

Communication

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Communication

Comparison of Clinical Characteristics between Responders and Non-Responders to Hamstring Stretching in Individuals with Chronic Low Back Pain

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Abstract: Hamstring muscle (HM) flexibility is frequently compromised in people with chronic low back pain (CLBP), contributing to disability and leading to a less favorable recovery. In a previous article, we presented the results of a study on the immediate effect of passive HM stretching on flexibility in 90 people with CLBP. There was considerable variability in the changes after stretching. The objective of this supplementary analysis was to compare the clinical characteristics of individuals who experienced a significant improvement in flexibility with those who did not. We fixed a threshold of 7° to indicate an improvement in passive Straight Leg Raise (SLR) angle and differentiate between 'Responders' and 'Non-responders' to passive HM stretching. Only Body Mass Index differed between groups; it was significantly smaller in Responders ($p=0.007$). The majority of Non-responders experienced workplace accidents, but this was of marginal difference compared to Responders ($p=0.056$). Further studies should consider a broader clinical analysis with a larger sample size to understand which factors influence the HM stretching response in CLBP patients.

Keywords: hamstring muscle; chronic low back pain; stretching

1. Introduction

Hamstring muscle (HM) flexibility is frequently compromised in people with chronic low back pain (CLBP), contributing to disability and leading to a less favorable recovery.[1–3]. In a previous article, we presented the results of a study on the immediate effect of passive HM stretching on flexibility in 90 people with CLBP [4]. The improvement in HM flexibility following one-minute passive stretching was statistically significant, with the Straight Leg Raise (SLR) angle showing a mean improvement of 7° (95% CI 5.5 to 8.6°, $p<0.001$, ES: 0.42-0.44), Active Knee Extension angle showing a mean improvement of 4° (95% CI 2.4 to 5.1°, $p<0.001$, ES: 0.23-0.24) and Fingertip-to-Floor distance showing a mean improvement of 2cm, (95% CI 1.7 to 3.0cm, $p<0.001$, ES=0.20). Furthermore, there was considerable variability in the changes after stretching; substantial improvements occurred in some individuals, whereas others exhibited minimal or no change. From a clinical perspective, understanding the reasons behind the different responses to passive HM stretching in people with CLBP is very important. The objective of this supplementary analysis was to compare the clinical characteristics of individuals who experienced a significant improvement in flexibility with those who did not.

2. Materials and Methods

The original study was approved by a local ethics committee (Comité de Protection des Personnes – Ouest 1, Identifier: 2020T2-01_RIPH2 HPS_2019-A03000-57) and informed consent was obtained from all participants. A detailed description of the study methods, measurement, and intervention procedure was presented in a previous article. [4]. In the present supplementary analysis we divided the participants into two distinct groups based on the mean improvement in SLR angle of the less flexible lower limb and the previously estimated Minimal Detectable Change [4]. We fixed a threshold of 7° to indicate an improvement in passive SLR angle and differentiate between 'Responders' and 'Non-responders'. Additionally, we performed a correlation analysis between clinical characteristics and the improvement in the passive SLR angle in Responders, Non-responders, and all participants.

Continuous data were expressed as mean and standard deviation. The assumption of normality of the distribution was analyzed using the Shapiro-Wilk test. Comparisons between groups (Responders vs. Non-responders) were performed using the chi-squared or Fisher's exact tests for categorical data. Student t-test or non-parametric Mann-Whitney test (when the assumptions of the t-test were met) were used for the comparisons concerning continuous variables. Relationships between continuous data were analyzed using Pearson or Spearman correlation coefficients, depending on the statistical distribution.

A sensitivity analysis was also performed to guaranty the robustness of findings considering a threshold of 6° to 8° to indicate an improvement in the passive SLR angle and to differentiate between 'Responders' and 'Non-responders'.

Statistical analyses were performed using Stata 15 software (StataCorp, College Station, USA). All tests were two-tailed, with a type I error set at 0.05.

