REABILITACIJOS MOKSLAI
Slauga, kineziterapija, ergoterapija
LITHUANIAN SPORTS UNIVERSITY

Reabilitacijos mokslai: slauga, kineziterapija, ergoterapija, *1*(32) 2025, 22–33, eISSN 2538-8673; DOI: https://doi.org/10.33607/rmske.v1i32.1599

Acute Effects of Foam Rolling on the Contractile Properties of Back Muscles in Active and Sedentary Women

Ligita Mažeikė*, **Greta Bačiūnaitė, Laura Žlibinaitė**

Kauno kolegija Higher Education Institution, Faculty of Medicine, Department of Rehabilitation, Kaunas, Lithuania
* Correspondence: ligita.mazeike@go.kauko.lt; Tel. +370 693 95 292

Abstract

Background. Foam rolling, a form of myofascial release, is widely used in sport, physical therapy, and fitness to address muscle tightness, improve performance, and enhance recovery. Tensiomyography (TMG) provides valuable insights into muscle properties in active and sedentary women.

Aim. To evaluate the acute effect of foam rolling on the contractile properties of the back muscles as measured by TMG and to compare the responses between active and sedentary women.

Methods. Sixteen healthy women (22.00 ± 0.55 years), eight active and eight sedentary, participated in this study. Participants performed a single 15-minute foam rolling session targeting erector spinae and trapezius muscles. Muscle contractile properties: maximal radial displacement (Dm) and contraction time (Tc), were assessed using TMG before and immediately after intervention.

Results. In sedentary women, Tc decreased in the left upper ($p = 0.03$) and lower trapezius ($p = 0.01$), while Dm improved in the lower left trapezius ($p = 0.003$) and right erector spinae ($p = 0.03$). In active women, Tc decreased in the right upper trapezius ($p = 0.03$) and the right erector spinae ($p = 0.01$), with improvements in Dm in the left upper ($p = 0.001$), left lower ($p = 0.03$), and right lower trapezius ($p = 0.04$). Between groups, Tc reduction in the right erector spinae was greater in active women ($p = 0.08$).

Conclusions. Foam rolling improved contraction time and reduced stiffness of the back muscles in both groups; however, mechanical improvements were superior in active women.

Keywords: back muscles; contractile properties; foam rolling; tensiomyography; TMG

1. INTRODUCTION

Foam rolling (FR), a commonly used myofascial release technique, has gained substantial attention in recent years due to its accessibility and practical benefits (Glänzel et al., 2023). Its growing popularity can be attributed to factors such as cost-effectiveness, ease of application, and time efficiency. Moreover, the technique closely resembles traditional massage therapy, which has been shown to improve athletic performance and promote recovery (Ozden & Yesilyaprak, 2021; Nakamura et al., 2021a). While FR is widely utilised by elite athletes, evidence suggests that its benefits extend beyond sport settings, offering positive outcomes for the general population as well. It has been advocated to improve pain threshold (Fijavž et al., 2024), flexibility (Konrad et al., 2023), skeletal muscle oxygenation (Soares et al., 2020), reduce arterial stiffness (Lee & Lee, 2021), decrease muscle stiffness (Schroeder et al., 2021), and improve sympathovagal balance (Lastova et al., 2018).

This therapeutic approach involves the use of rolling motions of the body mass on a firm and inflexible foam cylinder, targeting a specific muscle or area of interest (Voglar & Grandovec, 2022). Although FR is frequently characterised in literature and clinical settings as a self-myofascial release technique, the clear mechanism of its benefits remains uncertain (Nakai et al., 2023). Various factors such as psychological (enhanced well-being or placebo effects due to increased plasma endorphins), physiological (increased blood flow, parasympathetic circulation and inflammatory responses), neurological (alterations in mechanoreceptor, proprioceptor, and pain receptor activity), and biomechanical (diminished tissue adhesion, modified tissue stiffness, and thixotropic responses) have been studied (Glänzel et al., 2023), but the clear effect on tissue stiffness has yet to be determined. Tissue stiffness refers to the ability of tissue to resist deformation or elongation when subjected to an applied force (Baumgart et al., 2019). Even a single FR intervention can increase the range of motion and force transmission (Nakamura et al., 2021b; Voglar & Grandovec, 2022), and the effect can remain for more than 30 minutes (Monteiro et al., 2018).

