

Relationship between Radiographic Grading of Knee Osteoarthritis and Functional Limitation in Elderly Patients

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ABSTRACT

Background: Knee osteoarthritis (OA) has functional association with pain, reduced mobility and problems in main domain of activity. The objective of this study was to find out the relationship between the grades of knee OA according to Kellgren and Lawrence system and the functional limitation in the daily activities of the elderly patients using WOMAC Questionnaire.

Patients and Methods: This cross-sectional study was conducted on 160 subjects aged ≥ 50 years, out of which, 131 (82%) of the patients were female and 29 (18%) were male. All participants were diagnosed with knee OA at an orthopedic clinic using the Kellgren and the Lawrence system for classification of Osteoarthritis of the knee with no history of knee joint surgery. Outcome indices were functional limitations in 17 living activities obtained from a WOMAC questionnaire.

Results: A significant correlation was found between increase in knee OA stages in x-rays and the severity of limitation in physical function (p value < 0.01). The results indicated that functional limitation was proportional to the increase in Osteoarthritis x-ray grades. Greatest limitation of movement was found in descending stairs, where the least scores with mild to moderate OA (1.41 ± 0.76 ; $P < 0.01$) became (3.78 ± 0.47 ; $P < 0.01$) as the X-ray grade increases to IV.

Conclusion: Functional disability is the principle reason for which patients with chronic knee pain seek medical treatment. The findings of our study suggest that patients with greater disability and functional limitations in their daily activities have advanced knee OA grades III to IV according to the Kellgren-Lawrence scale.

Keywords

Osteoarthritis, Disability, WOMAC, Kellgren and Lawrence scale.

Introduction

Osteoarthritis (OA) of the knee joint is a common chronic and degenerative disease all over the world [1]. It is characterized pathologically by both focal loss of articular cartilage and marginal and central new bone formation. OA ranks as the 11th highest contributor to global disability and is the leading cause of functional limitations in older adults such as difficulty in walking

and climbing stairs [2,3]. The knee joint is the principal large joint to be affected, resulting in disabling symptoms in an estimated 10% of people older than 55 years, a quarter of them being severely incapacitated [4].

The prevalence of OA is growing every year with a large increase in the ageing and the elderly population in comparison to the young and it is more common in women [4-6]. In USA, 37% of the individuals aged 60 and above, suffer from OA of knees while clinical evaluation for the presence of OA yielded a prevalence

of 12.1% in a population aged 25-74 years [7,8]. The proportion of people aged 65 years and older in Asia is estimated to increase from 7% in 2008 to 16% in 2040 [9,10]. In a recent review, it was concluded that the prevalence of knee OA or knee pain is as high as or higher than other Caucasian populations. The prevalence of knee OA in rural areas of Bangalore, India was 17% in the adult population and 16.4% in the elderly [11]. In a study conducted at Al-Qaseem region of Saudi Arabia, Al-Arfaj and Colleagues documented the prevalence rate of clinical knee OA as 13%; which increased with age reaching 30.8% in those aged 46-55 years and 60.6% in the age group 66-75 years [12]. It is estimated that in 2025, the prevalence of knee OA will increase by 40% globally due to aging of world population and the obesity epidemic [13]. A World Health Organization report on the global burden of disease indicates that knee OA is likely to become the fourth most important cause of disability in women and the eighth most important in men [14].

OA-related disability is a major public health problem impacting the lives of many older adults. Moreover arthritis-related conditions are the 2nd most common reason for medical visits related to chronic conditions, second only to hypertension. The associated risk factors of knee OA have been reported by many studies and include age, gender, and repeated bending of the knee. Also OA is more prevalent among those engaged in agriculture, manual labor (men) and household work (women) [5,6,12,13]. OA leads to impairment in body functions and structures (as pain, reduced muscle strength, instability and reduced range of motion) and moderate-to-severe limitations in activities, such as stair climbing, walking and transfers (rising from a chair, rising from bed, getting in and out of a bath and a car) [13]. Physical disability arising from pain and loss of function negatively affects the quality of life and psychological behavior and increases the risk of morbidity and mortality [15]. The disabilities in physical activity become a major burden as the patients sometimes need assistance in even simple routine activities. In addition to direct medical costs, the healthcare costs of in-patient and ambulatory care related to the amount of disability associated with arthritis exceeds that of other chronic conditions [16-19].

