ISSN: 2322 - 0902 (P)
ISSN: 2322 - 0910 (O)

International Journal of Ayurveda and Pharma Research

Research Article

ASSESSMENT OF MUSCULOSKELETAL CHANGES IN MENOPAUSE– A CROSS SECTIONAL STUDY

Doley Lakhiprova[1]*, Sarma Tikendrajit[2], Baishya Pranabjyoti[3]

*[1]Lecturer, Dept. of Sharir Rachana, NEIAH, Shillong, Meghalaya, India.

[2]Associate Professor, [3]Professor & HOD, Dept. of Sharir Rachana, Govt. Ayurvedic College & Hospital, Guwahati, Assam, India.

ABSTRACT

Menopause is associated with a natural decline in estrogen, progesterone and testosterone. These leads to certain health concern signs and symptoms like vasomotor symptoms, urogenital atrophy, cardiovascular diseases, psychological changes, decrease bone mass density leading to osteoporosis and fracture, diminished of muscle mass and strength. In Ayurveda, *Rajanivritti* is the word found in relation with menopause. In female, ageing influences *Rajanivritti* where *Dhatuksyaya* has observed. There is limitation of presence of sign and symptoms of *Rajanivritti*, except the age which is mentioned as 50 years. Increased of *Vata dosa*, imbalance in *Pitta* and *Kapha* with subsequence *Anulumakkshyay* are observed in ageing, leading to abnormalities in all *Dhatus* specially *Mamsa* and *Asthidhatu*. In this work muscle strength, joint movement, bone mass density (BMD) has observed in 60 menopause women, where significant alteration noted in muscle strength of upper extremities and bone mass density (BMD) shows osteopenia.

KEYWORDS: *Rajanivritti*, Menopause, Muscle power, Muscle strength, Joint movement, BMD

INTRODUCTION

Menopause is defined as the permanent cessation of menstruations resulting from loss of ovarian follicular activity. It is associated with natural decline of estrogen, estrone, progesterone, thyroxin, and dehydroepiendrosterone (DHEA) along with decrease in intramuscular lipoprotein lipase (LPL)[1]. All these leading to changes in muscle mass due to increase in intramuscular fat, decrease in type-2 fibres, increased in type-1 fibres and decreased in muscle strength due to reduction in motor units, calcium release as well as ability to recruit all motor units[2]. Apart from all these, the alterations are also observed in bone mass density (BMD) leading to bone loss like osteoporosis etc. along with changes in joint movements. The concept of menopause is found scattered in different context. The terminology like *Rajanivritti*[3] emphasize specially for menopause, however did not show any significant sign and symptoms. Almost in all classics 12 and 50 years are the age mentioned as the *Raja Darsana* and *Rajanivrittikala*[4-9]. The basic characteristic of this stage is mentioned as absence of *Artava*. However different clinical conditions are mentioned, which may give glimpse of characters of menopausal women. The basic characteristics i.e. absence of *Artava* (menstruation) after attaining the specific age (of 50 years) is seen in some conditions like- *Artavakshyaya, Nastartava/Anrtava, Rajonasa,* and *Kshinaartava* etc.

Artavakshaya- The menstruation does not appear in its appropriate time or it is delayed, which is scanty and does not last for three days and having pain in vagina. Chakarapani opined that in this condition pain occurs due to aggravations of *Vayu* caused by loss of *Artava* which filled this region[10].

Nastaartava/ Anartava- *Doshas* obstruct the passage of *Artava* and thereby leads to absence of menstruation[11]. Vagbhata mentioned that aggravated *Vata* and *Kapha* obstruct the passage of *Artava* thus menstrual blood is not discharge[12].

Rajonasa- Bhavaprakasha has includes *Rajonasa* among eighty specific disorders of *Vata*[13].

Kshina artava- It is caused by *Pitta* with *Vayu*. In this condition menstruation is delayed and scanty which associated with pain in vagina. It also has the features of *Vata* and *Pitta Artavadusti*[14-16].

