# Medical exercise and physiotherapy frequency and compliance as predictors for a recurrence of chronic nonspecific low back pain

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# Abstract

Purpose

A considerable part of nonspecific low back pain patients suffer from a recurrence of symptoms after therapy cessation. The aim of this study was to evaluate the predictive value of active and passive treatments and treatment modalities on a recurrence of back pain after cessation of medically prescribed therapy.

Methods

Patients with unspecific low back pain from a health- and therapy-center were included. Treatments and treatment modalities as therapy measures were monitored and categorized as active or passive measures. During the year after therapy cessation, patients were monitored to retrieve information about recurrence of symptoms. Patients were dichotomized (recurrence versus no recurrence). An ROC-Analysis was used to determine optimal cut-offs for relevant treatment characteristics' impact on recurrence risk. The relative risk for a recurrence was calculated based on Chi 2 -test.

Results

Data from 96 patients (56f, 49±11 years) were analysed. A total of 34 patients had recurring back pain. The frequency of active treatment differed significantly between groups with or without recurrence. A therapy frequency of 1.45 active treatments/week was a sensitive cut-off (sensitivity: 0.73) to discriminate the recurrence groups. Participants with a therapy frequency of less than 1.45 treatments per week showed an 82% increased relative recurrence risk (RR: 1.824 (95%-CI: 1.077-3.087)).

Conclusions

The results empathize the importance of active treatments (i.e. exercise) in the therapy and (secondary) prevention of unspecific low back pain. Less than 1.45 active treatment sessions/week increases the 1-year-risk of a recurrence by 82%.


# Introduction

The etiology and underlying pathophysiological mechanisms of low back pain (LBP) are still poorly understood [1]. Anatomical correlates mostly fail to explain specific causes for LBP; associations between anatomical abnormalities found with x-ray or MRI and pain symptoms are relatively weak [2, 3]. Vice versa, many patients with diagnosed abnormalities (e.g. disc degeneration) show no LBP symptoms, while others with no present abnormalities experience back pain [2–4]. Further, psychosocial factors such as stress and anxiety seem to play an important role in the development of LBP [5].

In acute (0–6 week duration) low back pain, keeping a physically active lifestyle is effective to reduce pain symptoms [6]. Although the recovery rate in acute cases is up to 90% in the first 6 weeks [7], more

than 50% of all patients experience at least one recurrence in the 22 months after care seeking [8]. Exercise therapy (i.e. motor control exercise) was shown to be sustainable (1 year) in a recently published meta-analysis [9]. In a Cochrane review, the authors conclude that (medical) exercise therapy is suggested to be able to prevent recurrences of back pain [10]. These effects were shown in both acute and sub-acute (6–12 weeks of duration) patients, chronic patients were not included in this review. In chronic low back pain, comparable results are known from single studies: Recurrences low back pain were fewer in patients who maintained exercise therapy [11]. Exercise therapy thus may be effective for recurrence prevention in chronic low back pain patients, likewise. Beyond the recurrence preventive effects, exercise reduces pain and improves function in chronic (≥ 12/13 weeks duration, depending on the definition) cases to a greater extent than no treatment or passive measures [12–14]. In chronic cases, exercise is thus highly recommended.

In healthy adults, an exercise frequency of two to three times per week is recommended [15]. It is yet unknown, if 1), LBP patients outside a controlled study situation are able to perform at least two exercise sessions per week and 2) if this training frequency is also the best in terms of recurrence-risk reduction in LBP patients. The aim of this study was, consequently, to evaluate therapy frequency and compliance as predictors of recurrent episodes of unspecific low back pain during one year after exercise therapy cessation.

# Materials And Methods

Design and ethics

We adopted a prospective quasi-experimental prediction study. The study was conducted in accordance with the declaration of Helsinki with all its modifications. The protocol was approved by the local Ethics Committee of the Faculty of Psychology and Sport Science (Goethe-University Frankfurt).