3. Results

After 1 minute of passive stretching, the improvement in SLR angle was equal to or exceeded 7° in 28 participants (31%) (Responders); the change was less than 7° (Non-responders) in 62 participants (70%). We found no statistically significant differences in any of the clinical characteristics analysed between the Responders and the Non-responders except for body mass index (BMI), which was greater in the Non-responder group. The results also showed that of the 90 participants, 17 had experienced a workplace accident. The majority of these individuals (n=15, 88%) were in the Non-responder group; however, this difference was marginal (p=0.056). (Table 1)

Table 1. Comparison of clinical characteristics between Responders and Non-responders.

	Responders	Non-responders	<i>p value</i>
Number and percentage of participants	28 31%	62 70%	
Age [years]	45.6 ± 8.9	43.8 ± 9.2	0.372
Men	16 (30%)	37 (70%)	0.822
Women	12 (32%)	25 (68%)	
BMI [kg/m²]	25.2 ± 5.5	28.1 ± 5.7	0.007*
Education level:			
No diploma	0 (0%)	1 (100%)	0.152
Less than baccalaureate	13 (30%)	30 (70%)	
Baccalaureate level	8 (25%)	24 (75%)	
Higher education studies	7 (58%)	5 (42%)	
Type of work:			
Sedentary	9 (43%)	12 (57%)	0.214
Physical	11 (23%)	36 (76%)	
Mixed	7 (37%)	12 (63%)	
Living environment:			
Urban	19 (31%)	43 (69%)	0.887
Rural	9 (32%)	19 (68%)	

Active smoking			
Yes	10 (27%)	27 (73%)	0.644
No	18 (34%)	35 (66%)	
Workplace accident			
Yes	2 (12%)	15 (88%)	0.056
No	26 (36%)	47 (64%)	
Time since pain onset [months]	73.9 ± 97.5	84.1 ± 88.9	0.295
Pain before stretching			
VAS [0-100]	36.8 ± 21.8	38.2 ± 22.5	0.877
Pain after stretching			
VAS [0-100]	40.5 ± 21.6	42.7 ± 23.8	0.835
Pain change			
VAS [0-100]	3.7 ± 12.6	4.0 ± 18.1	0.605
ODI	34.4 ± 14.2	34.4 ± 12.0	0.785
FABQ Physical Activity	14.6 ± 5.4	14.2 ± 6.3	0.949
FABQ Work	25.0 ± 11.3	28.5 ± 10.6	0.193
HADS Anxiety	10.1 ± 3.8	10.1 ± 3.5	0.953
HADS Depression	7.9 ± 3.1	8.1 ± 3.3	0.728

Data are n (%) or mean ± SD. BMI, Body Mass Index; VAS, Visual Analogue Scale; ODI, Oswestry Disability Index; FABQ, Fear-Avoidance Beliefs Questionnaire; HADS, Hospital Anxiety and Depression Scale; * $p<0.05$; 'Responders' were defined as those with an improvement of $\geq 7^\circ$ in Straight Leg Raise angle after stretching and 'Non-responders' as a change $<7^\circ$.

Furthermore, moderate statistically significant correlation between BMI and the improvement in the passive SLR angle in Responders was found ($r=0.44$, $p<0.05$). There were no others statistically significant correlations. (Table 2.) A sensitivity analysis considering a threshold of 6° to 8° of improvement in the passive SLR angle to differentiate between Responders and Non-responders revealed very similar distributions between the groups. Specifically, using a 6° threshold identified 33 Responders and 57 Non-responders, while a 8° threshold identified 25 Responders and 65 Non-responders. In both cases, only the BMI differed significantly between the groups. Using a 6° threshold, the BMI was 28.1 ± 5.9 in Non-responders compared to 25.7 ± 5.2 in Responders ($p=0.03$). Using an 8° threshold, the BMI was 27.8 ± 5.8 in Non-responders compared to 25.7 ± 5.5 in Responders ($p=0.05$).