In Ayurveda ageing is considered as vital factors for *Rajanivritti* leading to various physical, physiological and psychological changes along with *Dhatuksyaya*. Susruta mentioned symptoms like *Kshyaya* (decrease/decline) of *Dhatu* (tissue), *Indriya* (sense organ), *Bala* (strength), *Virya* (semen), *Utshah* (enthusiasm) etc, where these characteristic are also seen in menopause[17]. Caraka also mentioned certain

changes along with ageing process that are- diminutions of *Dhatu*, *Indriya, Bala, Virya, Paurushaparakrama* (manliness), *Graham* (valor), *Dharan* (power), *Smarana*, *Vachana* and *Vigyana* etc. along with *Vatadosha* predominant[18]. Bhagvata also mentioned certain sign and symptoms with ageing, like appearance of *Slathamamsa, Sandhi, Asthi* (loosening of muscles, bones and joints), *Twakaparushyaavamanam* (changes of normal texture of skin), *Kayashyavepathu* (trembling/ shaking of body), *Shlesmasitghranamukhaudiranam* (excessive mucous secretions from mouth nose etc) and *Dhatukshyaya* (lose of body tissues)etc[19]. In Bhelasamhita it is mentioned that all *Dhatu* are decreased during old age (*Vrddhasyajantuswa cha parikshineshudhatusutatoualparetabhavatisujirnoudu rbalawthowa…sarvadhatuparikshyayat*)[20]. Increased of *Vatadosa*, imbalance in *Pitta* and *Kapha* with subsequence *Anulumak kshyay* is observed in ageing, leading to abnormalities in all *Dhatus* specially *Mamsa* and *Asthidhatu* in this context. Limited references are available in Ayurveda regarding the declining of status of musculoskeletal components in ageing. *Bhela* however clarified as below-

"*Raktammamsavasaasthinimajjasukramtothaanalah*
Sakrinmutre cha
tairmandamvidyannavatitahparam"[21]

Here the *Mamsa* muscular tissue, *Vasa* indicate the adipose tissue, *Asthi* osseous tissue, *Majja* bone marrow and *Sukra* reproductive tissue, semen for male, menstrual blood for female will be reduced.

In this work we tried to elucidate the relation between musculoskeletal alterations in menopausal women. Here we observed the functions of muscles like muscle strength, power, along with joint movement and BMD in 60 menopausal women. These alterations are analyzed through both (Ayurveda and Modern) sciences. To observe muscle strength, hand grip strength was performed by hand grip dynamometer, and MMT i.e. manual muscle testing (MMT) was performed manually. To observe the joint movements in relation with cervical and thoraco-lumbar vertebral spine, ROM i.e., range of motions are performed with Goneometer and measuring tape. BMD also carried out in some cases of menopausal women. Data obtained from the present research work are observed, discussed logically and a possible conclusion is laid down thereby.

In previous study we have found the relation between musculoskeletal alterations in menopausal women. In a study the changes in muscle strength is observed specifically where a decreased of quadriceps strength is noted in menopause women[1]. It is also interesting to observed that before the research work a paper entitled "The relationship between estrogen and muscle strength: a current perspective by Kirsty Jayne" shows that positive relations between effects of estrogen on muscle strength is observed in 16 numbers of paper while negative or unascertainable effects of estrogen on muscle strength observed in 19 numbers of papers[22].

MATERIALS AND METHODS

Present study completed with observing the changes in following aspects.

1. Muscle strength and power- assessed by
   a) Hand grip strength by Dynamometer[23]
   b) Manual muscle testing (MMT)[24]
2. Joint movements- assessed by Range of motions
   a) Cervical Range of motion (ROM)[25]
   b) Thoraco-lumber Range of motion (ROM)[25]
3. Bone mass density (BMD)

In our work women 45-50 years of age with history of amenorrhea not less than 12 months are selected and pathological, surgical menopause along with history of musculoskeletal disorders, metabolic disorder like diabetes mellitus, hypothyroidisms are excluded.

RESULTS AND DISCUSSION

Table-1: Assessment of Hand Grip Strength (In Kg)

Age	n	Mean	SD	SE
45	16	17.68	2.18	0.55
46	9	18	1.84	0.61
47	7	17.14	2.4	0.9
48	5	15	0.7	0.31
49	1	20		
50	22	15.45	2.15	0.46

Table shows that maximum mean value i.e. 18kg is observed in 9 numbers of women in 46 years of age, while lowest mean value i.e. 15kg is observed in 5 numbers of women in age of 48 years. Single number of woman in 49 years of age with 20kg grip strength has not much significant in this observation.

Table 2: Assessment of Muscle Strength in Hip Extension (5, 4, And 3 Grades Are Incorporated)

Grade	n	Percentage
Grade 5	2	3.33%
Grade 4	45	75%
Grade 3	13	21.66%

Table shows that 45 (75%) numbers of women are observed in grade 4, followed by 13 (21.66%) numbers of women are in grade 3, while only 2 (3.33%) numbers of women are observed in grade 5.

