Relationship between radiologic gravity and predicting instruments of physical and mental health in elderly with knee osteoarthritis

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**Abstract**

**BACKGROUND:** This study aimed to investigate the relationship between radiologic severity by the grades of the Kellgren-Lawrence scale (K&Ls) independently and in two groups (grades "0 and 1" and "2 to 4") and instruments that assess depression symptoms, cognitive loss, risk of fall and quality of life related to knee osteoarthritis. **METHODS:** The analyzed materials were derived from a database and collected between 2013-2014 in Amparo (São Paulo, Brazil). 181 elderly with knee osteoarthritis who had a radiologic exam were evaluated for depressive symptoms, cognitive loss, quality of life and risk of fall by: Geriatric Depression Scale (GDS), Mini Mental State Examination (MMSE), WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index), Timed Up and Go test (TUG) and Berg Balance Scale (BBS). To statistical analyses was used Fisher’s exact test, Mann-Whitney test, Kruskal-Wallis test and Spearman's coefficient. **RESULTS:** There was no significant relationship between the instruments investigated and the grades assessed individually. However, when assessed by groups, grades “2 to 4” had the worst WOMAC score, the highest frequency and the worst risk of fall in the BBS, but not in the TUG. For GDS and MMSE, no significant relationships were found. In addition, K&Ls was correlated with the WOMAC score, with no differences between their domains. **CONCLUSION:** Only when evaluated in groups, the radiological scores of the Kellgren-Lawrence scale pointed to a worse status in the WOMAC and BBS and the WOMAC score accompanies the increase in the radiological grade.

**1. Introduction**

Knee osteoarthritis (KOA) is a chronic, and low-grade inflammatory form of arthritis that affects all the joint structures such as hyaline cartilage, synovial membrane, subchondral bone as well as other joint tissues, thus considered one of the main causes of physical disability in the elderly. The development and progression of KOA can lead to a joint impairment that can generate creaking, stiffness, edema, movement limitations, and increased levels of pain and risk of falling, compromising the individual's independence and autonomy, favoring the development of mental disorders and decreased quality of life (1–3).

Since KOA presents multiple characteristics, both morphological and symptomatic, its diagnosis and the monitoring of progression are based on positive joint symptoms and radiologic typical findings of the disease (4, 5) and its treatment must be based on a multifactorial approach (1, 2, 6). The symptoms of KOA and the typical alterations present in X-ray are not relatively dependent. In this sense, the radiological diagnosis of KOA is associated in the literature with instruments that assist in the identification of the symptoms of the disease, diagnosing symptomatic OA (4, 5).

For Felson (7) the more severe the radiological grade, by the Kellgren-Lawrence (K&L) scale, the greater the probability of presenting knee OA symptoms. This scale classifies radiological severity from 0 to 4 in relation to joint changes, such as the appearance of osteophytes, the narrowing of the joint space, sclerosis subchondral bone and deformities (8). In addition, higher radiological grades on the K&L scale are associated with the presence of depressive symptoms (9, 10), worse pain, stiffness and functional difficulty scores (9, 11, 12) and worse performance in functional tests predictive of fall risk (12, 13). Furthermore, the presence of mild cognitive impairment is associated with a higher incidence of KOA (14).

However, the non-association of radiological severity with the presence of depressive symptoms, pain, functional difficulty and the risk of falling has also been documented (15–19) and little has been explored about the relationship between radiological severity and cognitive loss in elderly people with KOA.

Therefore, it is not clear how the radiological severity determined by the Kellgren-Lawrence scale is related to instruments that measure mental health (depressive symptoms and cognitive loss), quality of life related to KOA (pain, stiffness and functional difficulty) and functionality (risk falls), such as the Geriatric Depression Scale, the
Mini Mental State Examination, the WOMAC questionnaire and the physical performance tests Timed Up and Go and Berg Balance Scale, respectively.