In recent years, tensiomyography (TMG) has emerged as a versatile and highly reliable non-invasive tool for assessing skeletal muscle contractile properties, including contraction velocity, stiffness, muscle fatigue, fibre type, responsiveness, and other biomechanical parameters (Hanney et al., 2022). The contraction time (Tc) and maximal radial displacement (Dm) are the most analysed parameters of the TMG method. The results of Tc and Dm correlate significantly with isokinetic dynamometry (Toskic et al., 2019). The Tc parameter is an indicator of muscle ability to contract at fast rates and is associated with fatigue and type of muscle fibres, with higher values indicating a high level of fatigue or predominance of slow-twitch muscle fibres, and vice versa (Buoite Stella et al., 2024). The Dm parameter fully represents muscle tension, stiffness, contractile force (Tabaković et al., 2024), and fatigue (Piqueras-Sanchiz et al., 2024). The decrease in Dm indicates increased muscle stiffness, whereas higher values are associated with reduced muscle tone (Buoite Stella et al., 2024). However, the degree of correlation between peak moment, Tc, and Dm tends to decrease as the level of physical activity increases (Toskic et al., 2019).

Lack of physical activity and increasing prevalence of sedentary behaviour can cause a wide variety of adverse health effects (Anderson & Durstine, 2019). Reduced physical activity leads to functional and conditional decline, characterised by muscle imbalance, weakness, and decreased flexibility, which can contribute to chronic musculoskeletal disorders (Roren et al., 2023). The association between a sedentary lifestyle and low back pain is attributed to factors such as muscle fatigue from prolonged core muscle contractions, elevated intradiscal pressure, and weakening of posterior lumbar structures (Lee et al., 2022). Prolonged periods of static postures, especially in sitting, may contribute to musculoskeletal disorders in the lower back by increasing muscle tension and maintaining a shortened position of the muscles in the lumbar region (Kett et al., 2021).

A study investigating the differences in mechanical and contractile properties of knee joint flexor and extensor muscles between differently trained men and women revealed that individuals with different levels of physical activity generally exhibit similar levels of muscle stiffness and muscle contraction velocity (Toskić et al., 2022). However, current evidence on the effects of FR is not sufficient and creates a gap in the question of whether this observation can be applied to the back muscles and how it might be implemented into practice. Despite its extensive use in rehabilitation and sport settings, there is a limited understanding of the influence of FR on the mechanical properties of myofascial tissue, specifically stiffness. The aim of this study was to evaluate the acute effect of FR on the contractile properties of back muscles measured by TMG and to compare responses between active and sedentary women.

2. METHODS

Participants. The study involved 16 healthy young women (mean age 22.00 ± 0.55 years; weight 61.10 ± 4.92 kg; height 168.80 ± 4.35 cm; BMI 21.40 ± 1.25 kg/m2). Based on the level of physical activity, participants were assigned to two groups: physically active (n = 8) and sedentary (n = 8). The inclusion criteria for physically active women were as follows: regular practice of any non-professional sport activities, exercise at least 150 min/week. The inclusion criteria for sedentary women were sedentary employment and not engaging in physical activity for ≥ 150 min/week. Individuals were excluded if they had any wounds or burns in the back region or if they reported a history of neuromuscular disease and musculoskeletal injury involving the back. The baseline characteristics of the participants are presented in Table 1. The required sample size for the study, calculated by power analysis (G*Power 3) of predicted changes in TMG following FR, with α error = 0.05, and power = 0.80, was 16 participants.

All participants provided written informed consent after being fully informed regarding the procedures, protocol, aims, and possible risks of this study. Participation in the study was voluntary. The study complied with the requirements of the Declaration of Helsinki and was approved by the Institutional Human Research Ethics Committee (Protocol No. 1/22/23).

Table 1. **Baseline characteristics of the participants**

	Physically active group (n = 8)	**Sedentary group (n = 8)**	**P**
Age, yrs	21.40 ± 0.50	22.60 ± 0.60	0.17
Height, cm	169.30 ± 4.90	168.30 ± 3.10	0.40
Weight, kg	62.30 ± 4.70	59.90 ± 5.13	0.64
BMI, kg/m^2	21.70 ± 1.20	21.10 ± 1.30	0.41

Procedure. Participants were instructed to refrain from engaging in any physical exercise and fascia treatment that could induce fatigue for a period of 48 hours prior to testing. All measurements were performed in a closed and ventilated laboratory, with a temperature range of 20–22 °C. The mechanical properties of the back region muscles (upper trapezius, lower trapezius, and erector spinae) were measured with TMG two times – before and immediately after FR. In the next step, the participants performed a single bout of FR for 15 minutes, under the supervision of a physiotherapist who provided instructions on the technique. The same intervention was repeated for both sedentary and physically active participants. Data from pre- and post-intervention TMG measurements in sedentary and physically active women were analysed.

