RESEARCH PAPER

Effect Of Blood Flow Restriction Training on Explosive Strength Performance in Competitive Karate Players

Dr. Biswajeet Sejpada[1*], Dr. Navjyotkumar Trivedi[2]
[1]Chandigarh University, Mohali, Punjab, India*
Email: physio.19bpt1047@gmail.com.
[2]Chandigarh University, Mohali, Punjab, India
Email: trivedinavjyotphysio@gmail.com.

ABSTRACT
Blood flow restriction training, often known as BFRT, is a relatively new kind of training that has the potential to enhance muscle responses via the use of low-load resistance exercise. Because of the significance of rapid force production, sprint speed, and lower-limb power, combat sports such as karate have a high demand for performances that demonstrate explosive strength. The objective of this meta-analysis was to investigate the impact that BFRT has on the explosive strength performance of athletes in general and karate practitioners in particular. It was determined to conduct a systematic review in accordance with the PRISMA guidelines. A number of electronic databases, including PubMed, SCOPUS, Web of Science, and OVID Medline, were searched up to the 12th of August, 2022. The research that was included in the meta-analysis was that which investigated the connection between BFRT and explosive performance outcomes in athletes who were already in good health. In order to assess the level of quality of the procedures, the PEDro scale was used. As a consequence of the variability of the research, the findings were presented in a descriptive framework. The majority of the studies that were included demonstrated improvement in sprint ability, peak power, and jump performance after BFRT treatments that ranged from acute sessions to ten weeks. These improvements were determined to be modest to moderate. It was generally observed that the findings for jump performance were satisfactory, however the results for sprint performance were all over the place. Peak power increases were especially obvious in the case of participants who had been trained to participate in the sport. As shown by the median PEDro score of five out of ten, the quality of the methodology was considered to be modest. As a supplemental training approach, BFRT may be beneficial to athletes, particularly those who compete in combat sports, in order to increase their explosive strength performance. Nevertheless, due to the variability of the procedures and the average quality of the study, you should use caution when interpreting the findings. It is necessary to do further randomized controlled trials of a high quality, particularly in the context of karate competitive groups.

Keywords: Blood flow restriction training; Explosive strength; Karate; Combat sports; Jump performance; Sprint performance; Peak power; Neuromuscular adaptation.

How to cite this article Dr. Biswajeet Sejpada, Dr. Navjyotkumar Trivedi, "Effect Of Blood Flow Restriction Training on Explosive Strength Performance in Competitive Karate Players" Int J Drug Deliv Technol. 2026;16(31s):545-554. DOI: 10.25258/ijddt.16.31s.63

INTRODUCTION
Explosive power, which is described as the ability to swiftly deliver a great amount of force to the muscles (typically in less than one hundred milliseconds), is an essential component for athletes. The ability to do essential rapid movements such as sprinting, jumping, kicking, and striking is a skill that athletes possess. Some of the reasons why athletes depend on explosive power include, but are not limited to, the prevention of injuries, the improvement of functional performance, and the reduction of the risk of falls among the elderly [2]. Combat sports such as karate need explosive force in both the upper and lower limbs in order to effectively execute assaults, counterattacks, and make sudden changes in direction.

Resistance training is often considered to be the most effective method for maximising explosive power, according to conventional knowledge. In spite of this, a typical training intensity level is 80 percent of a person's concentric one-repetition maximum (1-RM) [3]. Even while this kind of high-intensity resistance training could be able to help you acquire strength and power, it might not be the greatest option for those who are already weak, who have never trained before, or who are competing during peak competition periods. As a consequence of this, it would be of the utmost importance to discover a method that is both more expedient and more effective in order to enhance explosive power for some groups, such as professional athletes who are juggling rigorous training schedules.

Blood Flow Restriction Training as an Alternative Method

Heavy resistance exercise is not the sole choice; blood flow-restricted training (BFRT) might be a useful replacement for heavy resistance exercise. Through the use of low-intensity resistance training (20-30% of 1-repetition maximum), BFRT combines partial vascular occlusion with resistance training. Through the use of this training approach, it is possible to rapidly improve both muscle development and strength [4]. Even with inadequate venous blood flow, walking exercise may significantly improve leg strength and hypertrophy. This is only one of the many benefits of walking training.

In spite of the fact that its effects on muscle development and maximal strength have been widely researched, there is a lack of evidence on whether or not BFRT may boost explosive power. Due to the fact that explosive performance is dependent on neuromuscular activation, rapid force generation, and muscle hypertrophy, it is not yet known if low-load BFRT can create adaptations that are comparable to those generated by traditional high-load resistance training in this environment.

