

Effectiveness of Home based Exercises in Alleviation of Symptoms Among Patients with osteoarthritis of Knee Joint in an Urban Primary Care Setting in Trivandrum, Kerala

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ABSTRACT

Introduction: An estimated 3.8% of world population suffer from Osteoarthritis of the knee joint. It is a progressive degenerative disease seriously impeding the quality of life due to pain and decreased mobility. The purpose of this research was to verify the effectiveness of 6 months isometric quadriceps, hamstring strengthening exercises on pain, function and joint stiffness of patients with knee osteoarthritis.

Material and methods: It was an intervention study (pre/post-test study) among 60 patients from OPD, Physical Medicine and Rehabilitation Unit, Urban Health Centre, Pangappara with Osteoarthritis knee done for a period of 6 months. Outcome measure was improvement in WOMAC Score (pain, physical function and knee joint stiffness). WOMAC score before and after intervention were compared.

Results: WOMAC score showed a significant difference between before and after the intervention showing effectiveness of exercises.

Conclusion: The 6 months isometric quadriceps exercise showed beneficial effects on Quadriceps muscle strengthening, pain and functional disability.

Keywords: Osteoarthritis, Knee Joint, Isometric Exercises, WOMAC Score, Home Based Exercise.

INTRODUCTION

It is estimated that approximately 3.8% of the world's population¹ can't run or can't walk with ease due to osteoarthritis (OA) of the knee joint. OA is the most common type of arthritis found worldwide especially in the elderly life.^{2,3} The prevalence of OA is similar across the globe and it is expected to increase dramatically as the population ages, especially in low and-middle income countries. OA of knee is a condition that can seriously affect the quality of life.^{4,5,6} OA mostly affects people in early middle age and women constitute the majority. An estimated 10% to 15% of all adults aged over 60 have some degree of OA, with prevalence higher among women than men.⁷ Osteoarthritis can be acute or chronic in nature. It can be progressive in nature and can serve as an impediment to once routine activities. The treatment of OA involves: treating associated pain; viscosupplementation with intra-articular hyaluronate injections; intra-articular corticosteroid injections; joint replacement surgery; and, in rare circumstances, autologous chondrocyte implantation into the damaged areas.⁸⁻¹⁰

Non pharmacological treatment approaches to Osteoarthritis are Exercise, weight control and non drug pain relief techniques. Three major physical impairments, such as knee

pain, stiffness, and decreased quadriceps strength, are highly associated with a knee OA and are believed to contribute to physical disability and progression of the disease.¹¹⁻¹³ As the quadriceps muscle plays the role of shock absorber, a weakness of this muscle decreases the joint protection resulting in greater stress and overload on the knee.¹⁴ Quadriceps strengthening exercises performed over eight weeks proved effective in function improvement as the use of non-hormonal anti-inflammatory drugs in patients with OA of the knee moderate-intensity exercises showed themselves to be a good form of treatment not only for the improvement of symptom in the increase of the glycosaminoglycan content.¹¹ The Osteoarthritis Research Society International (OARSI) recommended non pharmacological methods including patient education programs, weight reduction, coping strategies, and exercise programs for treatment of knee OA.¹⁵ Isometric exercise is the most appropriate and easy to understand by the patients and can be easily and safely performed at home because it requires no or minimal apparatus.¹⁶

Exercise is also inexpensive and, if done correctly, has few negative side effects. Implementing regular home based exercise can help alleviate the symptoms and prevent progression of osteoarthritis.¹⁷ In this study we tried to evaluate the effectiveness of a home based exercise programme in alleviating pain of osteoarthritis patients attending Physical Medicine and Rehabilitation out Patient Department of Pangappara, Urban Health Training Centre of Medical College Thiruvananthapuram, Kerala, India

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MATERIAL AND METHODS

The Intervention Study (Pre/Post Test) was conducted in the Physical Medicine and Rehabilitation clinic, Urban Health Training Centre, Pangappara, Thiruvananthapuram.¹⁸ The study subjects were previously diagnosed patients with osteoarthritis knee joint attending the clinic who consented to participate in the study. Those with CHD/stroke, other chronic debilitating diseases and those with severe knee pain who were unable to do these exercises were excluded. The study was carried out during May to November 2017.

