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# CORELATION BETWEEN OBESITY, GONARTHROSIS AND RECOVERY PLAN EFFECTIVENESS

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**Abstract**

This paper is a comparative, interventional, longitudinal study in which we monitored the differences in functional outcomes in a series of patients with osteoarthritis of the knee according to BMI (Body Mass Index). The patients were divided into two groups: group 1 comprised 8 normal weight patients and group 2 comprised 9 obese patients. All patients received the same principles of treatment within up to 4 weeks of recovery. Scales and measurements such as VAS (Visual Analog Scale), BARTHEL (Barthel Index), LEQUESNE (Lequesne Algofunctional Index), WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) showed functional improvements in both groups analysed. However, higher improvements were observed, favouring normal-weight patients according to the statistical tests applied but also to the clinical results recorded. The results recorded by us support the necessity of approaching patients with knee osteoarthritis by a multidisciplinary team that is formed by the attending physician, physiotherapists and dieticians to also act on weight loss by reducing the excessive pressure at the lower level. The limitations of this work are given by the low number of subjects included in both groups, the different degree of gonarthrosis and the different treatment period.

## Introduction

Osteoarthritis (OA) is a pathology that affects a high number of people worldwide, causing disability manifested mainly by pain. This pain becomes chronic over time and becomes more persistent, affecting patients' quality of life [1]. The causes of OA are multifactorial and include: the natural ageing process, obesity, previous trauma, mechanical overload, but also genetics [2], [3], [4].

The initial treatment of knee osteoarthritis starts with conservative methods, failure of this treatment indicates the need for surgery [5]. Conservative treatment methods include: exercise, weight loss, pharmacologic therapy and the use of orthotics [6], [7]. Surgical treatment involves partial or total replacement of the joint and is indicated in the late stage of arthrosis when pain and loss of function are significant [8], [9].

The main objectives of the recovery plan are to reduce pain and maintain joint function, but these objectives cannot be achieved by a single therapeutic method, but by a combination of techniques that must be individualized according to the particularities of each patient [10], [11]. Nonsteroidal anti-inflammatory drugs (NSAIDs) and hyaluronic acid combined with platelet-rich plasma contribute to stiffness relief, improve physical function, and are viable solutions in the treatment of knee osteoarthritis [12], [13].

Weight loss is associated with slower long-term damage to articular cartilage in the knee joints, and current guidelines recommend weight loss as the mainstay treatment [14], [15].

A cohort study correlated the relationship between BMI and radiologic progression of gonarthrosis over 6.6 years, finding a positive correlation between high BMI (>27 kg/m2) and progression of knee osteoarthritis [16]. A systematic review tracked body mass index and susceptibility to gonarthrosis, concluding a significant association between BMI and the development of knee osteoarthritis [17].

The aim of this study was to monitor the differences in functional outcomes in knee osteoarthritis in normal and obese patients according to BMI, using conservative treatment.

**Material-method**

This study is a comparative, interventional, longitudinal study, as we evaluated the evolution of each patient following the application of the conservative recovery plan and compared the results of the two groups initially formed.

Each patient was informed about the purpose, duration, and conduct of the study and could withdraw at any time. All patients included in the study signed an informed consent form and agreed to actively participate.

This study was conducted at Stefan cel Mare University and partner clinics between July 15, 2024, and March 17, 2025, including 17 patients diagnosed with gonarthrosis.

The patients were divided into two different groups and benefited from an individualized recovery plan, according to their particularities. Group 1 included patients with a normal weight (8 patients), according to BMI, which is between 18.5 and 24.9. Group 2 included patients who were obese (9 patients), with a BMI over 30. Both groups consisted only of patients diagnosed with gonarthrosis or knee osteoarthritis.

The recovery plan included several basic principles, which were divided according to the stage of recovery. In the acute stage, which lasted an average of one week, we used methods and techniques aimed at reducing pain and inflammation. In the second stage (subacute stage), we focused on gradually regaining joint mobility, and in the last stage, we emphasized increasing strength, stability, and dynamic balance. The exercises and techniques used followed the principle of progressivity and were customized according to the principles mentioned above. The duration of the recovery plan varied from patient to patient, and the recovery plan did not exceed four weeks.

Initial and final measurements were taken at the beginning and end of recovery and included: weight, height, age, gender, knee mobility, thigh and calf circumference, as well as the VAS, BARTHEL, WOMAC, and LEQUESNE scales. These measurements were performed under the same conditions to minimize assessment errors and reduce the negative impact on the final results. The patients were explained the purpose of the study, its duration, and how to complete the scales for each sub-item.