2. Materials And Methods

The data in this study was derived from an original database obtained by the study: “Comparative analysis of the epidemiological profile of the elderly in a community: a Cohort Study”, carried out in 2013-2014 in the municipality of Amparo - São Paulo, Brazil. It included individuals were selected amongst those registered in the Family Health Program (FHP-Amparo) and met the inclusion and exclusion criteria.

The Inclusion Criteria were: 60 years of age or older, fixed address in the city, radiologic examination referring to KOA; Have been assessed by all instruments included in this study. For the exclusion criteria were: Not having understood any of the questions or tests included in the evaluation protocols; Having undergone knee joint reconstruction surgery; Have physical or mental impairment, severe visual, auditory or cognitive impairment, incapacitating disease that prevented the performance of the proposed evaluations, such as cases of Parkinson's disease and neoplasia in terminal stage.

2.1 Assessment Instruments:

The instruments selected in this study are classificatory and assess radiologic severity, depressive symptoms, cognitive loss, risk of falling and quality of life (specifically for osteoarthritis). All questionnaires, tests and exams were applied by specialists: health agents, interviewers and doctors previously trained, during a single home visit to the elderly or during a visit to the FHP Amparo health unit. This project were approved by the local Research Ethics Committee under number: 05622818.6.0000.5404.

2.1.1 Kellgren-Lawrence scale: used to classify osteoarthritis based on radiographic evaluation. For the knee joint, radiography is performed in a posteroanterior projection with full extension of the joint. The classification of radiological severity is described in degrees ranging from zero to four (Grade 0 - Normal: no joint changes; Grade 1 - Suggestive: suggestive for the presence of osteophytes; Grade 2 - Mild: presence of small osteophytes and possible narrowing of the joint space; Grade 3 - Moderate: presence of osteophytes in large quantity and moderate size, narrowing of the joint space and possible deformation of the bony extremities; Grade 4 - Severe: presence of osteophytes in large quantity and size, severe narrowing of the joint space, sclerosis of the subchondral bone and bone deformity (8).

In the present study, all the X-rays were evaluated by two physicians, one radiologist and one rheumatologist, independently and blinded to the patients' clinical variables, increasing the reliability of the radiologic evaluation. The intraobserver and interobserver reliability was tested using the Kappa agreement coefficient.

2.1.2 Geriatric Depression Scale (GDS): It consists of a 15-question questionnaire with objective answers about how the elderly person felt in the last week that allows the identification of depressive symptoms. Positive answers are scored and the result is calculated by adding the questions together. The elderly person is considered to have a normal psychological condition of 0 to 5 points, indicating mild depression of 6 to 10 points or severe depression of 11 to 15 points (20).
2.1.3 Mini Mental State Examination (MMSE): It consists of a questionnaire used for cognitive screening to identify dementia (21). Each question has its own correction method and each score is scored. The maximum final score is 30 points, with 9 or less points indicating severe cognitive loss, 10 to 20 points moderate loss, 21 to 26 mild loss and 27 or more points indicating cognitive impairment (22).

2.1.4 WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index): this questionnaire for subjective assessment of quality of life for people with osteoarthritis consists of three domains: pain (five items), stiffness (two items) and physical activity (17 items). The possible answers are determined by the Likert scale: none (0), little (1), moderate (2), intense (3) and very intense (4). The WOMAC score represents the sum of the scores of the three domains, the values most refer to the condition related to pain, stiffness and functional difficulty: None = 0 (best status), Little: 25, Moderate: 50, Intense: 75, Very intense: 100 (worst state) (23,24).

2.1.5 Timed Up and Go Test (TUG): This test assesses mobility and dynamic balance in the elderly, and is also a predictive tool for the risk of falls. The subject is asked to get up from a chair and walk as quickly and safely as possible for 3 m, then return to the chair and sit in the starting position. The result is determined by the duration of the test, the faster the elderly person completes the task, the better the functional performance, while a longer duration of the test indicates a greater risk of falls (25,26).

2.1.6 Berg Balance Scale (BBS): this functional test assesses the risk of falls in the elderly based on static and dynamic balance based on 14 tasks of increasing difficulty. The score for each task ranges from zero to four points, with zero referring to the inability to perform the task and four referring to the ability to perform the task independently. The risk of falling is defined based on the sum of the task scores, being high: 0 to 36 points, moderate: 37 to 44 points and without risk: 45 to 56 points (27,28).