Sample size was calculated using nMaster software using mean and SD of VAS/WOMAC Scoring using pre test and post-test, mean and SD of 9.63(1.28) and 11.93 (1.86)¹⁹ with α error 0.1% and β error 99%, to get a sample size of 30, but all willing patients (total 60 patients) attending the clinic during the recruitment of participants were included in the study.

The baseline status of symptoms of people suffering from osteoarthritis were recorded using semi-structured questionnaire. The WOMAC Score (The Western Ontario and McMaster Universities Osteoarthritis Index) was used for assessing functional ability for osteoarthritis knee patients before and after 6 months of home based exercise. The latest version of the instrument (WOMAC[®] 3.1) is available in over 100 alternate language forms, The WOMAC[®] 3.1 has been linguistically validated and is widely used in the evaluation of knee and hip osteoarthritis.

Isometric Quadriceps Hamstring Exercise: Isometric Quadriceps Hamstring Exercises are done to strengthen the muscles around the knee joint. The patients were instructed to perform the exercise only in the presence of their care giver. Collected data were entered in an excel sheet. Quantitative variables were expressed in terms of mean and SD and qualitative variables were expressed as proportions. Statistical significance was assessed by Wilcoxon Sign Rank Test. SPSS trial version 16 was used for analysis.

RESULTS

The study included 60 patients from Pangappara Urban Health Center area whose age, occupation, duration of OA, medications taken etc were noted. Subjects were given training and performed home based isometric exercise for six months and their WOMAC Scores before and after were measured to assess clinical improvement.

1. Socio demographic profile of study participants.

1.A. Age of the study participants

The mean age of the population was 51.13, with a Standard Deviation of 8.114. Minimum age was 34 years and maximum age was 68 years. Out of the 60 patients, 36 patients were aged above 50 years.

1.B. Gender of Participants (N=60)

Out of 60 study participants with OA Knee joint, 32 (53.3%) were males and 28 (46.7%) were females. (Table.1)

1. C. Educational status of the study participants (N=60)

Out of total patients 32(53.3 %) had only primary education (up to fourth standard), while 10(16.7%) had studied up to

the middle class (eighth standard), remaining 8(13.3%) had studied up to high school, rest 10(16.7%) were graduates. (Table.1)

1.D. Occupational status of study participants (N=60):

Among the participants 42(70%) were unskilled workers including house wives while 16(26.7%) were skilled workers like carpenters, mechanics, technicians etc. Remaining 2(3.3%) were in clerical/government job. (Table.1)

2. Comorbidity profile of study participants.

2. A. Hypertension Status of Study Participants (N=60)

Among the participants 34 (56.7%) were hypertensive while 26(43.3%) were non hypertensive. (Table.2)

2. B. Diabetes status of study participants (N=60):

Among the participants 14(23%) were diabetic and rest 46(76.7%) were non diabetic. (Table.2)

2.C. BMI category of study participants (N=60)

Obesity is an important risk factor for developing Osteoarthritis knee joint.²¹ In this study 40(66.67%) subjects were overweight and obese, 16(26.67%) were with normal BMI, 4(6.67%) were underweight. (Table.2)

3. Profile of Osteoarthritis among study participants

3.A. Knee joint affected by osteoarthritis (N=60):

Among the patients with Osteoarthritis knee joint, 30 (50 %) presented with osteoarthritis of right knee, while 14(23.3 %) presented with Osteoarthritis of left knee and 16(26.7%) had bilateral involvement. (Table.3)

3.B. Proportion of patients with Other Joint Involvement (N=60)

Among the study participants 50(83.3%) had other joint involvement along with knee joint. 42(70 %) of the study participants had poly articular involvement, affecting many joints²⁰ like spine, elbow, ankle etc, while 6(10 %) participants had only elbow involvement and 2(3.3 %) had involvement of the spine. 10(16.7 %) patients had only knee joint involvement. (Table.3)

3.C. Duration of pain in Knee joint Osteoarthritis (N=60):

