BALNEO RESEARCH Balneo and PRM Research Journal English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Research article

The role of the therapeutic physical exercise and the complex recovery treatment for the patients with chronic degenerative diseases during the COVID-19 pandemic

Andrei Emanuel Silisteanu[1], Oana Raluca Antonescu[2*], Mihaela Racheriu[2]

[1] Healthcare Management, Lucian Blaga University of Sibiu, Faculty of Medicine /FPACS-Cluj Napoca, Romania; silisteanu.andrei10@yahoo.com (A.E.S)
[2] Lucian Blaga University of Sibiu, Faculty of Medicine,Sibiu, Romania ; oanaraluca.antonescu@ulbsibiu.ro (O.R.A.), mihaela.racheriu@ulbsibiu.ro (M.R.)
* Correspondence: oana.raluca.antonescu@gmail.com

Citation: Silisteanu A.E., Antonescu O.R., Racheriu M. - The role of the therapeutic physical exercise and the complex recovery treatment for the patients with chronic degenerative diseases during the COVID-19 pandemic.
Balneo and PRM Research Journal **2022,** *13(4): 529*

Academic Editor(s):
Constantin Munteanu

Received: 15.11.2022
Accepted: 05.12.2022
Published: 15.12.2022

Reviewers:
Elena Valentina Ionescu
Gabriela Dogaru

Publisher's Note: Balneo and PRM Research Journal stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Abstract: ***Background:*** Osteoarthritis is one of the most common causes of pain and musculoskeletal disability and mainly affects the middle-aged and the elderly. The condition is chronic and disabling, it diminishes the patients' quality of life. ***Purpose.*** The study had the purpose of pointing out a possible connection between physical activity and the reduction of pain accompanied by the increased functional capacity in patients with chronic degenerative diseases during the COVID-19 pandemic. ***Material and method:*** The study was conducted on an outpatient basis for a period of 6 months on a number of 40 patients diagnosed with osteoarthritis. The evaluation of the patients was made at the beginning of the treatment and at its end (after 4 weeks), as well as at the control after 12 weeks. ***Results:*** The study included a number of 40 patients over 45 years old, divided into 2 study groups: in group L1-knee osteoarthritis and in group L2 -hip osteoarthritis. The therapeutic physical exercise reduced pain and stiffness, and it also improved the functional capacity. ***Conclusions:*** Therapeutic physical exercise has an important role in the reduction of pain and disability, as well as in the increase in the quality of life, if it is done properly.
Keywords: osteoarthritis, therapeutic physical exercise, pain, pandemic COVID-19

1. Introduction

Osteoarthritis is one of the most common causes of pain [1,2] and musculoskeletal disability. The knee is the most affected joint [3, 4], having a role in keeping static and dynamic balance, orthostatic stability and gait [5]. Knee osteoarthritis mainly affects the middle-aged and the elderly.

The prevalence of knee osteoarthritis in China was approximately 8.1% [6] and it is continuously increasing. It is expected that the number of the elderly will increase from 524 million in 2010 to 1.5 billion in 2050 [7].

From a clinical point of view, patients with knee osteoarthritis have joint degradation (imaging-bending of the joint space, subchondral bone sclerosis and osteophytes), chronic pain, physical disability and stiffness. The condition is chronic and disabling, it diminishes the patients' quality of life (QOL), it increases anxiety and depression [8-10].

In the USA, the prevalence of knee osteoarthritis is estimated at approximately 32.5 million American adults, according to the Center for the Control and Prevention of Diseases [11].

The demographic aging index in Romania increased from 102.0 % in 2010 to 119.8 % in 2019, and the population is aging rapidly. The average age of the population in the

EU in 2019 (according to Eurostat) was 43.7 years, but in Romania it was 42.5 years. The number of patients with knee osteoarthritis assessed by DALY (Disability Adjusted Life Years) increased from 312 in 2017 to 323 in 2019 [12]. The incidence of osteoarthritis increases with age, which can be associated with sex, obesity, demographic, genetic, biomechanical factors, mechanical stress, sedentary lifestyle, anxiety and depression [3, 13].