FR intervention. The FR intervention was composed of three exercises for specific muscles on both sides, including: 1) upper part of the trapezius muscle (UTM), 2) lower part of the trapezius muscle (LTM), 3) erector spinae muscle (ESM). Participants were instructed to use FR with the pressure of one's body mass and without eliciting muscle spasms or cramping. Participants were lying on a mat and performing FR in repetitive, smooth strokes with the entire body weight pressed onto the roller. The targeted muscle group was rolled back and forth for a fixed duration. Each FR exercise was performed in five repetitions of 45 seconds with a 15-second interval between repetitions, using a cadence of 50 strokes per minute controlled by a metronome. The back-and-forth movements created friction between the soft tissues and the foam cylinder. The total duration of the FR intervention was 15 minutes. These parameters were selected based on previous literature (Behm et al., 2020; Globokar et al., 2023).

Outcome measures. TMG measurements were taken in a static position to minimise variability in sensor placement. The TMG device (TMG-BMC d.o.o., Ljubljana, Slovenia) detected changes in muscle contractile properties: Dm (displacement in millimetres due to an electrical stimulus, associated with muscle stiffness) and Tc (time from 10% to 90% of Dm on the ascending curve). The sensor was positioned on the muscle belly, and two electrodes were placed on the muscle borders, as close to the sensor as possible. The optimal measurement point (the thickest part of the muscle belly, about 2 cm lateral to dorsal midline) was located via visual orientation and palpation during voluntary and elicited contraction. Once identified, the sensor and electrode positions were marked with a dermatological pen to ensure exact relocation post-intervention (Lohr & Medina-Porqueres, 2021). Electrical stimulation was gradually increased by 10 mA, ranging from 30 mA to 100 mA, or until the muscle response plateaued. To avoid fatigue and potentiation, at least 10 seconds were maintained between consecutive measurements. The highest two twitch responses from the displacement graph were recorded and averaged for analysis.

TMG measurement was performed in a seated upright position for the upper trapezius muscle, and in a prone position for the lower part of the trapezius and the erector spinae muscles. A foam pad was placed proximal to the ankle joint to ensure 5° knee flexion, as recommended by the TMG user guidelines. All measurements were performed by the same investigator.

Data analysis. SPSS (Statistical Package for Social Science) version 29 was used for the statistical analysis of the results. All data in the tables are presented as mean ± standard deviation (SD). The normality of the data distribution was checked by the Kolmogorov–Smirnov Test. All data were found to be normally distributed, and parametric statistics were used for the analysis. To compare the differences between groups, the Independent-Sample T-Test was used. Paired-Samples T-Test was used to compare pre and post-values. Statistical significance was set at $p < 0.05$. Cohen's d-effect size was also calculated using a confidence interval of 90%. The effect size (d) values were interpreted according to the proposal of Cohen (1988): trivial (0.0–0.19), small (0.2–0.59), moderate (0.6–1.1), large (1.2–1.9), and very large (> 2.0).

3. RESULTS

Within groups. FR had a significant effect on Tc and Dm of LTM ($d = 3.2$, $p < 0.05$; and $d = 2.7$, $p < 0.05$, respectively) on the left side for sedentary women. Significant improvements were established in the Tc of the UTM on the left side ($d = 0.92$, $p < 0.05$), and in the Dm of ESM on the right side ($d = 0.4$, $p < 0.05$) (Table 2).

Table 2. **Muscle contraction time and maximal radial displacement pre and post-FR in sedentary women**

Muscle	Variable	Time	Mean ± SD	P	Effect size (d)
Right UTM	Tc	Pre	31.3 ± 4.5	0.05	1.3
		Post	26.0 ± 3.7		
	Dm	Pre	1.3 ± 0.2	0.06	2.3
		Post	1.8 ± 0.3		
Left UTM	Tc	Pre	27.6 ± 4.0	**0.03**	0.9
		Post	24.4 ± 2.8		
	Dm	Pre	1.3 ± 0.3	0.16	0.9
		Post	1.6 ± 0.3		

Muscle	Variable	Time	Mean ± SD	P	Effect size (d)
Right LTM	Tc	Pre	20.6 ± 2.1	0.22	0.8
		Post	18.9 ± 2.0		
	Dm	Pre	0.8 ± 0.2	0.03	1.4
		Post	1.1 ± 0.2		
Left LTM	Tc	Pre	21.1 ± 1.5	**0.01**	3.2
		Post	18.1 ± 0.9		
	Dm	Pre	0.53 ± 0.1	**0.003**	2.7
		Post	0.9 ± 0.2		
Right ESM	Tc	Pre	28.7 ± 3.9	0.19	0.9
		Post	25.8 ± 2.7		
	Dm	Pre	1.5 ± 0.7	**0.03**	0.4
		Post	1.8 ± 0.8		
Left ESM	Tc	Pre	27.8 ± 5.5	0.11	1.0
		Post	23.2 ± 3.2		
	Dm	Pre	1.5 ± 0.9	0.07	0.3
		Post	1.7 ± 0.8		

Note: UTM – upper trapezius muscle; LTM – lower trapezius muscle; ESM – erector spinae muscle; Tc – contraction time; Dm – maximum radial displacement.

