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Scientific review

EFFECTS OF SELF-MASSAGE WITH FOAM ROLLER ON FLEXIBILITY AND OTHER MOTOR SKILLS – LATEST RESEARCH REVIEW[1]

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Abstract: During the past decade, self-massage of the muscular fascia using a foam roller (FR) has become an increasingly common way of supplementing traditional methods of soft tissue treatment, while both professional and recreational athletes use it as a tool for warm-up and/or post-training relaxation. Considering the relevance of this topic among researchers, coaches, and physiotherapists, the aim of this this paper is to present a narrative review with the systematization of the latest research on the effects of foam rolling on motor skills. Publication search was conducted using the following databases: Google Scholar, PubMed, and ScienceDirect. The following keywords were used in the search: foam rolling, self-myofascial release, fascia, and muscle soreness. The selection of papers was based on the following criteria: 1) publications written in English and published in the period 2019-2022, and 2) original scientific papers focused on examining the effects of soft tissue massage using FR on the range of motion (ROM), motor abilities (strength, power, speed, balance and others), acute muscle pain, and delayed muscle soreness. Recent research results confirm earlier findings that FR can have short-term, positive effects on flexibility and ROM, while findings regarding the effects on muscle strength, explosive power, and balance are equivocal. In addition, it has been noted that this type of treatment can delay the onset of fatigue, and alleviate the painful sensitivity of muscles after intensive work-out. Although foam rollers have been in use for a long time both in sports and in rehabilitation, due to the heterogeneity of methods applied in related studies, there is still no official recommendation on the optimal way of applying these tools (treatment duration, pressure and cadence, i.e. the frequency of vibration if such a roller is used).

Keywords: *foam rolling, vibration, flexibility, range of motion, myofascial relaxation*

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INTRODUCTION

The fascia system, with its diverse components, builds a three-dimensional continuum of soft, loose, and dense fibrous connective tissue that permeates the body and allows all body systems to function in an integrated manner (Gatt et al., 2018). Fascia can be generally classified as superficial, deep, visceral or parietal, and further classified according to the anatomical location. In the context of this review, we are primarily interested in the superficial fascia that is located directly beneath the skin and superficial layers of fat.

When healthy, fascia is a loose and wavy connective tissue but it can lose its flexibility when damaged by local trauma or inflammation. With acute inflammation, fascia tightens and loses flexibility. Long-term bad postural positioning that partially or completely prevents fascia from sliding and some other short-term processes can lead to its shortening. When this happens, the stretching of fascia can cause pain in distant sensitive areas such as nerves and blood vessels, muscles, which in turn leads to the limitation of the usual range of motion, etc. (Gatt et al., 2018).

Relaxing the fascia through manual therapy or other techniques reduces pressure on those areas and blood circulation returns to normal (Findley et al., 2012). In the last decade, self-myofascial release (SMR) using a foam roller (FR) has become an increasingly common way of supplementing traditional soft tissue treatment methods. The first use of a foam roller was recorded in the work of practitioners of the Feldenkrais method in the 1980s. After a series of positive experiences, foam rollers were very quickly introduced into the training processes of both recreational and professional athletes. Treatment with FR uses the pressure of the body weight on the roller, and therefore on the soft tissue during movement (Adamczyk et al., 2020). Changing body position makes it possible to isolate certain parts of the body and treat soft tissue restrictions (Healey et al., 2014).

Previous research has shown that massage with FR has short-term positive effects on flexibility, range of motion (ROM), pain sensitivity ("inflammation") of muscles, and also reduces the sensitivity of so-called myofascial pain points (also known as trigger points) (Macdonald et al., 2014; Miller & Rockey, 2006; Mohr et al., 2014). Mechanical compression applied on soft tissues increases blood flow (vasodilation) through muscles which can help quickly relieve fatigue symptoms after exercise. Research indicates that the application of FR can increase the hydration and elasticity of fascia (Adamczyk et al., 2020). Studies in the field of SMR indicate the effectiveness of this technique in relieving pain due to many physiological responses. Some of them are increased blood flow, reduced arterial stiffness, improved vascular endothelial function, and increased nitric oxide concentration (Adamczyk et al., 2020). However, the physiological mechanisms of the reported effects remain unclear, although initial evidence suggests an increase in arterial perfusion, enhanced fascial layer sliding, and modified corticospinal excitability after treatment (Zügel et al., 2018).

