*International Journal of Health Sciences and Research*
*Volume 14; Issue: 8; August 2024*
*Website: www.ijhsr.org*
*Review Article* *ISSN: 2249-9571*

# Association Between Metabolic Syndrome and Chronic Musculoskeletal Pain: An Updated Review

**Bhawna Verma[1], Sunidhi Rana[2], Krishan Narang[3]**

[1]Assistant Professor, College of Physiotherapy, PGIMS, Rohtak, Haryana, India.
[2]Assistant Professor, Prem Physiotherapy and Rehabilitation Centre, Panipat, Haryana, India
[3]MPT Student, College of Physiotherapy, PGIMS, Rohtak, Haryana, India.

Corresponding Author: Sunidhi Rana

**DOI: https://doi.org/10.52403/ijhsr.20240839**

## ABSTRACT

**Background:** Metabolic syndrome is an increasing health problem worldwide. It is a syndrome encompassing the presence of central obesity and two of the three following criteria: high blood pressure, impaired glucose metabolism, and elevated non-high-density lipoprotein (non-HDL) cholesterol level (atherogenic dyslipidaemia) It is associated with an increased risk of cardiovascular disease.
**Objectives:** The objective of the current study was to explore the association between metabolic syndrome and chronic musculoskeletal pain.
**Methods:** The current literature on metabolic syndrome connection with chronic musculoskeletal pain has been reviewed and the evidence is collected to explore the above objectives.
**Results:** A total of 17 studies were included in this review among which 16 studies supported that there is a clear association between metabolic syndrome and chronic musculoskeletal pain.
**Conclusion:** The results of this review suggest a positive association existed between the presence of chronic musculoskeletal pain and metabolic syndrome components. Awareness of this association could enable an early MS diagnosis and the implementation of preventative measures.

***Keywords:*** Metabolic Syndrome, Chronic Musculoskeletal Pain, Fibromyalgia, Knee Pain, Neck Pain, Shoulder Pain, Low back pain

## INTRODUCTION

Metabolic syndrome (MetS) is becoming a prevalent problem worldwide. There has been a global shift in disease patterns with a decrease in the overall impact of infectious diseases and an increase in the impact of cardiovascular and metabolic diseases. Metabolic syndrome is a cluster of risk factors defined by high fasting glucose and triglycerides, low HDL cholesterol, high blood pressure, and abdominal obesity.[1] The overall association of metabolic syndrome and its individual risk factors with diabetes mellitus, cardiovascular diseases, and overall mortality has increased the interest of clinicians and researchers globally towards this syndrome. It is associated with a 2-fold risk of cardiovascular diseases and a 5-fold risk of diabetes.[2]

The prevalence of metabolic syndrome has been reported as high as 35% in the United States and 37% in Finland.[3] Almost one in

three adults in India suffers from MetS.[4] In the urban Indian population, the prevalence of metabolic syndrome has been reported to be 19.52% in Mumbai, 24.9% in Jaipur, and 11.2% in Chennai.[1] In urban Indian populations, the age-adjusted prevalence of metabolic syndrome was found to be overall approximately 25% (approximately 31% in women and 18.5% in men.[5] In recent times, various researchers on musculoskeletal pains and disorders have seen an association of musculoskeletal pains with metabolic factors in general and metabolic syndrome in specific. Metabolic syndrome has been found to be associated with neck pain.[6] Also, common risk factors have been found for atherosclerosis and carpal tunnel syndrome as well as shoulder pain.[7, 8] A large population-based study showed metabolic syndrome is associated with shoulder pain in men.[9] Metabolic syndrome has been shown to be associated with pain intensity in upper extremity pain disorders. Musculoskeletal specialists are now giving importance to the role of various components of metabolic syndrome in patients with musculoskeletal pains. The exact underlying relationship between metabolic syndrome and musculoskeletal disorders is not known. However, researchers have given importance to this association to the extent that shoulder periarthritis has been reported as a red flag for metabolic syndrome in women.[10] As individuals with musculoskeletal illnesses become more sedentary, their metabolic syndrome may worsen. This is because sedentary behaviour can lead to muscle loss, which increases the risk of injury to musculoskeletal structures.[11]

Thus, metabolic syndrome is a prevalent problem affecting the overall health of the individual. The present study was focused on better understanding the association between musculoskeletal disorders and MetS in the context of chronic musculoskeletal pain in individuals with metabolic syndrome.

