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EVALUATION OF THE FACTORS AFFECTING THE SEVERITY AND FUNCTIONAL DISABILITY OFPATIENTS WITH PRIMRY KNEE OSTEOARTHRITIS

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ABSTRACT

Objective: To investigate the influences of age, sex, body mass index (BMI), the Kellgren Lawrence radiological osteoarthritis index (KLOAI) on the severity and functional disability of patients with primary knee osteoarthritis (PKO).

Methods: 70 patients, 60 females, 10 males from our outpatient clinic diagnosed as PKO according to American College of Rheumatology were involved in the study. Bilateral standing AP knee radiography of all patients were taken and evaluated according to the KLOAI. BMI was calculated as the weight in Kg divided by the square of the height in meters. Lequesne index (LI), painless walking distance (PWD), painless walking duration (PWD,) were used to estimate the severity and functional disability of PKO.

Results: After controlling for age, gender and BMI, for each unit increase in KLOAI the LI is expected to increase by a mean of 1.5 units. Males had a significantly lower mean LI (by 3.8 units) compared to females of similar age, BMI and radiological severity. Older age was associated with a more severe LI, for each year increase in age the LI is expected to increase by 0.1 unit when controlling for radiological severity, gender and BMI. There was significant correlation between BMI and radiological severity.

Conclusion: Obesity as measured by BMI was associated with definite knee OA. Radiographic

changes as measured by KLOAI had significant correlation with severity of PKO as measured by LI. Patients with older age had more severe PKO. Males have lower severity of PKO than females. LI can be used in daily practice to follow up the OA in weight bearing joints.

Keywords: knee, osteoarthritis, disability, radiological severity

INTRODUCTION

Osteoarthritis (OA) is by far the most common joint disorder in the world, and is one of the leading causes of disability and pain in the elderly (1). The knee joint is the most common site of lower extremity involvement (2). Both prevalence and severity parallel age in most individuals (3) and one in four people aged over 55 years have knee pain (4) and by the age of 65 years 30% of men and 40% of women have radiographic changes of knee osteoarthritis (5). Gender and race play roles in the prevalence and severity of OA. The frequency of OA is about equal in the genders between age 45 and 55, but after age 55 OA is much more common in women (6).

The association of obesity with the presence of knee OA has been examined through analysis of cross-sectional data from population surveys performed in the United States (7–12), and Europe (13–17) as well as in the Framingham Osteoarthritis Study, a longitudinal cohort study (18–19). Although all these studies have demonstrated an association between obesity and knee OA, the measures of obesity differ between studies and these measures including body mass index (BMI), body fat distribution and percent body fat (20). These data confirm that body weight, measured by BMI, is associated with knee OA in both sexes. Data from the United States First National Health and Nutrition Examination Survey (NHANES-I), conducted from 1971 through 1975, revealed that 4% of adults aged 25 to 74 had radiographic changes of definite knee OA; about one-quarter had moderate- severe radiographic changes (21). There are reasons to suspect that the correlation between radiographic severity and level of disability may be poor (22). Traditionally the severity of osteoarthritis has been assessed using a system which scores radiographic feature believed to be characteristic of this disorder using the Kellgren-Lawrence Scale (23). There are many factors that affect the clinical status and intensity of primary knee OA and our study is to clarify some of these factors.

AIM OF THE STUDY

To investigate the influences of age, sex, body mass index (BMI), the Kellgren Lawrence Radiological Osteoarthritis index

(KLOAI) on the severity and functional disability of patients with primary knee osteoarthritis (PKO).

PATIENTS AND METHODS

This study was carried out at the Department of Rheumatology in Baghdad Teaching Hospital from October 2001 till July 2002.

70patients; 60 females (85.7%) and 10 males (14.3%) diagnosed as primary knee osteoarthritis (PKO) according to American College of Rheumatology were involved in the study.

Measurements of the body weight and height were made and BMI was calculated as the weight in Kg divided by the square of the height in meters (24). Cut-off points for obesity were determined according to guidelines of World Health Organization (WHO). Cut-off values are as follow: 18.5 – 24.99: normal, 25.0 – 29.99 grade 1 overweight, 30.0 – 39.99 grade 2 overweight, > or = 40.0 grade 3 overweight (25).