2.2 STATISTICAL ANALYSIS

To describe the profile of the sample according to the variables under study, frequency tables of categorical variables with absolute frequency (n) and percentage (%) values were performed. Descriptive statistics of numerical variables were also made with mean values, standard deviation, minimum and maximum values, median and quartiles. To compare the categorical variables between the radiologic grades determined by the Kellgren-Lawrence Scale, Fisher's exact test was used for variables with less than five categories.

Due to the absence of normal distribution of variables, the Mann-Whitney test for two categories and the Kruskal-Wallis test for three or more categories were used to compare the numerical variables between the grades of osteoarthritis. To analyze the relationship between numerical variables and grades of osteoarthritis, Spearman's correlation coefficient was calculated. The significance level of 5% (p <0.05) was adopted and the statistical analysis computer system used was: The SAS System for Windows, version 9.2. SAS Institute Inc, 2002-2008, Cary, North Carolina, United States of America.

3. Results

181 subjects were selected to participate in this study and had a mean age of 67.3 ± 6.8 years, with 56.35% being female and 43.64% male and are described as to the radiological severity in Table 1. The prevalence of females was 53.57% in the grades 0 and 1 group and 60.86% in the grades 2 to 4 group.
Table 1

Description of the sample by radiological gravity (K&L).

| Radiological Grade | 0   | 1   | 2   | 3   | 4   |
|--------------------|-----|-----|-----|-----|-----|
| Number of elderly  | 60  | 52  | 24  | 32  | 13  |
| Frequency (%)      | 33.15 | 28.73 | 13.26 | 17.68 | 7.18 |

Analyzing the K&L scale grades separated into two groups, classified by the presence (grades 2 to 4) or not (grades 0 and 1) of knee osteoarthritis (KOA) was observed on group 2 a 4 69 subjects and 112 on group 0 e 1, representing a frequency of 38.12% and 61.88% respectively.

Most of the population evaluated in this study had radiological grades not indicative of the presence of KOA. While a minority presented the diagnosis of the disease, with a predominance of grade 3 (moderate).

Table 2

Description of the sample regarding the performance in the evaluated tests (numerical variables).

| Variable | N   | Mean (SD) |
|----------|-----|-----------|
| GDS      | 181 | 6.89 (1.68) |
| MMSE     | 181 | 23.45 (3.98) |
| WOMAC    | 181 | 16.25 (21.4) |
| TUG      | 181 | 10.88 (4.74) |
| BBS      | 181 | 50.28 (6.65) |

The average scores on the GDS, MMSE and WOMAC tests point to a population considered to have a “mild” level for depressive symptoms and cognitive loss and a “low” level for the presence of pain, stiffness and functional difficulty. As for the risk of falling, the average scores in the TUG and BBS tests point to elderly people without risk.

3.1 Relationship between the instruments evaluated and the radiological grades of the Kellgren-Lawrence Scale.

When grades 0, 1, 2, 3 and 4 of K&L scale were compared independently to GDS, MMSE, WOMAC, TUG and BBS tests, no significant differences were observed for any of the categorical variables (Table 3). The same was observed in the comparative analysis in relation to numerical variables (Table 4).

Table 3

Comparison between grades of the Kellgren-Lawrence between categorical variables.

| Variable | Grade 0 (%) | Grade 1 (%) | Grade 2 (%) | Grade 3 (%) | Grade 4 (%) | p-Value* |
|----------|-------------|-------------|-------------|-------------|-------------|----------|