It is recommended to do physical exercise because it can reduce pain and stiffness, but it can also improve the physical function and the muscular strength [14-17].

A systematic analysis made by Cochrane showed that physical exercise can control the pain for a short period, it improves the physical function that can be kept for 2 to 6 months after therapeutic exercise [18], but not excessively [19].

During the COVID-19 pandemic, physical activity in adults underwent essential changes by accommodating the presentation of online programs, adapting exercises to the gravitational environment acting on major body functions and the neuromyoartrokinetic (NMAK) system [20].

It is also recommended to do therapeutic physical exercise in water. The advantages are the reduction of the muscular contracture, the improvement of the muscular spasm, the facilitation of the blood circulation (due to the constant temperature and hydrostatic pressure), the toning of the muscles by water resistance, whereas its possibility to float can lower the injury risk and protect the joints by reducing weight; it is even more suitable for patients who are reluctant to physical exercise. There are studies [21,22] that show the effectiveness of therapeutic aquatic exercise to relieve pains in joints and improve physical function.

A review made by Cochrane shows that the use of therapeutic exercise based on force training can reduce pain and dysfunction caused by the knee osteoarthritis syndrome [13]. Physical therapy is effective in the treatment of knee osteoarthritis, it achieves functional improvement [23] by an exercise program focused on the force training of the quadriceps muscle and it increases performance in the lower limbs [24].

Physical therapy by therapeutic exercise can delay or even avoid the need for surgery at the level of the knee joint [25].

In order to be effective, the therapeutic exercise program must be made twice a week, for 12 weeks [25, 26] and it must contain heating for 20-25 minutes (aerobic exercises), by toning the muscles of the lower limbs (20-25 min) and exercises to stretch the muscles of the lower limbs (10-15 minutes).

As for the mechanisms of pathogenesis in knee osteoarthritis, an interdependent relationship was identified between leptin (an adiponectin with a key mediator role that correlates obesity and knee osteoarthritis) and body mass index [27].

When osteoarthritis is related to obesity, we can talk about a complex biopsychosocial condition, which increases the morbidity and mortality of patients, but it also becomes a public health issue [2, 28].

Coxarthrosis is a degenerative, slow and progressive condition located at the hip, with a frequency between 2 and 4% in people aged between 50-70 years. The damage causes the reduction of the joint mobility and it affects stability and gait, which causes disability [29]. The risk factors are age, sex, heredity, nutrition conditions, muscular system conditions and professional activity [19].

The development of healthy eating and physical activity behaviors in childhood and adolescence are very important for adult life [30]. This is why it is important that the recovery treatment be individualized according to the pathology [31]. For the recovery of patients with this pathology, it is important to take into account two parameters: body mass index and nutritional conditions [29].

Also very important is body composition, which represents those adipose tissues that are located mainly subtegumentary and retroperitoneal. Adipose tissue includes white adipose tissue (protects internal organs and is an insulator for maintaining

constant body temperature), brown adipose tissue (in small amounts in adults, especially in the scapular and subscapular region) and beige adipose tissue, which is derived from white adipose tissue and has no specific location [32].
The treatment of patients diagnosed with osteoarthritis, especially the knee osteoarthritis, has a prophylactic purpose, but also recovery, especially of the functional deficit [33, 34]. The complex treatment in osteoarthritis is pharmacological and recovery, involving the use of electrotherapy (low and average frequency currents, ultrasound) and physical therapy.
The use of ultrasound has fibrinolytic effects and muscle relaxation effects [35, 36], it enables the blood flow, it accelerates the biochemical reactions and it changes the cellular metabolism. The purpose of the therapeutic exercise is to restore joint mobility, to prevent the atrophy of the quadriceps muscles and also to restore static posture and gait [31].
The WHO confirmed the COVID 19 pandemic in March 2020. Due to the prioritization of emergency services determined by the pandemic, it has been a challenge to manage chronic diseases, such as osteoarthritis, heart diseases, cancer and diabetes. The impact of this situation is significant if we consider that osteoarthritis is an important cause of disability, which means a decrease in the quality of life of these patients and an increase in the medical costs for these conditions.
The limitation of physical activity due to the imposed quarantine determined the aggravation of these conditions in many cases.