46(76 %) patients were suffering from pain due to Osteoarthritis knee joint for more than one year, and the remaining 14(23%) were having pain for less than one year. (Table.3)

3.D. Frequency of hospital visit by the patients with OA Knee joint before the intervention (N=60):

83.3% of the patients had taken intermittent treatment before participating in the study. They had been seeking medical care for osteoarthritis knee joint at a frequency less than one visit per six months at any health facility. But 16.7% sought care at a frequency of one visit per month. Before the beginning of the study all of them were instructed to visit the Physical Medicine and Rehabilitation OPD regularly, that is one visit per month.

3.E. Patient Satisfaction with the treatment received before intervention (N=60)

46(76.7%) patients were satisfied by the current treatment

that they were receiving from the Urban Health Centre Pangappara, but 14 (23.3%) were not satisfied with the current treatment. (Table.3)

3.F. Ability of Study Participants to do daily Routine Activities
52(86.7%) of the study participants were able to perform daily routine activities like, walking, taking bath and using

rest rooms by themselves. 8(13.3%) participants couldn't perform daily routine activities without the help of others. (Table.3)

4. WOMAC Score Before and After The Exercise Programme.

In WOMAC Score the patients with higher scores would

Factors	Category	Frequency	Percentage
Gender	Male	32	53.3
	Female	28	46.7
Educational status	Primary	32	53.3
	Middle	10	16.7
	High school	8	13.3
	Graduate	10	16.7
Occupational Status	Unskilled	42	70
	Skilled	16	26.7
	Govt.job/ Clerical	2	3.3

Table-1: Socio-Demographic profile of the study participants (n=60)

Factors	Category	Frequency	Percentage
Hypertension	Yes	34	56.7
	No	26	43.3
Diabetes Mellitus Status	Present	14	23.0
	Absent	46	76.7
BMI	Underweight	4	6.67
	Normal	16	26.67
	Overweight	12	20.0
	Obese	28	46.67

Table-2: Comorbidity profile of study participants

Factors	Category	Frequency	Percentage
Knee Joint involvement	Left	14	23.3
	Right	30	50
	Bilateral	16	26.7
Involvement of other joints	Polyarticular	42	70
	Elbow joint	6	10
	Spine	2	3.3
	No other joint involved	10	16.7
Duration of Pain	More than 1 year	46	76
	Less than 1 year	14	23
Patient Satisfaction with the current treatment	Satisfied	46	76.7
	Not satisfied	14	23.3
Activities of Daily Living	Able to perform	52	86.7
	Not able to perform	8	13.3

Table-3: Profile of Osteoarthritis among study participants

Scores	Pre Intervention	Post Intervention
Mean (SD)	66.3(8.6)	50.7(4)
Median (IQR)	60(58,75)	50(50, 50)
Range	58-80	45-60

Table-4: WOMAC score pre and post intervention

Scores	WOMAC score before intervention	WOMAC score after Intervention	P value
Mean (SD)	66.3(8.6)	50.7(4)	<0.001
Median (IQR)	60(58,75)	50(50, 50)	

Table-5: Effectiveness of exercise programme- Wilcoxon Sign Rank Test

have maximum pain and lower the score the lesser will be the pain. In this study mean WOMAC score before the home based exercise programme was 66.3 (SD:8.676), Minimum value was 58 and the maximum score was 80. In this study WOMAC Score of patients reduced after 6 months exercise programme .The mean WOMAC score after the exercise programme was 50.67(SD: 4), minimum score was 45 and the maximum score was 60.(Table.4)

5. Effectiveness of exercise programme

Wilcoxon Sign Rank Test was used to compare the WOMAC Score before and after the 6 month home based exercise intervention programme,

Wilcoxon Signed Rank Test indicated that WOMAC score was significantly lower after the 6 month home based intervention; $Z= 4.643$; p value <0.001 (Table.5)

DISCUSSION

In this study 60 patients were recruited from the Physical Medicine And Rehabilitation OPD of urban health centre Pangappara and they were given training of home based isometric Quadriceps Hamstring exercises. At the end of the six months it was found that there was remarkable symptomatic improvement in the participants. According to the World Health Organization report on burden of disease.¹⁴ Knee OA is one of the most important causes of disability in men and women. The Osteoarthritis Research Society International (OARSI) recommended non pharmacological interventions like patient education programmes, weight reduction, coping strategies, and exercise programs for treatment of knee OA.¹⁵ "Isometric exercises" are simple and inexpensive to perform and they rapidly improve strength^{22,23} without any side effects.