6
|        | 0-5   | 6-10  | 11-15 | 12-15 | 13-15 | 14-15 | 15-15 | 16-15 | 17-15 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| GDS    |       |       |       |       |       |       |       |       |       |
| p      | 0.988 |       |       |       |       |       |       |       |       |
| 0-5    | 9 (16.36) | 5 (12.50) | 6 (18.75) | 8 (20.00) | 2 (15.38) |       |       |       |       |
| 6-10   | 43 (78.18) | 35 (85.00) | 25 (78.13) | 30 (75.00) | 11 (84.62) |       |       |       |       |
| 11-15  | 3 (5.45) | 1 (2.50) | 1 (3.13) | 2 (5.00) | 0 (0.00) |       |       |       |       |
| MMSE   |       |       |       |       |       |       |       |       |       |
| p      | 0.774 |       |       |       |       |       |       |       |       |
| 0-9    | 1 (1.82) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |       |       |       |       |
| 10-20  | 9 (16.36) | 8 (20.00) | 7 (21.88) | 12 (30.00) | 3 (23.08) |       |       |       |       |
| 21-26  | 28 (50.51) | 22 (55.00) | 13 (46.88) | 22 (33.00) | 6 (46.15) |       |       |       |       |
| 27-30  | 17 (30.91) | 10 (25.00) | 10 (31.23) | 6 (15.00) | 4 (30.77) |       |       |       |       |
| WOMAC  |       |       |       |       |       |       |       |       |       |
| p      | 0.450 |       |       |       |       |       |       |       |       |
| 0-25   | 19 (31.67) | 18 (34.62) | 8 (33.33) | 5 (15.63) | 2 (15.38) |       |       |       |       |
| 26-50  | 29 (48.33) | 24 (46.15) | 12 (50.00) | 18 (56.23) | 4 (30.77) |       |       |       |       |
| 51-75  | 8 (13.33) | 6 (11.54) | 2 (8.33) | 5 (15.63) | 4 (30.77) |       |       |       |       |
| 76-100 | 4 (6.67) | 4 (7.69) | 2 (8.33) | 4 (12.50) | 3 (23.08) |       |       |       |       |
| TUG    |       |       |       |       |       |       |       |       |       |
| p      | 0.124 |       |       |       |       |       |       |       |       |
| 0-10   | 32 (53.33) | 28 (53.85) | 15 (62.50) | 19 (59.30) | 5 (38.46) |       |       |       |       |
| 11-20  | 27 (45.00) | 24 (46.15) | 9 (37.50) | 11 (34.38) | 6 (46.15) |       |       |       |       |
| 21-29  | 1 (1.67) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 2 (15.38) |       |       |       |       |
| 30-44  | 0 (0.00) | 0 (0.00) | 0 (0.00) | 2 (6.25) | 0 (0.00) |       |       |       |       |
| BBS    |       |       |       |       |       |       |       |       |       |
| p      | 0.061 |       |       |       |       |       |       |       |       |
| 0-36   | 3 (5.00) | 1 (1.92) | 2 (8.33) | 2 (6.25) | 3 (23.08) |       |       |       |       |
| 37-44  | 1 (1.67) | 2 (3.85) | 1 (4.17) | 4 (12.50) | 1 (7.69) |       |       |       |       |
The results suggest that when independently evaluated the radiological grades of the K\&L scale are not statistically related to any of the tests evaluated.

3.2 **Relationship between the instruments evaluated and the radiological grades of the Kellgren-Lawrence Scale divided into two groups.**

When comparing the grades of the K\&L scale classified into two groups “0 and 1” and “2 to 4” between the categorical variables, there was a significant difference for the BBS test, which showed a higher frequency of high and moderate grades 2 to 4 (Table 5). This data suggests that moderate and high risk of falling are significantly more frequent in elderly people with KOA.

