Is kinesiophobia associated with disturbances in dynamic balance in individuals with chronic non-specific low back pain?

A cinesiofobia está associada a distúrbios de equilíbrio dinâmico em indivíduos com dor lombar crônica não-específica?

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ABSTRACT

BACKGROUND AND OBJECTIVES: Chronic non-specific low back pain is a disabling condition that has a high worldwide prevalence. The aim of the study was to investigate the association between deficits in dynamic balance, age and body mass index (BMI), and kinesiophobia, as well as to establish a comparison between men and women.

METHODS: A cross-sectional study with 145 individuals between 18 and 50 years of age with non-specific chronic low back pain. Sociodemographic data were collected, and dynamic balance was assessed using the Y-Balance Test. The Tampa Scale was used to assess kinesiophobia. A linear regression was applied to investigate the association between kinesiophobia and a set of predictor variables (balance, gender, BMI). Men and women were compared using the Student's t-test (kinesiophobia and dynamic balance).

RESULTS: The overall mean kinesiophobia score was 41.3. The Y-Balance Test mean for the right and left lower limb, respectively, was 59.4 and 59.5. An association was found between kinesiophobia and two predictors: balance and BMI (R^2:6.8%). No significant differences were found between gender for kinesiophobia (42.1 for women and 40.3 for men). However, women had worse dynamic balance compared to men (mean reach of 56.1 versus 63.5, respectively; p<0.05).

CONCLUSION: Kinesiophobia was found to be associated with disturbances in dynamic balance and BMI of individuals with non-specific chronic low back pain. However, the model explained a small variation in kinesiophobia. Women showed worse dynamic balance compared to with men.

Keywords: Chronic pain, Low back pain, Postural balance, Age and gender distribution.

RESUMO

JUSTIFICATIVA E OBJETIVOS: A dor lombar crônica não-específica é uma condição incapacitante que possui alta prevalência mundial. O objetivo deste estudo foi analisar a associação entre déficits do equilíbrio dinâmico, idade e índice de massa corporal (IMC) e a cinesiofobia, além de realizar uma comparação entre homens e mulheres**.**

MÉTODOS: Este estudo transversal incluiu 145 indivíduos com idade entre 18 e 50 anos com dor lombar crônica não-específica. Foram coletados dados sociodemográficos. O equilíbrio dinâmico foi avaliado por meio do *Y-Balance Test*. A escala Tampa foi usada para avaliar a cinesiofobia. Aplicou-se uma regressão linear para investigar a associação entre cinesiofobia e um conjunto de variáveis preditoras (equilíbrio, sexo, IMC). Homens e mulheres foram comparados por meio do teste T de Student (cinesiofobia e equilíbrio dinâmico).

RESULTADOS: O escore médio geral de cinesiofobia foi de 41,3. A média do *Y-Balance Test* para o membro inferior direito e esquerdo, respectivamente, foi de 59,4 e 59,5. Verificou-se uma associação entre cinesiofobia e dois preditores, a saber, equilíbrio e IMC (R^2:6,8%). Não foram encontradas diferenças significantes entre sexo para cinesiofobia (42,1 para mulheres e 40,3 para homens). Entretanto, as mulheres apresentaram pior equilíbrio em comparação aos homens (média de 56,1 de alcance versus 63,5, respectivamente; p<0,05)**.**

CONCLUSÃO: Verificou-se que a cinesiofobia apresentou associação com distúrbios no equilíbrio dinâmico e IMC de indivíduos com dor lombar crônica não-específica. Entretanto, o modelo explicou uma pequena variação na cinesiofobia. As mulheres apresentaram um pior equilíbrio dinâmico em comparação aos homens.

Descritores: Dor crônica, Dor lombar, Equilíbrio postural, Distribuição por idade e sexo.

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INTRODUCTION

Low back pain (LBP) is defined as pain between the 12th thoracic vertebra and above the upper gluteal fold, with or without irradiation to the lower limbs[1,2]. It is worth noting that LBP can increase health care and social costs, mainly due to treatment and productivity losses[3,4]. Chronic low back pain (CLBP) is one of the main causes of absenteeism in Brazil[4], and it is one of the four main conditions that impose increases in years of life lived with disability in the world[5].

Disability related to CLBP is multifactorial and associated with cognitive, emotional, environmental and social factors[1,6-8]. Increased age and body mass index (BMI) are associated with increases in the prevalence of CLBP, and individuals aged between 50 and 59 years old have an approximately eight times higher risk of having CLBP when compared to individuals between 20 and 29 years[9].

