



www.aassjournal.com

ISSN (Online): 2322 – 4479

ISSN (Print): 2476–4981

Original Article

www.AESAsport.com

Received: 18/11/2015

Accepted: 08/05/2016

Comparing Levels of Depression in Healthy Active and Inactive Elders versus Those with Knee Osteoarthritis Disease

¹Amir Shams, ²Samaneh Poor Hadi, ³Robab Sahaf*

¹Sport Sciences Research Institute of Iran (SSRI), Tehran, Iran. ²Iranian Research Center on Aging, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran. ³Iranian Research Center on Aging, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.

ABSTRACT

Knee osteoarthritis can have negative effects on the physical and mental conditions, social and family relations, general health and positive feelings of elders. For example, severe limitation of motion and increased depression, which are results of this disease, can have negative impacts on elders. The purpose of this study was to compare the levels of depression in healthy active and inactive elders versus those with knee osteoarthritis disease. Two hundred and twenty (220) elders with knee osteoarthritis disease (110 active and 110 inactive patients) and 220 healthy elders (110 active and 110 inactive) were voluntarily selected, and they filled the questionnaire about elders' personal characteristics, physical activity and depression levels. Four groups had differences with respect to education, age and gender. The results of chi-square test revealed that women with knee osteoarthritis disease had increased levels of depression compared to men with the same condition ($p < 0.05$). Older patients had increased levels of depression and educated elders reported lower levels of depression. The results of the one way analysis of variance (ANOVA) revealed that there exist a significant difference in depression scores of healthy active and healthy inactive elders and those with knee osteoarthritis disease. The results of Tukey's test revealed that healthy active elder had lower depression scores compared to inactive elders with knee osteoarthritis disease. Carrying out exercises and physical activities can help improve the health state of patients with knee osteoarthritis problem and can also improve the elders' mental condition and thus decrease their pain and depression.

KEY WORDS: *Physical Activity, Elderly Patients, Pain, Osteoarthritis.*

INTRODUCTION

Osteoarthritis is a collection of clinical symptoms. This disease affects not only the joint cartilage but also all parts of the knee joint which include the bone tissue that underlies the knee cartilage, ligaments, capsules, synovial membrane and the muscles around the knee (1, 2). Researchers believe that knee osteoarthritis is the most common disease of the synovial joints,

and it is the most important cause of elders' disability. The disease is defined with progressive destruction of the knee cartilage and it commonly occurs in women before the age of 45 and in men before the age of 55. The outbreak of this disease increases with aging in both sexes (3, 4). Findings show that age is the most critical factor responsible for this disease.

*. Corresponding Author:

Robab Sahaf

E-mail: Robabsahaf@gmail.com

Severe pain is the main symptom of knee osteoarthritis (4-6). Other symptoms include morning stiffness that lasts for about 30 min. The disabilities in most of the patients result from the pain and morning stiffness. The pathophysiological deficiencies of the disease are weakness, muscles' atrophy of knee, especially quadriceps femoris muscle, joint instability and limited movement (7).

Weakness in elders due to knee osteoarthritis has important effect on their movement, independency and daily activities, and results in social isolation and limited recreational, sport and career activities and decrease in income. However, the main purpose of policymakers is to increase the independency of the elders in both physiological and daily physical activities, hope of life, and quality of living and also to improve their mental health. Unfortunately, nowadays most people separate the physical and mental health of the elders, but findings indicate that physical and mental needs are interrelated and have effect on each other during lifetime (8).

Many findings have revealed that with ageing, chronic diseases (for example osteoarthritis) increase while the physical health decreases. Also, issues concerning the mental health of the elders are becoming less important (9, 10). Depression is one of the mental disorders that have been observed to be on the increase in elders with knee osteoarthritis, and it is a sign of the disease recrudescence (11-13). Depression is a mental disorder that is comprised of feelings of despair, discomfort, distress, lack of hope and motivation, decrease of self- confidence and pessimism (14, 15).

Reduction of physical activity and social relations, bad temperament, low concentration and less mental health are symptoms of depression in ages above 65 (16). According to Bergh *et al.* (2003), Ettinger *et al.* (1997) and Unutzer *et al.* (2008), the feelings loneliness, social isolation and chronic pains resulting from arthritis are main factors of elders' depression (11, 17, 18). Findings have shown that depression is higher in osteoarthritis patients than the public population (18, 19). According to Axford *et al.* (2008) and Scopaz *et al.* (2009), alteration in patients functions results in mood swing and emergence of depression symptoms (3, 20). In patients with osteoarthritis disease,

there is a linear relationship between depression, depression symptoms, functional disorder and weaker physical and pathological conditions (14, 16, 18, 21).