## MATERIALS & METHODS

An electronic search was performed covering the last 2 decades (2006–2023). The main search items were metabolic syndrome, shoulder pain, knee pain, fibromyalgia, carpal tunnel syndrome, chronic low back pain, neck pain and chronic musculoskeletal disorders. All of the identified literature was reviewed for titles and abstracts. The selected studies on chronic musculoskeletal pain were reviewed.

## RESULT

**Table 1: Research studies on Chronic musculoskeletal Pain in Metabolic Syndrome**

| Sr. No | Author, year | Study design | Patient Population | Methodology | Results |
|---|---|---|---|---|---|
| **Fibromyalgia Syndrome** | | | | | |
| 1. | Loevinger BL (2006) | Case-control study | 109 Women with fibromyalgia were compared with 46 healthy women | Urine samples collected over a 12-hour period were used to measure cortisol and catecholamine levels. | Women who experience fibromyalgia-related chronic pain are more likely to develop metabolic syndrome, which is linked to comparatively high norepinephrine levels and comparatively low cortisol and adrenaline |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | output.[12] |
| 2. | Çakit O (2020) | A cross-sectional study | 24 female fibromyalgia syndrome patients with metabolic syndrome and 76 female fibromyalgia patients without metabolic syndrome and 38 healthy females | The outcome measurements included the visual analogue scale, fatigue severity scale, Beck depression inventory, fibromyalgia impact questionnaire, and pain threshold. Using the total myalgic score (TMS) and control point score, the severity of FMS was evaluated. | This research revealed that the prevalence of MetS was almost four times greater in patients with fibromyalgia syndrome, and the coexisting MetS may increase the severity of fibromyalgia syndrome.[13] |
| **Carpel Tunnel Syndrome** | | | | | |
| 3. | Balci K (2007) | A cross-sectional study | 107 right-handed patients, 96 of them female and 11 of them male, had a clinically and electrophysiologically confirmed diagnosis of CTS patients, both with and without metabolic syndrome | For individual instances in both upper extremities, electromyography and other neurophysiological investigations were carried out. Stevens American Association of Electrodiagnostic Medicine Mini Monograph was used for the severity of CTS. | Patients with CTS had a threefold higher prevalence of metabolic syndrome, and their CTS was shown to be more severe in those with metabolic syndrome than in those without it.[14] |
| 4. | Onder B (2012) | Cross sectional study | 150 patients who had electrophysiologically confirmed diagnosis of CTS patients with and without metabolic syndrome. | The motor and sensory nerve conduction was examined in the upper extremities' median and ulnar nerves. | According to the results, metabolic syndrome might be a risk factor for CTS. Simultaneously, the existence of MeTS exacerbates the severity of the disease.[15] |
| 5. | Yurdakul FG (2014) | Cross sectional study | 200 CTS patients with and without diabetes and metabolic syndrome. | Stevens grade for severity of CTS based on electrophysiological data was used. The electrophysiological results were compared in four groups: no metabolic syndrome or diabetes (n=84), diabetes alone (n=20), combination MetS and diabetes (n=44), and MetS alone (n=52). | Patients with MeTS seem to experience CTS more severely than those with diabetes. Although other elements of the metabolic syndrome may have a greater impact on the severity of CTS, diabetes is one of the well-known risk factors for the condition.[16] |
| 6. | Roh YH (2015) | A Matched Case-Control Study | 35 patients with metabolic syndrome and surgically treated carpal tunnel syndrome (CTS) were age- and sex- matched with 37 | Preoperative and 3-6-12 month postoperative assessments were conducted for grip, pinch strength, sense of touch using Semmes- | After carpal tunnel release, individuals with CTS and MetS experience a delayed functional |