Table 2. Correlations between improvement in passive Straight Leg Raise angle and clinical characteristics.

	All participants (n=90)	Non-responders (n=62)	Responders (n=28)
Age	0.10	-0.04	0.11
BMI	-0.15	0.05	0.44*
Time since pain onset	-0.16	-0.10	-0.13
Pain VAS before stretching	0.03	0.08	0.10
Pain VAS after stretching	0.03	0.05	0.15
Pain VAS change	0.05	0.00	-0.02
ODI	-0.13	-0.10	0.07
FABQ Physical Activity	0.07	0.10	0.08
FABQ Work	-0.07	0.16	0.31
HADS Anxiety	-0.09	-0.23	0.03
HADS Depression	-0.10	-0.14	-0.01

BMI, Body Mass Index; ODI, Oswestry Disability Index; VAS, Visual Analogue Scale; FABQ, Fear-Avoidance Beliefs Questionnaire; HADS, Hospital Anxiety and Depression Scale; * $p < 0.05$; 'Responders' were defined as those with an improvement of $\geq 7^\circ$ in Straight Leg Raise angle after stretching and 'Non-responders' as a change $< 7^\circ$.

4. Discussion

We performed this supplementary analysis to identify clinical differences between Responders and Non-Responders to passive HM stretching, however only BMI differed between groups; it was significantly smaller in Responders. The reason for the effect of BMI on stretch efficacy is not obvious.

Anxiety has been shown to be more frequent in people with obesity or overweightness than in the general population [5]. Anxiety could potentially reduce the capacity to relax muscles during stretching and thus reduce stretching efficacy. In addition, higher levels of fear of movement have been reported among people with CLBP and obesity compared to those without obesity [6]. However, we found no correlation between Hospital Anxiety and Depression Scale (HADS) and Fear-Avoidance Belief Questionnaire (FABQ) scores and improvement in flexibility [4], suggesting that other factors may play a role in the BMI and stretching effect relationship. On the other hand, the application of stretching force on the HM by the therapist requires greater effort in individuals with obesity or overweight due to the increased mass of the lower limb. This, in turn, may influence the effectiveness of the stretching. Yet, in the Responders improvement in passive SLR was correlated with higher BMI, indicating that the influence of BMI on the stretching effect could be more complex. Despite a marginal difference ($p = 0.056$), the results showed that of the 90 participants, 17 had experienced a workplace accident, and the majority of these individuals ($n = 15$, 88%) were in the Non-Responder group. Workplace-related factors are known to impact the recovery of patients with CLBP; therefore, a workplace accident could indeed influence the stretching effect [7].

The interpretation of this supplementary analysis is limited by the sample size; a much larger sample size would be required to draw robust conclusions for such a group-based analysis. However, we can state that varying the choice of threshold used to distinguish between the groups revealed similar results. Therefore, it should not be considered a source of bias in this study. The hypothesis of the initial study was that psychosocial factors would impact stretching efficacy [4], but the overall and group-based analyses revealed no relationship between these factors. The question of why HM flexibility improves after HM stretching in some individuals can therefore not simply be explained by psychosocial characteristics evaluated by the FABQ and HADS questionnaires. Other clinical factors like state of lumbar degenerative changes, flexibility of other muscles (ex. piriformis, erector spinae, hip adductors), and neurodynamics issues need to be considered. In the presence of pain, muscles in the posterior chain may contract simultaneously during stretching [8], which may prevent effective stretching of the HM. Furthermore, the SLR does not only stretch the HM; therefore, its amplitude may be limited by other anatomical structures. One study found that increases in HM flexibility measure could be achieved through myofascial release techniques applied to the posterior muscle chain but not specifically the HM [9]. Therefore, it is important to thoroughly examine the individual to find the cause or causes of the reduced SLR angle. None of the participants presented radicular pain. Therefore, it is unlikely that the stretching effect was limited by radicular pain. However, some participants had degenerative changes within the intervertebral disc or a history of radicular pain that might have influenced neurodynamics, even in the absence of evident radicular symptoms. These conditions could potentially impact the effectiveness of stretching [10]. Future studies should take the above factors into account in order to explain why some CLBP patients improve HM flexibility while others do not. In conclusion, the only clinical factor found to relate to a positive response to HM stretching was a low BMI.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Dataset available on request from the authors.