Table 3: Assessment of Muscle Strength in Knee Flexion (5, 4, and 3 Grades Are Incorporated)

Grade	n	Percentage
Grade 5	6	10%
Grade 4	47	78.33%
Grade 3	7	11.66%

Table shows that the maximum i.e. 47 (78.33%) number of women are observed in grade 4; while 7 (11.66%) numbers of women are in grade 3 and 6 (10%) numbers of women are in grade 5.

Table 4: Assessment of Range of Motion (Rom) of Cervical Spineflexion

Range	N	Percentage
$<40^0$	10	16.67%
$40\text{-}60^0$	50	83.33%
$>60^0$	0	0%

Table shows that 50 (83.33%) numbers of women are observed within the normal range i.e. 40- 60^0 while decreased ROM i.e. $<40^0$ is observed in 10 (16.67%) numbers of women.

Table 5: Assessment of Range of Motion (Rom) of Cervical Spinelateral Flexion, (In Degree)

Range	n (right flexion)	Percentage	n (left flexion)	Percentage
$<30^0$	5	8.33%	9	15%
$30^0\text{-}45^0$	55	91.67%	51	85%
$>45^0$	0	0%	0	0%

In case of right lateral flexion 55 (91.67%) numbers of women are observed within normal range i.e. $30\text{-}45^0$, while only 5 (8.33%) numbers of women are observed below the normal range. In case of left lateral flexion 51 (85%) numbers of women are observed in normal range i.e. $30\text{-}45^0$ while 9 (15%) numbers of women are observed below normal range.

Table 6: Assessment of Range of Motion (Rom) of Cervical Spine extension (in Degree)

Range	N	Percentage
$<30^0$	12	20%
30^0	30	50%
$>30^0$	18	30%

Table shows that 30 (50%) numbers of women are within the normal value, 18 (30%) numbers of women are above the normal value while 12 (20%) numbers of women are observed in lower than normal value.

Table 7: Assessment of Range of Motion (Rom) of Cervical Spine rotation (in degree)

Range	n (right flexion)	Percentage	n (left flexion)	Percentage
$<45^0$	30	50%	28	46.67%
$45^0\text{-}80^0$	30	50%	32	53.33%
$>80^0$	0	0%	0	0%

In case of right rotation, 30 (50%) numbers of women are observed below the normal range i.e. 45^0, while 30 (50%) numbers of women are observed within the normal range $45\text{-}80^0$ range. in case of left rotation 28 (46.67%) numbers of women are below the normal range i.e. 45^0, while 32 numbers of women are observed within the normal range ($45\text{-}80^0$).

Table 8: Assessment of Range of Motion (Rom) of Thoraco-Lumber Spine Flexion (In Cm)

Range	N	Percentage
<10 cm	60	100%
10 cm	0	0%
>10 cm	0	0%

Table shows that 100% (60 numbers) of women are distributed below the normal value.

Table 9: Assessment of Range of Motion (Rom) of thorac-Lumber Spine Lateral Flexion (In Degree)

Range	n (right flexion)	Percentage	n (left flexion)	Percentage
$<35^0$	51	85%	50	83.33%
35^0	9	15%	7	11.67%
$>35^0$	0	0%	3	5%

In right lateral flexion 51 (85%) numbers of women are observed below the normal value, while 9 (15%) numbers of women are observed within the normal value. In case of left lateral flexion 50 (83.33%) numbers of women are observed below the normal value, 7 (11.67%) numbers are within the normal value while 3 (5%) numbers are above the normal value.

Table 10: Assessment of Range of Motion (Rom) of Thoraco-Lumber Spine Extension (In Cm)

Range	N	Percentage
<7 cm	60	100%
7 cm	0	0%
>7cm	0	0%

100% (60 numbers) women are observed below the normal value i.e. <7 cm.

Table 11: Assessment of Range of Motion (Rom) of Thorac-Lumber Spine Rotation (In Degree)

Range	n (right flexion)	Percentage	n (left flexion)	Percentage
$<45^0$	54	90%	55	91.67%
45^0	6	10%	5	8.33%
$>45^0$	0	0%	0	0%

In case of right rotation 54 (90%) numbers of women are observed below the normal value, while 6 (10%) numbers of women are observed in normal value. In case of left rotation 55 (91.67%) numbers of women are observed below the normal value while 5 (8.33%) numbers of women are observed within normal value.