Despite the biopsychosocial causal model, it should be noted that individuals with LBP have relevant physical manifestations, such as postural control deficits[10]. In this sense, postural control is characterized by the ability to maintain or return the body to a state of balance, and it depends on mobility and the ability to stabilize[11,12]. Individuals with CLBP may present movement instability and less muscle strength when compared to individuals without LBP[11,13,14]. A study[11] has shown that individuals with a history of LBP showed deficits in dynamic balance even after pain was resolved, which may increase the risk of recurrences. This aspect is relevant, because proprioceptive alterations in individuals with CLBP may cause postural balance disturbances[15-17].

In this context, kinesiophobia is characterized by irrational and debilitating fear of movement, arising from the belief of vulnerability to injury. However, other conditions, such as poor self-perception of health, pain intensity, depression, and anxiety may also be associated with kinesiophobia[7,18,19]. A previous study showed that quality of life, physical and social function, and pain were negatively associated with increased kinesiophobia scores in individuals with CLBP[19]. Thus, the hypothesis is that such changes could cause a gradual decrease in mobility and, consequently, a reduction in activity and participation in this population.

However, although the balance deficit is a clinical manifestation of individuals with CLBP, it is not clear whether there is an association with the fear of moving, and whether there are considerable differences between men and women. In this sense, understanding the association between kinesiophobia and possible balance deficits is relevant, because individuals with musculoskeletal pain may develop the fear that certain movements cause painful episodes and/or a recurrence of injury[20]. Individuals with LBP can develop avoidance behaviors and the belief that movements are linked to pain and, therefore, avoid movement, limiting their mobility[20].

Therefore, the objective of the present study was to investigate whether kinesiophobia is associated with a set of predictors in individuals with non-specific CLBP. Secondarily, the study aimed to compare kinesiophobia scores and dynamic balance between men and women.

METHODS

A cross-sectional observational study, characterized by the investigation of baseline data from a randomized controlled trial[21]. Data collection was conducted in a clinical setting between March 2019 and January 2020. The study was reported according to the recommendations of STROBE (Strengthening the Reporting of Observational Studies in Epidemiology Statement)[22].

Participants were recruited through social media announcement and calls in the community and rehabilitation clinics. Participants were included according to the following criteria: 1) young adults, male and female, aged between 18 and 50 years old; 2) residents of Brasília and administrative regions; 3) presenting a non-specific CLBP condition for more than 12 consecutive weeks.

The sample size calculation is presented in detail in another study, which indicated a total sample of 144 participants[21]. The sample size calculation has considered a statistical power of 80% and confidence interval of 95% to detect differences in pain intensity and disability between Pilates and home exercises. Standard deviation and mean pain intensity for Pilates was based on a previous study (3.30±2.30) and for home exercise on a pilot study (2.15±1.99). Standard deviation and mean disability were based on a pilot study (8.4±5.6 for Pilates and 13.6±13.6 for home exercise). The calculation indicated a sample size of 126 participants. Assuming a 15% dropout rate, it was determined that 144 participants would be needed (72 per group)[21]. After being included in the study, all participants underwent anamnesis.

Dynamic balance was evaluated by the Y-Balance Test (YBT). This test was performed in unipodal support, with the purpose of measuring the reach of lower limbs in three directions: anterior (A), posterolateral (PL), and posteromedial (PM). The data were normalized by the size of each individual's lower limb[23].

The test was applied using a wooden structure composed of a fixed base with three poles that allow movements in the A, PL, and PM directions. Each pole has a mobile base that is moved by the limb contralateral to the supporting limb. Three measurements were taken for each limb, in each direction. In the test interpretation, the farther the reach, the better the dynamic balance.

The test result was calculated as a percentage using the following equation:

$$\text{Composite Score} = \frac{(A + PL + PM)}{(3 \times \text{limb length})} \times 100$$

The Tampa scale, translated and validated for Brazilian Portuguese, measured kinesiophobia[24]. The scale evaluates the excessive, irrational and debilitating fear of performing movements, and it is composed of a self-administered questionnaire with 17 questions. Each question has four possible answers: "totally disagree", "partially disagree", "partially agree" and "totally agree". To obtain the final score, it is necessary to invert the

scores of questions 4, 8, 12, and 16, with the minimum score being 17 points and the maximum 68. The higher the final score, the higher the degree of kinesiophobia.
The study was approved by the Institutional Ethics Committee, CAAE: 64255917.7.000, and the participants were invited to participate by signing the Free and Informed Consent Term (FICT).