2. Material and method

The study was conducted on an outpatient basis for a period of 6 months on a number of 40 patients diagnosed with osteoarthritis. The rules of ethics and deontology in force were observed.
Inclusion criteria: patients diagnosed (clinically and imaging) with knee osteoarthritis or hip osteoarthritis, for at least 6 months, age over 45 years, without chronic diseases, without prostheses or surgical interventions, cooperative patients.
Exclusion criteria: age under 45 years, patients with surgical interventions at the level of the knee and hip joints, diseases of other organs, neuropsychiatric diseases, uncooperative patients.
The evaluation of the patients was made at the beginning of the treatment and at its end (after 4 weeks), as well as at the control after 12 weeks.
The demographic data were collected (age, sex, living environment, body mass index) and the following scales were applied to assess the clinical-functional status as follows:

- for osteoarthritis, the VAS scale was used in order to assess pain, the WOMAC questionnaire (Western Ontario and McMaster Universities Osteoarthritis Index) to assess pain, stiffness, functional capacity and QOL (Quality of life) for the quality of life
- BMI is an important factor in the assessment of the nutritional status and was calculated by using the Quetelet formula [BMI = Weight (Kg) / Height² (m)].

All the patients received pharmacological treatment according to the presented pathology (non-steroidal anti-inflammatory drugs with local and general administration). They made an individualized physical therapy program and they used low and average frequency currents for analgesic and anti-inflammatory purposes.
Ultrasound (frequency 1MHz, power 0.4W/cm2), pulsed form, was also applied, in order to reduce pain, joint stiffness and muscular contracture.

Statistical analysis

The data obtained during the evaluation were recorded in Microsoft Excel files, then the values for the median, mean and standard deviation were used, whereas the application of the t-student test was useful as it compared the results obtained and it

observed whether the working hypothesis was confirmed. After the t-test is calculated, the value of the p-index can be estimated, which shows the possibility of an error related to the hypothesis. The results are statistically significant if $p < 0.05$.

3. Results

The study included a number of 40 patients over 45 years old, divided into 2 study groups: in group L1 patients with knee osteoarthritis (KO) and in group L2 patients with hip osteoarthritis (HO) . The distribution of patients from the 2 study groups, by gender and age group, are shown in Table 1.

Table 1. Distribution of patients by gender and age

Group	Age/ Gender	45-54 years	55-64 years	65-74 years	>75 years	Total
Group 1	Women	2	3	4	2	11
	Men	2	2	2	3	9
Group 2	Women	2	4	1	1	8
	Men	2	5	2	3	12

In the study groups, 19 patients (47.5%) were female and 21 patients (52.5%) were male.The average age of the patients in the study groups was over 60 years, namely: patients with knee osteoarthritis: 64 ±10.53 years whereas patients with hip osteoarthritis 62.25 ±8.44 years.

Most of the patients with knee osteoarthritis were in the 65-74 age group, while most patients with hip osteoarthritis were in the 55-64 age group. The results obtained after the use of the treatment and the therapeutic physical exercise were statistically significant for each evaluated parameter. Thus, for weight and body mass index, the p values are lower than 0.05 (Table 2).

Table no. 2. Evolution of weight and body mass index parameters

Disease	Statistic /Moment	Initial weight	Final weight	Control Weight	Initial BMI	Final BMI	Control BMI
KO	Average/SD	74.79±13.52	72±13.38	68.71±10.56	26.86±3.84	26.37±3.86	25.65±3.77
HO	Average/SD	82.9±13.95	77.6±14.81	73.67±12.42	28.15±3.41	27.41±3.33	26.62±3.26
	Test t-std	0.0071	0.0013		0.0035	0.0045	

For pain and quality of life, for all the assessed moments, the results were statistically significant, $p<0.05$ (Table 3).