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References

1. Ekedahl, H.; Jönsson, B.; Frobell, R.B. Fingertip-to-Floor Test and Straight Leg Raising Test: Validity, Responsiveness, and Predictive Value in Patients with Acute/Subacute Low Back Pain. *Arch Phys Med Rehabil* **2012**, *93*, 2210–2215, doi:10.1016/j.apmr.2012.04.020.
2. Sadler, S.G.; Spink, M.J.; Ho, A.; De Jonge, X.J.; Chuter, V.H. Restriction in Lateral Bending Range of Motion, Lumbar Lordosis, and Hamstring Flexibility Predicts the Development of Low Back Pain: A Systematic Review of Prospective Cohort Studies. *BMC Musculoskelet Disord* **2017**, *18*, 179, doi:10.1186/s12891-017-1534-0.
3. Sassonker, K.; Magnezi, R.; Moran, D. Comparing Right and Left Hamstring Flexibility and Its Association to Nonspecific Low Back Pain among Women of Different Age Groups. *J Bodyw Mov Ther* **2023**, *36*, 404–409, doi:10.1016/j.jbmt.2023.07.014.
4. Dobija, L.; Pereira, B.; Cohen-Aknine, G.; Roren, A.; Dupeyron, A.; Coudeyre, E. Immediate Effect of Passive Hamstring Stretching on Flexibility and Relationship with Psychosocial Factors in People with Chronic Low Back Pain. *Heliyon* **2023**, *9*, e19753, doi:10.1016/j.heliyon.2023.e19753.
5. Amiri, S.; Behnezhad, S. Obesity and Anxiety Symptoms: A Systematic Review and Meta-Analysis. *Neuropsychiatr* **2019**, *33*, 72–89, doi:10.1007/s40211-019-0302-9.
6. Vincent, H.K.; Omli, M.R.; Day, T.; Hodges, M.; Vincent, K.R.; George, S.Z. Fear of Movement, Quality of Life, and Self-Reported Disability in Obese Patients with Chronic Lumbar Pain. *Pain Med* **2011**, *12*, 154–164, doi:10.1111/j.1526-4637.2010.01011.x.
7. Ia, S.; C, M.; E, I.; N, O.; S, P.; D, V.E.; Q, M.; S, H.-J. Systematic Review of Prognostic Factors for Return to Work in Workers with Sub Acute and Chronic Low Back Pain. *Journal of occupational rehabilitation* **2017**, *27*, doi:10.1007/s10926-016-9666-x.
8. Weisman, M.H.S.; Haddad, M.; Lavi, N.; Vulfsons, S. Surface Electromyographic Recordings after Passive and Active Motion along the Posterior Myofascial Kinematic Chain in Healthy Male Subjects. *Journal of Bodywork and Movement Therapies* **2014**, *18*, 452–461, doi:10.1016/j.jbmt.2013.12.007.
9. Fauris, P.; López-de-Celis, C.; Canet-Vintró, M.; Martin, J.C.; Llurda-Almuzara, L.; Rodríguez-Sanz, J.; Labata-Lezaun, N.; Simon, M.; Pérez-Bellmunt, A. Does Self-Myofascial Release Cause a Remote Hamstring Stretching Effect Based on Myofascial Chains? A Randomized Controlled Trial. *Int J Environ Res Public Health* **2021**, *18*, 12356, doi:10.3390/ijerph182312356.
10. Shacklock, M. Clinical Neurodynamics. A New System of Musculoskeletal Treatment. In *Clinical Neurodynamics. A new system of musculoskeletal treatment*; 2005 ISBN 978-83-7609-016-0.

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