Statistical analysis
Data were analyzed using the SPSS version 25.0 software. Initially, the normality assumptions were verified using the Shapiro-Wilk test, indicating normality of the kinesiophobia and balance variables. The age and BMI variables (scores) were non-parametric.
Data were analyzed descriptively through mean and standard deviation, median and interquartile range, and frequency measures (%). For the non-parametric variables, the 95% confidence interval was estimated using the bootstrapping procedure with 1000 samples. Regarding the participants' BMI description, the individuals were classified as eutrophic (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), and obese (greater than or equal to 30 kg/m²)[25].
A multiple linear regression analysis was performed to estimate the association between the kinesiophobia score (dependent variable) and a set of predictors (independent variables), including only continuous variables with normal distribution. Predictors were dynamic balance measure (reach distance in cm), gender (reference category: female) and BMI classifications (dummy variable, considering eutrophic as the reference). The collinearity and homoscedasticity assumptions were confirmed in the exploratory analysis, respectively, through analysis of the correlation matrix and measures of tolerance and variance inflation factor (VIF), and analysis of the residuals. The model fit was verified by the AIC (Akaike's information criterion).
In order to compare the kinesiophobia score and the dynamic balance measurement between men and women, the Student's t test for independent samples was applied. The significance level was set at 5% ($p<0.05$), with a 95% confidence interval.

RESULTS

Table 1 presents the data of the participants characterization. The study included 145 individuals, 81 women (55.9%) and 64 men (44.1%).
Table 2 presents the data regarding the regression analysis. Kinesiophobia was found to be explained by a set of two significant predictors (YBT performance and BMI classified as obese). The remaining predictors were not significant and did not contribute to the model (Table 2).
The data showed that increases in kinesiophobia were associated with decreased reach on the YBT (worse performance) and obese individuals showed decreased kinesiophobia scores compared to eutrophic individuals.

Table 2. Data regarding the regression analysis between kinesiophobia (dependent variable) and the gender, body mass index (BMI), and dynamic balance (composite YBT) predictors

Kinesiophobia R: 0.261 R^2: 0.068	Coefficient		CI95%		p-value
	B	SE	LB	UB	
Intercept	52.99	4.01	45.07	60.93	-
Gender					
Male	-0.71	1.41	-3.49	2.08	0.615
Female‡	-	-	-	-	-
IMC:					
Overweight	-3.14	1.83	-6.76	0.47	0.087
Obese	-4.01	1.75	-7.47	-0.54	0.024
Normal‡	-	-	-	-	-
Composite YBT	-0.14	0.06	-0.26	-0.03	0.017

YBT = Y-Balance Test; B = parameter estimate coefficient; SE = standard error; 95%CI = 95% confidence interval; LB = lower bound; UP = upper bound. ‡Reference categories in the model.

Table 1. Characteristics of the study's participants, stratified in female and male genders. Data are presented by mean (standard deviation) for parametric variables (kinesiophobia and YBT) and median and interquartile range (BMI and age)

	General		Female		Male	
		CI95%		CI95%		CI95%
Age (years)	38.0 (15.0)	36.0 - 39.0	38.0 (17.5)	35.0 - 41.0	37.0 (12.8)	34.0 - 39.0
BMI (kg/m²)	28.7 (13.4)	27.1 - 30.5	29.2 (13.1)	26.9 - 31.7	27.9 (14.5)	26. - 31.7
BMI (n - %*)						
Eutrophic (18.5-24.9 kg/m²)	37 (25.5)	-	21 (25.9)	-	16 (25.0)	-
Overweight (25-29.9 kg/m²)	44 (30.4)	-	24 (29.6)	-	20 (31.2)	-
Obese (≥30 kg/m²)	64 (44.1)	-	36 (44.5)	-	28 (43.8)	-
Kinesiophobia (17-68)	41.3 (8.2)	39.6 - 42.7	42.1 (8.1)	40.2 - 43.9	40.3 (8.3)	38.3 - 42.4
Composite YBT (%)						
Right side	59.4 (12.9)	57.3 - 61.5	56.1 (11.5)	53.5 - 58.6	63.5 (14.5)	59.9 - 66.7
Left side	59.5 (12.3)	57.5 - 61.5	56.1 (11.1)	53.7 - 58.6	63.4 (12.6)	60.2 - 66.5
YBT between R/L	59.4 (12.3)	57.4 - 61.5	56.3 (11.1)	53.9 - 58.8	‡63.4 (12.7)	60.2 - 66.5

BMI = body mass index; YBT = Y-Balance Test; 95%CI = 95% confidence interval.
*Percentage value in reference to the total of each column; ‡Significant difference compared to women: $p<0.01$.

As presented in table 1, the comparison between men and women showed that kinesiophobia scores were similar (mean difference of 1.8 and 95%CI [-0.9; 4.5]; p>0.05). However, the study found that women had a lower reach on the YBT, indicating worse balance compared to men (mean difference of -7.03 and 95%CI [-10.94; -3.13]; p<0.01).

DISCUSSION

The present results showed that a lower reach on the YBT and the obese category were associated with kinesiophobia. Nevertheless, such findings should be analyzed with caution, considering that the shared variance was only 6.8% (R^2). Furthermore, women presented lower reach scores on the YBT compared to men.

