular cartilage, also plays a crucial part in it. in some studies it is showed that, there is increased volume loss of cartilage in women as comparative to men. [5] some other risk factors for knee osteoarthritis includes obesity, knee injury, history of knee surgery, occupational bending and lifting.[2] Osteoarthritis is primary reason for physical disability and is connected to increased health care utilization and diminish quality of life in middle and old age populations.[3] Majority of people with knee pain have restrictions in function that prevent them from involving their usual activities. Osteoarthritis mainly damages nearly all structures within a joint. It not only causes articular cartilage loss but also bony remodelling happens, with capsular stretching and periarticular muscles. Sometimes trauma to bone occurs because of synovitis, ligament laxity and development of lesions in the bone marrow in patients. Moreover loss of cartilage can occur because of regional areas of loss of articular cartilage can increase the central stress around the joint. Excess loss of articular cartilage area along with bone remodelling, leading to tilted joints and misalignment. [2]

Structural worsening of the joint takes place in the view fact the misalignment which is most formidable risk factor, joint failure can materialize, since it augment the degree of central loading, creating brutal cycle of joint damage. Pain and joint damage can occur on account of confined inflammation in the synovium and the cartilage. Some of the activities which can bring pain in osteoarthritis are climbing stairs, getting out of a chair, and walking long distances. An instability symptom type of 'give way' in their knees noticed by patients. Night time pain in the knee may show either of some severe symptomatic disease or pain from causes other than osteoarthritis, likewise inflammatory arthritis, tumours, infection. [2]

For assessing the various causes of knee pain in patients with osteoarthritis examination is included. In which it primarily involves range of motion of knee joint, tenderness at the site of femur and tibia, any deformities of legs like varus (bowlegged) or valgus (knock-knees), also in addition gait pattern should also be observed to analyse any abnormal gait is there. [2]

Diagnosis of knee osteoarthritis doesn't differ in men and women. According to severity of signs and symptoms it can differ. Usually women tremendously complaints of severe pain and disability. Additionally, more advanced radiographic findings are generally seen. To figure out the alignment of limb in radiographic assessment, the weight bearing views should be included. Positive findings typically recognized in radiographic views are narrowing of joint space, formation of osteophytes, sclerosis and subchondral cysts. In more advanced stages, magnetic resonance imaging can be done for further confirmation. [2] Perimenopausal or early postmenopausal period has escalating frequency of osteoarthritis, as hormonal imbalance influences on progression of osteoarthritis. In postmenopausal women, estrogen descends the serum calcium and phosphate suppress the bone resorption. [15] Etiological factors for development of osteoarthritis considered to be mechanical stress on the cartilage, metabolic and hormonal influences. The prevalence of osteoarthritis (grade 2 or higher) in postmenopausal population was 2.8% for hands and 3.6% for knees. [16] Decline in Estradiol and elevation in follicle stimulating hormone level are major hormonal changes that occur during menopausal phase in women. Reduction in bone formation and rise in bone changeover results from hormonal changes which leads to bone loss. [10] Bone metabolism contains several endogenous hormones such as, growth hormone (GH), cortisol and estrogen and others. Insufficient sleep thought about potential mechanism behind the bone degeneration, as lack of sleep could inhibit the production of growth hormone and cortisol as per reported by various researches. [10] As per recent studies, liberation of growth hormone and cortisol is also correlated with late sleep. Especially in middle-aged and older adults, both long and short sleep durations has association with negative health consequence as per evidences. Inadequate sleep duration is known to leading cause of increase in risk of obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. [3]

On the basis of connection between osteoarthritis and sleep duration with metabolic disease and mental health it is showed that there would be direct or direct association between sleep duration and osteoarthritis. [3]

2. METHODOLOGY:

A Retrospective Observational, Cross-sectional study done at D.Y. Patil Medical College Hospital and Research Institute, Kolhapur 1 year and 6 months on Postmenopausal women with knee osteoarthritis study subjects were selected fulfilling inclusion and exclusion criteria using Convenience sampling method with sample size of 95.

Inclusion criteria: Postmenopausal women 45 to 55 years of age, Subjects with diagnosed knee osteoarthritis. Exclusion criteria: Those with rheumatoid arthritis or other autoimmune diseases, Those with sleep disorders, Subjects with history of recent trauma or knee surgery, Subjects with any infection, Postmenopausal women with history of any post-traumatic knee arthritis, malignancy, Subjects taking hormonal replacement therapy (HRT)

3. PROCEDURE

The study protocol was presented for approval in front of institutional ethical committee of D .Y. Education Society,

Kolhapur after the approval from the committee field work was started. Analysis of sleep pattern in postmenopausal women with knee osteoarthritis an observational study which was performed in the postmenopausal women. It is observational study performed in postmenopausal women, they were approached and were explained about the whole research. A written consent form was taken from the participants who were willing to participate in the study.