### Table 5
**Comparative analysis between groups and categorical variables.**

| Variable | Group 0 and 1 | Group 2 to 4 | p-Value* |
|----------|---------------|--------------|----------|
| GDS      |               |              | p = 0.751|
| 0–5      | 14 (14.74)    | 17 (18.82)   |          |
| 6–10     | 78 (81.05)    | 67 (77.65)   |          |
| 11–15    | 5 (4.21)      | 3 (3.53)     |          |
|                          |       |       | p = 0.435 |
|--------------------------|-------|-------|-----------|
| **MMSE**                 |       |       |           |
| 0-9                      | 1 (1.05) | 0 (0.00) |           |
| 10-20                    | 17 (17.89) | 22 (25.88) |           |
| 21-26                    | 51 (52.63) | 43 (50.59) |           |
| >=27                     | 27 (28.42) | 20 (23.53) |           |
| **WOMAC**                |       |       | p = 0.275 |
| 0-25                     | 37 (33.04) | 15 (21.74) |           |
| 26-50                    | 53 (47.32) | 34 (49.28) |           |
| 51-75                    | 14 (12.50) | 11 (15.94) |           |
| 76-100                   | 8 (7.14) | 9 (13.04) |           |
| **TUG**                  |       |       | p = 0.169 |
| 0-10                     | 60 (53.57) | 39 (56.52) |           |
| 11-20                    | 51 (45.54) | 26 (37.68) |           |
| 21-29                    | 1 (0.89) | 2 (2.90) |           |
| >=30                     | 0 (0.00) | 2 (2.90) |           |
| **BBS**                  |       |       | p = 0.031 |
| 0-36                     | 4 (3.57) | 7 (10.14) |           |
| 37-44                    | 3 (2.68) | 6 (8.70) |           |
| 45-56                    | 105 (93.75) | 56 (81.16) |           |

* p-Value: Result related to Fisher's exact test.

The comparison between groups and categorical variables, showed a significant difference in the scores of WOMAC and BBS tests (Table 6). These data indicate higher levels of pain, stiffness, functional difficulty and risk of falling in elderly people with KOA than in elderly people without it.
Table 6
Comparative analysis between groups and numerical variables.

| Variable | Group 0 and 1 (N = 112) | Group 2 to 4 (N = 69) | p-Value* |
|----------|------------------------|----------------------|----------|
| GDS      | 6.97 (1.70)            | 6.80 (1.67)          | p = 0.298|
| MMSE     | 23.77 (3.84)           | 23.09 (4.13)         | p = 0.295|
| WOMAC    | 13.43 (18.76)          | 20.83 (24.57)        | p = 0.026|
| TUG      | 10.25 (2.86)           | 11.90 (6.65)         | p = 0.408|
| BBS      | 51.13 (5.96)           | 48.90 (7.49)         | p = 0.035|

*p-Value for the Mann-Whitney test.

3.3 Correlation between numerical variables and the grades of the Kellgren-Lawrence scale.

In the analysis of correlation between the numerical variables and grades of KOA (in the total sample and in the groups), a significant correlation was found for WOMAC (Table 7).

Table 7
Analysis of correlation between numerical variables and the grades of the Kellgren-Lawrence.

| Variable | Total Sample (N = 181) | Group 0 and 1 (N = 112) | Group 2 to 4 (N = 69) |
|----------|------------------------|------------------------|----------------------|
| GDS      | -0.03544               | 0.6367                 | -0.01559             | 0.8808                | 0.16215               | 0.1382               |
| MEEM     | -0.01185               | 0.8746                 | -0.07265             | 0.4841                | 0.05039               | 0.6470               |
| WOMAC    | 0.17099                | 0.0214                 | -0.02285             | 0.8110                | 0.22709               | 0.0606               |
| TUG      | 0.08274                | 0.2681                 | 0.00831              | 0.9307                | 0.20181               | 0.0963               |
| BBS      | -0.14007               | 0.0600                 | 0.04691              | 0.6234                | -0.15289              | 0.2098               |

*r = Spearman’s correlation coefficient; p = p-Value; N = number of subjects.

This result suggests that the higher the radiological grade of KOA, the higher the WOMAC result.

3.4 Comparative and correlation analyzes between the grades of the Kellgren-Lawrence and WOMAC domains.
Based on the results presented, possible significant differences between the WOMAC domains in the assessed population were investigated. For this purpose, the three WOMAC domains were compared between the independent grades and between the groups (0 and 1 and 2 to 4) (Tables 8 and 9).