Participants

Patients with (a) unspecific low back pain (duration ≥ 13 weeks) (b) and between 18–65 years of age were included into the study. Patients were prior to first medically prescribed treatment in an exercise- and physiotherapy practice at study initiation. Patients with a specific cause for LBP (trauma, vertebrae fractures, disc herniation etc.), any previous surgical procedure at the spine or lumbar region or other relevant diseases or conditions (neurologic conditions, joint replacements) were excluded from further analysis. All patients gave informed consent to study participation.

Measurements and data processing

All therapeutic modalities as well as the total treatment time were monitored (by the therapeutic staff) during study conduction. Therapeutic modalities were divided into active (active physiotherapy, medical exercise therapy) and passive (massage therapy, manual therapy, and thermotherapy) physiotherapeutic modalities. Physiotherapy consists of both active (up to non-extensive exercises) and passive (see

above) physiotherapeutic treatments[16]. Active and passive physiotherapy are usually supervised/provided by a physiotherapist, medical exercise therapy by a sports therapists/medical exercise therapists/athletic trainer. Medical exercise therapy was supervised and defined as exercises that “involves voluntary muscle contractions and/or body movement with the aim of relieving symptom”[17] .

Pain was assessed using a numeric rating scale (NRS 0–10 cm). Characteristic chronic pain intensity and disability was assessed by means of the Chronic Pain Grade questionnaire (CPG) [16]. The CPG assesses pain and disability for the past 3 months and allows a differentiation in the subscales pain intensity (PI: 0 = “no pain” to 100 = “the worst pain imaginable”), and disability (DS: 0 = “no disability” to 100 = “I was incapable of doing anything”) [18, 19].The incidence of recurrences was also continuously monitored for twelve months after the end of the therapy. A recurrence is given when a participant was seeking help or treatment in a medical clinic or practice due to low back pain. More precise, participants were asked if they suffered from a period of (low back) pain lasting for 24 hours or more and suffering from pain, sickness absence or disability in at least this time [20].

Therapy frequency was calculated as therapy sessions (active and passive physiotherapy, medical exercise therapy) per week during the entire treatment period. Patients were stratified by recurrence or no recurrence to investigate the interaction between therapy frequencies (both cumulated and separated per modality) and recurrence rates in non-specific back pain patients.

Statistics

Group differences were evaluated using non-parametric Wilcoxon comparisons. Using a Receiver Operating Characteristics (ROC) Curve, optimal cut-offs for active (physiotherapy and medical exercise therapy) and passive physiotherapy frequencies to identify increased recurrence risk were defined. Subgroups were analyzed using chi-square t-test and the relative Risk-Ratios for recurrence of symptoms were calculated. All analyses were performed after the initial checking for the underlying assumptions for parametric/nonparametric testing (distribution of data, variance homogeneity). An alpha error of < 5% was considered as tolerable for all analyses.

# Results

Overall, n = 416 patients with LBP symptoms were initially screened. From these, 278 were excluded because of specific causes for LBP (disc herniation, spondylolisthesis, fractures) or other relevant conditions (osteoarthritis, neurological disorders). N = 42 participants were dropped out during study conduction (28 incomplete datasets, 3 withdrew consent, 11 no reasons). Complete datasets (data of recurrence and training data) were processed for n = 96 patients (see Table 1). An overview on the detailed mean therapy frequencies of the entire sample is shown in Table 2.