| | | | | | |
|---|---|---|---|---|---|
| | | | control patients without metabolic syndrome. | Weinstein monofilament, and Boston Carpal Tunnel Questionnaires (BCTQ). | recovery; however, a year after surgery, significant improvements in symptom severity and hand function are comparable to those in patients without MeTS.[17] |
| 7. | Mi J (2021) | A Two-Sample Mendelian Randomization Study | Carpel tunnel Syndrome. | From the largest T2D genome-wide association studies meta-analysis, which included 596,424 controls and 62,892 cases, summary-level data on the disease was retrieved. UK BioBank provided summary-level information on arm fat mass, arm fat-free mass, and waist circumference. From the FinnGen consortium, associations between single nucleotide polymorphisms and exposures associated with CTS were discovered (4505 patients and 86,854 controls). | The results of this study suggest that T2D and obesity are independent risk factors for carpal tunnel syndrome. The inverse-variance-weighted approach combined with univariate Mendelian randomization revealed a favourable relationship between BMI and CTS risk.[18] |
| **Neck Pain** | | | | | |
| 8. | MäntyselkäP (2010) | A cross-sectional study | 1294 middle-aged subjects in Pieksämäki, Finland. A total of 399 males and 500 females with metabolic syndrome. | Using the 12-item General Health Questionnaire (GHQ-12), psychological distress was measured. Perceived neck discomfort daily was classified as neck pain. Using the National Cholesterol Education Programme guidelines, MetS was determined. | This study showed that neck pain was associated with MetS. Although neck pain was more common in women than in men, this association was stronger in men.[6] |
| **Shoulder Pain** | | | | | |
| 9. | Rechardt M (2010) | cross-sectional study | 6,237 subjects with shoulder pain and chronic rotator cuff tendinitis. | weekly alcohol intake was measured in units, and interviews were used to gather information on sociodemographic, lifestyle, and work-related physical strain factors. Carotid intima-media thickness was measured ultrasonographically. | Results indicated that shoulder pain was correlated with carotid intima-media thickness, several other metabolic variables, and abdominal obesity.[9] |
| 10. | Contieri JPO | Case-control | 102 female patients (72 | Fasting glucose, | Higher levels of |

| | | | | | |
|---|---|---|---|---|---|
| | (2015) | study | with shoulder periarthritis and 40 control group) | HbA1c, cholesterol, triglycerides, LDL, and HDL cholesterol were measured for each participant. Patients with periarthritis responded to the SF-12 quality of life questionnaire and the PSS (Pennsylvania Shoulder Score) questionnaire for pain, function, and patient satisfaction with the shoulder's pathology. | LDL cholesterol, HbA1c, dyslipidemia, hypertension, and cardiovascular morbidity were observed in women with shoulder periarthritis. There was greater total cholesterol and BMI. Additionally, discovered that the group with shoulder disease had a more patients who met the criteria for MeTS.[10] |
| 11. | Burne G (2019) | A systematic review | Metabolic syndrome and rotator cuff related shoulder pain. | All pertinent English-language publications up to 2019 that addressed shoulder pain related to rotator cuff syndrome and MetS. | The review's low-to-moderate quality evidence points to a connection between MetS and RCRSP.[19] |
| 12. | Sargin S (2022) | prospective cross-sectional study | 114 patients of shoulder joint pain | Every patient had a thorough examination of their shoulders, and their range of motion was measured. Body mass index and waist-to-hip ratio were computed. Measurements were made of blood pressure. Levels of lipids and blood glucose were measured while fasting. For present pain, a visual analogue scale was used. | This study demonstrated a strong correlation between MetS and shoulder pain.[20] |
| **Low Back Pain** | | | | | |
| 13. | Duruoz (2010) | a cross-sectional study | 60 patients with chronic mechanical low back pain. | The Istanbul Low Back Pain Disability Index, Oswestry Disability Index, and Roland-Morris Disability Questionnaire were used to determine functional deficit. A depression assessment was conducted using Beck's depression scale. Based on the National Cholesterol Education Program's (NCEP) 2001 definitions, the | This study findings showed that metabolic syndrome is more common in the elderly, in those with persistent low back pain, and in individuals with elevated body mass index.[21] |