According to Yohannes and Caton (2010) and Kim *et al.* (2011), osteoarthritis patients who suffer from depression express the pain more compared to normal patients (22, 23), which result in more weakness in carrying out normal chores. Bergh *et al.* (2003) believe that the more the pain is in osteoarthritis patients, the more their depression level which result in a reduction in their quality life (11). Researchers believe that patients with chronic pains usually suffer from depression, family relationship disorders, sleep disorders and decrease in physical and psychological functions (10, 14). According to Unutzer *et al.* (2008), significant parts of the population with chronic pain suffer from stress, incompatibility, social and family stresses (18). According to Murphy *et al.* (2008) and Ettinger *et al.* (1997), pain relief in knee osteoarthritis patients result in a decrease in the physical problems and depression, thus improving their vitality (17, 24).

Sometimes, joint stiffness and progressive movement disorders attain a level that some of patients experience mobility loss and become crippled. As a result, movement disorders in patients cause many problems in their physical and psychological state and the social and economic condition of the society at large (18). The treatment of osteoarthritis is soothing, and the main purpose is pain relief and prevention of mental disorders (9).

Jordan *et al.* (2003) in a research mentioned ten useful points about osteoarthritis disease; the first point is the use of no pharmaceutical therapy to reduce the pain in the patient (25). Most scientific resources consider patients' pain relief as the first aim of the treatment. Because of the age of the patient, the use of pharmacological methods is seriously dangerous (13). Recent finding indicates that engaging in exercises and physical activities helps improve the strength in joints movement and the muscles involved in movement (8, 26).

As a result, engaging in sport is one of the favorite therapies of doctors for patients. Frequently engaging in sport and improving the physical strength, increasing the range of

movement and the strength of the knee joints and muscles, can reduce the intensity of pain, the feeling of fatigue, morning stiffness, stress and depression in patients with osteoarthritis disease, and thus improve their self-confidence (27-29). According to Taylor *et al.* (2004) and Iwamoto *et al.* (2011), engaging in physical activity can improve the quality of life, self-confidence and psychological state of osteoarthritis patients. Therefore, higher psychological health results in less complain about the pain accompanying osteoarthritis (26, 30).

However, Minor *et al.* (1989) concluded that engaging sport has no effect on relieving the pain felt by patients with osteoarthritis but the pain increases after engaging in physical activity and reduces after rest (31). Barrett and Smerdely (2002), Dreher *et al.* (2008) and Salmon (2001) did not find any significant relationship between physical activity and depression (32-34). Moreover, Lawlor and Hopker (2001) after examining fourteen researches concluded that there exist no significant relationship between physical activity and depression (35). The conduction of more researches in this field is inevitable in as much as different researches regarding the role of physical activity in relieving the pain in osteoarthritis patients have different results, and also considering the special characteristics of old age and the effects of physical activity and sport on elders with this disease, who are more vulnerable compared to healthy elders.

By taking into account the researches that have shown that engaging in physical activity and sport can reduce the pain and depression in patients, the purpose of this research was to compare the levels of depression in healthy active and inactive elders versus those with knee osteoarthritis disease, in order to answer the question of whether physical activity can reduce the pain and depression felt by osteoarthritis patients.

MATERIALS AND METHODS

This research is an ex-post facto research which aims to compare the amount of depression between active and inactive elders who are healthy or suffer from knee osteoarthritis.

Participants. The sample included 440 elders (220 healthy active and inactive elders and 220

active and inactive elders with osteoarthritis disease) with age-range of 60-80 years-old, who were selected voluntarily. The absence of osteoarthritis was detected based on the clinical and observational methods according to specialist doctors. The research environments were parks, public space, hospitals and Rheumatology Departments of Loghman, Labafinejad, Taleghani and Emam Hossein hospitals (for active and inactive patients with osteoarthritis disease).