DISCUSSION

As menopause is a progressive physiological absence of menstruation, which can be understood along with *Dhatukshyaya* occurs due to ageing. Apart from ovum and menstrual blood, *Artava* also characterized the functional aspect of female reproductive hormones where it has affected according to age. As this symptoms occurs approaching the ageing, hence involvement of *Vayu* is prominent. The concept of *Bhavaprakasha* regarding the *Rajonasa* under 80 *Nanatmajavatavyadhi* clearly hypothesized the concept of *Vata* involvement in menopause. Vagbhata emphasized diminution of physio-psychological characters according to decade. He mentioned that in 6 decade i.e. around 60 years there is declines in *Sukra*. In same parlance *Artava* can be considered for functional aspect in female reproductive system.

Menopause is natural transition between two phase related to pre and post reproductive aspect. As female proceeding to this stage, certain physiological, psychological and even morphological alterations are observed. These characteristics changes are discussed as post-menopausal status (PMS) noted by different scale where following symptoms are observed.

1. Hot flashes, sweating
2. Cardiovascular symptoms like palpitation, heart racing, and feeling of heart discomfort etc.

3. Depressive mood, irritability, anxiety, physical and mental exhaustion, decreased concentration, reduced libido.
4. Bladder problems or urogenital atrophy, and dryness of vagina.
5. Weight gain
6. Decreased functions of muscles and joints.

In this stage *Vayu* takes pivot role to create all these symptoms. However, *Pitta* and *Kapha* also shows their actions. The *Dosic* alteration in relation to PMS can be understood as below.

Dosa	**Symptoms**
Vata	Dryness of mucous membrane including vagina Scanty bleeding during Peri-menopause Constipation Insomnia Anxiety Decreased concentration Reduction in libido Palpitation
Pitta	Hot flushes Irritability Heavy bleeding in Peri-menopause Skin rashes Anger High blood pressure
Kapha	Weight gain Fluid retention Depression Lacking of motivations Increased visceral fat mass

The concern *Dhatuagni* of the concern *Dosas* are also plays important role in PMS. The present study observed the musculoskeletal involvements in PMS relating to muscle power, muscle strength, and joint movements. From Ayurvedic aspect these involvements are hypothesized by observing the *Mamsa and Asthidhatu* changes in Post-Menopausal Status. The derivative of *Mamsa* is *Peshi* under the action of *Vayu* which can be understood as muscles.

It is very important and interesting to observe that in *Bhelasamhita* there is a specific reference regarding the changes of musculoskeletal component where mentioned that the blood, muscles, adipose tissue (*Vasa*) bones, bone marrow are decreased according to age. Apart from these he also mentioned about decreased in semen which can be understood as menstrual blood in female, as well as decreased in faeces and urine output.

Bhagvata-1 also mentioned the musculoskeletal effect with ageing with appearance of *Slathamamsa, Sandhin, Asthi* which clearly indicate the weakness as well as lacking in strength of all these structures.

All these changes can be understood along with the changes of musculoskeletal changes in Post-Menopausal Status as mentioned earlier.

In this particular study a range of 15.45–18kg is noted in 60 menopause women. The result shows that 4.95% diminution in relation to the grip strength rating for female (in kg) by sport & science resource. Here the normal HGS noted in 45-49 years age group is 18.2 -32.4kg. This gives a glimpse of diminutions of hand grip strength in menopausal women, which indicate reduction in muscle strength. The result of hand grip strength significantly less in the age group 40–49kg as data given by the study "Massy Westropp et al. BMC Research notes 2011", where noted the strength is 29kg. Considering with this study marked 39.03 % reductions in HGS is observed.

In this study for the muscle strength of lower limb we used the MMT where follow the criteria by PST in SMA, June 14, 2010, where 6 grades viz. grade 5,4,3,2,1 and o are mentioned. However as menopause is a physiological process, therefore the 3 upper grades are incorporated in this study. Observing the results the alteration of muscle strength of lower limb in 60 menopausal women is difficult to interpret. However a glimpse of decreased

muscle strength is observed in different grades. Maximum i.e. 45 numbers women in hip extension as well as 47 numbers of women in knee flexion are placed in grade 4, while 7 and 4 numbers of women in knee flexion and extension are observed in grade 3 which is inclining to decreased of muscle strength. The muscles involved in the MMT for the specific two joints viz. hip and knee joints are-Psoas major and Illiacus, Gluteus maximus, Hamstring muscles, and Quadriceps femoris, hamstring muscles respectively. In the study by "Julie p Greeves et al, a decreased of quadriceps strength is noted in menopause women. The previous study also shows that the positive relations between effects of estrogen on muscle strength. Thus the present study also finds relations in the decreased of muscle strength with PMS only in hand grip strength i.e., in upper extremity, while in lower extremity a very little decreased specifically in knee flexion and extension which is for hamstring and quadriceps strength are noted. As stated earlier symptoms according to *Dosic* virulence with ageing shows its effects on *Mamsa* and *Asthidhatu* influenced thereby.