Table 8
Comparative analysis between the WOMAC domains and the grades of the Kellgre-Lawrence.

| Domains         | Grade 0 (N = 60) | Grade 1 (N = 52) | Grade 2 (N = 24) | Grade 3 (N = 32) | Grade 4 (N = 13) | p-Value* |
|-----------------|------------------|------------------|------------------|------------------|------------------|---------|
| PAIN            | 5.18 (6.46)      | 4.55 (6.07)      | 5.76 (6.14)      | 4.10 (4.72)      | 7.23 (7.98)      | p = 0.430 |
| STIFFNESS       | 1.27 (1.81)      | 1.13 (1.83)      | 1.30 (1.76)      | 1.54 (2.14)      | 1.92 (2.60)      | p = 0.763 |
| FUNCTIONAL LIMITATION | 9.80 (15.03) | 7.45 (12.32)    | 9.03 (12.54)    | 10.92 (15.16)    | 16.31 (19.80)    | p = 0.505 |

* p-Value for the Kruskal-Wallis test.

Table 9
Comparative analysis between the WOMAC domains and the groups of Kellgren-Lawrence grades.

| Domains         | Group 0 and 1 (N = 112) | Group 2 to 4 (N = 69) | p-Value* |
|-----------------|-------------------------|-----------------------|---------|
| PAIN            | 4.92 (6.27)             | 5.22 (5.90)           | p = 0.430 |
| STIFFNESS       | 1.21 (1.81)             | 1.51 (2.06)           | p = 0.487 |
| Functional Limitation | 8.81 (14.04) | 11.01 (15.02)       | p = 0.205 |

* p-Value for the Mann-Whitney test.

Between the WOMAC domains and the grades of the K&L, no significant differences were observed when analyzed either independently or in groups.

Table 10 shows the correlation analysis between the WOMAC domains and the radiological grades in the total sample and in the division between groups. As a result, no significant correlations were found.
### 4. Discussion

The aim of this study was to evaluate the relationship between radiological severity by the grades of the Kellgren-Lawrence scale independently and divided into two groups: “0 and 1” and “2 to 4”, characterizing a “without” group and a group “with” radiological KOA and instruments that assess depressive symptoms, cognitive loss, risk of falling and specific quality of life for osteoarthritis in elderly individuals. This investigation stands out for independently evaluate the radiological grades of KOA by K&L scale, once the most common in the literature is the comparison of them in grouped grades, establishing or not the presence of radiological KOA. When assessed independently, the grades of the K&L scale are not related to depressive symptoms, cognitive loss, pain, stiffness, functional difficulty and risk of falling.

When assessing the presence or not of KOA (groups 2 to 4 and 0 and 1) in the tests related to mental health (GDS, MMSE) the groups evaluated obtained similar ratings, showing no significant differences between individuals with or without KOA. However, we should consider that most of the selected sample was classified in the GDS and MMSE tests with the presence of depressive symptoms and mild cognitive loss and being a cross-sectional study we cannot say that there is no relationship between the K&L scale and these questionnaires.

Regarding to the presence of depressive symptoms and the K&L scale, Kim et al. (9) observed that elderly people with symptomatic KOA (WOMAC > 39), had significantly higher scores in the GDS than those without symptoms and concluded that the presence of depressive symptoms is associated with an increased risk of having symptomatic OA, however this was only observed in the elderly with K&L grades from 0 to 3, but not with grade 4. Although this study suggests that there is a relationship between the GDS and the grades of K&L evaluated groups determined by the presence of symptomatic OA, differing from the type of analysis investigated here, which refers to the presence of depressive symptoms and their relationship with the severity of radiological OA.

For El Monaem et al. (10), the radiological classification of K&L is correlated with the emergence of depression in individuals with KOA assessed by the Beck depression inventory (BDI), indicating different results from ours in relation to depressive symptoms and radiological severity. This might be explained to used a different questionnaire, suggesting that there may be differences between them (GDS and BDI) and according to the findings to Bentz and Hall (29) GDS has more ability to correctly depression diagnosis than the BDI.