Data Collection. The inclusion criteria for elders with osteoarthritis diseases consisted of (a) age between 60 to 80 years, (b) a medical specialist must verify their osteoarthritis disease, (c) Over a year of their disease diagnosis, and the absence of any chronic disease like cancer, multiple sclerosis, asthma, renal failure, heart failure, diabetes, and neurologic disease like cerebral palsy and Parkinson before contacting osteoarthritis diseases. For active healthy elders, the inclusion criteria consisted of (a) age between 60 to 80 years, (b) engaging in regular physical activity, (c) ability to stand up without assistive devices, (d) not having the history of falling and fracture of lower limb in previous two years, (e) not having limitation of movement in sacroiliac joint, knee, ankle and not taking anticonvulsants and psychedelic drugs. Data collection tool were questionnaires. First, a demographic questionnaire was used which included personal characteristics like height, weight, gender, history of disease, taking painkillers by elders and their educational level.

The standardized Geriatric Depression Scale was used and verified for diagnosis and assessment of elders' depression (36, 37). Malakouti *et al.* (2006) standardized and translated the tool in Persian and recognize it as a useful tool with a favorable reliability and validity for Iranian population (38). Cronbach's alpha coefficient of the scale used was 0.9, retest coefficient was 0.58, and reliability by factor analysis was 0.9. The questionnaire included 15 questions that measured depression. 0- 4 score means not having depression, 5-9 moderate depression and 10-15 severe depression.

For specifying whether elders were active or inactive, The Yale Physical Activity Survey (YPAS) was used (39, 40). Elders answered the questions regarding their one-week activities in previous

month and their energy was calculated accordingly. Their energy consumption in one week was calculated in kilocalorie and converted to MAT (Micro Activity Test) unit. Elders with less than 3000 MAT unit in a week were classified as inactive and those with higher than 3000 MAT unit in a week were categorized as active elders (40).

Statistical Analysis. To provide descriptive analysis of the data, indices such as mean, standard deviation, and relative frequency (in percent) were used. Chi-square test, one way ANOVA, and Tukey

test were also calculated. All the information regarding the subjects were analyzed in statistical package for social sciences (SPSS) (version 21) software at the significance level of $P < 0.05$.

RESULTS

Data concerning the elder's depression were presented according to demographic characteristics, age, gender, educational level and body mass index and are shown in Tables 1, 2 and 3.

Table 1. Depression in healthy active and inactive elders based on demographic variables

Group	Variable	Healthy active elder Frequency (%)			Healthy inactive elder Frequency (%)		
		Not being depressed	Severe depression	Moderate depression	Not being depressed	Severe depression	Moderate depression
Age	60-74	(59.7) 43	(29.2) 21	(11.1) 8	(50.7) 36	(32.4) 23	(16.9) 12
	Above 74	(52.6) 20	(31.6) 12	(15.8) 6	(48.79) 19	(41) 16	(10.3) 4
Gender	female	(48.8) 21	(39.5) 17	(11.6) 5	(44.4) 20	(35.6) 16	(20) 9
	male	(62.7) 42	(23.9) 16	(13.4) 9	(53.8) 35	(35.4) 23	(10.8) 7
Education	Diploma and lower	(53.7) 22	(36.6) 15	(9.8) 4	(52.3) 23	(38.6) 17	(9.1) 4
	Higher education	(49.4) 41	(26.1) 18	(14.5) 10	(48.5) 32	(33.3) 22	(18.2) 12

Table 2. Depression in active and inactive elders with knee osteoarthritis disease based on demographic variables

Group	Variable	Healthy active elder Frequency (%)			Healthy inactive elder Frequency (%)		
		Not being depressed	Severe depression	Moderate depression	Not being depressed	Severe depression	Moderate depression
Age	60-74	(19.1) 13	(54.4) 37	(26.5) 37	(8.3) 3	(38.9) 14	(52.8) 19
	Above 74	(31) 13	(45.2) 19	(23.8) 10	(6.8) 5	(43.2) 32	(50) 37
Gender	female	(26.8) 15	(42.6) 24	(30.4) 17	(6.8) 5	(46.6) 34	(46.6) 34
	male	(20.4) 11	(59.3) 32	(20.4) 11	(8.1) 3	(32.4) 12	(59.5) 22
Education	Diploma and lower	(19.5) 8	(53.7) 22	(26.8) 11	(3.9) 3	(42.1) 32	(53.9) 41
	Higher education	(26.1) 18	(49.3) 34	(24.6) 17	(14.7) 5	(41.2) 14	(44.1) 15