The participants were included on the basis of the inclusion and exclusion criteria. Data collection sheet including their personal details, and study related measures were taken from the participants also the sheet involved about the interpretation of the scales taken. For analysing participants completed a comprehensive questionnaire such as Pittsburgh sleep quality index (PSQI) and Lequesne Scale. After the collection of the whole sample size the master chart containing all the information of data sheet was formed and then the final result was obtained through the statistical analysis.

4. RESULTS

The total number of 93 postmenopausal women with knee osteoarthritis aged 45-55 years was included in this study.

Descriptive statistics was used to find out the frequency percentage mean and SD from demographic data and variable studied.

Descriptive statistics of age (years) in Mean and Standard deviation (mean and SD).

A descriptive statistics of age in years. Among 93 participants considered for this study, the mean age (in years) of the study participants is 50.04 years with SD of 3.31 years. The minimum and the maximum age was 45 and 55 respectively.

Descriptive statistics on sleep duration of the participants in the study:

Table.1. Descriptive statistics (Mean, SD) of Sleep Duration

Variable	Mean	S.D.
Sleep Duration	5.68	0.62

Table.2. Shows a descriptive statistics of sleep duration of the participants among 93 participants considered for this study, the mean sleep duration was 5.68 with SD of 0.62, respectively.

Graphical representation of sleep duartion distributation among study participants:

SLEEP DURATION (Hrs./Min)	No of Patients	Percentage
4.1 -5	10	10.75%
5.1 - 6	43	46.24%
6.1 - 7	40	43.01%
Total	93	100.00%

Table-2- Descriptive statistics (%) of sleep duration

Table-2 shows that sleep duration of participants in percentage. Among 93 participants considered for the study, in which 4.1-5 hrs. Sleep was seen in 10 participants, 5.1-6 hrs. was seen in 43 while, about 40 were having 6.1-7 hrs. of sleep respectively.

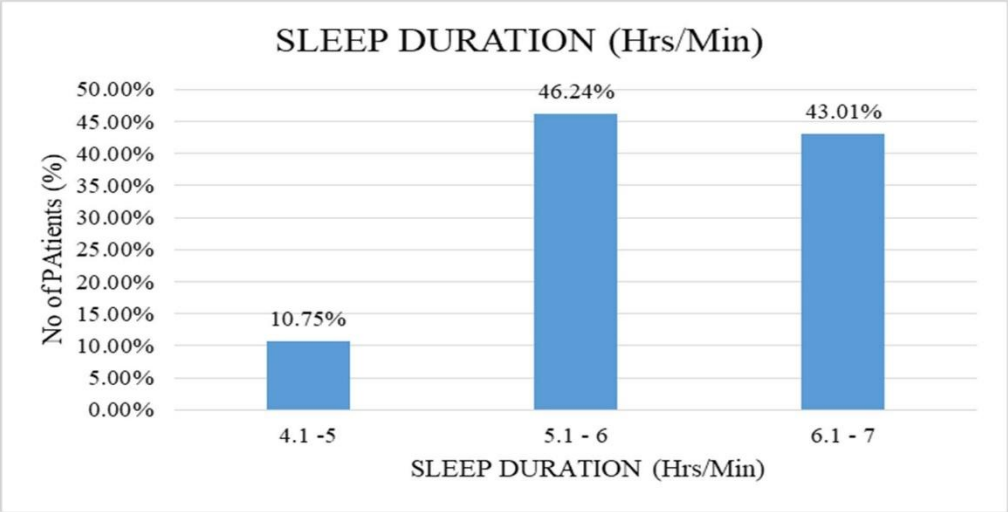

Figure.1. This is graphical representation of Sleep Duration distribution among study participants

Figure.1. Graph represents sleep duration distributation of study participants. Among 93 participants in which 4.1-5 hrs of sleep was seen in 10.75 %, 5.1-6 hrs. sleep was in 46.24 % and 6.1-7 hrs was in 43.01%.

Pittsburgh Sleep Quality Index distribution among study participants:

PITTSBURGH SLEEP QUALITY INDEX(PSQI)	No of Patients	Percentage
Mild	24	25.81%
Moderate	60	64.52%
Severe	9	9.68%
Total	93	100.00%

Table.3. Pittsburgh sleep quality index of study participants depending on sleep patterns.