Although knee OA is affecting people alarmingly causing disability, reducing quality of life and increasing the costs to the health system; there is no proven strategy to prevent or cure knee OA, rather the focus of intervention is to address pain and functional limitations [20]. Understanding the pattern of functional decline is necessary not only to effectively treat functional limitation in knee OA but also to evaluate efficacy of new treatment interventions. The purpose of the current study was to determine the relationship between the grades of Radiological knee OA using Kellgren and Lawrence (KL) system and the functional limitation in the daily activities in the elderly patients using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Questionnaire. The Kellegran- Lawrence grading system is a standard method for studying OA according to the recommendation by the WHO while WOMAC index is also a reliable tool for evaluating patients with knee OA [21-24].

Methods

The study design was a cross-sectional with convenient sampling. About 160 newly diagnosed patients' of unilateral or bilateral knee OA, more than 50 years old (131 female and 29 males) were recruited for this study. The subjects were selected from an orthopedic clinic of a Private hospital at the Southern region of Saudi Arabia. The exclusion criteria were patients less than 50 years old; those who had been diagnosed with rheumatoid arthritis, patients with a grade 0 according to the Kellgran-Lawrence system of OA, and those who had knee surgery or neurological disorders. All patients were informed about the study's purposes, and their approvals to participate in the study were taken. No financial incentive was given to patients as their participation was voluntary. The etiology of OA was assessed by the female doctor who was collecting the data from the patients. The study protocol was approved by the Hospital Research Committee.

Data collection

Demographic data such as age, gender, level of education, occupation and medical history was collected. Knee joints were examined and Anterior-posterior standing and lateral radiographs of knee joints either single or bilateral were taken from all patients. Radiographs were read by a consultant radiologist who was completely unaware of the patient's clinical conditions. The X-ray reports suggested unilateral or bilateral involvement, and the presence or absence of osteophytes, joint space narrowing, cysts and sclerosis according to the grades of Kellgran- Lawrence system: grade 0 = Normal with no feature of osteoarthritis; 1= Doubtful narrowing of joint space and possible osteophytic lipping; 2 = Definite osteophytes and possible narrowing of joint space; 3= Moderate multiple osteophytes, definite narrowing of joint space, and some sclerosis and possible deformity of bone ends; 4= Large osteophytes, marked narrowing of joint space, severe sclerosis and definite deformity of bone ends.

Functional limitations were assessed by using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The WOMAC index is a disease-specific, self-administered questionnaire, and is most commonly used as a reliable tool for evaluating patients with knee OA. It has an established validity, reliability and responsiveness and is widely used by clinical investigators in clinical trials, large scale databases and registries [21]. It includes five items about pain, two items about stiffness and seventeen items on degree of functional disability in patients with knee OA.

Outcome indices were limitations in 17 functional activities that include: self-reported difficulty with mobility, such as climbing stairs, getting in and out of the car, rising from sitting and squatting positions, walking on flat surface, shopping, activities of daily living, such as putting on socks, bathing and getting on/off the toilet, and heavy and light domestic duties. Item responses range from 0: no difficulty to 4: extreme difficulty [25-29].

Statistical analyses were performed with the SPSS software version 21, and significance was set at < level of 0.05. Participant

characteristics were reported as Mean \pm SD. Pearson correlation analyses were performed to examine the relationships between physical activity variables and measures of physical function. The differences in functional limitations scores between the grades were analyzed with analysis of variance (ANOVA). All objective physical activity measures were significantly correlated with each other ($P < 0.01$).

Results

The results reported that there was a substantially larger number of female [131 (82%)] patients than male [29 (18%)] patients and all of them were older than 50 years (Table 1). A significant correlation with p value < 0.01 was seen between increase in knee OA stages in x-rays and the severity of limitation in physical function. According to the x-ray findings, around 21.9 % subjects had grades I and II while majority (78.1%) of patients belonged to grades III and IV with advanced knee OA according to Kellgren-Lawrence grading system. Significant strong relationships were identified between functional limitations and increase in OA x-ray grades (Table 2). The least score observed among mild group in measuring the limitation in descending stairs, was with grades I

and II [mean 1.41 ± 0.76 , $P < 0.01$] compared to high scores in patients with advanced knee OA grades IV (3.78 ± 0.47 , $P < 0.01$). In case of ascending stairs the findings were almost the same with increasing limitation of movements in case of mild to moderate knee OA (1.78 ± 0.83 , $P < 0.01$), with highest scores in grade IV (mean 3.81 ± 0.45 , $P < 0.01$). Similar results were found regarding the standing in patients with low grade OA (0.78 ± 0.66 , $P < 0.01$), and the patients with advanced OA (3.15 ± 0.69 , $P < 0.01$). In case of bending to the floor the results were a little higher for low grades (2.69 ± 0.78 , $P < 0.01$), as compared to patients with advanced grades (3.96 ± 0.19 , $P < 0.01$).