Table 3. Frequency of three levels of depression in healthy active and inactive elders and those with osteoarthritis disease

Group	Healthy active Frequency (%)	Healthy inactive Frequency (%)	Active with osteoarthritis Frequency (%)	Inactive with osteoarthritis Frequency (%)
variable				
Not being depressed	(53.7) 63	(5.0) 55	(23.6) 26	(7.3) 8
Moderate depression	(30.0) 33	(35.5) 39	(50.9) 56	(41.8) 46
Severe depression	(12.7) 14	(14.5) 16	(25.5) 28	(50.9) 56

From the results of the one-way ANOVA showed that there is a significant difference in depression level of four groups of healthy active and inactive elders and those with osteoarthritis disease ($p < 0.05$, $F_{3,436} = 25.66$, $p < 0.05$). The results of Tukey test revealed that there exist significant difference in the average number of depression in active patients with osteoarthritis disease, healthy active elders and inactive elders with osteoarthritis disease ($p < 0.05$). Also, based on X2 test results, there is a significant difference in the average number of depression in inactive elders with osteoarthritis disease, active healthy elders, healthy inactive elders and elders with osteoarthritis disease ($p < 0.05$). However there was not significant difference between active elders with osteoarthritis disease and healthy inactive elders ($p > 0.05$). An examination of the depression level showed that healthy active elders, healthy inactive elders and active elders with osteoarthritis disease had lower level of depression compared to inactive elders with osteoarthritis disease.

DISCUSSION

Knee osteoarthritis can have negative effects on the physical and mental conditions, social and family relations, general health and positive feelings of elders. For example, severe limitation of motion and increased depression resulting from this disease can have negative impacts on elders. Thus, the purpose of this study was to compare the levels of depression in healthy active and inactive elders versus those with knee osteoarthritis disease.

Disorder (such as mental or physical) in patients with knee osteoarthritis disease depends on different factors. The amount of disorder depends on pain, joints deformities, depression and other disease symptoms (9, 21). However there are other factors that are directly related to knee osteoarthritis and have effect on elders' disorder (11). Depression is one of the most common mental disorders in patients with osteoarthritis disease. The amount of depression is estimated to be about 27 to 35 percent. The relationship between knee osteoarthritis and depression is proven in different studies (17). According to Sherman (2003) and Unutzer *et al.* (2008), alteration in the functions of elders with osteoarthritis disease results in depression and

mood swing (13, 18). Findings of this study showed that there is a relationship between the levels of depression and gender of elders, with elder women having osteoarthritis disease possessing higher levels of depression compared to elder men having this same disease. Silverwood *et al.* (2015) concluded that elder women with osteoarthritis disease have higher level of depression compared to elder men with osteoarthritis disease. Lower level of depression in elder men can be related to continuous activities in men. Also, limited outdoor activities of women and traditional beliefs about women which consider them as wives and child care could be responsible for the difference between the depression level among men and women with knee osteoarthritis disease (28). However Dekaghin *et al.* (2009) did not find any difference between the depression level of men and women with knee osteoarthritis (4). Probably the type of assessment tool and statistical sample might be the reasons for the inconsistency in their findings. Also, findings of recent research have shown that the level of depression was higher in elders with osteoarthritis disease with lower education compared to educated elders. Stubbs, Hurley, and Smith (2015) also verified these findings (10). Therefore, higher level of education results in lower depression in osteoarthritis patients. Probably higher knowledge and education of elders results in obtaining more information about osteoarthritis disease and its side effects, and thus choosing more active and healthy ways of living. The findings of the research indicated that osteoarthritis patients between the ages of 75-80 years old have more depression compared to elders who are between 60-74 years old. According to Corti and Rigon (2003) and Dahaghin *et al.* (2009), the risk of knee osteoarthritis disease and depression increase with aging. Researchers believe that elders with osteoarthritis disease have weaker muscles, less joints' range of movement and they feel more pain; as a result, their depression level increase and physical activity decrease (4, 41).