| | | | | | |
|---|---|---|---|---|---|
| | | | | diagnosis of metabolic syndrome was established. | |
| 14. | Ha JY (2011) | a cross-sectional study | 1085 participants with chronic lower back pain. | The Korean Society for the Study of Obesity and the National Cholesterol Education Programme Adult Treatment Panel III (NCEP-ATP III) criteria were used to diagnose MetS. | This study demonstrated that individuals with chronic lower back pain in Korea frequently have metabolic syndrome.[22] |
| **Knee Osteoarthritis** | | | | | |
| 15. | Xie (2017) | cross-sectional study | Knee OA in metabolic syndrome patients | Associations between MetS and its components with OA were evaluated by conducting multivariable adjusted logistic regression. | The findings of this study indicated that there was a positive association between the prevalence of MetS and knee OA. However, MetS as a whole was associated with the higher prevalence of knee osteophytes, but not joint space narrowing.[23] |
| 16. | Shinzato (2021) | Case-control study | Two groups of participants 64 with and 42 without MetS with similar age and sex distribution. | Using a standardised questionnaire, the researchers collected clinical and demographic data during an in-person interview, including details ondrugs and comorbidities. Blood pressure at least twice, waist circumference, fasting glucose, triglycerides, high-density lipoprotein and cholesterol were all tested. | Chronic musculoskeletal pain was more common in MetS patients, especially in the weight-bearing sites, such as LBP and KOA, which may make walking difficult. As a result, physical activity is decreased, which exacerbates the condition and deteriorates musculoskeletal health.[11] |
| 17. | Ibrahim (2023) | cross-sectional study | Knee OA in metabolic syndrome patients | Multivariable regression was used to determine the association of MetS and its components, with the WOMAC total and subscale scores. | This study demonstrated that after adjustment for BMI, neither MetS nor its individual parameters were associated with worse knee symptoms.[24] |

## DISCUSSION

In this review study, two fibromyalgia syndrome studies are included. According to Loevinger et al., women who suffer from persistent pain associated with fibromyalgia have an increased risk of developing metabolic syndrome. According to Çakit O et al. fibromyalgia syndrome patients had a nearly four-fold higher prevalence of MetS, and having a concomitant MetS may exacerbate the condition. The association between fibromyalgia and metabolic syndrome is corroborated by both investigations. For Carpel Tunnel Syndrome five studies are included in this review. According to research by Balci K et al. and Onder B et al. individuals with CTS had a three-fold increased prevalence of metabolic syndrome, and their condition was demonstrated to be more severe in those with metabolic syndrome than in those without it. According to Yurdakul FG et al. individuals with MetS appear to have a more severe case of CTS than those with diabetes. Diabetes is one of the well-known risk factors for CTS, even if other components of the metabolic syndrome may have a bigger effect on the condition's severity. According to Roh YH et al. people with CTS and metabolic syndrome had a delayed functional recovery following carpal tunnel release; yet, a year following surgery, notable improvements in symptom severity and hand function are similar to those in patients without MetS. Moreover, Mi J et al. found that obesity and type 2 diabetes are separate risk factors for carpal tunnel syndrome. The association between carpal tunnel syndrome and metabolic syndrome is corroborated by all five investigations. Neck pain has been linked to MetS, according to Mäntyselkä P et al. Research by Rechardt M et al. linked shoulder pain to carotid intima-media thickness, several other metabolic variables, and abdominal obesity. According to Contieri JPO et al., women with shoulder periarthritis had increased levels of dyslipidemia, hypertension, LDL cholesterol, HbA1c, and cardiovascular morbidity. Both total cholesterol and BMI were higher. It was also shown that a higher number of patients who met the MetS criteria belonged to the group with shoulder illness. Burne G et al. found low-to-moderate quality evidence points to a connection between MetS and RCRSP. Additionally, Sargin S et al. discovered a significant association between MetS and shoulder discomfort. According to research by Duruoz et al. people with an elevated body mass index, chronic low back pain, and the elderly are more likely to have metabolic syndrome. Moreover, Ha JY et al. found that metabolic syndrome is commonly present in Koreans with chronic lower back pain. According to Xie DX et al. there is a correlation between knee OA and the prevalence of MetS. Higher rates of chronic musculoskeletal pain in MetS have been reported by Shinzato et al. especially in weight-bearing sites, such as LBP and KOA, which may make walking more difficult. As a result, physical activity is decreased, which exacerbates the condition and deteriorates the health of the musculoskeletal system. Ibrahim T et al. showed that neither MetS nor any of its component factors was linked to worsening knee symptoms when BMI was taken into account.