Significant changes within the group in the Tc of the UTM and the ESM for physically active women were on the right side ($d = 0.6$, $p < 0.05$; and $d = 4.1$, $p < 0.05$, respectively). Significant improvements in Dm of the UTM on the left side ($d = 1.28$, $p < 0.05$), and of the LTM on both sides (right $d = 0.5$, $p < 0.05$; left $d = 3.4$, $p < 0.05$) (Table 3).

Table 3. **Muscle contraction time and maximal radial displacement pre and post-FR in physically active women**

Muscle	Variable	Time	Mean ± SD	P	Effect size (d)
Right UTM	Tc	Pre	25.3 ± 3.7	**0.03**	0.6
		Post	22.8 ± 4.4		
	Dm	Pre	1.8 ± 0.2	0.26	0.56
		Post	1.9 ± 0.1		
Left UTM	Tc	Pre	21.3 ± 0.8	0.29	0.7
		Post	20.1 ± 2.2		
	Dm	Pre	1.5 ± 0.2	**0.001**	1.28
		Post	1.8 ± 0.3		
Right LTM	Tc	Pre	18.9 ± 1.5	0.06	3.3
		Post	14.9 ± 0.8		
	Dm	Pre	0.9 ± 0.2	**0.04**	0.5
		Post	1.0 ± 0.2		

Muscle	Variable	Time	Mean ± SD	P	Effect size (d)
Left LTM	Tc	Pre	17.4 ± 2.2	0.08	2.3
		Post	13.4 ± 1.2		
	Dm	Pre	0.6 ± 0.1	**0.03**	3.4
		Post	1.0 ± 0.2		
Right ESM	Tc	Pre	28.9 ± 3.2	**0.01**	4.1
		Post	19.2 ± 1.0		
	Dm	Pre	1.6 ± 0.7	0.08	0.7
		Post	2.1 ± 0.7		
Left ESM	Tc	Pre	26.1 ± 5.1	0.13	1.5
		Post	19.9 ± 2.5		
	Dm	Pre	1.7 ± 0.6	0.12	0.5
		Post	2.1 ± 0.9		

Note: UTM – upper trapezius muscle; LTM – lower trapezius muscle; ESM – erector spinae muscle; Tc – contraction time; Dm – maximum radial displacement.

Between groups. Before FR, there were no significant differences between the groups in the Tc or Dm of the UTM, LTM, or ESM. After FR, the LTM on both sides and the ESM on the right side Tc were significantly faster in physically active women than in sedentary ($p < 0.05$). However, considering only the difference in improvement of the results, no significant differences between groups were observed (Table 4).

Table 4. **Differences in muscle properties between groups after FR**

Muscle	Variable	Group	Change (mean ± SD)	P
Right UTM	Tc	Sedentary	5.3 ± 2.8	0.28
		Physically active	2.5 ± 1.1	
	Dm	Sedentary	1.8 ± 0.3	0.22
		Physically active	0.1 ± 0.1	
Left UTM	Tc	Sedentary	3.2 ± 1.4	0.19
		Physically active	1.1 ± 1.9	
	Dm	Sedentary	1.6 ± 0.4	0.97
		Physically active	0.3 ± 0.1	
Right LTM	Tc	Sedentary	1.8 ± 2.1	0.73
		Physically active	4.0 ± 2.2	
	Dm	Sedentary	0.3 ± 0.1	0.21
		Physically active	0.2 ± 0.1	
Left LTM	Tc	Sedentary	3.0 ± 1.0	0.36
		Physically active	4.0 ± 2.5	
	Dm	Sedentary	0.4 ± 0.1	0.40
		Physically active	0.5 ± 0.2	

Muscle	Variable	Group	Change (mean ± SD)	P
Right ESM	Tc	Sedentary	2.8 ± 3.1	**0.008**
		Physically active	9.7 ± 3.5	
	Dm	Sedentary	0.3 ± 0.3	0.25
		Physically active	0.5 ± 1.0	
Left ESM	Tc	Sedentary	4.6 ± 3.5	0.40
		Physically active	6.2 ± 5.1	
	Dm	Sedentary	0.2 ± 0.4	0.39
		Physically active	0.3 ± 0.7	

Note: UTM – upper trapezius muscle; LTM – lower trapezius muscle; ESM – erector spinae muscle; Tc – contraction time; Dm – maximum radial displacement.