Recent studies on the impact of FR massage on motor skills suggest an improvement in the range of motion after a single or several repeated treatments, with the assumption that it enables more efficient movement patterns and results in reduced risk of musculoskeletal injuries (Chang et al., 2021; Folli et al., 2021; Fonta et al., 2021; Junker & Stöggl, 2019; Krause et al., 2017; Laffaye et al., 2019; Santana et al., 2021; Seever et al., 2022; Sulowska-Daszyk & Skiba, 2022; Yanaoka et al., 2021). Research findings on the impact of FR massage on other motor abilities (strength, power, speed, etc.) are not definite, so it is stated that this treatment does not inhibit, nor improve the characteristics of muscle function.

Considering the relevance of this topic in sports training and rehabilitation, the aim of this paper is to systematize the latest research on the effects of foam roller application on motor abilities, primarily through the impact on flexibility and range of motion.

METHOD

The publication search was conducted using the following databases: Google Scholar, PubMed, and ScienceDirect. The search was conducted using the following keywords: foam rolling, self-myofascial release, fascia, flexibility, ROM, motor ability, muscle soreness, muscle performance. The selection of papers was based on the following criteria: 1) publications written in English and published in the period 2019-2022; 2) original scientific papers focused on examining the effects of soft tissue massage using FR on joint mobility, motor skills (strength, power, speed, balance, etc.), acute muscle pain, and delayed muscle soreness.

RESULTS

After conducting the selection by the set criteria, 14 original scientific papers that investigated the application of standard FR (smooth, GRID, and wave roller; Table 1), as well as 8 studies (Table 2) that compared the effects of standard FR and vibrating foam-roller (VFR) were included in this review.

The short-term (acute) effects of foam-rolling (i.e., the effects that can be observed immediately after the applied procedure) were examined in 15 studies, while findings on possible delayed effects of FR massage (5 min to 48 h after treatment) were presented in five papers. Only two studies (Laffaye et al., 2019; Santana et al., 2021) examined the effects of the long-term use of FR (treatment range 2 to 8 weeks).

Study samples mostly comprised young people, up to 30 years of age. Most of the studies were conducted on physically active men (recreational or athletes), while women participated only in four studies on the effects of FR, as well as in 5 studies on VFR. It is important to note that some studies failed to include demographic data and information on the participants' level of physical activity.

The most numerous (19) are the studies that examined the impact of FR or VFR massage on flexibility (ROM in different joints of the lower extremities). In just over a half of all studies (13), foam roller was used for treatment of the hamstrings muscles (unilaterally or bilaterally). Only a few of the total number of papersresearc included in this review examined the effect of antagonist muscle group massage on hamstring flexibility and hip flexion ROM (de Benito et al., 2019; Ruggieri et al., 2021). Interestingly, the interventions listed in this review differ from each other in terms of treatment duration (FR and VFR), or vibration amplitude and frequency (VFR). Tables 1 and 2 depict key information about the research design, the applied treatment (including region/muscle group, duration, frequency, etc.) as well as the most important findings.