Regarding to cognitive losses and their association to K&L grades, divergences were found in relation to the results presented. The study by Yoshimura et al. (14) points to significantly lower MMSE score in individuals with radiological KOA (grade ≥ 2) than those without (grade 0 and 1). In addition, the incidence of radiological OA
decreases as the MMSE score increases, that is, once the individual performs better in relation to cognitive impairment. Similarly, the presence of cognitive losses were associated with a five times greater risk of incidence of radiological OA in individuals without the disease. However, there were no significant associations between the presence of cognitive impairment, MMSE score and knee OA progression, corroborating our results.

In addition, when comparing groups, we found that the risk of falling from high and moderate levels in BBS was more frequent in individuals with radiological OA than in individuals without. In addition, as well in the WOMAC as in BBS tests mean values were found that keep the groups in the same classification level, that is, in the WOMAC both groups are in the “Little” category and in the BBS in the “no risk” category.

Despite the groups belonging to the same level of classification, the difference in the mean between them points out to group “2 to 4” as worse than the group “0 and 1”, as it presents significantly higher values in WOMAC and lower values in BBS. In this sense, it is understood that even in good health regarding the level of pain, stiffness, functional difficulty and risk of falling, the elderly with radiological OA (grades 2 to 4) are more debilitated than those without OA (grades 0 and 1).

Kim et al. (13) indicated that patients with moderate and severe knee OA (grades 3 and 4) have worse functional performance in BBS than those considered to have mild OA (grade 2 or less), approaching our results. On the other hand, it is documented that individuals with a worse K&L classification also performed worse on the TUG (12, 13), which was not observed in our study. In the present study, the groups evaluated had similar performance in the TUG test, but unlike BBS, they did not show significant differences. Thus, it is shown that the TUG test and the K&L classification for knee OA when evaluated between groups are not related, which was previously observed in relation to the hip joint (19).

The divergence between the results of these instruments that assess the risk of falling can be justified by the sample evaluated, which was poorly classified in the high and moderate risk levels in the TUG and also due to BBS measures of static and dynamic balance in several tasks, while the TUG measures mobility (gait) and balance solely by a single task. Therefore, the complexity given by the “increasing difficulty” component and the number of tasks to be performed in BBS may have influenced the test difficulty for elderly people with KOA. However, it was expected that this population would have difficulty in the movements of sitting, standing and walking, due to the presence of osteophytes and the reduction of the joint space, to be morphological alterations that hinder the joint functionality.

Li et al. (12) points to the WOMAC as related to the radiological grade. A significant worsening in its score, as well as in the visual analog pain scale (VAS), is suggested by individuals with knee OA in grades 3 and 4, when compared to individuals with grades 0 to 2. These data are also similar to our findings.

According to Lethbridge-Cejku et al. (30), radiological changes resulting from knee osteoarthritis are significantly associated with the presence of pain. People with grades 3 and 4 have a higher proportion of recurrent pain than people with lower grades and there is a significant increase in this proportion of constant pain with punctuated changes in K&L scale, such as increased osteophyte size, greater narrowing of the joint space and presence of subchondral sclerosis. This result may justify the reason why an instrument that measures pain, such as WOMAC, is related to image examination. In addition, for Pereira et al. (31) the proportion of individuals who report higher levels of pain (measured by a specific questionnaire and referring to pain experienced in the last six months) is higher among those who are classified in grades ≥ 2 by the K&L scale.

On the other hand, for Creamer et al. (15) these joint changes and the functional difficulty measured by WOMAC are not correlated. However, for Szibenyi et al. (11) the probability of individuals with KOA to present pain or reduced function, assessed by WOMAC and VAS is greater if these changes occur in the tibiofemoral (medial and / or lateral) and patellofemoral compartments at the same time and not in only one of them, which was not evaluated by Creamer et al. (15). Furthermore, pain was more associated with subchondral bone sclerosis than with other changes in knee OA (11), the presence of subchondral lesions generates mechanical pain and is related to body weight support (32, 33) however for Ciccuttini et al. (34) the greatest association of pain is with the development of osteophytes (16). In this sense, it seems that the type of change identified by the K&L scale is more efficient in predicting pain and functional reduction than the grade score itself.
Unlike our findings, for Kumar et al. (19) the radiological classification, determined by the K&L scale and divided into the group with OA (grades 2 and 3) and without OA (grades 0 and 1), is not related to pain or function. However, these were measured for the hip joint, using the outcome assessment instrument for hip deficiency and osteoarthritis (HOOS), which also indicated the non-association between the radiograph and the other dimensions assessed (symptoms, activities of daily living and quality of life related to the hip joint). Thus, the different results can be explained by different assessment methods and a different joint.