4. DISCUSSION

The aim of this study was to evaluate the acute effect of the FR on the contractile properties of back muscles as measured by TMG and to compare responses between physically active and sedentary women. The TMG tool was used to detect changes in muscle contractile properties: maximal radial displacement (Dm) (associated with muscle stiffness) and contraction time (Tc). FR intervention improved Tc and reduced stiffness of the back muscles in both groups; however, the mechanical properties of the back muscles in physically active women were superior after FR.

Contraction time may reflect alterations in muscle fatigue or in muscle fibre type composition. An increase in Tc could suggest elevated neuromuscular fatigue or a greater involvement of slow-twitch fibres, while a decrease may indicate improved readiness or fast-twitch fibre predominance. Similarly, changes in Dm offer insights into the mechanical properties of the muscle. A reduction in Dm, commonly interpreted as increased muscle stiffness, may be linked to fatigue-related alterations in muscle tone or structural adaptations. Excessive muscle stiffness may harm performance and recovery (Toskić et al., 2022).

No significant differences were found in Tc and Dm of the upper and lower trapezius and erector spinae muscles between active and sedentary women before FR in this study. Toskić et al. (2022) found no significant differences in contraction speed and stiffness of knee joint muscles across varying physical activity levels in young men and women. TMG parameters may lack sufficient discriminatory power to distinguish between young adults with different physical activity backgrounds. The Dm parameter, which assesses muscle stiffness, influences movement performance (Secomb et al., 2015). Participants in both groups were young and did not specifically target muscle stiffness development. The lack of significant differences in TMG characteristics before FR may also be due to their age, as the mechanical and contractile muscle properties in young individuals are still at a natural level and have not yet been affected by sedentary lifestyles or age-related changes seen in middle age.

Studies have demonstrated that an eight-minute FR can significantly reduce lumbar muscle stiffness after 4–5 hours of sedentary work (Kett & Sichting, 2020), and even a six-minute myofascial release treatment of the lumbodorsal fascia can positively impact the neuromechanical characteristics of lumbar erector spinae muscles (Lohr & Medina-Porqueres, 2021). In the current study, myofascial release was performed using a FR on the back muscles for 15 minutes. For physically active and sedentary women, FR had a moderate effect on the Tc of the upper trapezius muscle, and a very large effect on the lower trapezius muscle. Nevertheless, sedentary women exhibited a significantly longer Tc than active women. Meanwhile, FR had a very large effect on the Tc of the erector spinae muscle in active women and a moderate effect in sedentary. Furthermore, sedentary women exhibited a significantly longer Tc than active women. It could be explained that active women might have a higher percentage of fast-twitch fibre and bigger muscle fibres than sedentary women, resulting in higher Tc (Lohr & Medina-Porqueres, 2021). However, body composition, including fat-free mass and fat mass, was not measured in the study.

For both active and sedentary women, FR had a moderate to large effect on the Dm of the upper trapezius muscle, depending on the side. After FR, active women showed higher Dm than sedentary women. FR had a very large effect on the Dm of the lower trapezius on the left side, but a small effect for active women and a large effect for sedentary women on the right side. For both groups, FR had a small effect on the Dm of the erector spinae. FR increases local microcirculation, and at higher tissue temperature and perfusion, viscosity decreases (Schroeder et al., 2021), explaining reduced post-FR tissue stiffness. FR pressure may also affect tissue properties, such as myofascial restriction or fluid content changes (Cheatham & Stull, 2019), and break down cross-bridges between actin and myosin filaments, reducing muscle stiffness (Lee et al., 2022). In this context, it is plausible that reduced muscle stiffness and increased tissue elasticity contributed to the observed decrease in contraction time (Tc). Enhanced elasticity facilitates more efficient force transmission through the muscle-tendon unit, allowing faster transitions from the stretch to contraction phases. Meanwhile, reduced passive stiffness may lower resistance to deformation, enabling quicker muscle activation. These viscoelastic adaptations likely support improved neuromuscular responsiveness, which manifests as shorter Tc values following the FR intervention (Behm et al., 2020; Glänzel et al., 2023; Baumgart et al., 2019). Ruffini corpuscles in superficial fascial tissues, sensitive to tangential forces and lateral stretch stimuli, may explain tissue stiffness reductions through muscle relaxation by inhibiting sympathetic activity (Schroeder et al., 2021).