The materials used in the study were as follows:
- Instruments that aided in the actual recovery: BTL-4820S combination device – with 2 electrotherapy channels and 1 channel with an ultrasound probe, BTL-4810L combination device – with a laser therapy probe, elastic band, medicine ball, wall bars, ergonomic bicycle, sandbags.
- Instruments for assessing progress: goniometer – used to assess joint range of motion, measuring tape – used to measure perimeters, scales – to assess each patient's weight, height gauge – used to measure patients' height, VAS scale – applied to assess the initial and final degree of pain, WOMAC index – used to assess the severity of symptoms and the impact of gonarthrosis on patients, BARTHEL scale – applied to assess essential activities of daily living, LEQUESNE index – used to assess the severity of knee osteoarthritis.

To interpret the data, we used the following tools:
- Microsoft Excel to organize the data;
- Descriptive statistics, including: mean, standard deviation, minimum, maximum, and T-test;
- Graphs and tables to observe the evolution of the monitored parameters.

**Results**

The results are presented in tables and include: mean, standard deviation, minimum, maximum, and T-test, performed on both groups analyzed, as well as anthropometric and demographic data necessary for characterizing the groups.

Table 1—Anthropometric and demographic data of patients

| Patients | AGE | Height (cm) | Weight (kg) | BMI | Effected Knee | Degree of Gonarthrosis |
|---|---|---|---|---|---|---|
| P1 | 72 | 154 | 101 | 42,6 | left | Grade 3 |
| P2 | 70 | 154 | 72 | 30,4 | right | Grade 2 |
| P3 | 58 | 152 | 57 | 24,7 | right | Grade 2 |
| P4 | 73 | 175 | 72 | 23,5 | right | Grade 2 |
| P5 | 55 | 183 | 75 | 22,4 | left | Grade 1 |
| P6 | 65 | 158 | 91 | 36,5 | right | Grade 2 |
| P7 | 23 | 164 | 64 | 23,8 | left | Grade 1 |
| P8 | 49 | 167 | 67 | 24 | left | Grade 1 |
| P9 | 55 | 165 | 98 | 36 | right | Grade 2 |
| P10 | 29 | 180 | 64 | 19,8 | right | Grade 1 |
| P11 | 75 | 157 | 60 | 24,3 | left | Grade 2 |
| P12 | 51 | 175 | 103 | 33,6 | left | Grade 2 |
| P13 | 56 | 150 | 56 | 24,9 | left | Grade 2 |
| P14 | 48 | 165 | 82 | 30,1 | right | Grade 1 |
| P15 | 54 | 175 | 94 | 30,7 | right | Grade 2 |
| P16 | 59 | 185 | 110 | 32,1 | right | Grade 2 |
| P17 | 45 | 200 | 120 | 30 | left | Grade 2 |

Table 1 presents the anthropometric data, affected knee, and degree of gonarthrosis for each patient. Most patients had grade 2 gonarthrosis, 5 patients had grade 1, and only one patient had grade 3 gonarthrosis. The affected knee was both left and right, and most patients were in the third age group.

Table 2 - Evolution of normal weight patients

| Parameter | Average | Standard Deviation | Min | Max | T- test |
|---|---|---|---|---|---|
| Age | 52,25 | 18,55 | 23 | 75 | |
| Height (cm) | 166 | 12,56 | 150 | 183 | |
| Weight (kg) | 64,38 | 6,78 | 56 | 75 | |
| BMI | 23,43 | 1,66 | 19,8 | 24,9 | |
| Joint assessment - initial | 102,5 | 10,69 | 88 | 120 | 0,00535 |
| Joint assessment - final | 111 | 12,68 | 95 | 130 | |
| Initial thigh circumference | 53,88 | 3,18 | 50 | 59 | 0,00113 |
| Final thigh circumference | 54,88 | 3,36 | 51 | 61 | |
| Initial calf circumference | 35,38 | 2,13 | 32 | 38 | 0,00620 |
| Final calf circumference | 36,25 | 2,19 | 33 | 39 | |
| Initial VAS scale | 7,63 | 1,30 | 6 | 10 | 0,0000005 |
| Final VAS scale | 3,38 | 1,60 | 1 | 6 | |
| WOMAC - initial | 53,5 | 14,73 | 34 | 76 | 0,00034 |
| WOMAC - final | 42,25 | 12,79 | 23 | 56 | |
| BARTHEL - initial | 86,88 | 12,23 | 70 | 100 | 0,00725 |
| BARTHEL - final | 91,88 | 9,23 | 80 | 100 | |
| LEQUESNE -initial | 4,13 | 1,36 | 2 | 6 | 0,00038 |
| LEQUESNE - final | 2,25 | 1,04 | 1 | 4 | |