Bilateral weight bearing anteroposterior radiograph of both knees were performed and all radiographs were evaluated for OA by one radiologist using a scoring system based on the central three features of the Kellgren-Lawrence Scales; joint space narrowing (0–2), osteophytosis (0-2) and sclerosis (0-1) (23). Knee joint received KLOAI grade 0 (normal) through 4 (severe), definite knee OA was defined as KLOAI grade 2 or higher and moderate to severe OA if KLOAI grade 3 and 4 (26).

Finally, Lequesne index (LI) (Table 1) (27), painless walking distance in meters (PWD) and painless walking duration in minutes (PWD) were used to estimate the severity and functional ability of PKO.

STATISTICAL ANALYSIS

Data were translated into codes using a specially designed coding sheet, and then converted into a computerized database structure. The database was examined for errors using range and logical data cleaning methods, and inconsistencies were remedied. An expert statistical advice was sought for. Statistical analyses were done using SPSS version 7.5 computer software (Statistical Package for Social Sciences) in association With Excel version 5.

Frequency distribution for selected variables was done first. The univariate linear between KLOAI and different measures of clinical severity (like Lequesne index) was assessed for magnitude, direction and statistical significance by Spearman's rank correlation coefficient (since an index is measured on an ordinal level of measurement). To study the net and independent association of KLOAI with each of three indexes of severity adjusting the age, gender and BMI a multiple

regression was used with each of the three clinical indices of severity as the dependent (response) variable. The multiple regression model provides the following parameters:

1. P value the model should be statistically significant. In order to generalize the results obtained, the model should be statistically significant.
2. (β -regression coefficient}: estimates the expected change in the level of response (dependent) variable (measured in units) as a net response to the effect of each independent variable included in the model, after controlling for the other one.
3. p value for the calculated regression coefficient: it reflects the statistical significance of the calculated β.
4. Coefficient of determination (R2): Measures the percentage of variation in the response variable explained by the combination of independent variables included the model.

RESULTS

A total of seventy patients were enrolled in the study. Sixty (85.7%) patients were female 10 (14.3%) patients were male. 13 (18.6%) patients were below age 50 while 26 (37.1%) patients were at age 60 and above with a mean age± SD of 55.7 = 7.7 as shown in table 1.

The frequency distribution of the study sample by degree of obesity assessed by BMI is shown in table 2. The range and mean ± SD were 16.5 - 41.5 and 29.8 + 5.1 respectively.

There was obvious increment in the number of patients in relation to the severity of PKO according to LI from 2 (2.9%) patients in minor (1-4) score to 24 (34.3%) patients in extremely severe (14^{+}) score as shown in table 3. There were 51 (72.9%) patients had mild (1-2) radiographic changes while only 19 (27.1%) patients had moderate to severe (3-4) radiographic changes according to KLOAI (Table 3).

The mean values for disease duration, PWD and PED, were 3-7 years, 241.4 meters and 901 minutes respectively as shown in table 4.

As shown in table 5, the median LI increased from a minimum of 10 for patients with lowest KLOAI (grade 1) to a maximum of 17 for patients with the most severe KLOAI (grade 4), the observed direct (positive) trend was weak (r = 0.2) and not significant statistically (P>0.05) PWD and PWD_1, had no obvious correlation with KLOAI.

As shown in table 6, if KLOAI was used as a decision criterion for predicting a severe LI (11+score) handicap category, 3 cutoff values of radiological severity were used, at the low cut off point (= 1) of radiological severity, the sensitivity will be high (88.6%)

and specificity will be very low (26.9%) for detecting a severe handicap, while at the highest cutoff value of 3, the sensitivity will be very low (6.8%) and the specificity is highest (100%). Based on different cutoff values of KLOAI severity, the confidence in a positive test will increase from a minimum of (67.2%) at the lowest cutoff value of 1 to 100% at the highest cutoff value of 3.

A multiple regression model was used to show the net effect of KLOAI on each of three response (dependent) parameters of clinical handicap severity, namely the LI, PWD and PWD1, after controlling for the possible confounding effect of age, gender and BMI on the explored relation. The last two clinical parameters, namely PWD and PWD, showed no association with the radiological index since the two regression models were not significant statistically (P model = 0.15 and 0.35 respectively) and the coefficient of determination were so small (0.09 and 0.06 respectively).