Table 1. *Overview of research on the effects of foam-rolling on flexibility and other motor abilities*

Research	Methods	Treatment	Results
Santana et al., 2021	20 males; Four sessions 48 hours between session; Assessment of the total number of repetitions, fatigue resistance index, and muscle soreness. 3 sets of 10-RM knee extensions performed in each session; FR treatments between the sets of knee extensions: 1- agonist; 2- antagonists; 3- agonists and antagonists; 4- passive rest.	Treatment applied between the sets of exercise, separately for each leg: 1- quadriceps femoris, 60s 2- hamstrings, 60s each; 3- front and back thighs, 30s each muscle group, total 120s for both legs.	In comparison to passive rest, significantly higher total training volume, fatigue resistance index, and total number of repetitions, and lower muscle soreness were observed after FR treatments.
Laffaye et al., 2019	20 males; Half squat jump (SJ), countermovment jump (CMJ), active and passive hip, knee, and ankle ROM and muscle pain sensitivity were assessed immediately after training (8 sets of squats: 20s squats/10s rest), then 24 and 48 h later.	Foam-rolling of iliotibial band and the front tight (sartorius and rectus femoris) was applied unilaterally, the other leg served as control. Two sets of 60s FR for each region.	Foam-rolling had no influence on thr jump height, leg muscle stiffness, and strength. The treated leg had 50% less muscle soreness sensitivity and greater hip ROM than the control leg.
Behara and Jacobson, 2017	14 males; Pretest – assessment of max and average power, speed, and torque of knee flexors and extensors, and hip ROM. Three groups: 1- dynamic stretching (8 min); 2- foam-rolling (8 min); 3- control group. Posttest immediately after, and 7 days after the intervention.	The treatment was applied bilaterally for 60 s per region: quadriceps femoris, gluteal region, hamstrings, and gastrocnemius.	The applied procedures did not lead to significant changes in the power, torque and speed of the tested muscles.
Krause et al., 2017	16 participants; Three sessions: 1) foam-rolling; 2) passive static stretching; 3) no intervention. Assessment of connective tissue stiffness and gliding, angle of first stretch sensation, and active and passive knee flexion ROM, before and immediately after the intervention.	Unilateral treatment of quadriceps femoris: 1. FR 2×60 s, break 30 s. Rolling duration 2s. 2. Passive static stretching 2×60 s	A significant increase in knee flexion ROM was observed after the FR treatment.
Cheatham, & Stull, 2019	36 participants (14 women); Three groups depending on the FR type: 1- smooth surface; 2- multi-level surface; 3- GRID surface. Knee ROM and pain threshold of m. quadriceps femoris assessed before and after the treatment.	Unilateral treatment of hip flexors and m. quadriceps femoris lasting 2 minutes.	ROM increased by 3° for the smooth, 5° for the multilevel, and 6° for the GRID FR group. Pain threshold increased by 14 kPa for the first, 179 kPa for the second, and 182 kPa for the third group.