Table 1
Descriptive characteristics of study sample and the corresponding therapy characteristics.

| **Parameter** | **n** |
|---|---|
| Female [n] | 56 |
| Male [n] | 40 |
| Parameter | Mean (SD) |
| Age [years] | 49 (11) |
| Treatment duration [d] | 90 (± 70) |
| Therapy sessions (total) [n] | 33.3 (28.0) |
| Treatment frequency (total) [sessions/week] | 3.0 (1.8) |
| Treatment frequency (active physiotherapy and medical exercise therapy) [sessions/week] | 1.84 (0.81) |
| Treatment frequency (passive physiotherapy) [sessions/week] | 1.15 (1.13) |
| n = number; SD = standard deviation | |

Table 2
Mean treatment frequencies of entire study sample

| **Therapeutic measure** | **Mean therapy frequency [sessions/week]** | **SD** |
|---|---|---|
| Medical exercise therapy | 0.70 | 0.71 |
| Active physiotherapy | 1.14 | 0.77 |
| Active therapy total | 1.84 | 0.81 |
| Manual Therapy | 0.44 | 0.66 |
| Massage | 0.28 | 0.52 |
| Hot Pack | 0.36 | 0.65 |
| Hot air | 0.04 | 0.18 |
| Passive physiotherapy total | 1.15 | 1.13 |
| SD = standard deviation | | |

Of the included patients, 34 had a recurrence. The frequency of the active treatments (physiotherapy and medical exercise therapy) differed significantly between patients with and such without a recurrence (1.6

± 0.7 vs. 2.0 ± 0.9 sessions/week; see Table 3 and Fig. 1). No other outcome was different between groups.

Table 3
Treatment and low back pain-specific group characteristics and corresponding statistical analysis (recurrence vs. no recurrence).

| Parameter | recurrence (mean ± SD) | Ø recurrence (mean ± SD) | p-value |
|---|---|---|---|
| Age [years] | 50.7 ± 10.4 | 47.9 ± 10.7 | .252 |
| Treatment duration [days] | 101.9 ± 85.9 | 83.5 ± 61.1 | .780 |
| Total therapy sessions [n] | 35.4 ± 32.6 | 32.2 ± 25.3 | .969 |
| Treatment frequency [sessions/week] | 2.8 ± 1.5 | 3.1 ± 1.9 | .440 |
| Treatment frequency (passive physiotherapy) [sessions/week] | 1.2 ± 1.3 | 1.1 ± 1.4 | .675 |
| Treatment frequency (active physiotherapy and medical exercise therapy) [sessions/week] | 1.6 ± 0.7 | 2.0 ± 0.9 | .037* |
| NRS [points], 0–10 | 3.7 ± 3.3 | 3.2 ± 2.8 | .808 |
| CPG Pain [a.u.], 0-100 | 63.3 ± 15.5 | 44.4 ± 19.0 | .225 |
| CPG function [a.u.], 0-100 | 38.7 ± 13.7 | 32.2 ± 22.7 | .687 |
| * = p < .05; n = number; NRS = numeric rating scale; CPG = chronic pain grading | | | |

The area under the curve (AuC) of the ROC Analysis for the factors recurrence and active therapy frequency showed a significant result (0.629 (95%-CI: 0.515–0.743), p = .0038). With a sensitivity of 0.73 and a specificity of 0.5, a cut-off of 1.45 active treatment sessions per week was determined (see Fig. 2).

Patients with a frequency of lower 1.45 active therapy sessions per week showed a significantly higher recurrence rate ($Chi^2$: 4.895, p < .05, see Table 4). They had an 82% increased recurrence risk (RR: 1.824 (95%-CI: 1.077–3.087)) during the 12 months after cessation of therapy.

Table 4
Contingency table and Chi² results of the active (physiotherapy and medical exercise therapy) therapy freequency-based dichotimisation.

| | | recurrence | | |
|---|---|---|---|---|
| | | no | yes | total |
| Active therapy frequency [sessions/week] | < 1.45 | 17 | 17 | 34 |
| | ≥ 1.45 | 45 | 17 | 62 |
| total | | 62 | 34 | 96 |
| Chi²: 4.895, p < .05 | | | | |

# Discussion

The results of the current study emphasize the importance of active physiotherapy and medical exercise therapy in the treatment and recurrence prevention in low back pain [7, 10, 21]. General recommendation of at least two training sessions per week could not always be accomplished by our sample. The group without recurring pain exercised more often than the group with a pain recurrence. No significant differences were found in any of the other relevant parameters (total number of treatment sessions, duration of treatment, pain or function at the beginning of treatment) between patients with or without recurrence. The results confirm current recommendations of two training session per week. That may encourages therapists and patients to accomplish these recommendations to prevent recurring LBP, likewise. The ROC analysis, in contrast, showed a sensitive cut-off at only 1.45 training session per week to detect patients with a higher recurrence risk. The relative risk for recurring back pain during twelve months was increased by 82% in the group with less than 1.45 sessions per week.