In the present study the mean age of the patients with osteoarthritis knee joint was 51 years with a maximum of 68 years and a minimum of 34 years. About 36 patients in our study had age above 50 years. Indian Society of Hip and Knee Surgeons (ISHKS) has established a joints registry which reports the average age of Osteoarthritis as 64.4 years with a range of 45 to 88 years.²⁴ In a cross sectional study carried out in patients attending the orthopaedics outpatient department of Medical College Hospital in Thiruvananthapuram, Kerala, India in 2010 by Anu Anna George et al, the median age of the patients was found to be 55.5 years and 65% were above 50 years.²⁵ mean age of 52.21 years (57.32 in males and 51.33 in females) among osteoarthritis patients was noted in a study carried out in the Outpatient Department and Lifestyle Disease Management Clinic, Department of Physical Medicine and Rehabilitation, Government Medical College, Kozhikode, Kerala, India by Anit Antony et al²⁶ In the above mentioned studies conducted in Kerala, like in our study, the mean age of patients with osteoarthritis was found to be lesser than national average.

Out of 60 study participants with OA Knee joint, 32 (53.3%) were male patients and 28 (46.7%) were females (Table.1). In many studies it was seen that women were more affected and burdened by osteoarthritis of the knee than men.⁸⁻¹¹ The results of a meta-analysis of sex differences in OA prevalence,

incidence and severity by Sreekanth V K et al, demonstrated the presence of sex differences in OA prevalence and incidence, with females generally at a higher risk. Females also tend to have more severe knee OA, particularly after menopausal age.²⁷ In the present study, proportion of females were less because of the smaller sample size to estimate the proportion.

Kerala is the diabetes capital of India with a prevalence of diabetes as high as 20% — double the national average of 8%.⁴² Progression to pre-diabetes and diabetes occurred at a very fast rate in Kerala population.²⁸ The proportion of diabetes in patients in this study is 23.3 % (Table.2) which was comparable to general population. There are evidences of association between OA and diabetes or increased blood glucose.^{29,30} In a prospective study, Nüesch et al. showed that OA subjects are at increased risk for mortality due to diabetes, cardiovascular disease, and cancer.³¹

Yi-min Zhang et al. in a meta-analysis with eight studies including 2 cohort studies and 6 cross-sectional studies with 9762 participants showed that hypertension was significantly associated with higher radiographic knee OA and symptomatic knee OA risks.³² In the present study, 56% were hypertensive. (Table.2)

In this study 24 % of the patients had experienced pain of osteoarthritis within a year, which restricted their routine activities. Peat et al in their narrative review published in 2001 stated that during one year period, 25% of people over 55 years may demonstrate persistent episode of knee pain.⁴⁸ This is consistent with the finding of the present study.

83% of the patients enrolled in the study were on irregular treatment before participating. They had been seeking medical care for osteoarthritis knee joint at frequency less than one visit per month at any health facility.

Majority of the study participants (86.7%) were able to perform daily routine activities without the help of others. But 13.3% needed help from care givers to perform daily routine activities (Table.3). According to Peat et al about 10% of people aged over 55 years have painful disabling knee OA of whom one quarter are severely disabled.³³

Osteoarthritis commonly affects large weight-bearing joints, such as the hips and knees and the joints of hands, feet, spine.³⁴ In the current study, 6(10%) participants had hand involvement and 2(3.3 %) had involvement of the spine ;10(16.7%) had only knee joint involvement and 42(70 %) had poly articular involvement, that is more than four joint involvement (Table.3). In a cross sectional study conducted by Amanda E. Nelson et al it was noticed that 13% had hand involvement, 25% knee, 11% hip, and 28% had Lower spine involvement.³⁵