On the correlation analysis between the grades of the K&L scale and the numerical variables, the results indicated the WOMAC as significant when a value the total sample. This result reveals the worsening of pain, stiffness and functional difficulty as the radiological grade increases. Corroborating the findings of Szebenyi et al. (11), who also found as a result the correlation between pain and function with the classification of the K&L scale for KOA. The VAS and WOMAC scores functioned as a subscale of the K&L scale in all grades (0 to 4). For Kim et al. (9) there is a significant correlation between the K&L classification, and the total score and all subscales of the WOMAC. In their study, 660 elderly people were investigated and they found that those with symptomatic KOA, classified by the WOMAC score > 39, obtained higher scores on the K&L scale than those without symptoms. Furthermore, as the radiological grades increased, the frequency of symptomatic OA became more prevalent.

On the other hand, other studies suggest that the WOMAC score and the radiological grades by the K&L are not correlated (16, 18). Unlike our study, they had most of their sample classified in grade 3. Still in our results, as presented in other studies, when comparing the three WOMAC domains between grades, the groups evaluated and the total sample, there were no significant differences or correlations (18, 35).

This study is a pioneer in the comparison between the independent degrees of the K&L scale and factors associated with KOA, such as depressive symptoms, cognitive loss, quality of life related to OA and risk of falling in elderly Brazilians. In addition, it assesses several factors associated with KOA in the same investigation. As limitations, this study presents a cohort selected for convenience, cross-sectional analysis and did not have all the instruments for assessing symptoms correlated with the topic in the literature for possible comparisons.

Further studies are suggested to better understand the relationship between the presence of depressive symptoms and cognitive loss and the radiological classification determined by the K&L scale. In addition, studies that understand the relationship between radiological severity and the risk of falling, measured by different instruments.

5. Conclusion

The radiological grades of the Kellgren-Lawrence scale, when evaluated independently, are not related to the assessment instruments GDS, MMSE, WOMAC, TUG and BBS. However, when evaluated by groups, individuals with established radiological KOA showed worse status in WOMAC and BBS than individuals with none or few radiological features in plain X-rays. In addition, WOMAC total score was correlated with the Kellgren-Lawrence scale, following the increase in the radiological grade, which does not occur with depressive symptoms, cognitive loss nor in risk of falling.

6. Abbreviations

K&L - Kellgren-Lawrence
GDS - Geriatric Depression Scale
MMSE - Mini Mental State Examination
WOMAC - Western Ontario and McMaster Universities Osteoarthritis Index
TUG - Timed Up and Go test
BBS - Berg Balance Scale
KOA – Knee Osteoarthritis
FHP – Family Health Program

7. Declarations

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Research Ethics Committee (CEP) of the State University of Campinas under number: 3,180,678, CAAE: 05622818.6.0000.5404. The information obtained by this study was derived from the database made possible by the study: “Comparative analysis of the epidemiological profile of the elderly in a community: a Cohort Study”, carried out in 2013-2014 in the municipality of Amparo in São Paulo - Brazil and approved by CEP under number: 387.026, CAAE: 19669313.13.6.0000.5404. Therefore, because it is a secondary analysis and because there is no contact or risk to the volunteers, the informed consent form (ICF) was waived.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS’ CONTRIBUTIONS

IBC and AMVC provided the use of a database from their original study; IBC and ICR developed this study and performed statistical analyzes, BLC and IBC read the included radiographic exams. All authors participated in the writing, reading and approval of the final manuscript.

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