Additional passive measures, such as manual therapy, massage or thermotherapy do not seem to influence the recurrence risk. The effects of manual massage are described at biomechanical, neurological, endocrinological, physiological and psychological levels[22] and are recommended in acute cases and initially before the beginning of an active treatment approach [23]. It seems reasonable to use these passive treatment measures as an additional analgesic therapy, but they do not seem to positively influence long term outcomes [14]. Several underlying mechanisms could influence function and pain sensation through exercise in LBP patients [24], including muscle hypertrophy [25], exercise induced immune modulation[26, 27] neuronal adaptations[24] as well as improvement of mechanics in every-day, work related tasks [28]. However, on the base of the current data we cannot give clear recommendations about the concrete content of the active treatment. Recent reviews showed that, comparably to therapy itself, functional strengthening and motor control exercise are promising for recurrence prevention, likewise [29–31]. A more differentiated analysis of training methods and exercises was not possible due to the only handwritten and analog therapy documentation. Although that monitoring was undertaken

prospectively and not asked retrospectively, that must be considered as a limitation of our study. Some further limitations of this study should be addressed. Pain and functional restrictions were relatively low in the study sample. As we only included a single center may limits the transferability of our results. Additionally, difference concerning the health insurance (state vs. private insurance) could have influenced the results. Furthermore, we have not conducted an a priori sample size calculation. The sample size seems to be accurate for the between group analyses; larger sample sizes might, however slightly would have influenced our ROC findings.

In the course of the digitalization of therapy and training documentation, our findings are a promising starting point for further investigation. However, despite the assumedly heterogeneity of concrete training content, active (physio- and exercise) therapy frequency was the only significant predictor of pain recurrence. An active treatment approach with an appropriate therapy frequency – independent of concrete exercise content – seems thus to be successful in preventing recurrent LBP.

# Conclusion

Our results empathize the importance of an active treatment approach in therapy and prevention of unspecific low back pain. A therapy with less than 1.45 active treatment sessions/week increases the risk of a recurrence during one year by 82%. Patients with LBP thus might be encouraged to realize at least three exercise therapy sessions each two weeks.

# Declarations

### Ethics approval and consent to participate

The study was conducted in accordance with the declaration of Helsinki with all its modifications. The protocol was approved by the local Ethics Committee of the Faculty of Psychology and Sport Science (Goethe-University Frankfurt). All patients gave informed consent to study participation.

### Competing interests

The authors declare that there are no competing financial and/or non-financial interests in relation to the work described.

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### Authors' contributions

FK collected the data, wrote the first draft of the manuscript and approved the submitted version. He agreed both to be personally accountable for his own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

DN made substantial contributions to the conception or design of the work as well as to the acquisition, analysis, or interpretation of data and approved the submitted version of the manuscript. He agreed both to be personally accountable for his own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

WB made substantial contributions to the conception or design of the work and substantively revised and approved the submitted version of the manuscript. He agreed both to be personally accountable for his own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

LV made substantial contributions to the conception or design of the work and substantively revised and approved the submitted version of the manuscript. He agreed both to be personally accountable for his own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

### Data availability

The datasets analysed during the current study is available from the corresponding author on reasonable request.