Junker & Stöggl, 2019	40 participants; 8-week treatment, three groups: 1- upper leg foam-rolling, 5 exercises, 2×week; 2- core-stability, 5 exercises, 2×week; 3-CG. Bourbon test for trunk muscle strength, standing long jump, triple jump, balance test, and sit-and-reach tests (SAR) were applied.	Bilateral treatment of five regions: calf muscles, quadriceps femoris, hamstrings, iliotibial band, and gluteus. For each region, 3 sets of 30-50 seconds of FR with 60s break.	Foam-rolling may be an effective technique to increase SAR ROM without concomitant decrease in muscle endurance and power, and balance ability.
Nakamura et al., 2021	45 participants; Three groups depending on the FR treatment duration. ROM of dorsiflexion, stiffness of Mm. gastrocnemii and muscle strength were measured before, 2, and 30 minutes after foam-rolling.,	Unilateral foam-rolling of calf-muscles: A group 1 × 30s; B group 3 × 30s; B group 3 × 30s; C group 10 × 30s.	2 min after the treatment significant increase in dorsiflexion ROM observed for groups B and C. ROM was restored to its initial values 30 min after FR.
Folli et al., 2021	23 participants (6 women). On three separate days, MVC and SAR were assessed before and immediately after the foam-rolling, static stretching, or placebo intervention.	Bilateral treatment over the hamstrings, 60 s per leg.	All three interventions increased SAR ROM, but none significantly affected MVC.
Lopez-Samanes et al., 2021	11 professional tennis players; Two types of warm-ups in two sessions: 1. dynamic stretching; 2. foam-rolling. Before and after the treatment, squat jump, 505 agility test, 10 m sprint, straight leg raise, and Thomas test.	Unilateral 8 min. treatment: 1. 3 sets of increasing intensity dynamic mobility exercises, break 15s. 2. FR of quadriceps, hamstrings, gluteus, and gastrocnemius for 60s per region	Dynamic stretching improved time in the 505 test. Both protocols had minimal effect on squat jump, 10m sprint, and ROM. Dynamic stretching could be a better type of warm-up for changes of direction and sprinting.
Seever et al., 2022	42 participants, two groups: FR and CG. Two-week intervention, acute effects were measured during and immediately after the treatment. Chronic and residual effects on dorsiflexion ROM and dynamic balance (Y-Balance test) of both legs were measured 24h and 7 days after the intervention.	Bilateral foam-rolling of calf muscles, 3×60s per leg, 6×per week.	Significantly higher dorsiflexion ROM was recorded as a result of individual treatment, after the intervention, as well as 7 days later. FR did not affect Y-balance test performance.
Sulowska-Daszyk & Skiba, 2022	62 participants (recreational, long-distance runners) were divided into two groups: FR and CG without any intervention. Flexibility was assessed before and 15min after the treatment.	Bilateral FR, ~2min (10 movements) per muscle group: hamstrings, gluteus maximus, hip adductors, quadriceps, iliotibial band and gastrocnemius.	Flexibility and ROM were greater in the FR than in the CG group. In CG, a significant improvement was observed only in the hip flexors.
Chang et al., 2021	50 healthy, untrained, and non-sedentary participants randomly divided into FR and CG. Stiffness of gastrocnemius and ankle dorsiflexion ROM were measured before and after the intervention.	The FR group - unilateral treatment of the dominant leg, 3×1 min with a 30s rest between sets. CG - 5-minute passive rest (sitting).	Significantly lower stiffness and greater dorsiflexion ROM after application of FR than after sitting.

Yanaoka et al., 2021	10 active males participated in two tests lasting three days each. Before and after thr treatment with FR, hip joint ROM, muscle stiffness, and muscle pain sensitivity were assessed using the Loughborough Intermittent Shuttle Test (LIST) at 0, 20, and 60 min, and 24 and 48 h after the intervention.	At the end of the 90-minute LIST, a 2-minute massage of the right hamstrings was applied. Medium and hard-density FR was used. The left leg served as the control leg.	Compared to the left leg, larger hip ROM of the right leg was observed immediately after, as well as 20 min, 60 min, 24, and 48 hours after the FR intervention.
Fonta et al., 2021	25 healthy active subjects (11 women). Two interventions were applied (static stretching and foam-rolling) with a 7-day break. Before and after the interventions, trunk and hip flexion ROM, trunk lateroflexion and rotation ROM, as well as isometric MVC and trunk extensors endurance were measured.	1) 3min FR dorsal side and lateral part of the thoracic spine 2) 3min FR on the dorsal side and the lateral part of the lumbar spine 3) 1 min in a standing position against the wall while using FR on the paravertebral muscles of the trunk	Both interventions significantly increased ROM of all observed segments. MVC and trunk extensor endurance were significantly increased after FR but decreased after static stretching.