There is a complex underlying mechanism through which metabolic syndrome may result in chronic musculoskeletal pain The key components of metabolic syndrome are impaired fasting glucose, obesity, dyslipidaemia and elevated blood pressure.[1] The relationship between metabolic syndrome and chronic musculoskeletal pain may be explained by considering the individual components of metabolic syndrome Impaired fasting glucose which is also a characteristic of diabetes mellitus may lead to changes in microcirculation and the formation of non-enzymatic glycosylation products and advanced glycosylation end products.[26] These changes affect the structure of tendons and capsular

fibrosis. Musculoskeletal implications of diabetes mellitus are well established. Obesity has been found to lead to chronic inflammatory state through the release of proinflammatory cytokines by adipocytes.[25] This inflammatory state may also lead to the development of musculoskeletal symptoms Dyslipidaemia has been linked with Xanthoma formation and ectopic fat accumulation.[27] Hypertension may affect the overall cardiovascular endurance of the individuals. Two key factors that may play a role in both metabolic syndrome and musculoskeletal pain are physical inactivity and nutrition. The relationship between metabolic syndrome and chronic musculoskeletal pain is summarized in figure 1

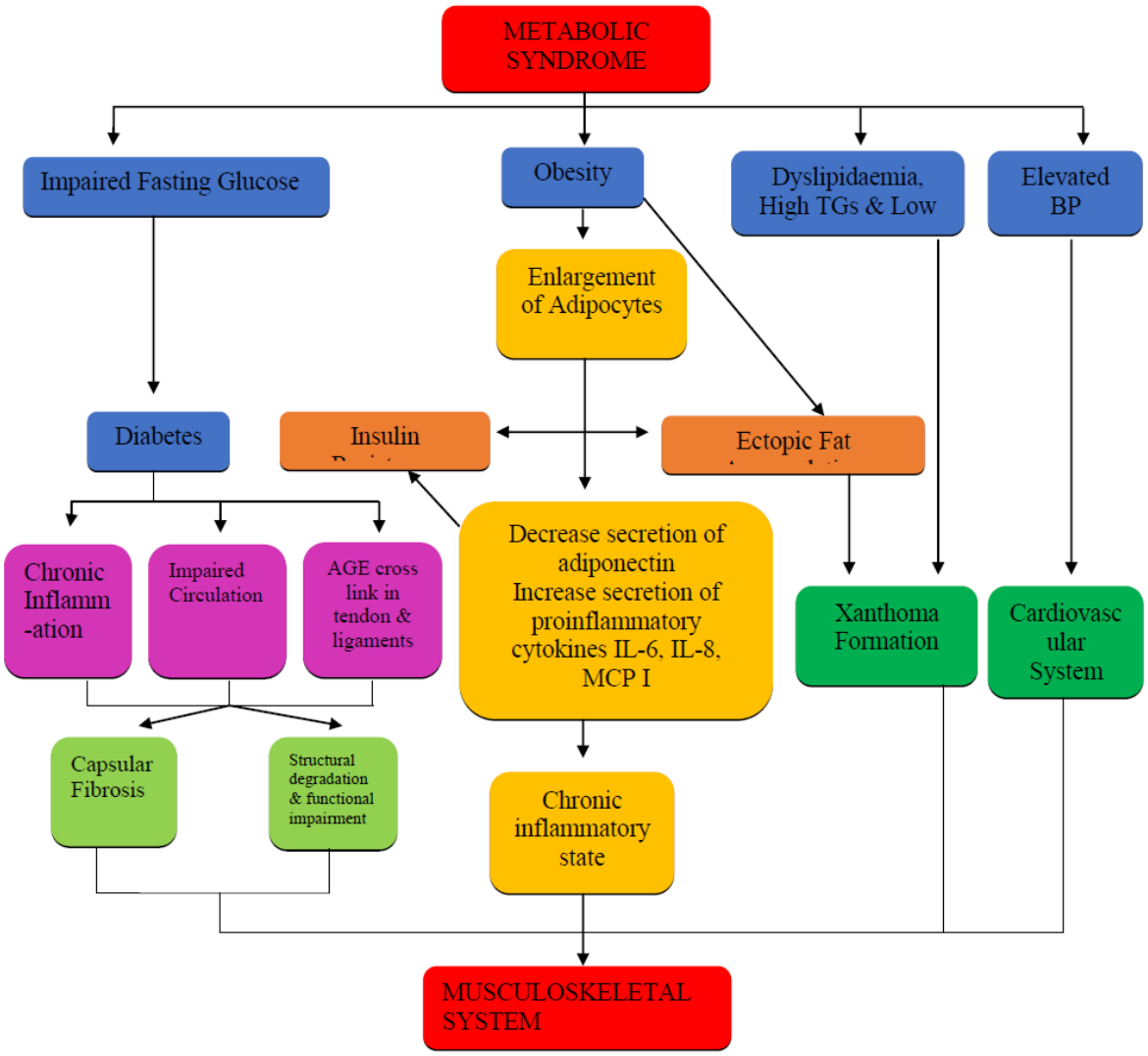


**Figure 1: Relationship between Metabolic Syndrome and Musculoskeletal Pain**

## CONCLUSION

The results of this review suggest a positive association existed between the presence of chronic musculoskeletal pain, and MetS components. Therefore, MetS has emerged as a top concern for our nation's doctors and public health experts, requiring coordinated, comprehensive efforts for research, management, early detection, prevention, and treatment. Awareness of this association could enable an early MetS diagnosis and the implementation of preventative measures.

### *Declaration by Authors*

**Ethical Approval:** not needed

**Acknowledgement:** None
**Source of Funding:** None
**Conflict of Interest:** The authors declare no conflict of interest.

## REFERENCES

1. Sewant, A. Markashwar, R., Shah, S., Raghavan, R., Dhongde, G., Raje, H., & Ashavaid, T. F. Prov. metabolic syndrome in urban India. Cholesterol 2011, Article ID 920983
2. K. Berch-Jolesen. "The metabolic syndrome in a global perspective. The public health impact, Duo M Bull 2007)54(2):157-159.
3. Ford ES. Prevalence of the metabolic syndrome defined by the International Diabetes Federation among adults the US. Diabetes Care 2005; 28:2745-2749
4. Krishnamoorthy Y, Rajaa S, Murali S, Rehman T, Sahoo J, Kar SS. Prevalence of metabolic syndrome among adult population in India: A systematic review and meta-analysis. PLoS One. 2020 Oct 19;15(10):e0240971. doi: 10.1371/journal.pone.0240971.
5. Bhalwar R. Metabolic syndrome: The Indian public health perspective. Medical journal armed forces india 76 :2020;8 -16. https://doi.org/10.1016/j.mjafi.2019.12.001