Also, the results demonstrated that that level of depression is different between healthy active and inactive elders and those with osteoarthritis disease, also healthy elders and active patients with osteoarthritis disease have lower level of

depression score compared to inactive patients with osteoarthritis disease. These findings are similar to the findings of Ettinger *et al.* (1997), Scopaz *et al.* (2009) (17, 20), while findings from Minor *et al.* (1989), Barrett and Smerdely (2002), Dreher *et al.* (2008), and Salmon (2001) are different (31-34). The muscles of elders become weaker and their biological actions reduce with aging. These changes limit their functions. Every pressure, chronic disease and deficiency that cause less physical activity in elders reduce their ability and independence in carrying out their personal works and result in loneliness, mood swing and depression. Engaging in sport helps to improve their heart function, increase their physical strength, muscle strength and results in pain relief and less depression, mental disorders and fatigue which results in healing (13, 42).

The findings have been able to show that there is a relationship between depression and reduction of physical activity and those with higher level of depression are less active and have a lower physical strength compared to healthy people. This is the reason why osteoarthritis patients who suffer from depression are not willing to engage in physical activities because they feel pain, and this result in more depression and less activity in them. Engaging in sport and physical activities has positive effects on elders' mental and physical health. There is a relationship between physical activity and mental health, temper, quality of life, depression and anxiety. The advantages of elders with osteoarthritis disease engaging in sports and physical activities are probably related to exercise effect in muscles, increase of joints range of movements, strength, and muscles power and pain relief in patients.

According to one of the theoretical models, social-psychological changes related to engaging in sports are probably because of activating the central nervous system and the release of endorphin (27, 34). Engaging in physical activity increases the basic metabolism, improves blood circulation especially in brain's neurons, consumes extra calories and reduces depression with endorphin release (31, 34). As long as the current research findings indicate that the level of depression is higher in inactive elders with osteoarthritis disease compared to others, by

carrying out workshops concerning the mechanism of knee osteoarthritis mechanism, one can explain the role of physical activities in reduction of pain and depression in elders who are valuable resources of the society, reduce their medical cost of treatment and also improve their physical and mental health.

CONCLUSION

The results of this research (which showed that the level of depression in active elders with osteoarthritis disease was lower) can be suggested to officials in their planning which considers the programs associated with the role of physical activity and exercise in order to reduce the depression level in older adults. The level of depression can be reduced with the prevention and control of the disease. Also, the movement problems associated with osteoarthritis patients can cause physical, mental, social and economic damages, cause loneliness and also mental disorders. Therefore, engaging in sport can be one of the effective treatments for these patients.

The results of current study can be helpful to medical staff, medical centers, nursing homes, rehabilitation centers, physiotherapist, orthopedic doctors and medical specialists in order to include the opportunity of engaging in sport and physical activities as a method of cure for patients thereby preventing early osteoarthritis disease in the society which results in less mental disorders in elders.

APPLICABLE REMARKS

- Based on these results, exercise and physical activity can have a significant effect on decrease depression among older adults with knee osteoarthritis disease.

ACKNOWLEDGMENTS

Authors would like to acknowledge all the participants who made this research possible. Also, we would like to thank the personnel of clinics and rheumatology centers at Loghman, Labbafinejad, Taleghani, and Imam Hossein hospitals in Tehran for their sincere cooperation in collecting the required information.