As shown in table 7, after controlling for age, gender and BMI, for each unit increase in KLOAI the LI is expected to increase by a mean of 1.5 units, the calculated regression coefficient was statistically significant. Males had a significantly lower mean LI (by 3.8 units) compared to females of similar age, BMI and radiological severity. Older age was associated with a more severe LI, for each year increase in age the LI is expected to increase by 0.1 unit when controlling for radiological severity, gender and BMI. Only BMI had no obvious or statistically significant association with LI after adjusting for age, radiological severity and gender. This can be readily explained by the significant correlation of BMI with radiological severity, which is shown in table 8 (when two highly correlated variables were entered in multiple regression equation as independent variables, the effect of one of them was cancelled because of the problem of collinearity).

Table 1: Frequency distribution of the study sample by age and gender

	Age in years	N	%
1	<50	13	18.6
	50-59	31	44.3
	60+	26	37.1
	Range	40-81	
	Mean ± SD	55.7±7.7	
2	Gender		
	Female	60	85.7
	Male	10	14.3
	Total	70	100

Table 2: Frequency distribution of the study sample by degree of obesity (assessed by BMI)

	N	%
Body Mass Index (BMI) in Kg/m2		
Within normal	12	17.1
Grade-I obesity	24	34.3
Grade-II obesity	30	42.9
Grade-III obesity	4	5.7
Range	16.5-41.5	
Mean ± SD	29.8±5.1	
Total	70	100

Table 3: Frequency distribution of the study sample by Lequesne index for the qualification of handicap severity and KellgrenLawrence index for radiological severity of knee OA

		N	%
1	Lequesne index for the qualification of Handicap severity		
	Minor (1-4)	2	2.9
	Moderate (5-7)	4	5.7
	Severe (8-10)	20	28.6
	Very severe (11-13)	20	28.6
	Extremely severe (14+)	24	34.3
	Range	2-20	
	Median	12	
2	Kellgren Lawrence index for radiological Severity of knee OA		
	Mild (1-2)	51	72.9
	Moderate to severe (3-4)	19	27.1
	Range	1-4	
	Median	2	
	Total	70	100

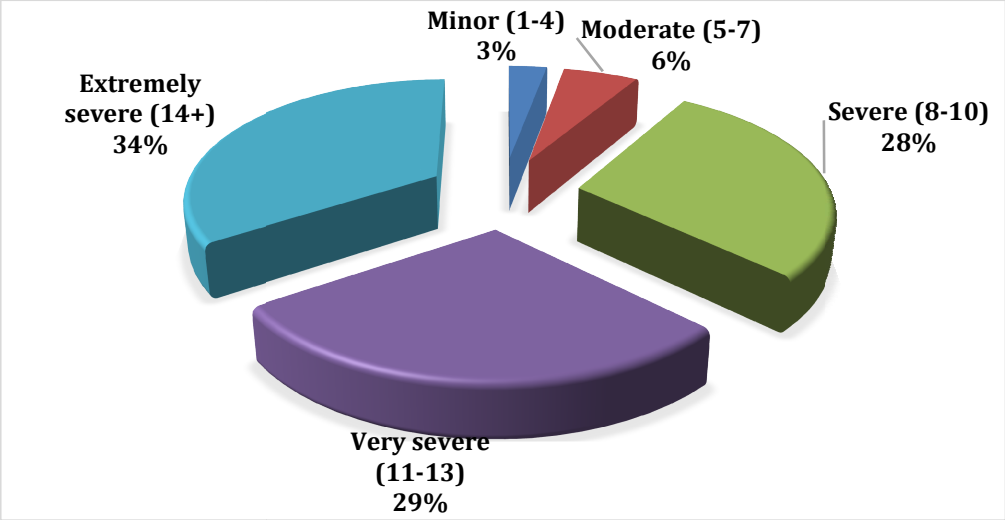

Figure 1: Pie chart showing the relative frequency of different grades of Lequesne index for the qualification of handicap

Table 4: The mean and SD of 3 parameters of the study sample

		Min.	Max.	Mean	SD
1.	Duration of the disease in years	< 1 year	20.0	3.7	4.4
2.	Painless walking distance (m)	50	750	241.4	164.6
3.	Painless walking duration (min)	3	20	9.1	4.9

Table 5: The difference in mean and median of 3 dependent (response) variables between the 4 grades of Kellegran-Lawrence scale of radiological severity

Kellegran-Lawrence scale of assessing radiological severity of knee OA.				
	1	2	3	4
Lequesne score for clinical Assessment Of knee OA severity				
Range	7-15	2-18	6-20	15-19
Median	10	12	11	17
R=0.2 P>0.05				
Painless walking distance (m)				
Range	100-500	50-70	100-500	100-200
Mean	241.7	248.7	237.5	166.7
SD	173.0	176	150	57.7
R=0.01 P>0.05				
painless walking duration (min)				
Range	5-15	3-20	5-15	5-10
Mean	8.8	9	10	6.7
SD	4.3	4.7	4.8	2.9
R=0.04 P>0.05				

Table 6: Validity parameters of kellegran-Lawrence index for radiological severity at three different cut off values for predicting a severe Lequesne index category (score—11+).