Table.3 Shows that participants with mild sleep quality are 25.81%, moderate sleep quality are 64.52% which is highest of all, and severe sleep quality are in 9.68%, respectively.

Graphical represention Pittsburgh Sleep Quality Index distributation among study participants:

Figure.2. This graphical representation shows Pittsburgh Sleep Quality Index (PSQI) distributation among study participants.

Figure.2. Shows Pittsburgh Sleep Quality Index (PSQI) distributation of study participants. Majorly moderate sleep quality as seen in about 64.52%, then about 25.81% were having mild sleep quality and lastly, severe sleep quality was seen in about 9.68%, respectively.

Lequesne Scale distributation of study participants:

LEQUESNE SCALE	No of Patients	Percentage
Mild	4	4.30%
Moderate	45	48.39%
Severe	44	47.31%
Total	93	100.00%

Table.4. Lequesne scale of study participants depending on severity of knee osteoarthritis.

Table.4 Shows that participants with mild severity of knee osteoarthritis are 4.30%, moderate severity are 48.39% which is highest of all, and severe type knee osteoarthritis are in 47.31%, respectively.

Graphical representation of Lequesne Scale distributation among study participants:

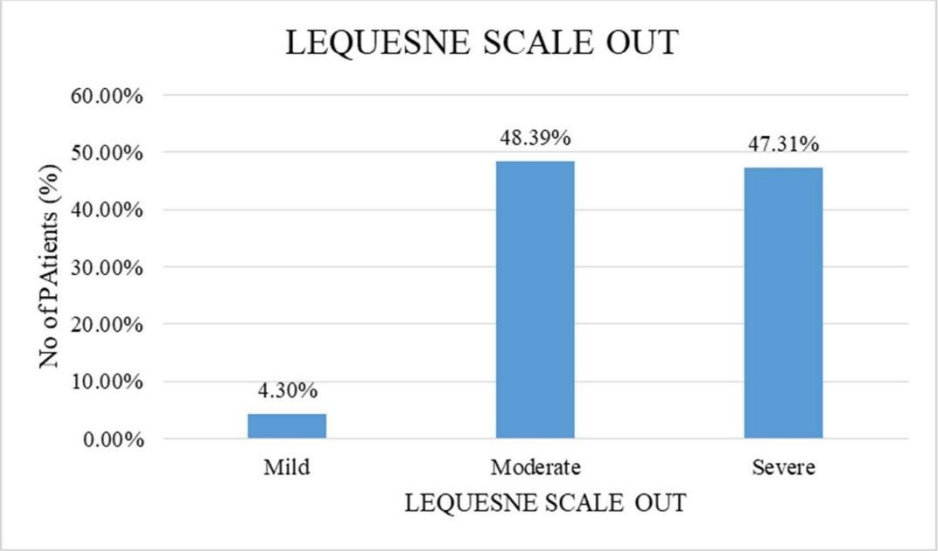

Figure.3. Lequesne Scale distribution of study participants.

Figure.3. Shows Lequesne Scale distributation of study participants. Majority of study participants were having moderate severity of knee osteoarthritis about 48.39%, while 47.31% having severe type of knee osteoarthritis and other 4.30% having mild severity.

5. DISCUSSION

A total number of 93 postmenopausal women with knee osteoarthritis were assessed in this research span. In this research, postmenopausal women with knee osteoarthritis having poor sleep quality were included. The mean age of participants was 50.04.

Sleep pattern was assessed by Pittsburgh Sleep Quality Index (PSQI) which is essentially used as the most reliable and valid questionnaire for analysing sleep quality, sleep latency, sleep duration, sleep disturbances, daytime dysfunction, habitual sleep efficiency, use of sleeping medication. Knee osteoarthritis severity was assessed by using Lequesne Scale.

The present study revealed that there is higher rate of poor sleep quality among postmenopausal women with knee osteoarthritis (OA) with associated factors such as reduced mobility and pain intensity leading to poor sleep pattern. The present study identified there is significant correlation between sleep duration and knee osteoarthritis (OA) in postmenopausal women. Our findings showed that short sleep duration is majorly seen as compared to long sleep duration. Also these are associated with detrimental health impacts.

Previous studies were focused on association of sleep duration with knee osteoarthritis in middle and older adults while this observational study was to analyse the overall sleep pattern among postmenopausal women with knee osteoarthritis [3]. The previous study conducted in Ahmedabad city revealed that prevalence of postmenopausal women with knee osteoarthritis is about 59.35%

[23].