In case of cervical flexion 50 (83.33%) numbers of women are observed within the normal range i.e. 40-60^0 while 10 (16.67%) numbers of women are observed below the normal range i.e. <40^0. In relation with cervical lateral flexion 55 (91.67%) numbers of women in right lateral flexion (RLF) and 51 (85%) numbers of women in left lateral flexion (LLF) are observed within the normal range i.e. 30-45^0 while 5 (8.33%) numbers in right and 9 (15%) in left are observed below the normal range i.e. 30^0. In cervical extension 30 (50%) women are observed in the normal range i.e., 30^0, 12 (20%) are observed below the normal range while 18 (30%) women are observed above the normal range. Therefore in cervical region we have not found any significant changes.

In case of cervical rotation among 60 PMW 30 (50%) numbers of women in right rotation (RR) and 28 (46.67%) numbers of women in left rotation (LR) are observed within normal range i.e. 45-80^0, while 30 (50%) and 32 (53.33%) numbers of women in RR and LR respectively are observed, below the normal range i.e. <45^0. In case of ROM of thoraco-lumber flexion the total numbers i.e., 60 (100%) women are observed below the normal range. In ROM of thoraco-lumbar lateral flexion 51 (85%) numbers of women in RLF and 50 (83.33%) numbers of women in LLF are observed below the normal range i.e. 35^0, while 9 (15%) and 7 (11.67%) number of women in RLF and LLF are observed in normal range respectively. 3 (5%) numbers of women are observed in more than normal range i.e. >35^0 in case of LLF. In case of thoraco-lumbar extension the total numbers i.e. 60 (100%) women are observed below the normal range i.e. <7cm. In ROM of thoraco-lumbar rotation 54 (90%) women in RR and 55 (91.67%) of women in LR are observed below the normal range, i.e. <45^0, while 6 (10%) and 5 (8.33%) numbers of women in RR and LR are observed within normal range respectively.

From all these observations the study shows that the ROM relating to thora-columbar spine are decreased which may be due to reduction in strength of back muscles or due to osteoporotic changes in the thoraco-lumbar vertebrae is not cleared. ROM in cervical spine is found almost in normal.

In this study, carried out Bone Mass Density (BMD) in 12 women, where osteopenia was noted in 11 numbers of women, between T score -1 to -2.5 while in single number of woman osteoporosis with T score -2.8 was observed.

CONCLUSION

The present study carried out in 60 Menopausal women which hypothesized to observe the relationship between Menopausal Status & Musculoskeletal components. Increased of *Vata,* imbalance in *Pitta* and *Kapha* are provocation factors for symptoms of post-menopausal status. These influences concern *Dhatuvahasrotas* with reduction of *Dhatuwagni* (specifically *Mamsa* and *Asthiagni* in this context). These processes hamper in conversion of *Poshyadhatu* leading to disturbance in formation of specific *Dhatu* where it is observed by reductions of activities of muscles and bones. In our study we found the muscle strength assessed in relation with hand grip strength for upper extremity muscles are significantly decreased. Muscle strength assessed in lower extremity by MMT specifically in hip and knee joint were found no significant result. We also observed that apart from the menopausal status other factors like ageing, metabolic changes in muscle protein synthesis, muscle protein breakdown, increased of catabolic stress such as oxidative stress and inflammation are also plays key role. The study advocates carrying out further research work with large sample and with higher sophisticated instrument to establish the hypothesis for the benefits of upgrading science.

REFERENCES

1. Julie P. Greeves et al, Changes in muscle strength in women following the menopause: a longitudinal assessment of the efficacy of hormone replacement therapy.
2. Kirsty Jayne Elliott-sale, The relationship between oestrogen and muscle strength: a current perspective.