REFERENCES

1. Shakibi M, Ramezani M, Atapour J, Alavi K. The evaluation of disability in differently-involved joints among patients with osteoarthritis. *The Journal of Qazvin University of Medical Sciences*. 2005;9(1):23-8 [Article in Farsi].
2. Xie F, Lo NN, Pullenayegum EM, Tarride JE, O'Reilly DJ, Goeree R, et al. Evaluation of health outcomes in osteoarthritis patients after total knee replacement: a two-year follow-up. *Health and quality of life outcomes*. 2010;8:87.
3. Axford J, Heron C, Ross F, Victor CR. Management of knee osteoarthritis in primary care: pain and depression are the major obstacles. *Journal of psychosomatic research*. 2008;64(5):461-7.
4. Dahaghin S, Tehrani-Banihashemi SA, Frouzanfar MH, Barghamdi M, Norollahzadeh E, Gholami J, et al. Risk factors of knee osteoarthritis, WHO-ILAR-COPCORD study. *Tehran University Medical Journal*. 2009;66(10):721-8 [Article in Farsi].
5. Gameroff MJ, Olfson M. Major depressive disorder, somatic pain, and health care costs in an urban primary care practice. *The Journal of clinical psychiatry*. 2006;67(8):1232-9.
6. Wang Q, Jayasuriya R, Man WY, Fu H. Does functional disability mediate the pain-depression relationship in older adults with osteoarthritis? A longitudinal study in China. *Asia-Pacific journal of public health / Asia-Pacific Academic Consortium for Public Health*. 2015;27(2):Np382-91.
7. Neogi T, Frey-Law L, Scholz J, Niu J, Arendt-Nielsen L, Woolf C, et al. Sensitivity and sensitisation in relation to pain severity in knee osteoarthritis: trait or state? *Annals of the rheumatic diseases*. 2015;74(4):682-8.
8. Bennell KL, Hinman RS. A review of the clinical evidence for exercise in osteoarthritis of the hip and knee. *Journal of science and medicine in sport / Sports Medicine Australia*. 2011;14(1):4-9.
9. 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 and cartilage / OARS, Osteoarthritis Research Society*. 2010;18(1):24-33.
10. Stubbs B, Hurley M, Smith T. What are the factors that influence physical activity participation in adults with knee and hip osteoarthritis? A systematic review of physical activity correlates. *Clinical rehabilitation*. 2015;29(1):80-94.
11. Bergh I, Steen G, Waern M, Johansson B, Oden A, Sjostrom B, et al. Pain and its relation to cognitive function and depressive symptoms: a Swedish population study of 70-year-old men and women. *Journal of pain and symptom management*. 2003;26(4):903-12.
12. McIlvane JM, Schiaffino KM, Paget SA. Age differences in the pain-depression link for women with osteoarthritis. Functional impairment and personal control as mediators. *Women's health issues : official publication of the Jacobs Institute of Women's Health*. 2007;17(1):44-51.
13. Sherman AM. Social relations and depressive symptoms in older adults with knee osteoarthritis. *Social science & medicine (1982)*. 2003;56(2):247-57.
14. Magni G, Marchetti M, Moreschi C, Merskey H, Luchini SR. Chronic musculoskeletal pain and depressive symptoms in the National Health and Nutrition Examination. I. Epidemiologic follow-up study. *Pain*. 1993;53(2):163-8.
15. Marks R. Comorbid depression and anxiety impact hip osteoarthritis disability. *Disability and health journal*. 2009;2(1):27-35.
16. Lin EH, Katon W, Von Korff M, Tang L, Williams JW, Jr., Kroenke K, et al. Effect of improving depression care on pain and functional outcomes among older adults with arthritis: a randomized controlled trial. *Jama*. 2003;290(18):2428-9.
17. Ettinger WH, Jr., Burns R, Messier SP, Applegate W, Rejeski WJ, Morgan T, et al. A randomized trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis. The Fitness Arthritis and Seniors Trial (FAST). *Jama*. 1997;277(1):25-31.
18. Unutzer J, Hantke M, Powers D, Higa L, Lin E, S DV, et al. Care management for depression and osteoarthritis pain in older primary care patients: a pilot study. *International journal of geriatric psychiatry*. 2008;23(11):1166-71.
19. Axford J, Butt A, Heron C, Hammond J, Morgan J, Alavi A, et al. Prevalence of anxiety and depression in osteoarthritis: use of the Hospital Anxiety and Depression Scale as a screening tool. *Clinical rheumatology*. 2010;29(11):1277-83.
20. Scopaz KA, Piva SR, Wisniewski S, Fitzgerald GK. Relationships of fear, anxiety, and depression with physical function in patients with knee osteoarthritis. *Arch Phys Med Rehabil*. 2009;90(11):1866-73.