M. Koch et al concluded that lower the oestrogen level at the time of transition into menopause phase it give rise to incidence of knee osteoarthritis in females. Sedentary lifestyle and greater BMI were also associated with risk of osteoarthritis [24].

Previous literature by Liu YP et al concluded that in postmenopausal women, pathogenesis of OA is result of estradiol deficiency. Inflammatory markers such as IL-1, IL-6, and TNF-α and cytokines in serum and synovial fluid play important role to advance and exacerbate the incidence of knee osteoarthritis in postmenopausal stage. The changes in oestrogenic level takes place as inflammation level in body differs. Significant reduction in oestrogen level is vital cause behind pathophysiology of OA in postmenopausal women [9].

For sustained positive health, the adequate sleep duration considered per night was between 7 and 8 hours. Proportionately, various researches proved that insufficient sleep (<7 h per day) could be related with obesity, metabolic diseases, and type 2 Diabetes [25].

The fundamental structural arrangement of typical sleep is referred to as sleep architecture. Rapid Eye Movement (REM) sleep and Non-Rapid Eye Movement (NREM) sleep are two main categories of sleep. NREM, also known as slow-wave cycle sleep or non-rapid eye movement, is a deep, typically dreamless sleep state that happens frequently during a typical

sleep intervals. It is distinguished by delta waves and a low level of autonomic physiological activity. REM known as, both eyes move quickly and simultaneously, which is linked to REM sleep. [26]

The first, second, third and fourth stages of NREM sleep correspond to a range of relative depth. NREM and REM sleep alternate cyclically during a sleep session. Although the purpose of these two sleep cycles is yet unknown, sleep problems are linked to irregular cycling and or absent sleep stages. A brief period of NREM stage 1 precedes the start of the sleep event, which then moves through stages 2, 3, and, 4, before ending with REM. However, people alternate between NREM and REM sleep stages during the night rather than spending the rest of night in REM sleep. About 75 to 80 % of total sleep time is made up of NREM sleep, with the remaining 20 to 25 % being made up of REM sleep. The initial NREM-REM sleep cycle lasts between 70 and 100 minutes are spent in the second and subsequent cycles. In healthy people, the amount of REM sleep increases during the night and peaks in the latter third of the sleep cycle. Stage 2 starts to make up the majority of NREM sleep as the sleep episode goes on, and stages3 and 4 may occasionally vanish.

[26]

In sleep- stage cycling, NREM stage 1 sleep acts as a transitional period. The average person's sleep session starts in NREM stage 1. This stage, which typically lasts 1 to 7 minutes in the first cycle and accounts for 2 to 5% of total sleep, is easily disrupted by a loud disturbance. In the first cycle, stage 2 sleep lasts between 10 to 25 minutes. It gets longer with each cycle and eventually makes up to 45 to 55 % of entire sleep episode. [26] More powerful stimuli are needed to arouse a person in stage sleep than in stage 1. Slow-wave sleep (SWS), which mostly takes place in the first third of the night, is the collective term of sleep stages three and four. Stage 3 makes up to 3 to 8 percent of sleep and lasts barely a few minutes. Stage 4 is the final NREM stage, accounts for roughly 10 to 15 percent of sleep and lasts for 20 to 40 minutes in the first cycle. In stage 4, the arousal threshold is the highest of all NREM stages. Sleep affects endocrine processes such as melatonin, thyroid hormone, growth hormone. Growth hormone release usually, happens during slow-wave sleep (SWS) and in the first few hours following the start of sleep. [26]

Circadian Rhythm is a 24 Hour sleep cycle. All of the daily rhythms in physiology and behaviour are referred to as circadian rhythms. Throughout the day, they regulate hormone secretion, body temperature, heart rate, muscle tone, and physical activity and food intake. They also govern the sleep-wake cycle. Neural mechanisms in the hypothalamus that acts as biological clock, produce the rhythms. Endogenous clocks allow both plants and animals to synchronize their daily physiological and behavioural rhythms with the external day-night cycle. These clocks are thought to be based on a set of biochemical pathways involving clock genes that exhibit approximately 24- hour rhythms of expression. [26]