EG – experimental group; CG – control group; FR- foam roller; ROM- Range of Motion; MVC – maximal voluntary contraction

Table 2. *Overview of studies comparing the effects of a standard foam roller (FR) versus a vibration roller (VFR)*

Research	Methods	Treatment	Results
Ruggieri et al., 2021	15 women, experienced in resistance training, participated in 5 sessions (familiarization, no treatment, FR, VFR, vibration only). During all of the sessions (except for familiarization) before and after intervention, PT, HQ ratio, and the level of activation of the quadriceps and hamstrings, and hip flexion ROM were assessed.	Unilateral treatment of dominant leg hamstrings. Individual muscle heads of hamstrings were treated 3×10s (30s in total). A break between sets lasted 10s. VFR frequency 68Hz.	FR and VRF led to significant increase in ROM for both limbs. The vibration only treatment had an effect only on the treated leg. All three interventions led to a bilateral decrease in the hamstrings PT, and thus to lower HQ ratios.
Tsai & Chen, 2021	16 NCAA Division I volleyball players participated in three sessions: FR; VFR; passive rest. Explosive leg power was assessed using the drop jump test (DJ) performed before, and 2 and 5 min after the intervention.	Bilateral treatment to quadriceps (knees bent and then extended), gluteus, biceps femoris, tibialis anterior, iliotibial band, gastrocnemius, and plantar fascia. 15 minutes (1 min per region, 40 movements/min). VFR frequency 45Hz.	FR increased DJ height and mean power generation at the hip, only 2 minutes, but not 5 minutes after the massage when the values were similar to the pre-test. VFR did not affect the DJ height, but it did contribute to a significant drop in average power.
de Benito et al., 2019	24 recreational athletes (7 women) participated in 3 sessions: FR; VFR; and no treatment. Subjects were fatigued, and the SAR, Y-balance test, and sense of joint stability were evaluated before fatiguing and after the appropriate intervention.	Bilateral treatment to quadriceps femoris and hamstrings. 2×60s (30 movements/min), 30s rest. VFR frequency 30Hz.	The tested abilities were significantly improved after FR and VFR compared to the no-treatment session. There were no significant differences between FR and VFR.
Lim et al, 2019	16 males randomly assigned to FR or VFR group. Isometric EMG activity of rectus femoris (RF), vastus lateralis (VL) and vastus medialis (VM) of the dominant leg, and SAR were assessed before and after the interventions.	Unilateral treatment of the hamstrings of the dominant leg. 5 min (40 movements/min; 30s rest every minute). VFR frequency 32Hz.	Both FR and VFR lead to similar, significant increase in thr SAR ROM. After VFR, a significantly higher activation of RF, VL, and VM was recorded. The activation of RF and VL was significantly higher after VFR than after FR.
Lim & Park, 2019	20 subjects (3 women) randomly assigned to FR or VFR group. Active hip flexion and sitting knee extension ROM, and vertical jump height were measured before and after the intervention.	Unilateral treatment of the hamstrings 5×60s, (total duration 10 min) VFR frequency 32Hz.	Both interventions significantly increased hip and knee ROM. VFR had a greater effect on ROM than FR. Neither VFR nor FR significantly affected jump height.

Romero-Moraleda et al., 2019	38 participants (6 women) randomly assigned to FR or VFR group. Foam-rolling was administered 48h after a single exercise session (10×10 eccentric flywheel squats). VAS, pain threshold, O2 saturation, ROM, and jump height were assessed before and immediately after administerng FR and VFR.	Bilateral treatment of quadriceps femoris 5×60s, 30s rest between sets. VFR frequency 18Hz.	VAS and ROM improved in both groups, but the changes were significantly greater after VFR than FR. In both groups, there were similar, significant improvements in pain threshold, O2 saturation, and jump height.
García-Gutiérrez et al., 2018	38 students (19 women) participated in 3 sessions (FR, VFR, no treatment). Dorsiflexion ROM and isometric MVC of the plantar and dorsiflexors were measured before and after the intervention.	Unilateral treatment of triceps surae of dominant thr leg: 3×20s with a 10s rest between sets. VFR frequency 49Hz	Both treatments contributed to a similar, significant bilateral increase in ROM. No significant changes in MVC were recorded.
Ridha et al., 2021	14 healthy males with limited knee flexion ROM were randomly assigned to FR or VFR group. MVC and the EMG activity of biceps femoris (BF) and semitendinosus (ST) at 30° and 90° knee flexion were measured before and after the intervention.	The authors did not describe the details of the treatment.	After VFR, higher EMG activity of BF30, BF90, and ST90 was observed. After the FR groups, a decrease in EMG amplitude was observed at BF90