Variable		Frequency	Age Percent
Age (year)	50-60	49	30.6
	61-70	46	28.8
	>70	65	40.6
Gender	Male	29	18.1
	Female	131	81.9
	Total	160	100

Table 1: General characteristics of participants [n=160].

			X ray Grades			
			1	2	3	4
Descending stair	None	Count	3	2	0	0
		% of Total	1.9%	1.3%	0.0%	0.0%
	Slight	Count	0	18	3	0
		% of Total	0.0%	11.3%	1.9%	0.0%
	Moderate	Count	0	9	14	2
		% of Total	0.0%	5.6%	8.8%	1.3%
	Very	Count	0	3	20	14
		% of Total	0.0%	1.9%	12.5%	8.8%
	Extremely	Count	0	0	7	65
		% of Total	0.0%	0.0%	4.4%	40.6%
Ascending Stairs	None	Count	1	2	0	0
		% of Total	.6%	1.3%	0.0%	0.0%
	Slight	Count	1	9	2	0
		% of Total	.6%	5.6%	1.3%	0.0%
	Moderate	Count	1	15	7	2
		% of Total	.6%	9.4%	4.4%	1.3%
	Very	Count	0	6	25	11
		% of Total	0.0%	3.8%	15.6%	6.9%
	Extremely	Count	0	0	10	68
		% of Total	0.0%	0.0%	6.3%	42.5%
Rising from sitting	None	Count	2	1	0	0
		% of Total	1.3%	.6%	0.0%	0.0%
	Slight	Count	1	12	2	1
		% of Total	.6%	7.5%	1.3%	.6%
	Moderate	Count	0	13	14	0
		% of Total	0.0%	8.1%	8.8%	0.0%
	Very	Count	0	6	17	11
		% of Total	0.0%	3.8%	10.6%	6.9%
	Extremely	Count	0	0	11	69
		% of Total	0.0%	0.0%	6.9%	43.1%

Standing	None	Count	3	11	3	0	
		% of Total	1.9%	6.9%	1.9%	0.0%	
	Slight	Count	0	17	12	1	
		% of Total	0.0%	10.6%	7.5%	.6%	
	Moderate	Count	0	4	23	11	
		% of Total	0.0%	2.5%	14.4%	6.9%	
	Very	Count	0	0	6	44	
		% of Total	0.0%	0.0%	3.8%	27.5%	
	Extremely	Count	0	0	0	25	
		% of Total	0.0%	0.0%	0.0%	15.6%	
	Bending to floor	None	Count	0	1	0	0
			% of Total	0.0%	.6%	0.0%	0.0%
Slight		Count	2	1	0	0	
		% of Total	1.3%	.6%	0.0%	0.0%	
Moderate		Count	1	7	0	0	
		% of Total	.6%	4.4%	0.0%	0.0%	
Very		Count	0	21	14	3	
		% of Total	0.0%	13.1%	8.8%	1.9%	
Extremely		Count	0	2	30	78	
		% of Total	0.0%	1.3%	18.8%	48.8%	
Walking on flat surface		None	Count	3	8	0	0
			% of Total	1.9%	5.0%	0.0%	0.0%
	Slight	Count	0	13	8	1	
		% of Total	0.0%	8.1%	5.0%	.6%	
	Moderate	Count	0	11	19	4	
		% of Total	0.0%	6.9%	11.9%	2.5%	
	Very	Count	0	0	16	48	
		% of Total	0.0%	0.0%	10.0%	30.0%	
	Extremely	Count	0	0	1	28	
		% of Total	0.0%	0.0%	.6%	17.5%	
	Getting in off Car	None	Count	3	15	1	0
			% of Total	1.9%	9.4%	.6%	0.0%
Slight		Count	0	8	9	4	
		% of Total	0.0%	5.0%	5.6%	2.5%	
Moderate		Count	0	7	25	4	
		% of Total	0.0%	4.4%	15.6%	2.5%	
Very		Count	0	2	7	16	
		% of Total	0.0%	1.3%	4.4%	10.0%	
Extremely		Count	0	0	2	57	
		% of Total	0.0%	0.0%	1.3%	35.6%	
Going Shopping		None	Count	2	3	0	0
			% of Total	1.3%	1.9%	0.0%	0.0%
	Slight	Count	0	2	2	0	
		% of Total	0.0%	1.3%	1.3%	0.0%	
	Moderate	Count	1	19	7	1	
		% of Total	.6%	11.9%	4.4%	.6%	
	Very	Count	0	8	27	19	
		% of Total	0.0%	5.0%	16.9%	11.9%	
	Extremely	Count	0	0	8	61	
		% of Total	0.0%	0.0%	5.0%	38.1%	
	Putting on socks	None	Count	3	27	24	3
			% of Total	1.9%	16.9%	15.0%	1.9%