Table 2 shows the evolution of normal-weight patients, where we can observe a significant improvement in functionality and symptoms experienced by patients. The average age of patients is 52.25, influenced by the inclusion of a 23-year-old patient in the study. The average BMI is 23.43 with a standard deviation of 1.66, and the maximum recorded is 24.9, which fits perfectly within the inclusion criteria we set for the study. The muscle balance and perimeters assessed initially and finally showed the favorable progress achieved during recovery, and the scales support the authenticity of the results obtained through anthropometric measurements. The T-test evaluated the initial and final averages of the results, and the differences were statistically significant for each sub-item analyzed, according to $p < 0.05$.

Table 3 - Evolution of patients with obesity

| Parameters | Average | Standard Deviation | Min | Max | T-test |
|---|---|---|---|---|---|
| AGE | 57,67 | 9,57 | 45 | 72 | |
| Height (cm) | 170,11 | 15,33 | 154 | 200 | |
| Weight (kg) | 96,78 | 14,34 | 72 | 120 | |
| BMI | 33,56 | 4,2 | 30 | 42 | |
| Joint assessment - initial | 93,67 | 10,75 | 73 | 103 | 0,00002 |
| Joint assessment - final | 105,22 | 10,92 | 90 | 120 | |
| Initial thigh circumference | 68,78 | 6,46 | 58 | 77 | 0,1411 |
| Final thigh circumference | 70,5 | 5,72 | 58,5 | 78 | |
| Initial calf circumference | 43,33 | 4,36 | 36 | 49 | 0,0007 |
| Final calf circumference | 44,11 | 4,37 | 36 | 50 | |
| Initial VAS scale | 7,22 | 1,64 | 5 | 10 | 0,00001 |
| Final VAS scale | 3,22 | 1,64 | 0 | 5 | |
| WOMAC - initial | 68,11 | 12,65 | 52 | 85 | 0,0041 |
| WOMAC - final | 58,22 | 11,27 | 45 | 79 | |
| BARTHEL - initial | 75 | 9,01 | 60 | 90 | 0,00002 |
| BARTHEL - final | 82,78 | 8,33 | 70 | 95 | |
| LEQUESNE -initial | 5,11 | 1,45 | 2 | 7 | 0,00003 |
| LEQUESNE - final | 2,67 | 1,22 | 0 | 4 | |

The evolution of patients with obesity is shown in Table 3. The average age of patients in group 2 is similar to that in group 1 for the same reason, but the height and BMI of patients are higher in group 2. Joint mobility was initially lower in obese patients, but following the recovery plan, they improved in this aspect; however, mobility did not improve as much as in group 1. The initially assessed perimeters are higher in obese individuals because they took into account muscle mass as well as fat mass in the thighs and calves. At the end of recovery, both the scales and the other parameters assessed were improved according to $p < 0.05$, but a higher improvement was observed in group 1, based on the differences in the analyzed means.

**Discussions**

Following the application of the recovery plan on individuals with a BMI classified as obese and on individuals with normal weight, we observed significant

improvements in joint mobility, muscle tone, pain, a reduced degree of impairment compared to the initial one, and a higher degree of independence in both groups analyzed. Patients with normal weight achieved better results in terms of mobility of the affected knee, a decrease in impairment according to the WOMAC scale, and a decrease in pain and severity of impairment felt by these patients compared to patients who were obese. Given the small number of patients analyzed and the multiple factors involved in recovery, we can assume that the results obtained may be slightly subjective.

A cohort study found a positive association between knee osteoarthritis and obesity BMI, with excess weight and a higher BMI being a risk factor for knee gonarthrosis [18]. Excessive mechanical stress on the joints leads to osteoarthritis, and the symptoms can be eliminated through weight loss. At the same time, the management of these patients should include physical therapy exercises combined with a personalized diet [19], [20]. Furthermore, a meta-analysis found that weight loss improves physical function, respectively the WOMAC score [21].

These studies demonstrate the need for weight loss in patients with obesity and beyond, in order to improve recovery management in knee osteoarthritis.