21. Hawker GA, Gignac MA, Badley E, Davis AM, French MR, Li Y, et al. A longitudinal study to explain the pain-depression link in older adults with osteoarthritis. *Arthritis care & research*. 2011;63(10):1382-90.
22. Kim KW, Han JW, Cho HJ, Chang CB, Park JH, Lee JJ, et al. Association between comorbid depression and osteoarthritis symptom severity in patients with knee osteoarthritis. *The Journal of bone and joint surgery American volume*. 2011;93(6):556-63.
23. Yohannes AM, Caton S. Management of depression in older people with osteoarthritis: A systematic review. *Aging & mental health*. 2010;14(6):637-51.
24. Murphy SL, Smith DM, Clauw DJ, Alexander NB. The impact of momentary pain and fatigue on physical activity in women with osteoarthritis. *Arthritis and rheumatism*. 2008;59(6):849-56.
25. Jordan K, Arden N, Doherty M, Bannwarth B, Bijlsma J, Dieppe P, et al. EULAR Recommendations 2003: an evidence based approach to the management of knee osteoarthritis: Report of a Task Force of the Standing Committee for International Clinical Studies Including Therapeutic Trials (ESCISIT). *Annals of the rheumatic diseases*. 2003;62(12):1145-55.
26. Iwamoto J, Sato Y, Takeda T, Matsumoto H. Effectiveness of exercise for osteoarthritis of the knee: A review of the literature. *World Journal of Orthopedics*. 2011;2(5):37-42.
27. Karmisholt K, Gyntelberg F, Gotzsche PC. Physical activity for primary prevention of disease. Systematic reviews of randomised clinical trials. *Danish medical bulletin*. 2005;52(2):86-9.
28. Silverwood V, Blagojevic-Bucknall M, Jinks C, Jordan JL, Protheroe J, Jordan KP. Current evidence on risk factors for knee osteoarthritis in older adults: a systematic review and meta-analysis. *Osteoarthritis and cartilage / OARS, Osteoarthritis Research Society*. 2015;23(4):507-15.
29. Teychenne M, Ball K, Salmon J. Physical activity and likelihood of depression in adults: a review. *Preventive medicine*. 2008;46(5):397-411.
30. Taylor AH, Cable NT, Faulkner G, Hillsdon M, Narici M, Van Der Bij AK. Physical activity and older adults: a review of health benefits and the effectiveness of interventions. *J Sports Sci*. 2004;22(8):703-25.
31. Minor MA, Hewett JE, Webel RR, Anderson SK, Kay DR. Efficacy of physical conditioning exercise in patients with rheumatoid arthritis and osteoarthritis. *Arthritis and rheumatism*. 1989;32(11):1396-405.
32. Barrett CJ, Smerdely P. A comparison of community-based resistance exercise and flexibility exercise for seniors. *The Australian journal of physiotherapy*. 2002;48(3):215-9.
33. Dreher M, Waltersbacher S, Sonntag F, Prettin S, Kabitz HJ, Windisch W. Exercise in severe COPD: is walking different from stair-climbing? *Respiratory medicine*. 2008;102(6):912-8.
34. Salmon P. Effects of physical exercise on anxiety, depression, and sensitivity to stress: a unifying theory. *Clinical psychology review*. 2001;21(1):33-61.
35. Lawlor DA, Hopker SW. The effectiveness of exercise as an intervention in the management of depression: systematic review and meta-regression analysis of randomised controlled trials. *BMJ*. 2001;322(7289):763.
36. Abbas Asghar-Ali A, Braun UK. Depression in geriatric patients. *Minerva Med*. 2009;100(1):105-13.
37. Nyunt MS, Fones C, Niti M, Ng TP. Criterion-based validity and reliability of the Geriatric Depression Screening Scale (GDS-15) in a large validation sample of community-living Asian older adults. *Aging & mental health*. 2009;13(3):376-82.
38. Malakouti K, Fathollahi P, Mirabzadeh A, Salavati M, Kahani S. Validation of Geriatric Depression Scale (GDS-15) in Iran. *Research in Medicine*. 2006;30(4):361-9 [Article in Farsi].
39. Dipietro L, Caspersen CJ, Ostfeld AM, Nadel ER. A survey for assessing physical activity among older adults. *Med Sci Sports Exerc*. 1993;25(5):628-42.
40. Semanik P, Lee J, Manheim L, Dipietro L, Dunlop D, Chang RW. Relationship between accelerometer-based measures of physical activity and the Yale Physical Activity Survey in adults with arthritis. *Arthritis care & research*. 2011;63(12):1766-72.
41. Corti MC, Rigon C. Epidemiology of osteoarthritis: prevalence, risk factors and functional impact. *Aging clinical and experimental research*. 2003;15(5):359-63.
42. Trudeau J, Van Inwegen R, Eaton T, Bhat G, Paillard F, Ng D, et al. Assessment of pain and activity using an electronic pain diary and actigraphy device in a randomized, placebo-controlled crossover trial of celecoxib in osteoarthritis of the knee. *Pain practice : the official journal of World Institute of Pain*. 2015;15(3):247-55.