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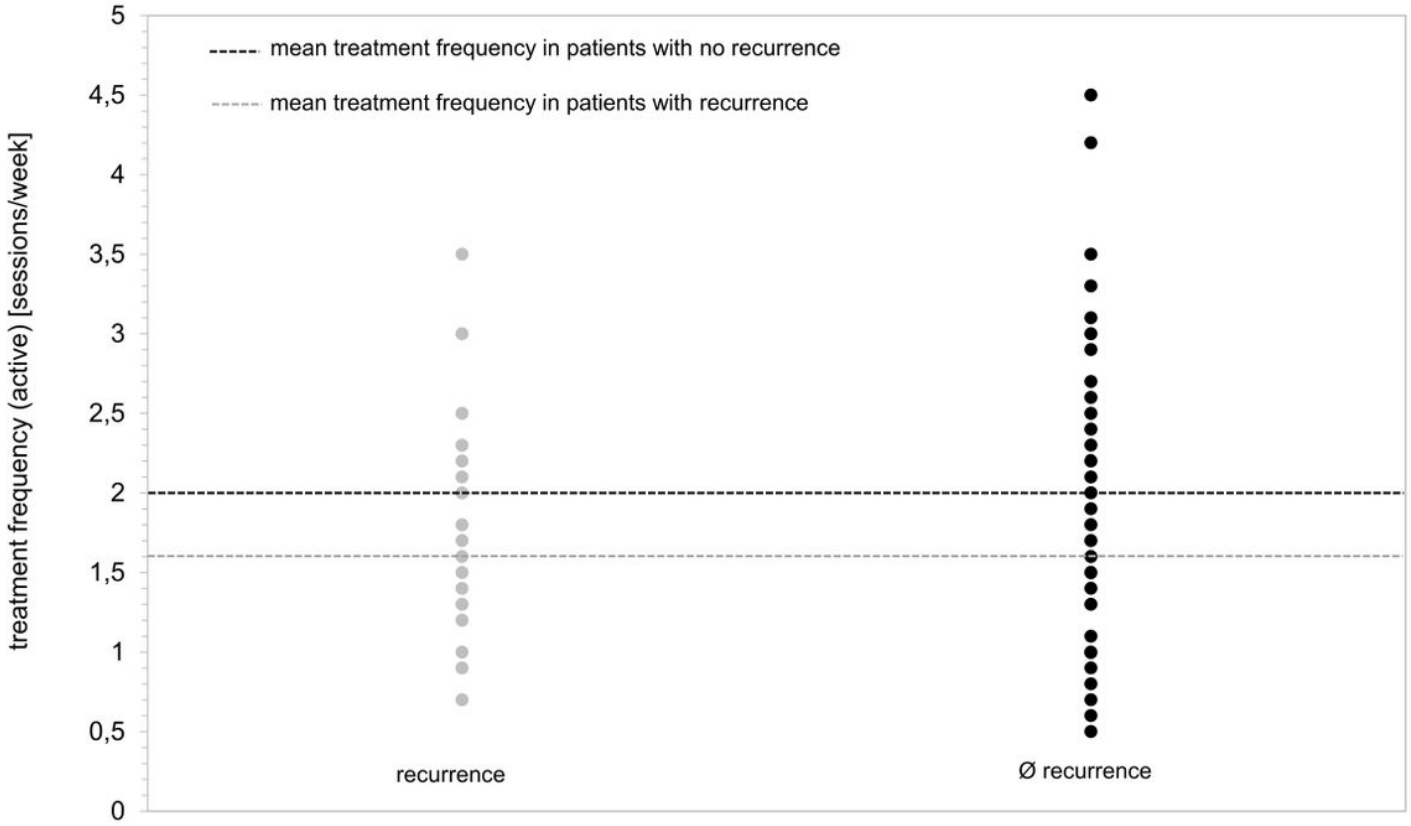
# Figures




## Figure 2

Individual active treatment frequencies [sessions/week] in patients with or without recurrence