This study has several strengths, including the use of TMG, a reliable and non-invasive tool to assess muscle contractile properties, and the inclusion of both physically active and sedentary women, which allows for a comparative analysis of FR effects across different activity levels. Additionally, the standardised protocol for FR and TMG measurements, as well as the supervision by a physiotherapist, ensures the consistency and validity of the intervention. However, the study also has limitations. The small sample size (n = 16) limits the generalisability of the findings and may reduce the statistical power to detect subtle differences between groups. Furthermore, the study focused solely on young, healthy women, restricting the applicability of the results to other age groups or individuals with musculoskeletal conditions. The absence of long-term follow-up data also prevents conclusions about the sustained effects of FR. Future research with larger, more diverse populations and extended observation periods is recommended to validate and expand upon these findings.

5. CONCLUSIONS

FR improved the contraction time and reduced stiffness of the back muscles in both physically active and sedentary women; however, the mechanical properties of the back muscles in physically active women were superior after FR.

Author Contributions: Conceptualisation, L.M. and L.Ž.; methodology, L.M., G.B., L.Ž.; formal analysis, L.M. and G.B.; investigation, L.M. and G.B.; data curation, L.M. and G.B.; writing—original draft preparation, L.M. and G.B.; writing—review and editing, L.M. and L.Ž.; supervision, L.M. and L.Ž. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

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

Conflicts of Interest: The authors declare no conflict of interest.

References

Anderson, E., & Durstine, J. L. (2019). Physical activity, exercise, and chronic diseases: A brief review. *Sports Medicine and Health Science*, *1*(1), 3–10. https://doi.org/10.1016/j.smhs.2019.08.006

Baumgart, C., Freiwald, J., Kühnemann, M., Hotfiel, T., Hüttel, M., & Hoppe, M. W. (2019). Foam rolling of the calf and anterior thigh: Biomechanical loads and acute effects on vertical jump height and muscle stiffness. *Sports* (Basel, Switzerland), *7*(1), 27. https://doi.org/10.3390/sports7010027

Behm, D. G., Alizadeh, S., Anvar, S. H., Mahmoud, M. M. I., Ramsay, E., Hanlon, C., & Cheatham, S. (2020). Foam rolling prescription: A clinical commentary. *The Journal of Strength & Conditioning Research*, *34*(11), 3301–3308. https://doi.org/10.1519/JSC.0000000000003765

Buoite Stella, A., Cargnel, A., Raffini, A., Mazzari, L., Martini, M., Ajčević, M., Accardo, A., Deodato, M., & Murena, L. (2024). Shoulder tensiomyography and isometric strength in swimmers before and after a fatiguing protocol. *Journal of Athletic Training*, *59*(7), 738–744. https://doi.org/10.4085/1062-6050-0265.23

Cheatham, S. W., & Stull, K. R. (2019). Roller massage: Comparison of three different surface type pattern foam rollers on passive knee range of motion and pain perception. *Journal of Bodywork and Movement Therapies*, *23*(3), 555–560. https://doi.org/10.1016/j.jbmt.2019.05.002

Cohen, J. (1988). *The concepts of power analysis. Statistical power analysis for the behavioral sciences* (pp. 1–17, 2nd ed.). Routledge.

Fijavž, J., Frangež, M., & Vauhnik, R. (2024). Effects of lower back foam rolling on the pressure pain threshold and the range of motion of the lumbar spine in healthy individuals. *Frontiers in Physiology*, *15*, 1476342. https://doi.org/10.3389/fphys.2024.1476342

Glänzel, M. H., Rodrigues, D. R., Petter, G. N., Pozzobon, D., Vaz, M. A., & Geremia, J. M. (2023). Foam rolling acute effects on myofascial tissue stiffness and muscle strength: A systematic review and meta-analysis. *Journal of Strength and Conditioning Research*, *37*(4), 951–968. https://doi.org/10.1519/JSC.0000000000004385

Globokar, E., Ipavec, M., Vreček, N., & Vauhnik, R. (2023). The immediate effects of foam rolling of the hamstrings muscle group on the contractile properties of the knee muscles in football players. *Journal of Bodywork and Movement Therapies*, *35*, 326–331. https://doi.org/10.1016/j.jbmt.2023.04.007

Hanney, W. J., Kolber, M. J., Salamh, P. A., Moise, S., Hampton, D., & Wilson, A. T. (2022). The reliability of tensiomyography for assessment of muscle function in the healthy population: A systematic review. *Strength & Conditioning Journal*, *44*(6), 18–35. https://doi.org/10.1519/SSC.0000000000000699

Kett, A. R., & Sichting, F. (2020). Sedentary behaviour at work increases muscle stiffness of the back: Why roller massage has potential as an active break intervention. *Applied Ergonomics*, *82*, 102947. https://doi.org/10.1016/j.apergo.2019.102947

Kett, A. R., Sichting, F., & Milani, T. L. (2021). The effect of sitting posture and postural activity on low back muscle stiffness. *Biomechanics*, *1*(2), 214–224. https://doi.org/10.3390/biomechanics1020018