All organs circadian rhythms are controlled by the suprachiasmatic nucleus (SCN). It can reset the clock genes in the SCN on a daily basis thanks to direct inputs from class of retinal nerve cells that function as brightness detectors. All of daily cycles are then brought into sync with external day- night cycle by the signals that the SCN sends to the rest of the brain and body. Through a network of relays via the hypothalamic dorsomedial nucleus, the SCN primarily affects sleep by informing the wake-sleep system's to synchronize their activity with the day-night cycles. Additionally, the SCN regulates hormones including corticosteroids, eating cycles and loco-motor activity. [26]

As people age, their sleep patterns undergo significant and ongoing alterations. The proportion of time spent in each stage of sleep, the way sleep is begun and maintained, and total sleep efficiency- that is, how well sleep is initiated and maintained- all exhibit noticeable changes from infancy to maturity. Age-related decline in sleep efficiency are a common tendency. Adult males awaken more frequently and spend longer time in stage 1 sleep while women complain of trouble falling asleep and mid-sleep awakenings more frequently than males, although maintaining SWS for longer. However, menstrual cycle affects women's sleep-wake patterns .[26] Previous study by Saptadip Samantha concluded that, in response to ambient time cues, the circadian system controls physiological processes throughout the day, serving as a biological timekeeper. The SCN, which synchronizes with the endogenous peripheral clocks, which was where the circadian rhythm systems main activity takes place. The core clock genes expression is controlled by a light-associated impulse that the retina sends to SCN. Human health is negatively impacted by circadian rhythm misalignment. Sleep issues, metabolic syndrome, neurodegenerative illnesses and mental illness are all influenced by circadian disruption. [27]

In the study conducted by Farook Al-Azzawi on hormonal changes during menopause it was concluded that ovarian senescence is represented by the menopausal transition, which is caused by a gradual decrease in the number of ovarian follicles and a decrease in the ovarian stoma's steriodogenic potential. Oestrogen levels significantly diminish after the last menstrual cycle and are often below the assays detection limits. It has been demonstrated that androgen production decreases with age, reaching 50% of its peak levels around menopause stage after peaking in third decade of life.[28]

A study conducted by Kun Wang et al on the associations of bedtime, nocturnal and daytime sleep duration with bone mineral density in premenopausal and postmenopausal women analysed that numerous investigations have found diurnal fluctuation in blood markers of bone production and absorption, indicating that bone metabolism is thought to be related to circadian rhythm. Bone metabolism involves a number of endogenous hormones such as growth hormone, cortisol, oestrogen and others. Numerous investigations revealed that sleep deprivation may suppress growth hormone output and increase cortisol

release, which was thought to be a potential mechanism linking to insufficient sleep to bone loss. Late sleep also linked to release of growth hormone and cortisol. Additionally, it was also observed that disruptions in the circadian rhythm impact the release of pituitary gonadotropins (LH and FSH) and the production of ovarian oestrogen.[14]

Another study conducted by Stella Maris about sleep quality and associated factors in postmenopausal women in which authors explained that poor sleep quality, night awakenings, insufficient sleep, hypersomnia, snoring and apnoea are common complaints among postmenopausal women. The occurrence of sleep disturbances rises following the official end of menstruation, and they frequently start during the menopausal transition. Also, the GABA-ergic, serotonergic (5HT), non-adrenergic (NA), and dopaminergic (DA), systems all shift throughout menopause, which affects how well people sleep. [29]

This study investigates that the majority of molecules involved in osteoblast differentiation are regulated by circadian rhythms, and the majority of genes linked to mineral decomposition manifest in circadian rhythm patterns. The circadian clock is linked to bone growth and the maintenance of bone homeostasis. However, the metabolism of lipids and amino acids also contributes significantly to bone differentiation. Therefore, energy metabolism plays a crucial role in bone growth and regeneration. [30]

It was acknowledged that the aetiology of osteoarthritis is a complex process involving strong interactions between genetic changes, environmental stressors and undesirable behavioural traits. Numerous studies have demonstrated that interference with the circadian rhythm affects the immune response. Patients with autoimmune disorders most commonly complain of weariness and sleep disturbances. Accordingly, population based cohort study conducted in which a U-shaped relationship between sleep duration and osteoarthritis in older persons has been discovered. [31]

6. CONCLUSION

This study concludes that short sleep duration in postmenopausal women with knee osteoarthritis results from hormonal changes, chronic pain. Also this study implies that postmenopausal women with knee osteoarthritis showed poor sleep quality. Highlighting the sleep problems in postmenopausal women is essential, as overall quality of life, pain intensity and reduced functional mobility could result from poor sleep quality. Targeted interventions aimed that emphasizing pain treatment, lifestyle modifications and cognitive behavioural therapy in this population may enhance sleep quality and general health of human being

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