6. Mäntys, P. Kautiainen, H. &Vandinis, M. Prevalence of neck pain in subjects with metabolic synd cross-unctional population-based study. BMC Musculoskeletal disorders. 2010; //(1) 171
7. Shiri, R., Helidvaara, M., Moilanen, L., Vikari, 1, Liinas, H. & Vikari-Juntara, E. A candid risk factors, carotid intima-media thickness and manifest athermeioro carpal tunnel syndrome. BMC musculoskeletal disorders. 2011; 12(1): 30
8. Viikari Junturs, E.,Shiri, R., Solovieva, S., Karppinen, 1, Leino Arjas, P. Varonem, II, & Uns, O Risk factor of atherosclerosis and shoulder pain pain-is there association? A systematic review European journal of pain 2008; 12(4): 412-426.
9. Rechardt M, Shiri R, Karppinen J, Jula A, Heliövaara M, Viikari-Juntura E. Lifestyle and metabolic factors in relation to shoulder pain and rotator cuff tendinitis: a population-based study. BMC Musculoskelet Disord. 2010 Jul 20;11:165. doi: 10.1186/1471-2474-11-165.
10. Contieri JP, Neves LM, Skare TL. Shoulder pain and metabolic syndrome. Acta Reumatol Port. 2015 Apr-Jun;40(2):198-9.
11. Marcia Midori Shinzato., et al. "Chronic Musculoskeletal Pain in Metabolic Syndrome: Most Common Anatomic Sites and Diseases". Acta Scientific Orthopaedics 4.4 (2021): 26-34.
12. Loevinger BL, Muller D, Alonso C, Coe CL. Metabolic syndrome in women with chronic pain. Metabolism. 2007 Jan;56(1):87-93. doi: 10.1016/j.metabol.2006.09.001.
13. Çakit O, Gümüştepe A, Duyur Çakit B, Pervane Vural S, Özgün T, Genç H. Coexistence of fibromyalgia and metabolic syndrome in females: The effects on fatigue, clinical features, pain sensitivity, urinary cortisol and norepinephrine levels: A cross-sectional study. Arch Rheumatol. 2020 Jun 25;36(1):26-37. doi: 10.46497/ArchRheumatol.2021.7534.
14. Balci K, Utku U. Carpal tunnel syndrome and metabolic syndrome. Acta Neurol Scand 2007: 116: 113–117.
15. Önder, B., Yalçın, E., Selçuk, B. et al. Carpal tunnel syndrome and metabolic syndrome co-occurrence. Rheumatol Int **33**, 583–586 (2013). https://doi.org/10.1007/s00296-012-2417-1
16. Gül Yurdakul F, Bodur H, Öztop Çakmak Ö, Ateş C, Sivas F, Eser F, Yılmaz Taşdelen Ö. On the Severity of Carpal Tunnel Syndrome: Diabetes or Metabolic Syndrome. J Clin Neurol. 2015 Jul;11(3):234-40. doi: 10.3988/jcn.2015.11.3.234.
17. Roh YH, Lee BK, Noh JH, Oh JH, Gong HS, Baek GH. Effects of Metabolic Syndrome on the Outcome of Carpal Tunnel Release: A Matched Case-Control Study. J Hand Surg Am. 2015 Jul;40(7):1303-9. doi: 10.1016/j.jhsa.2015.04.003. Epub 2015 May 13.
18. Mi J, Liu Z. Obesity, Type 2 Diabetes, and the Risk of Carpal Tunnel Syndrome: A Two-Sample Mendelian Randomization Study. Front Genet. 2021 Jul 22;12:688849. doi: 10.3389/fgene.2021.688849.
19. Burne G, Mansfield M, Gaida JE, Lewis JS. Is there an association between metabolic syndrome and rotator cuff-related shoulder pain? A systematic review. BMJ Open Sport Exerc Med. 2019 Dec 6;5(1):e000544. doi: 10.1136/bmjsem-2019-000544.