Putting on socks	Slight	Count	0	5	9	16
		% of Total	0.0%	3.1%	5.6%	10.0%
	Moderate	Count	0	0	10	28
		% of Total	0.0%	0.0%	6.3%	17.5%
	Very	Count	0	0	1	23
		% of Total	0.0%	0.0%	.6%	14.4%
Extremely	Count	0	0	0	11	
	% of Total	0.0%	0.0%	0.0%	6.9%	
Lying in Bed	None	Count	3	26	21	2
		% of Total	1.9%	16.3%	13.1%	1.3%
	Slight	Count	0	6	11	15
		% of Total	0.0%	3.8%	6.9%	9.4%
	Moderate	Count	0	0	11	29
		% of Total	0.0%	0.0%	6.9%	18.1%
	Very	Count	0	0	1	30
		% of Total	0.0%	0.0%	.6%	18.8%
	Extremely	Count	0	0	0	5
		% of Total	0.0%	0.0%	0.0%	3.1%
Taking off socks	None	Count	3	28	24	3
		% of Total	1.9%	17.5%	15.0%	1.9%
	Slight	Count	0	4	9	14
		% of Total	0.0%	2.5%	5.6%	8.8%
	Moderate	Count	0	0	9	30
		% of Total	0.0%	0.0%	5.6%	18.8%
	Very	Count	0	0	2	27
		% of Total	0.0%	0.0%	1.3%	16.9%
Extremely	Count	0	0	0	7	
	% of Total	0.0%	0.0%	0.0%	4.4%	
Rising from bed	None	Count	2	12	0	0
		% of Total	1.3%	7.5%	0.0%	0.0%
	Slight	Count	1	12	12	0
		% of Total	.6%	7.5%	7.5%	0.0%
	Moderate	Count	0	8	18	7
		% of Total	0.0%	5.0%	11.3%	4.4%
	Very	Count	0	0	14	31
		% of Total	0.0%	0.0%	8.8%	19.4%
Extremely	Count	0	0	0	43	
	% of Total	0.0%	0.0%	0.0%	26.9%	
Getting in out of bath	None	Count	2	14	1	0
		% of Total	1.3%	8.8%	.6%	0.0%
	Slight	Count	1	11	12	2
		% of Total	.6%	6.9%	7.5%	1.3%
	Moderate	Count	0	7	20	15
		% of Total	0.0%	4.4%	12.5%	9.4%
	Very	Count	0	0	10	30
		% of Total	0.0%	0.0%	6.3%	18.8%
Extremely	Count	0	0	1	34	
	% of Total	0.0%	0.0%	.6%	21.3%	
Sitting	None	Count	3	17	6	1
		% of Total	1.9%	10.6%	3.8%	.6%
	Slight	Count	0	9	18	7
		% of Total	0.0%	5.6%	11.3%	4.4%

Sitting	Moderate	Count	0	6	16	24	
		% of Total	0.0%	3.8%	10.0%	15.0%	
	Very	Count	0	0	4	43	
		% of Total	0.0%	0.0%	2.5%	26.9%	
	Extremely	Count	0	0	0	6	
		% of Total	0.0%	0.0%	0.0%	3.8%	
Getting on off Toilet	None	Count	2	14	2	0	
		% of Total	1.3%	8.8%	1.3%	0.0%	
	Slight	Count	1	12	15	2	
		% of Total	.6%	7.5%	9.4%	1.3%	
	Moderate	Count	0	6	19	17	
		% of Total	0.0%	3.8%	11.9%	10.6%	
	Very	Count	0	0	8	34	
		% of Total	0.0%	0.0%	5.0%	21.3%	
	Extremely	Count	0	0	0	28	
		% of Total	0.0%	0.0%	0.0%	17.5%	
	Heavy domestic duties	None	Count	1	0	0	0
			% of Total	.6%	0.0%	0.0%	0.0%
Slight		Count	1	0	0	0	
		% of Total	.6%	0.0%	0.0%	0.0%	
Moderate		Count	1	17	2	0	
		% of Total	.6%	10.6%	1.3%	0.0%	
Very		Count	0	15	27	9	
		% of Total	0.0%	9.4%	16.9%	5.6%	
Extremely		Count	0	0	15	72	
		% of Total	0.0%	0.0%	9.4%	45.0%	
Light domestic duties		None	Count	3	18	3	1
			% of Total	1.9%	11.3%	1.9%	.6%
	Slight	Count	0	14	23	5	
		% of Total	0.0%	8.8%	14.4%	3.1%	
	Moderate	Count	0	0	16	15	
		% of Total	0.0%	0.0%	10.0%	9.4%	
	Very	Count	0	0	2	38	
		% of Total	0.0%	0.0%	1.3%	23.8%	
	Extremely	Count	0	0	0	22	
		% of Total	0.0%	0.0%	0.0%	13.8%	