Table no. 3. Evolution of pain parameters and quality of life

Disease	Statistic/ Moment	Initial VAS	Final VAS	Control VAS	Initial QOL	Final QOL	Control QOL
KO	Average/SD	5.7±2.23	4.2±1.54	2.85±0.75	57.85±2.06	78.65±2.01	96.95±3.89
HO	Average/SD	8.05±0.69	5.9±0.31	4.7±0.47	58.75±2.22	79±3.68	99.15±4.26
	Test t-std	0.0421	0.0368		0.0497	0.0307	

For dysfunction and disability for both pathologies, the results are statistically significant with $p<0.05$ (Table 4)

Table no. 4. Evolution of the functional disability parameter

Disease	Statistic/Moment	Initial WOMAC	Final WOMAC	Control WOMAC
KO	Average/SD	66.25±12.46	47.8±5.04	35.9±3.32
HO	Average/SD	63.6±13.31	51.45±12.57	30.8±2.19

Test t-std	0.0362	0.0428

4. Discussion

The weight of patients with knee osteoarthritis decreased by 3.73% at the end and by 4.39% at the control. The weight of patients with hip osteoarthritis decreased by 6.39% at the end and by 4.74% at the control.

The body mass index in patients with knee osteoarthritis registered a decrease of 1.82% at the end and 2.49% at the control, whereas in patients with hip osteoarthritis the reduction of the values of the body mass index was 2.62% at the end of the treatment and of 2.81% in the control.

Pain was reduced at the end of treatment by 26.31% in patients with knee osteoarthritis and by 27.71% in patients with hip osteoarthritis. In the control, the pain reduction was 23.68% in patients with knee osteoarthritis and 14.91% in patients with hip osteoarthritis.

Disability decreased by 27.84% in patients with knee osteoarthritis at the end of treatment and by 17.96% in patients with hip osteoarthritis. In the control, disability decreased by 19.10% in patients with knee osteoarthritis and by 32.46% in patients with hip osteoarthritis.

The quality of life improved in patients with knee osteoarthritis by 35.95% at the end of the treatment and by 67.58% in the control. The quality of life in patients with hip osteoarthritis increased by 20.42% at the end of the treatment and by 20.32% in the control.

The therapeutic physical exercise reduced pain and stiffness, and it also improved the functional capacity, as shown by studies in the specialized literature [26, 37, 38].

In the situation created by the COVID-19 pandemic, the effectiveness of recovery programmes is directly proportional to the recovery of function remaining at the best parameters, so that patients can reintegrate socially and professionally [39].

The pain improved over a short period of time, as also shown in the analysis made by Cochrane in 2015 [18] whereas the physical function improved and continued for a period of 3 months (control), as indicated by the studies [18, 24].

Our study showed that there is a relationship between pain, disability from degenerative pathology and body mass index, an aspect confirmed by Chen's study [40], which shows that the number of diagnosed patients increases when the body mass index increases, whereas over 50% of patients with this pathology end up with surgical intervention [41].

Once again, it is confirmed that an increased body mass index causes mechanical stress, and it is an important risk factor for knee osteoarthritis [42] considered to be of a mechanical nature, inflammation being a secondary consequence of it [43,44]. This is why it is necessary to reduce the values of this index.

The results of our study are confirmed by another study [45] that provides data on the effect of biomechanical factors related to obesity and that triggers osteoarthritis. By the excessive mechanical loading of the joints obesity contributes to the initiation of the joint osteoarthritic process [46].

5. Conclusions

In degenerative diseases, a complex recovery treatment is very important, applied individually according to age, physical abilities and comorbidities. Therapeutic physical exercise has an important role in the reduction of pain and disability, as well as in the increase in the quality of life, if it is done properly.