20. Sargin, Serdar & ŞAHİN, Nilay & Karahan, Ali & AYDIN, Zafer. (2022). Frequency of Metabolic syndrome in Patients with Shoulder Pain. Ege Tıp Bilimleri Dergisi. 5. 10.33713/egetbd.1075491.
21. Duruöz MT, Turan Y, Gürgan A, Deveci H. Evaluation of metabolic syndrome in patients with chronic low back pain. Rheumatol Int. 2012 Mar;32(3):663-7. doi: 10.1007/s00296-010-1693-x.
22. Ha JY. Evaluation of metabolic syndrome in patients with chronic low back pain: using the fourth Korea national health and nutrition examination survey data. Chonnam Med J. 2011 Dec;47(3):160-4. doi: 10.4068/cmj.2011.47.3.160.
23. Xie DX, Wei J, Zeng C, Yang T, Li H, Wang YL, Long HZ, Wu ZY, Qian YX, Li KH, Lei GH. Association between metabolic syndrome and knee osteoarthritis: a cross-sectional study. BMC Musculoskelet Disord. 2017 Dec 16;18(1):533. doi: 10.1186/s12891-017-1890-9.
24. Ibrahim T, Ahmed AF, Nofal M, Hegazy A, Ghomrawi HMK. Metabolic syndrome and the likelihood of knee pain and functional disability: evidence from a large middle eastern population-based study. BMC Musculoskelet Disord. 2023 Aug 4;24(1):634. doi: 10.1186/s12891-023-06685-3.
25. Gustafion, B. Adipose tissue, inflammation and stherosclerosis. Journal of atherosclerosis and thrombus 2010,174 332-341. 10
26. Hsu, C. L., & Sheu, W. H. H. Diabetes and shoulder disorders, Journal of diabetes investigation 2016;7(5): 649-651.
27. Klemp, P., Halland, A. M., Majoos, F. L., & Stryn, K. (1993), Mancuskeletal manifestations in lyri a controlled study. Annals of the rheumatic diavares, 1993, 52(1) 44-45

How to cite this article: Bhawna Verma, Sunidhi Rana, Krishan Narang. Association between metabolic syndrome and chronic musculoskeletal pain: an updated review. *Int J Health Sci Res.* 2024; 14(8):337-346. DOI: *https://doi.org/10.52403/ijhsr.20240839*

******