Konrad, A., Nakamura, M., Warneke, K., Donti, O., & Gabriel, A. (2023). The contralateral effects of foam rolling on range of motion and muscle performance. *European Journal of Applied Physiology*, *123*(6), 1167–1178. https://doi.org/10.1007/s00421-023-05142-2

Lastova, K., Nordvall, M., Walters-Edwards, M., Allnutt, A., & Wong, A. (2018). Cardiac autonomic and blood pressure responses to an acute foam rolling session. *Journal of Strength and Conditioning Research*, *32*(10), 2825–2830. https://doi.org/10.1519/JSC.0000000000002562

Lee, C., & Lee, S. (2021). Acute effects of foam rolling exercises on arterial stiffness, flexibility and autonomic nervous system function in young and middle-aged women. *Exercise Science*, *30*(4), 491–500. https://doi.org/10.15857/ksep.2021.00465

Lee, H., Kim, C., An, S., & Jeon, K. (2022). Effects of core stabilization exercise programs on changes in erector spinae contractile properties and isokinetic muscle function of adult females with a sedentary lifestyle. *Applied Sciences*, *12*(5), 2501. https://doi.org/10.3390/app12052501

Lohr, C., & Medina-Porqueres, I. (2021). Immediate effects of myofascial release on neuromechanical characteristics in female and male patients with low back pain and healthy controls as assessed by tensiomyography. A controlled matched-pair study. *Clinical Biomechanics* (Bristol, Avon), *84*, 105351. https://doi.org/10.1016/j.clinbiomech.2021.105351

Monteiro, E. R., Wakefield, B., Ribeiro, M. S., Fiuza, A. G., Cunha, J. C. O. W., Novaes, G. S., Panza, P. S., Vianna, J. M., & Novaes, J. S. (2018). Anterior and posterior thigh self-massage and stretching acutely increases shoulder range-of-motion/Automassagem e alongamento nas regioes anterior e posterior de coxa aumentam de forma aguda a amplitude articular de ombro. *Motricidade*, *14*(S1), 174+.

Nakai, Y., Oe, K., Matsuno, R., Kiyama, R., Kawada, M., Takeshita, Y., Miyazaki, T., & Araki, S. (2023). Effect of self-myofascial release of the lower back on myofascial gliding, lumbar flexibility, and abdominal trunk muscle strength: A crossover study. *Sports* (Basel, Switzerland), *11*(8), 147. https://doi.org/10.3390/sports11080147

Nakamura M., Konrad A., Ryosuke K., Sato S., Yahata K., Yoshida R., & Wilke J. (2021b). Sex differences in the mechanical and neurophysiological response to roller massage of the plantar flexors. *Journal of Sports Science and Medicine*, *20*(4), 665–671. https://doi.org/10.52082/jssm.2021.665

Nakamura, M., Yasaka, K., Kiyono, R., Onuma, R., Yahata, K., Sato, S., & Konrad, A. (2021a). The acute effect of foam rolling on eccentrically-induced muscle damage. *International Journal of Environmental Research and Public Health*, *18*(1), 75. https://doi.org/10.3390/ijerph18010075

Ozden, F., & Yesilyaprak, S. S. (2021). Foam rolling, elbow proprioception, strength, and functional motor performance. *Journal of Athletic Training*, *56*(10), 1112–1123. https://doi.org/10.4085/445-20

Piqueras-Sanchiz, F., Martin-Rodriguez, S., Cornejo-Daza, P. J., Sánchez-Valdepeñas, J., Serrano-Gómez, V., Pareja-Blanco, F., & García-García, Ó. (2024). Identification of peripheral fatigue through exercise-induced changes in muscle contractility. *Journal of Human Kinetics*, *93*, 145–154. https://doi.org/10.5114/jhk/185297

Roren, A., Daste, C., Coleman, M., Rannou, F., Freyssenet, D., Moro, C., Lefèvre-Colau, M. M., & Nguyen, C. (2023). Physical activity and low back pain: A critical narrative review. *Annals of Physical and Rehabilitation Medicine*, *66*(2), 101650. https://doi.org/10.1016/j.rehab.2022.101650

Schroeder, J., Wilke, J., & Hollander, K. (2021). Effects of foam rolling duration on tissue stiffness and perfusion: A randomized cross-over trial. *Journal of Sports Science & Medicine*, *20*(4), 626–634. https://doi.org/10.52082/jssm.2021.626

Secomb, J. L., Lundgren, L. E., Farley, O. R., Tran, T. T., Nimphius, S., & Sheppard, J. M. (2015). Relationships between lower-body muscle structure and lower-body strength, power, and muscle-tendon complex stiffness. *Journal of Strength and Conditioning Research*, *29*(8), 2221–2228. https://doi.org/10.1519/JSC.0000000000000858