Additionally, increased kinesiophobia was found to be associated with worse dynamic balance, confirming the initial hypothesis of the study. However, the comparison with previous studies shows that this association is still conflicting. For example, authors[26] have verified a significant association between kinesiophobia and mobility and balance disorders in elderly people with LBP. On the other hand, another study[27] has showed that there were no differences between dynamic balance and the degree of kinesiophobia in economically active individuals with chronic pain. Another study showed[28] that, although there was no correlation between kinesiophobia and dynamic balance, a good proprioceptive ability was considered beneficial for individuals with pain, as it could decrease the generalized fear of the condition.

It is worth noting that previous studies[11,29] have shown reduced reach on the YBT in individuals with LBP when compared to individuals without pain. Thus, it is possible to assume that the fear of moving may be a factor that influences dynamic balance, considering the apprehension when performing dynamic tasks. However, the present study's findings must be interpreted with caution, considering that the regression model explained only 6.8% of the variation in the participants' kinesiophobia. According to study[30], such findings could be explained by the fact that pain has a greater impact on balance, on the other hand, their data showed that fear of pain during movement seems not to be enough to change body sway.

Another factor that could explain the present findings is self-efficacy, which is a predictor of recovery and is related to the psychosocial sphere and physical performance of individuals with LBP[31]. Authors[31] have shown that individuals with LBP who had a lower level of self-efficacy had greater pain intensity, lower torso range of motion, and worse postural stability.

The second significant predictor in the regression model was the BMI category classified as obese. Obese individuals had a decrease of approximately 4 points in the kinesiophobia scale when compared to eutrophic individuals. Although authors[32] had also shown an association between Kinesiophobia and BMI, their findings indicated that obese individuals had higher Kinesiophobia scores when compared to non-obese individuals.

Similarly, another study[33] showed that high BMI, age above 45 years, and sleep disorders can be considered as propensity factors for the development of LBP. However, a study[34] opposes these interpretations, as its findings have shown that increased age and obesity did not have a direct impact on the occurrence of LBP, but were considered as factors that make it difficult to perform some activities of daily life and can prolong the recovery time of these individuals. This aspect must be considered, since it is supposed that a 4-point difference in the kinesiophobia scale is not clinically relevant. Indeed, a previous study carried out with individuals with LBP in Italy who underwent rehabilitation showed that the minimally important change in the total score of the Tampa scale was approximately of 5.5 points[35].

It is worth highlighting that the biopsychosocial model advocates that LBP is multifactorial and complex, and depends on the interaction of several factors. Thus, it is important to emphasize that the fear of moving can be explained by factors other than BMI. Considering this complexity of associations, it is recommended that further research should be designed through the use of comprehensive scientific theory-based models, such as the use of Directed Acyclic Graphs (DAG) associated with structural equation modeling[36].

Significant differences in YBT reach between men and women were found, indicating worse dynamic balance in women. The study[37] investigated differences between men and women with nonspecific CLBP in postural control and the association between pain, disability, and fear of moving. Overall, the study found no considerable differences between men and women for the variables investigated. Nevertheless, the findings showed that women had a slower reaction time compared to men. In addition, greater pain intensity was associated with longer reaction time and lower speed only in women[37]. These findings suggest that women have a worse strategy for pain coping, which may reflect the dynamic balance disorders. This aspect is relevant, because the study[38] showed that, among the population investigated, women with higher pain intensity had a higher degree of kinesiophobia, disability, fatigue and problems in daily activities, such as carrying materials.

However, it is worth noting that, from the perspective of the comparison performed in the present study, a difference of approximately 7% was found between the performance of women compared to men in the YBT. Therefore, it is important to ponder that such a difference is not clinically important and that other factors should be considered. For example, the disability assessment of individuals contextualized by the International Classification of Functioning, Disability and Health (ICF)[39] showed that activity and participation domains, such as maintaining body position, carrying objects, and changing body position, were the most affected. Furthermore, the findings showed that gender had a greater influence in certain activities, such as women's restrictions in home activities[39]. Also, another study[40] observed that, when women with chronic pain have the same pain intensity as men, they have a better activity level, pain acceptance and social support, while men have greater kinesiophobia and mood disorders.

The absence of a group of participants without LBP is one limitation of the present study. This reference group would have favored a better comprehension about the impact of the presence of pain on the analyzed variables.

CONCLUSION

The present study showed that kinesiophobia had an association with dynamic balance disorders and BMI in individuals with nonspecific CLBP. However, the model explained a small variation in kinesiophobia and interpretations need to be made with caution. From a clinical point of view, the present findings show that the assessment of dynamic balance and kinesiophobia are relevant, but also complementary, and other variables should be considered. Additionally, it was found that women with LBP had worse dynamic balance when compared to men, which suggests the need for specific interventions in this population.

AUTHORS' CONTRIBUTIONS

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