WOMAC score showed a significant difference before and after training showing effectiveness of home based isometric quadriceps hamstring exercises. Males had a more significant difference in score compared to females showing more improvement. Osteoarthritis impairs strength of knee muscles, increases pain and stiffness around knee joint and all of them need to be treated to reduce sufferings from osteoarthritis knee. The present study showed a significant

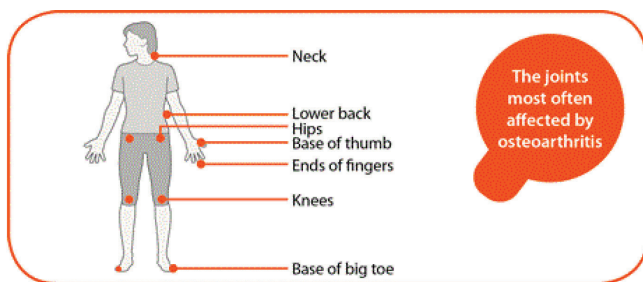


Figure-1: Pictorial representation of joints affected by osteoarthritis (Courtesy-Arthritis Research UK)

decrease in WOMAC Score, 6 months after training showing an improvement in pain, stiffness and muscle strength of knee joint. 16.0% reduction in WOMAC score was observed in a study conducted by Ihsane Hmamouchi et al.³⁶

The results of the present study showed that home based isometric quadriceps exercise programme brought about a significant reduction in knee pain and improvement in function in 6 months. The significant reduction in pain and improvement in function in the study participants may be attributed to improved quadriceps power and hence improved stability of the knee joint. In a randomized control trial conducted by Shyam D, Ganvir et al in Maharashtra, in between groups the experimental group had significant reduction in pain and improvement of knee function after a 5 week isometric exercise programme than the control group.¹⁹ Another study done by Boon Whatt Lim, et al. concluded that quadriceps strengthening exercise had beneficial effect on function of knee joint.³⁷ The study done by Shreyasee Amin et al. reported that subjects having stronger quadriceps strength had less knee pain and better physical function. Strong muscles stabilize the joints in a proper alignment, attenuate shocks that are transmitted to the joints and minimize the effect of impact by spreading the forces out over a greater area so it may be hypothesized that improvement in muscle strength is one of the main causes of reduced pain and disability.²² The Fitness Arthritis and Seniors Trial reported a modest 8% to 10% improvement in pain and functioning scores as a result of 18 months of aerobic or resistance exercise among their sample of knee OA patients.³⁸ Further Deyle et al³⁹, Falconer et al.⁴⁰ and Fisher et al.¹³ found the same positive effects of exercise programs on pain and function. It is well documented in the literature that impaired quadriceps strength has been found to be the greatest single predictor of lower limb function limitation.⁴¹ This study showed that by doing home based Isometric quadriceps hamstring exercise in a daily and systematic way under the supervision of their caregiver for a period of six months, can bring down sufferings of the patients with osteoarthritis in a cost effective way.

CONCLUSION

As the quadriceps muscle plays the role of shock absorber, weakness of this muscle decreases the joint protection resulting in greater stress and overload on the knee. Quadriceps strengthening exercises proved effective in functional improvement of knee joint.

The mean age of the population was 51.13(8.114). Obesity is an important risk factor for developing Osteoarthritis knee joint.¹² In this study 46% of the Osteoarthritis knee patients were pre-obese and obese warranting a need to reduce the BMI to improve the pain.

This study showed that by performing home based Isometric quadriceps hamstring exercise in a daily and systematic way under the supervision of their caregiver for a period of six months, could improve the function and strength of the knee joint of the patients with osteoarthritis in a cost effective way.