Knee mobility was assessed using a goniometer in both groups, with initial results suggesting an average of 102.50±10.69 in the normal weight group, and final results suggesting a much improved average mobility of 111.00±12.68, which is statistically significant, according to Table 2. In the group comprising obese individuals, the initial average is 93.6 ±10.75, and the final average is 105.22 ± 10.92, suggesting a considerable improvement in functionality at the end, but much lower compared to the normal weight group, according to Table 3. To restore knee mobility, we used passive, active, and a combination of mobilizations, which ultimately proved effective. The exercises were personalized and individualized according to each patient's potential, and the treatment principles applied to both groups were similar.

Muscle tone was assessed at the thigh and calf levels using a measuring tape. The initial and final results for both groups suggest an improvement or maintenance of muscle tone during treatment due to active exercises performed in the post-inflammatory stage, with statistically significant differences. Increased muscle tone in the lower limbs provides the necessary support to reduce stress on the joints and also improves dynamic stability and prevents sarcopenia, which can develop over time. The assessment performed with the measuring tape is subjective because it measures both fat mass and muscle mass in the lower limbs. The general trend was an increase in the measured perimeters, which may suggest an increase in muscle mass, given that the recovery period lasted up to 4 weeks and the patients benefited from constant muscle stimulation.

The pain experienced by patients was assessed using the VAS scale, which rates pain from 0 to 10. Patients in both groups had similar averages, minimums, and

maximums for these values at both the beginning and end of the study. Local pain and inflammation were treated with cryotherapy, physiotherapy, ultrasound therapy, phototherapy, and the PRICE method. Each patient received individualized therapy prescribed by the rehabilitation physician, who selected the most effective methods based on clinical analysis and consultation with specialized guidelines. The methods applied proved to be effective, and some patients no longer reported pain when walking or sitting.

The WOMAC scale analyzed the degree of impairment experienced by patients through a set of questions covering various topics such as pain, joint stiffness, and physical function. Patients who were obese achieved a mean difference of +14.61, with an initial score for this group of 68.11±12.65 and final measurements recording a score of 58.22±11.27, which was a satisfactory overall improvement, according to Table 3. The initial measurements in the group of normal-weight patients showed an average of 53.50±14.73, which was lower than in the other group, and the final assessments showed an improved average of 42. 25±12,79 according to Table 2. The initial reduction in inflammation, followed by exercises and physical therapy techniques such as FNP, active exercises, resistance exercises, and balance exercises, contributed significantly to improving the final score and implicitly favored a slowdown in the degenerative process.

In support of the WOMAC scale, we also used the LEQUESNE scale, which is a tool used to assess the severity of osteoarthritis. The differences between the two groups were significant, and this tool confirmed the positive evolution of patients detected with the WOMAC scale.

The therapeutic plan applied has as its objectives, in addition to improving functionality and quality of life, which is essential for all patients undergoing recovery. To quantify the level of independence of patients in daily activities, we used the BARTHEL scale, which covers topics such as personal hygiene, feeding, walking, and climbing and descending stairs. In the group of normal-weight patients, the initial score was 86.88±12.23, and the final score was 91.88±9.23, which shows a considerable improvement and a high degree of independence. The initial score in obese patients was 75±9.01, which is considerably lower, but the final results were satisfactory.

Analyzing the results of the two groups, we found that the therapeutic plan was effective and that the results were better for patients of normal weight, but at the same time, obese patients also recorded significantly better results compared to the initial ones. This reinforces the need to integrate people with gonarthrosis into a specialized rehabilitation center to improve their quality of life and restore joint function.

The limitations of this study are: the small number of subjects included in both groups, the different degrees of gonarthrosis among patients, and the different treatment periods from case to case. The strengths are represented by: the strict

division of patients into two groups and the exclusion of overweight patients, similar treatment principles in the case of gonarthrosis, and the number of measurements and scales used in the research.

The results obtained support the idea that a slight weight loss could significantly improve the benefits of recovery in patients with gonarthrosis. To alleviate symptoms and reduce mechanical stress on the joint, it is beneficial to combine physiokinesitherapy with a personalized nutritional plan for each patient.

**Conclusions**

The recovery plan applied to people with gonarthrosis proved to be effective according to the measurements taken during the study.

Both obese and normal-weight individuals showed improvement in joint mobility, muscle tone, WOMAC and BARTHEL scales, and a decrease in VAS and LEQUESNE scales, suggesting a better overall condition compared to the initial one.

The final results suggest a better improvement in functionality and a reduction in symptoms, leaning more towards normal weight patients. To the same extent, obese patients also achieved satisfactory improvement following the recovery plan applied.

Future studies should follow larger groups of patients and consider a multidisciplinary team-based intervention involving physical therapy and a personalized diet in order to provide patients with long-term positive effects.

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