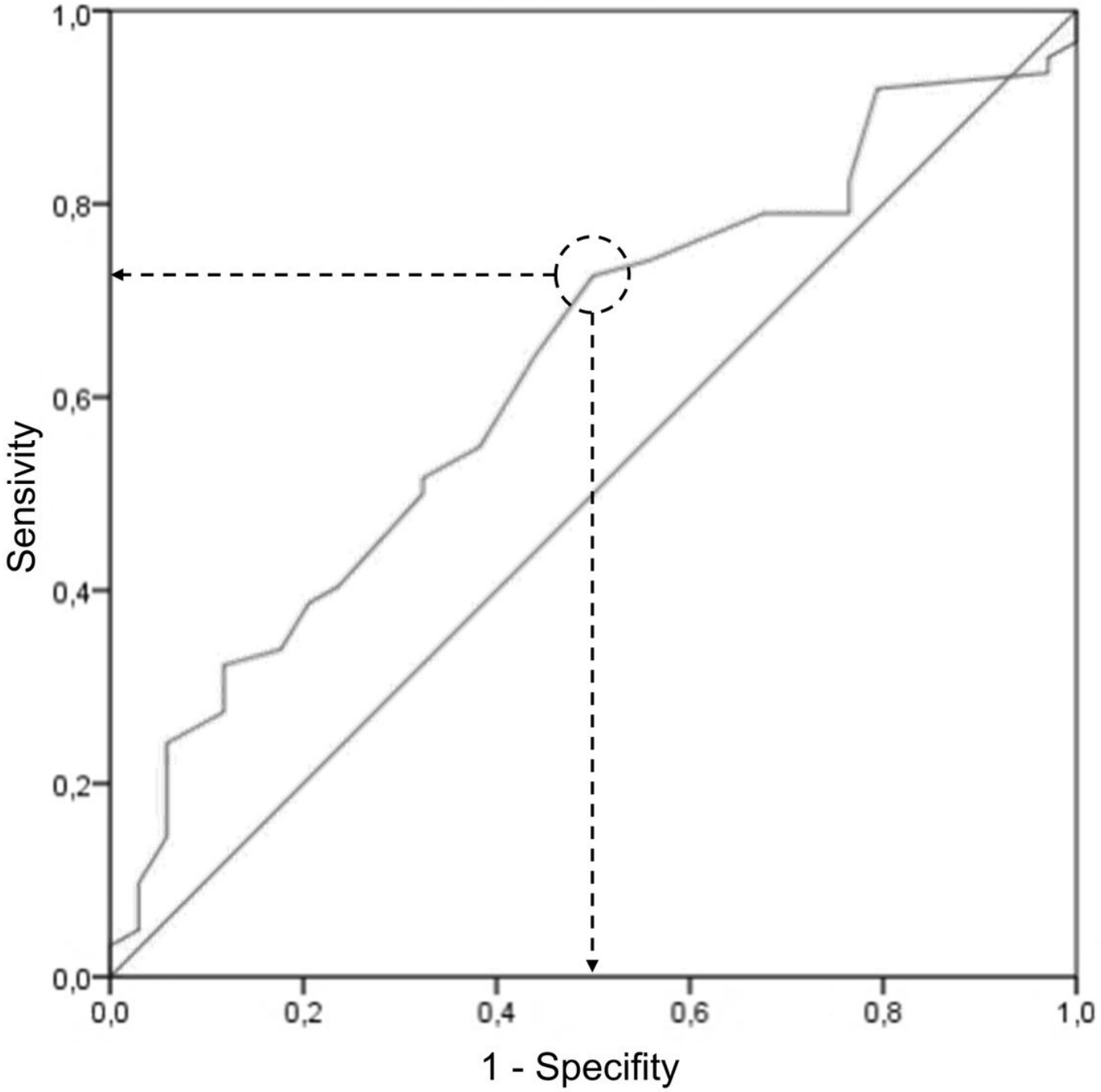



**Figure 4**

Graphic results of the ROC analysis