PT – Peak Torque; HQ – hamstrings to quadriceps ratio; MVC – maximal voluntary contraction

DISCUSSION

The aim of this paper was to review and analyse the latest research on the effects of the application of foam roller (FR) and a vibration foam roller (VFR) as a method of self-myofascial release on motor abilities, primarily on muscle flexibility and joint range of motion (ROM). The review included a total of 22 original research papers: 14 studies examined the effect of the standard foam roller (FR), and 8 studies that compared the effects of both FR and VFR.

Although the objectives of the studies covered by this review were very similar, there are obvious methodological differences among them including how the effects of the applied interventions were evaluated, the duration of the intervention, the structure/surface of the roller, as well as whether the treatment was applied unilaterally or bilaterally. Thus, in some studies the treatment was conducted before any other activity (Behara & Jacobson, 2017; Cheatham & Stull, 2019; Couture et al., 2015; Junker & Stöggl, 2019; Krause et al., 2017; Miller & Rockey, 2006; Mohr et al., 2014; Murray et al., 2016; Nakamura et al., 2021), while in others it was applied after exercise (Bushell et al., 2015; Laffaye et al., 2019; Macdonald et al. al., 2014; Pearcey et al., 2015), or between sets of physical activity (Santana et al., 2021).

Following the search criteria, the main effect of self-myofascial release using a foam roller is observed through the improvement in flexibility i.e., increased range of motion (Behara & Jacobson, 2017; Behm et al., 2020; Bushell et al., 2015; Cheatham et al., 2015; Cheatham & Stull, 2019; Junker & Stöggl, 2019; Krause et al., 2017; Nakamura et al., 2021; Wiewelhove et al., 2019). Although we did not use statistical techniques to compare the effects among the studies, the summary of the results indicates that after treating soft tissues, a short-term increase in ROM can be expected (range 2-6°, relative change 2-10%), regardless of the foam roller type. However, it is interesting to note that in some cases VFRs have shown to be more effective than standard FRs. Namely, both types of foam rollers lead to improved ROM, with Lim et al. (2019) and Romero-Moraleda et al. (2019) stating that the treatment using VFR had a greater effect compared to regular FR. Unfortunately, those few studies that examined the delayed effects of the intervention do not support the hypothesis about the residual effect of the applied treatment. Also, despite many studies supporting this view, there are conclusions on the lack of connection between foam-rolling and increased range of motion (Miller & Rockey, 2006).

In addition to the effect on ROM, some of the studies included in this review, investigated the effects of FR on other motor abilities, primarily on muscle strength and power. Only a few studies have evaluated changes in balance. Findings on the effect of foam-rolling on strength and power are ambiguous, although the most recent study supports the opinion that treatment with FR does not lead to significant changes in those muscular capacities (Behara & Jacobson, 2017; Behm et al., 2020; Couture et al., 2015; Folli et al., 2021; Laffaye et al., 2019; Wiewelhove et al., 2019). Studies where significant improvements were observed reported better characteristics of neuromuscular function (Santana et al., 2021), such as greater muscle activation (Lim et al., 2019; Ridha et al., 2021), greater maximal voluntary contraction force (MVC) and better force endurance (Fonta et al., 2021), and greater power (Moraleda et al., 2019; Tsai & Chen, 2021). Interestingly, positive effects on muscle activation were noted mainly after VFR, but not after FR, most likely due to the influence of vibration (Lim et al., 2019; Ridha et al., 2021). Explosive power generation in terms of vertical jump performance has also been a topic of research and just as with muscle strength, the findings are ambiguous: while some say they observed an increase in jump height after foam-rolling (Romero-Moraleda et al., 2019; Tsai & Chen, 2021), others suggest that such treatment does not lead to significant changes in jump performance (Junker & Stöggl, 2019; Lin & Park, 2019; Lopez-Samanes et al., 2021).