As a non-pharmacological treatment, is required to reduce the values of body mass index in order to reduce the symptoms of osteoarthritis at the hip and knee level, given that this pathology is considered a public health issue.

Author Contributions: Conceptualization, O.R.A. and M.R.; methodology, O.R.A. and A.E.S.; software, A.E.S.; validation, O.R.A., A.E.S. and M.R.; formal analysis, A.E.S.; investigation, O.R.A.; resources, M.R.; data curation, A.E.S.; writing—original draft preparation, O.R.A.; writing—review and editing, A.E.S; visualization, M.R.; supervision, O.R.A; project administration, O.R.A. All authors have read and agreed to the published version of the manuscript. All authors contributed equally to the manuscript.
Funding: This research received no external funding.
Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.
Conflicts of Interest: The authors declare no conflict of interest

References

1. Dor A, Kalichman L. A myofascial component of pain in knee osteoarthritis. *J Bodyw Mov Ther*. **2017**; 21(3):642-647
2. Antonescu OR, Silisteanu AE, Racheriu M, Szakács J. Emotionality and Quality of Life in Patients with Musculoskeletal Disorders. *Balneo and PRM Research Journal*. **2021**;12(3):270–274
3. Sánchez-Romero EA, Pecos-Martín D, Calvo-Lobo C, Ochoa-Sáez V, Burgos-Caballero V, Fernández-Carnero J. Effects of dry needling in an exercise program for older adults with knee osteoarthritis: A pilot clinical trial. *Medicine (Baltimore)*. **2018**; 97(26):e11255.
4. Jansen MJ, Viechtbauer W, Lenssen AF, et al. Strength training alone, exercise therapy alone, and exercise therapy with passive manual mobilization each reduce pain and disability in people with knee osteoarthritis: a systematic review. *J Physiother*. **2011**;57:11–20.
5. Silisteanu SC, Antonescu E, Totan M. Study on the importance of medical treatment and physical methods in recovering patients with knee osteoarthritis. *Balneo Research Journal.* **2019**;10(2): 90–97
6. Tang X, Wang S, Zhan S, Niu J, Tao K, Zhang Y, Lin J. The prevalence of symptomatic knee osteoarthritis in china: results from the china health and retirement longitudinal study. *Arthritis Rheumatol*. **2016**;68 (3):648–53.
7. World Health Organization. Global health and aging. In National Institute on Aging and National Institutes of Health 2011;1-32
8. Dong R, Wu Y, Xu S, Lei Zhang, Ying J, Jin H, Wang P, Xiao L and Tong P. Is aquatic exercise more effective than land-based exercise for knee osteoarthritis? *Medicine (Baltimore)*. **2018**;97(52): e13823.
9. Duica L, Szakács J, Silișteanu SC. Study on the correlation between knee osteoarthritis and anxiety in patients aged over 55. *Balneo Research Journal.* **2020**;11(1): 95–104
10. Hawker G, Gignac M, Badley E, Davis A, French M, Li Y, Perruccio A, Power J, Sale J, Lou W. A longitudinal study to explain the pain-depression link in older adults with osteoarthritis. *Arthritis Care Res. (Hoboken).* **2011**;63(10):1382–1390.
11. https://www.everydayhealth.com/osteoarthritis/osteoarthritis-research-news-you-can-use-from-eular-2022/
12. https://insp.gov.ro/wpfb-file/raport-starea-de-sanatate-2019-pdf/- Raportul national al starii de sanatate a populatiei, 2019.
13. Silişteanu SC, Antonescu E. The influence of the body weight index (BMI) in the recovery of the degenerative diseases of the joints. *Balneo Research Journal*. **2016**; 7(2): 66-71
14. Coudeyre E, Jegu AG, Giustanini M, Marrel JP, Edouard P, Pereira B. Isokinetic muscle strengthening for knee osteoarthritis: a systematic review of randomized controlled trials with meta-analysis. *Annals of Physical Rehabilitation Medicine.* **2016**;59 (3):207–15.
15. Li Y, Su Y, Chen S, et al. The effects of resistance exercise in patients with knee osteoarthritis: a systematic review and meta-analysis. *Clin Rehabil.* **2016**;30 (10) :947–59.
16. Brosseau L, Taki J, Desjardins B, et al. The Ottawa panel clinical practice guidelines for the management of knee osteoarthritis. Part three: aerobic exercise programs. *Clin Rehabil*. **2017**;31 (5) :612–24.
17. Brosseau L, Taki J, Desjardins B, et al. The Ottawa panel clinical practice guidelines for the management of knee osteoarthritis. Part two: strengthening exercise programs. *Clin Rehabil.* **2017**;31 (5):596–611.
18. Fransen M, McConnell S, Harmer AR, et al. Exercise for osteoarthritis of the knee: a Cochrane systematic review. *Br J Sports Med*. **2015;**49(24):1554–1554.
19. Gay C, Chabaud A, Guilley E, Coudeyre E. Educating patients about the benefits of physical activity and exercise for their hip and knee osteoarthritis. Systematic literature review. *Ann Phys Rehabil Med*. **2016**;59 (3):174–83.