Table 2: Correlation of physical activity with grades of knee osteoarthritis.

In case of getting in and off the car, the low grades have a mean of 0.88 ± 0.98 ($P < 0.01$), and the advanced grades had mean of 3.58 ± 0.81 ($P < 0.01$). For the task of putting on and taking off socks the result was almost the same for low grades (0.16 ± 0.37 , P value < 0.01), and for the advanced grades (2.28 ± 1.05 , P value < 0.01). For the function of rising from the bed the low grades were slightly higher (0.88 ± 0.79) as compared to lying in bed (0.19 ± 0.40 , $P < 0.01$). For the advanced grades the mean value of rising from the bed was significantly higher (3.44 ± 0.65) as compared to the lying in the bed (2.26 ± 0.92 , $P < 0.01$).

Discussion

The present study documented a highly significant increase in the disability of the patients with increasing grades of knee OA. Knee joint radiography is a common investigation done in clinical practice to observe radiographic pattern of OA in older adults self-

reporting knee pain, interfering their daily activities [23].

Our data showed that frequency of self-reported knee complaints or pain is higher in females (82%) as compared to males (18%) of same age group. This finding coincides with the published fact that OA of knee has a higher incidence and prevalence in females [30]. A recent German study revealed that 63% of women and 57% of men aged >40 years reported to have pain and/or joint complaints [31]. It has been documented that knee OA with coexisting severe radiological changes demonstrate features distinctly different from those with mild radiological changes, and it seems to be associated with reduced lower limb functions and limitations of knee range of motion. Our data reported that there is strong correlation between the stages of knee OA and the limitation of physical activities even in simple daily activities. Also, symptomatic disease and reduced function are more likely to be found if radiographic OA changes

are advanced [32]. We found a significant association between OA and advancing age and history of regular climbing of stairs with involvement of repeated knee bending, which is consistent with other studies [33,34]. Nonetheless, there are some studies that do not find any relationship between knee pain and radiographic changes [31].

An individual item analysis of the WOMAC revealed that an increase in the grades of OA is associated with greater difficulty with daily activities. By analyzing the items, we found greater limitation of function in ascending and descending the stairs; however the greatest limitation was bending to the floor which had immense psychological effect more than any other limitation as patients were deprived from offering prayers in normal position. Rising from the bed also affected slightly more than lying in bed, while the heavy domestic duties affected most compared to the light domestic activities. Guccione et al. [35] and Dillon et al. [36] reported in their studies, that rising up from a chair, ascending and descending stairs, bending to the floor, kneeling, squatting, performing heavy household chores, and walking a mile were reported as most problematic in their cohorts of individuals with knee OA which is consistent to our findings [37,38]. Our exploratory individual item analyses revealed that pain with greater difficulty occurs with most weight bearing activities of daily living that require knee bending such as stair climbing and a simulated car task performance. These activities become more limited and reduced with increase in x-ray grades of knee OA. It was also reported that bending to floor and heavy domestic duties are difficult to perform even in grade II OA.

The rate of OA is rapidly rising as population is ageing, thus it is important to assess and monitor the progression of physical disability with OA. Self-reporting of difficulty in performance of various activities of daily living is a practical approach, moreover plain radiography is a simple tool and WOMAC index has scales to assess pain, stiffness, physical, social and emotional functions thus providing a multi-dimensional perspective. All these measures should be repeatedly evaluated in patients with knee OA, in order to improve quality of life and functional capacity.

Conclusion

Functional disability is the principle reason for which patients with chronic knee pain seek medical treatment. The findings of our study suggested that presence of advanced knee OA grades III to IV according to Kellgren-Lawrence classification have greater disability and functional limitations of the daily activities.

Compliance with Ethical Standards

I declare that I have no conflict of interest in my study, and there is no funding for my study. The article does not contain any studies on human or animals, and the entire participant was clearly informed and I got their agreements about the study.

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