	Lequesne index for severity									
kellegran Lawrence index for radiological severity	Less severe <11	Severe 11+	Total	Sensitivity	Specificity	PPV	NPV	Agreement	False (-)	False (+)
Cut off point =1										
Mild (1)	7	5	12	88.6	26.9	67.2	58.3	65.7	11.4	73.1
Severe (2-4)	19	39	58							
Cut off point =2										
Mild (1-2)	19	32	51	27.3	73.1	63.2	37.3	44.3	72.7	26.9
Severe (3-4)	7	12	19							
Cut off point =3										
Mild (1-3)	26	41	67	6.8	100	100	38.8	41.4	93.2	0
Severe (4)	0	3	3							
Total	**26**	**44**	**70**							

Table 7: Multiple regression model with Lequesne index score of clinical severity as the dependent (response) variable.

Variable	Regression coefficient β	p
• Constant	-0.36	0.94[ns]
• Male gender (compared to females)	-3.8	0.006
• Kellgren-Lawrence scale of radiological severity	1.5	0.02
• Age in years	0.13	0.04
• BMI (Kg/Mm^2)	0.08	0.36[ns]

P model = 0.005; R^2= 0.19: Equation: Lequesne score (Y) = -0.36 -(3.8Xmale) + (1.5X KL score) + (0.13 X age in years) + (0.08 X BMI)

Table 8: Multiple regression model with Kellgren Lawrence score for radiological severity as the dependent (response) variable

Variable	Regression coefficient β	p
• Constant	0.02	0.98[ns]
• Male gender (compared to females)	0.6	0.02
• BMI (Kg/Mm^2)	0.04	0.02
• Age in years	0.01	0.31[ns]

P model = 0.02; R^2= 0.13; Both regression models were statistically significant and were able to explain around 20% of variation in the dependent variable

DISCUSSION

The results of this study support the association of obesity as measured by BMI with definite knee OA. Most studies used BMI as the measure of obesity, although some used relative weight (7, 18, 19). Our results are similar to those of Davis *et al* (9, 10) and Hochbeg *et al (*20).

The discrepancy between radiographic and symptomatic OA account for differing results of epidemiological studies designed to define risk factors. OA is a disease defined by a constellation of histological features, but in epidemiological surveys the radiographic score has provided the diagnostic gold standard (5, 15, 18). The relation between radiographic changes of knee OA and symptoms is known to be poor (15, 18) and certain features which contribute to the radiographic diagnosis such as osteophytosis may relate more to aging than any disease (28).

In the present study the relation between KLOAI and LI was weak in the univariate model and not significant statistically (P>0.05) but when KLOAI entered the multiple regression equation as independent variable and after controlling for age, gender and BMI, for each unit increase in KLOAI the LI is expected to increase by a mean of 1.5 units which is significant statistically (P=0.02).

This study showed that patients with older age had a more severe LI, for each year increase in age, the LI is expected to increase by 0.1 unit when controlling for other variables which is also significant statistically (P=0.04). This result is similar to that of McAlindon *et al (*4).

Considering the effect of gender on LI, male has a significantly lower mean LI by 3.8 units (P=0.006) compared to female of similar age, BMI and radiological severity and this could explain why women are more likely to experience functional limitation that men. This result is consistent with that of other community survey studies (4).

This study found that only BMI has no obvious association with LI after adjusting for age, gender and radiological severity which is due to the problem of collinearity

We used LI as a measure of severity of knee OA because it is easy and quick to use, it reflected the pain and functional status of the patient independently from objective measurement and it has been validated and its reproducibility is satisfactory (27).

CONCLUSIONS

1. Obesity as measured by BMI was associated with definite knee OA.
2. Radiographic changes as measured by

KLOAI had significant correlation with severity of PKO as measured by LI.

3. Patients with older age had more severe PKO.

4. Males have lower severity of PKO than females.

5. LI can be used in daily practice to follow up the OA in weight bearing joints.

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