20. Vizitiu E, Constantinescu M. Applications of physical activity before and during the COVID-19 pandemic for the elderly. Biomedical Engineering Applications for People with Disabilities and the Elderly in the COVID-19 Pandemic and Beyond. *Elsevier*. 2022;7:67-75
21. Bartels EM, Juhl CB, Christensen R, et al. Aquatic exercise for the treatment of knee and hip osteoarthritis. *Cochrane Database Syst Rev*. **2016**;3:CD005523.
22. Kim IS, Chung SH, Park YJ, Kang HY. The effectiveness of an aquarobic exercise program for patients with osteoarthritis. *Appl Nurs Res*. **2012**;25 (3):181–9.
23. Fitzgerald GK, Piva SR, Gil AB, Wisniewski SR, Oddis CV, Irrgang JJ. Agility and perturbation training techniques in exercise therapy for reducing pain and improving function in people with knee osteoarthritis: a randomized clinical trial. *Phys Ther*. **2011**;91(4):452–69.
24. Juhl C, Christensen R, Roos EM, Zhang W, Lund H. Impact of exercise type and dose on pain and disability in knee osteoarthritis: a systematic review and meta-regression analysis of randomized controlled trials. *Arthritis Rheumatol*. **2014**;66(3):622–36.
25. Skou ST, Roos EM, Laursen MB, et al. A randomized, controlled trial of total knee replacement. *N Engl Journal of Medicine*. **2015**;373(17):1597–606.
26. McAlindon TE, Bannuru RR, Sullivan MC, et al. OARSI guidelines for the non-surgical management of knee osteoarthritis. *Osteoarthritis Cartilage.* **2014**;22(3):363–88.
27. Ionescu V, Oprea C, Almasan ER, Stanciu LE, Iliescu MG. Biological variation under balneal treatment of serum level of leptin in relation with body mass index in case of patients suffering from knee osteoarthritis. *Journal of Environmental Protection and Ecology*. **2017**; 18(1): 375–385
28. G. Li, J. Yin, J. Gao, T.S. Cheng, N.J. Pavlos, C. Zhang, *et al.* Subchondral bone in osteoarthritis: insight into risk factors and microstructural changes. *Arthritis Res Ther*. **2013**;15 (6): 223
29. Silişteanu SC, Silişteanu AE.The importance of the nutrition and of the body weight index in the recovery of the patients older diagnosed with coxarthrosis. *Balneo Research Journal*. **2017**;8(1): 16-20
30. Constantinescu M, Vizitiu E. A comparative approach on the impact of diet and physical activity on young people between 19 and 26 years. *Balneo and PRM Research Journal*. **2021**;12(3):265–269
31. Silisteanu SC, Covasa M. Assisting the quality of life for old age persons (over 65 years old) with disabilities", Computational Intelligence for Multimedia Understanding (IWCIM). 2015 International Workshop, ISBN:978-1-4673-8457-5
32. Vizitiu E, Constantinescu M. Impact of physical activities on overweight people during the COVID-19 pandemic. Biomedical Engineering Applications for People with Disabilities and the Elderly in the COVID-19 Pandemic and Beyond. *Elsevier*. 2022; 27(313-324)