Soares, R. N., Inglis, E. C., Khoshreza, R., Murias, J. M., & Aboodarda, S. J. (2020). Rolling massage acutely improves skeletal muscle oxygenation and parameters associated with microvascular reactivity: The first evidence-based study. *Microvascular Research*, *132*, 104063. https://doi.org/10.1016/j.mvr.2020.104063

Tabaković, A., Abazović, E., Tabaković, M., & Kovačević, E. (2024). Correlations between tensiomyography variables and lower extremity power. *Baltic Journal of Health and Physical Activity*, *16*(4), 9. https://doi.org/10.29359/BJHPA.16.4.09

Toskić, L. D., Dopsaj, M. J., Marković, M. R., Toskić, D. R., & Ignjatović, A. M. (2022). Mechanical and Contractile properties of knee joint muscles measured by the method of tensiomyography in differently trained men and women. *Journal of Strength and Conditioning Research*, *36*(6), 1532–1539. https://doi.org/10.1519/JSC.0000000000003662

Toskić, L., Dopsaj, M., Stanković, V., & Marković, M. (2019). Concurrent and predictive validity of isokinetic dynamometry and tensiomyography in differently trained women and men. *Isokinetics and Exercise Science*, *27*(1), 31–39. https://doi.org/10.3233/IES-185152

Voglar, M., & Grandovec, A. (2022). Effects of foam rolling on strength and flexibility of hamstring muscles. *Sport Mont*, *20*(3), 81–85. https://doi.org/10.26773/smj.221013

Trumpalaikio volavimo poveikis skirtingo fizinio aktyvumo moterų nugaros raumenų kontraktilinėms savybėms

Ligita Mažeikė*, Greta Bačiūnaitė, Laura Žlibinaitė

Kauno kolegija, Medicinos fakultetas, Reabilitacijos katedra, Kaunas, Lietuva
* Susirašinėjimui: ligita.mazeike@go.kauko.lt; Tel. +370 693 95 292

Santrauka

Tyrimo pagrindimas. Volavimas, kaip miofascialinio atpalaidavimo metodas, plačiai naudojamas tiek sporte, tiek reabilitacijoje, siekiant sumažinti raumenų įtampą, pagerinti sportinius rezultatus ir paskatinti greitesnį atsigavimą. Tensiomiografijos (TMG) metodas leidžia objektyviai įvertinti raumenų savybes, atskleidžiant reikšmingus skirtumus tarp skirtingo fizinio aktyvumo moterų.

Tikslas. Nustatyti trumpalaikio volavimo poveikį skirtingo fizinio aktyvumo moterų nugaros raumenų kontraktilinėms savybėms.

Metodai. Tyrime dalyvavo 16 moterų (22,00 ± 0,55 metai), aštuonios fiziškai aktyvios ir aštuonios nesportuojančios. Jos atliko 15 minučių nugaros raumenų (nugaros tiesiamųjų ir trapecinio) volavimą. Prieš ir po volavimo tensiomiografu buvo vertinama raumenų kontraktilinės savybės: didžiausia susitraukimo amplitudė (Dm) ir susitraukimo laikas (Tc).

Rezultatai. Nesportuojančių moterų Tc sumažėjo kairėje kylančiojoje ($p = 0,03$) ir nusileidžiančiojoje trapecinio raumens dalyse ($p = 0,01$), o Dm pagerėjo kairėje nusileidžiančiojoje trapecinio raumens dalyje ($p = 0,003$) ir dešiniajame nugaros tiesiamajame raumenyje ($p = 0,03$). Fiziškai aktyvių moterų Tc sumažėjo dešinėje kylančiojoje trapecinio raumens dalyje ($p = 0,03$) ir dešiniajame nugaros tiesiamajame raumenyje ($p = 0,01$), o Dm padidėjo kairėje kylančiojoje ($p = 0,001$), kairėje nusileidžiančiojoje ($p = 0,03$) ir dešinėje nusileidžiančiojoje trapecinio raumens dalyje ($p = 0,04$). Tc sumažėjimas dešiniajame nugaros tiesiamajame raumenyje buvo didesnis fiziškai aktyvioms moterims ($p = 0,08$).

Išvados. Volavimas pagerino nugaros raumenų susitraukimo laiką ir sumažino standumą abiejose grupėse, tačiau pagerėjimas buvo didesnis fiziškai aktyvioms moterims.

Reikšminiai žodžiai: nugaros raumenys; kontraktilinės savybės; volavimas; tensiomiografija; TMG

Received 2025 03 21
Accepted 2025 05 05