3. Susruta Samhita, commentary Sri Dalhanacharya, edited by Voidya Trikamji Jadavji, Chaukhambha Orientalia, Varanasi, Sutra Sthana, 14/6, p-59.
4. Susruta Samhita, commentary Sri Dalhanacharya, edited by Voidya Trikamji Jadavji, Chaukhambha Orientalia, Varanasi, Sarir Sthana 3/11, p-351.
5. Susruta Samhita, commentary Sri Dalhanacharya, edited by Voidya Trikamji Jadavji, Chaukhambha Orientalia, Varanasi, Sutra Sthana, 14/16, p-70.
6. Astanga Sangraha, vol-2, English Translation by Prof.Murthy Srikanth K.R., Chaukhambha Orientalia, Varanasi, Sarira Sthana 1/21, p-10.
7. Bhava Prakasa, vol-1, commentary by Dr. Sitaram Bulusu, Chaukhambha Orientalia Purvakhanda 3/1, p-16.
8. Astanga Hridaya, vol-2, English Translation by Prof.Murthy Srikanth K.R., Chaukhambha Krishnadas Academy, Varanasi, Sarira Sthana 1/7, p-360.
9. Bhava Prakasa, vol-1, commentary by Dr. Sitaram Bulusu, Chaukhambha Orientalia Purvakhanda, 3/204, p-41.
10. Susruta Samhita, commentary Sri Dalhanacharya, edited by VoidyaJadavji Trikamji, Chaukhambha Orientalia, Varanasi, Sutra Sthana 15/16.
11. Susruta Samhita, commentary Sri Dalhanacharya, edited by VoidyaJadavji Trikamji, Chaukhambha Orientalia, Varanasi, Sarir Sthana 2/22,p-346.
12. Astanga Sangraha, vol-2, English Translation by Prof. Murthy Srikanth K. R., Chaukhambha Orientalia, Varanasi, Sarira Sthana 1/6, p-4.
13. Bhava Prakasa, vol-1, Commentary by Dr. Sitaram Bulusu, Chaukhambha Orientalia Madhyamkanda, 24/15, p-263.
14. Susruta Samhita, commentary Sri Dalhanacharya, edited by Voidya Jadavji Trikamji, Chaukhambha Orientalia, Varanasi, Sarir Sthana 2/4,p-244.
15. Astanga Sangraha, vol-2, English Translation by Prof.Murthy Srikanth K.R., Chaukhambha Orientalia, Varanasi, Sarira Sthana 1/14,p-7.
16. Astanga Hridaya, vol-2, English Translation by Prof.Murthy Srikanth K.R., Chaukhambha Krishnadas Academy, Varanasi, Sarira Sthana 1/11, p-361.
17. Susruta Samhita, commentary Sri Dalhanacharya, edited by Voidya Jadavji Trikamji, Chaukhambha Orientalia, Varanasi, Sutra Sthana 35/21, p-153.
18. Caraka Samhita, by Agnivesa of Chakrapanidatta, edited by Vaidya Trikamji Yadavji Chaukhambha Orientalia, Varanasi, Viman Sthana 8/122, p-280.
19. Astanga Sangraha, vol-2, English Translation by Prof.Murthy Srikanth K. R., Chaukhambha Orientalia, Varanasi, Sarira Sthana 8/22, p-104.
20. Bhela Samhita, English Translation by Dr.Krishnamurthy K. H., editor Prof Sharma Priya Vrata, Chaukhambha Visvabharati, Varanasi, Sarira Sthana 2/4, p-195.
21. Bhela Samhita, English Translation by Dr.Krishnamurthy K.H., editor Prof Sharma Priya Vrata, Chaukhambha Visvabharati, Varanasi, Sarira Sthana 2/6, p-196.
22. Kirsty Jayne Elliott-Sale The relationship between oestrogen and muscle strength, a current perspective, June 2014.
23. Nicola M Massy Westropp et al, Hand Grip Strength: age and gender stratified normative data in a population based study, 2011.
24. Physical Screening Test, in SMA (Spinal Muscular Atrophy), June 14, 2010.
25. Measurement of joint motion, A Guide to Goneometry, Part-IV, 5th edition. Testing of spine and temporomendibular joint by Cynthia C. Norkin, D. Joyce White.

Cite this article as:
Doley Lakhiprova, Sarma Tikendrajit, Baishya Pranabjyoti. Assessment of Musculoskeletal Changes In Menopause– A Cross Sectional Study. International Journal of Ayurveda and Pharma Research. 2020;8(10):84-90.
Source of support: Nil, Conflict of interest: None Declared

***Address for correspondence**
Dr Doley Lakhiprova
Lecturer,
Dept. of Sharir Rachana, NEIAH, Shillong, Meghalaya, India.
Email:
doley.lakhiprova@gmail.com