REFERENCES

1. Sancheti P, Shetty VD, Dhillon MS, Sprague SA, Bhandari M. India-Based Knee Osteoarthritis Evaluation (iKare): A Multi-Centre Cross-Sectional Study on the Management of Knee Pain and Early Osteoarthritis in India. *Clin Orthop Surg.* 2017;9:286–94.
2. Brandt KD. Non-surgical management of osteoarthritis with an emphasis on non-pharmacological measures. *Arch Fam Med.* 1995;4:1057-64.
3. Hurley MV, Scott DL, Rees J. Sensorimotor changes and functional performance in patients with knee osteoarthritis. *Ann Rheu.* 1997; 56: 641–648.
4. Population Foundation of India; Population Reference Bureau. The future population of India: a long-range demographic view.
5. Das SK, Farooqi A. Osteoarthritis. *Best Pract Res Clin Rheumatol.* 2008; 22:657-75.
6. Brooks PM. Impact of osteoarthritis on individuals and society: How much disability? Social consequences and health economic implications. *Curr Opin Rheumatol.* 2002; 14:573-7.
7. WHO Department of Chronic Diseases and Health Promotion. Available at: <http://www.who.int/chp/topics/rheumatic/en/>.
8. Blagojevic M, Jinks C, Jeffery A, Jordan KP. Risk factors for onset of osteoarthritis of the knee in older adults: a systematic review and meta-analysis. *Osteoarthritis Cartilage.* 2010; 18:24-33.
9. Hunter DJ, Felson D.T. Osteoarthritis: clinical review. *BMJ* 2006, 332:639–42.
10. Bellamy N et al. Intra-articular corticosteroid for treatment of osteoarthritis of the knee. *Cochrane Database of Syst Rev.* 2006;2:CD005328.
11. Felson DT, Naimark A, Anderson JJ, KazisL, Castelli W, The prevalence of knee osteoarthritis in the elderly: The Framingham osteoarthritis study. *Arthritis Rheum.* 1987;30:914-8.
12. Tornvall G. Assessment of physical capabilities with special reference to the evaluation of maximum voluntary isometric muscle strength and maximal working capacity'.
13. Fisher NM, Gresham G, Prendergast DR. Effects of a quantitative progressive rehabilitation program applied unilaterally to the osteoarthritic knee. *Arch Phys Med Rehabil.* 1993; 74:1319-26
14. Slemenda C, Brandt KD, Heilman DK, et al. Quadriceps weakness and osteoarthritis of the knee. *Ann Intern Med.* 1997; 127:97-104.
15. Rosa UH, VelásquezTlapanco J, LaraMaya C, et