33. Totan M, Antonescu E, Duica L, et al. Study of a Standardized Plant Extract Used as an Anti-Inflammatory Drug to Reduce Joint Pain. *Rev. Chim*. **2020**;71(7):513-521
34. Traistariu R, Alexandru DO, Kamal D, Kamal KC, Rogoveanu OC, Postolache P. Boswellia Derivates and Rehabilitation Program in Knee Osteoarthritis Patients. *Rev.Chim*.(Bucharest). **2018**:69(11): 3205-3208
35. Silisteanu SC, Antonescu E, Szakaks, Totan M, et al. Study on change in some physiological parameters under the action of therapeutic ultrasound. *Rev.Chim*. **2017**:68(6):1306-1309
36. Silisteanu SC, Mitariu L, Ranga R, Antonescu E, Duica L, Racheriu M, et al. Potentiating the Effect of Treatment with Voltaren Gel Using Ultrasonic Frequencies of 1 MHz. *Rev.Chim* (Bucharest). **2018**;69(7): 1749-1751
37. Hochberg MC, Altman RD, Toupin AK, et al. American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care Res (Hoboken).* **2012**;64(4):465–74.
38. Fernandes L, Hagen KB, Bijlsma JWJ, et al. EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis. *Ann Rheum Dis*. **2013**;72(7): 1125–35.
39. Constantinescu M, Vizitiu E. Recovery activities for the locomotor system during the COVID-19 pandemic. Biomedical Engineering Applications for People with Disabilities and the Elderly in the COVID-19 Pandemic and Beyond. *Elsevier*. 2022; 8(77-83)
40. Chen L, Zheng JJY, Li G Yuan J, et al. Pathogenesis and clinical management of obesity-related knee osteoarthritis: Impact of mechanical loading-Review article. *Journal of Orthopaedic Translation*. **2020**;24:66-75
41. Odum SM, Springer BD, Dennos AC, Fehring TK. National obesity trends in total knee arthroplasty. *J Arthroplasty*. **2013**; 28(8 Suppl):148-151
42. Visser AW, R. de Mutsert, S. le Cessie, M. den Heijer, F.R. Rosendaal, M. Kloppnburg, et al. The relative contribution of mechanical stress and systemic processes in different types of osteoarthritis: the NEO study. *Ann Rheum Dis*. **2015**;74(10):1842-1847
43. Felson DT. Osteoarthritis as a disease of mechanics. *Osteoarthritis Cartilage*. **2013**;21(1):10-15
44. Chen L, Yao F, Wang T, Li G, Chen P, Bulsara M, et al. Horizontal fissuring at the osteochondral interface: a novel and unique pathological feature in patients with obesity-related osteoarthritis. *Ann Rheum Dis*. **2020**:79(6):811-818

45. Practitioners RACoG. Guideline for the management of knee and hip osteoarthritis. (2nd ed.) (2018). Available at: https://www.racgp.org.au/download/Documents/ Guidelines/ Musculo-skeletal/guideline-for-the-management-of-knee-and-hip-oa-2nd-edition.pdf, Accessed 22nd Nov 2022
46. van Caam A, Thijssen E, van der Kraan PM. Obesity and osteoarthritis, more than just wear and tear: pivotal roles for inflamed adipose tissue and dyslipidaemia in obesity-induced osteoarthritis. *Rheumatology*. **2014**;54(4):588-600