Ambiguous findings were also obtained in terms of balance: de Benito et al. (2021) suggest that foam-rolling promotes the recovery of the ability to maintain dynamic balance, while Seever et al. (2022) say that long-term application of FR (two-week intervention) does not lead to significant changes in Y-balance test results.

Muscle soreness and muscle tone are characteristics of neuromuscular function that can have influence on motor abilities, primarily through limited ROM and reduction of capacities for muscle force and power generation. Several studies reported a decrease in muscle soreness (Laffaye et al., 2019; Santana et al., 2021), increase in pain threshold (Cheatham & Stull, 2019), and resistance to fatigue (Santana et al., 2021), which may have contributed to better flexibility and ROM immediately after the foam-rolling treatment (Cheatham & Stull, 2019; Folli et al., 2021; Fonta et al., 2021; Krause et al., 2017; Laffaye et al., 2019; Seever et al., 2022; Sulowska-Daszyk & Skiba, 2022).

When discussing the results and findings of the reviewed studies, one must consider the diversity among the applied protocols, with different outcome measures and intervention parameters, whereby the physiological mechanisms responsible for the reported findings are not fully known or sufficiently investigated. We should not ignore the fact that the outcome of the treatment may depend on the characteristics of the roller itself, and that the GRID rollers, multi-level, or vibrating rollers may have greater immediate post-intervention effects compared to smooth surface FRs (Cheatham & Stull, 2019). Although it has already been said, we would like to highlight the observed diversity in the research protocols, primarily in terms of the duration of the foam-rolling. In some studies, the treatment lasted only 15s, and in others up to 2 minutes (Cheatham & Stull, 2019), which obstructs the comparison of research results. Finally, despite gaps in knowledge and many contradictions regarding the effects of foam-rolling, there is a lack of studies that sought to determine the long-term effects of foam-rolling on physical abilities and neuromuscular function. Namely, one of the main disadvantages of longitudinal research is the impossibility of constant monitoring of participants (Miller & Rockey, 2006).

Although foam-rolling is often applied both in sports and rehabilitation, due to the heterogeneity of methods among the studies, there is currently no official recommendation on the optimal manner of use of FR (treatment time, pressure, and cadence). Nevertheless, current findings can be useful for future research that should further examine the underlying physiological mechanisms, with particular attention dedicated to possible contraindications and precautions when foam-rolling is used as a therapeutic tool or as an auxiliary tool in sports training. Although the basic physiological effects of FR and VFR are not fully understood and were not the subject of this paper, the potential of self-myofascial release using a foam roller certainly calls for additional research in this area.

CONCLUSION

The latest studies confirm earlier findings that foam-rolling can have a short-term positive effect on muscle flexibility and ROM in the joints, while the findings regarding the effect on the muscle function capacities (strength, explosive power, etc.) and balance are ambiguous. In comparison to static stretching, the favourable effects of foam-rolling on motor abilities or individual muscle's function (e.g. quadriceps femoris or hamstring muscles), or some motor tasks (e.g. jumps) have been confirmed when applied for longer than 60s, or if a VFR was used. Furthermore, some evidence suggests that FR may be a more appropriate alternative to static but not to dynamic stretching during warm-up. The research results certainly indicate that VFR massage could be an additional option for untrained adults as well as athletes to improve ROM. In addition, it has been noted that foam-rolling with FR or VFR can delay the onset of fatigue and relieve muscle soreness after intense exertion. Taking this into account, the findings suggest that the application of FR could have a positive effect on alleviating muscle hypertonicity, which is very important during warm-up, rehabilitation, or corrective exercise treatments for the prevention and correction of postural disorders.

LITERATURE

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