- al. Comparison of the effectiveness of isokinetic vs isometric therapeutic exercise in patients with osteoarthritis knee. *Reumatol Clin.* 2012; 8(1):10-4.
16. Sharma MK, Swami HM, Bhatia V, et al. An epidemiological study of correlates of osteoarthritis in geriatric population of UT Chandigarh. *Indian journal of Community Medicine.* 2007;32:77-78
 17. Snapshot [Internet]. [cited 2018 Mar 25]. Available from: <https://www.medicinenet.com/script/main/art.asp?articlekey=90187#treatment>
 18. Community Medicine | Medical College - Trivandrum [Internet]. [cited 2018 Apr 3]. Available from: <https://tmc.kerala.gov.in/?q=departments/community-medicine>
 19. Ansari N. An intervention study on the effectiveness of isometric quadriceps hamstrings exercise in the treatment of osteoarthritis, knee joint. *International Journal of Orthopaedics Sciences* 2018; 4:1010-1014
 20. Polyarticular Medical Definition | Merriam-Webster Medical Dictionary [Internet]. [cited 2018 Apr 5]. Available from: <https://www.merriam-webster.com/medical/polyarticular>
 21. United Nations. World Population to 2300. Available at: <http://www.un.org/esa/population/publications/.../WorldPop2300fi>.
 22. Amin S, Baker K, Niu J, et al. Quadriceps strength and the risk of cartilage loss and symptom progression in knee osteoarthritis. *Arthritis Rheum.* 2009 Jan;60(1):189-98
 23. Hurley MV, Scott DL. Improvements in quadriceps sensorimotor function and disability of patients with knee osteoarthritis following a clinically practicable exercise programme. *Br J Rheumatol.* 1998; 37:1181-7.
 24. Pachore JA, Vaidya SV, Thakkar CJ, Bhalodia HKP, Wakankar HM. ISHKS joint registry: A preliminary report. *Indian J Orthop.* 2013; 47(5):505-9.
 25. George AA, Anoop S, Jayan A, Nujum ZT. Obesity and Severity of Osteoarthritis. *Academic Medical Journal of India.* 2014; 2:52-5.
 26. Abdel-Moaty Ali Afifi et al. Osteoarthritis of the Knee Joint in Metabolic Syndrome. *Clin Rheumatol.* 2018 ; 37:2855-2861
 27. Srikanth VK, Fryer JL, Zhai G, Winzenberg TM, Hosmer D, Jones G. A meta-analysis of sex differences prevalence, incidence and severity of osteoarthritis. *Osteoarthritis Cartilage.* 2005; 13:769-81.
 28. Thankappan KR, Mini GK, Sarma PS, Varma RP. Incidence of type-2 diabetes among industrial Workers in Kerala, India. *Int J Diabetes in Developing Countries.* 2017; 37:280-5.
 29. Rahman MM, Cibere J, Anis AH, Goldsmith CH, Kopec JA. Risk of Type 2 Diabetes among Osteoarthritis Patients in a Prospective Longitudinal Study [Internet]. *International Journal of Rheumatology.* 2014 [cited 2018 Apr 6].
 30. D. J. Hart, D. V. Doyle, and T. D. Spector. Association between metabolic factors and knee osteoarthritis in women: the Chingford Study. *J Rheumatol.* 1995; 22:1118-23
 31. E. Nüesch, P. Dieppe, S. Reichenbach, S. Williams, S. Iff, and P. Jüni. All cause and disease specific mortality in patients with knee or hip osteoarthritis: Population based cohort study. *BMJ.* 2011; 342:d1165.
 32. Zhang W, Ouyang H, Dass CR, Xu J. Current research on pharmacologic and regenerative therapies for osteoarthritis. *Bone Res.* 2016;4:15040.
 33. Peat G, McCarney R, Croft P. Knee pain and osteoarthritis in older adults: a review of community burden and current use of primary health care. *Ann Rheum Dis.* 2001; 60: 91-97.
 34. DiCesare PE, Abramson SB. Pathogenesis of osteoarthritis.
 35. Nelson AE, Golightly YM, Renner JB, Schwartz TA, Kraus VB, Helmick CG, et al. Differences in Multi-joint Symptomatic Osteoarthritis Phenotypes by Race and Gender: The Johnston County Osteoarthritis Project. *Arthritis Rheum.* 2013; 65:373-7.
 36. Hmamouchi I, Allali F, Tahiri L, Khazzani H, Mansouri LE, Ali Ou Alla S, et al. Clinically important improvement in the WOMAC and predictor factors for response to non-specific non-steroidal anti-inflammatory drugs in osteoarthritic patients: a prospective study. *BMC Res Notes.* 2012; 5:58.
 37. Lim BW, Hinman RS, Wrigley TV, et al.: Does knee malalignment mediate the effects of quadriceps strengthening on knee adduction moment pain and function in medial knee osteoarthritis? A Randomized Controlled Trial. *Arthritis Rheum.* 2008;59:943-51.
 38. Ettinger WH, Jr, Burns R, Messier SP, et al.: A randomized trial comparing aerobic exercise and resistance exercise with a health education programme in older adults with knee osteoarthritis. The Fitness Arthritis and Seniors Trial (FAST). *JAMA.* 1997; 277:25-31.
 39. Deyle GD, Henderson NE, Matekel RL, et al.: Effectiveness of manual physical therapy and exercise in osteoarthritis of the knee. A Randomized Controlled Trial. *Ann Intern Med* 2000; 132:173-81
 40. Falconer J, Hayes KW, Chang RW: Effect of ultrasound on mobility in osteoarthritis of the knee. A randomized clinical trial. *Arthritis Care Res.* 1992; 5:29-35.
 41. McAlindon TE, Cooper C, Kirwan JR, et al. Determinants of disability in osteoarthritis of the knee. *Ann Rheum Dis.* 1993; 52:258-62.

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