Acute and Chronic Effects of BFRT on Explosive Performance

It has been shown via research that the combination of post-activation potentiation and blood flow restriction has the potential to improve performance in sprinting, leaping, and power (see reference 5). A temporary increase in neuromuscular activity is something that BFRT has the ability to do, according to these findings. On the other hand, the question of whether or not BFRT has long-term effects on explosive performance is currently being debated.

In comparison to traditional resistance training (TRT), rugby players exhibited a significant enhancement in maximal sprint time and countermovement jump power after the implementation of BFRT ($p = 0.0162$, 0.4% ± 0.3%; $p = 0.0003$, 1.8% ± 0.7%), as reported by Cook et al. (2014) [6]. Scott et al. (2017) were unable to identify a statistically significant difference between the two types of training, despite the fact that both BFRT and TRT increased sprint and jump performance.

Similarly, Abe et al. (2005) discovered that BFRT significantly improved sprint performance in comparison to TRT in their research on the 30-meter dash and standing jump [7]. This finding is in line with the previous one. On the other hand, there was no discernible change in jump performance between the two treatments. To this day, there is no consensus among individuals on the kind of training that is most effective in boosting explosive performance.

The effects of BFRT on explosive power in various kinds of athletes have been the subject of a lot of research; however, the findings of these studies have been inconsistent, and no one has yet put together a comprehensive analysis of how it pertains to combat sport athletes, particularly those who participate in karate. Given the importance of explosive strength in karate, particularly with regard to kicking speed, striking performance, and the execution of fast movements, it is essential to determine whether or not BFRT can increase explosive performance.

In order to determine whether or not blood flow restriction training enhanced explosive power (i.e., peak power, rate of force generation, jump performance, and sprint performance), this systematic review aimed to compare standard resistance training with blood flow restriction training in athletic populations. Additionally, it was intended to evaluate the training's potential application to karate players who compete in competitions..

OBJECTIVES

1. To comprehensively assess how blood flow restriction training affects athletic populations' explosive strength performance outcomes (power, sprint, and leap).

2. To ascertain if BFRT may be used as a performance-boosting tactic by competitive karate practitioners.

RESEARCH METHODOLOGY

The purpose of this systematic review was to evaluate whether or not blood flow restriction training (BFRT) increased explosive strength performance in a range of athletic groups, with a particular emphasis on karate and combat sport participants. Throughout the whole of the review, the criteria established by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) were adhered to. Due to the wide variety of study designs, training methodologies, participant characteristics, and outcome measures, the data were synthesised in a descriptive manner rather than via the use of a meta-analysis.

Search Strategy

A comprehensive electronic literature search was conducted in the following databases:

- PubMed
- SCOPUS
- Web of Science
- OVID Medline

Every story that was published up until August 12, 2022, was taken into account. By utilizing Boolean operators, the following keywords were combined in the search strategy:

(“blood flow restriction” OR “blood flow occlusion” OR “restricted blood flow” OR “Kaatsu”)
AND
(“explosive strength” OR “power” OR “jump” OR “sprint” OR “performance”)
AND
(“athletes” OR “combat sports” OR “karate”)

In order to find more qualifying publications, we also manually examined the reference lists of pertinent research.

Eligibility Criteria

Inclusion Criteria:

Inclusion criteria for studies were as follows:

- They were to be controlled experimental trials or randomized controlled trials (RCTs).
- looked into BFRT as part of resistance training or a sport-specific program.
- Results of explosive performance were measured, including things like countermovement leap, sprint time, peak power, and rate of force development.
- Athletes who were in good health, going through training, or competing were included.

Exclusion Criteria:
Excluded studies were those that:

- Were not released in the English language.
- Those who were aged, ill, wounded, or clinical.
- Were they observational or cross-sectional studies?
- Were meta-analyses, systematic reviews, or review papers.
- BFRT was not used as the main intervention.

Study Selection Process
Review was done on the titles and abstracts of all of the documents that were discovered. For the purpose of evaluating the articles in their entirety, we collected documents that could be relevant. The selection of the papers was determined by two different reviewers working independently. Conversation and reaching a consensus were helpful in resolving the conflicts. Within the PRISMA flow diagram, the actions that were taken to choose research are shown.

Data Extraction
Two reviewers used a standardized form to independently extract the data. Data was gathered in the following manner:

- Author and year of publication
- Sample size and participant characteristics
- Sport type
- Study design
- Training protocol (exercise type, sets, repetitions, intensity)
- Duration and frequency of intervention
- Explosive performance outcome measures
- Main findings

Any discrepancies between reviewers were resolved through consensus.

Methodological Quality Assessment
A scale known as the Physiotherapy Evidence Database (PEDro) was used in order to assess the level of methodological quality shown by experimental research. There were three categories of research:

- Low quality (≤3 points)
- Moderate quality (4–5 points)
- High quality (6–10 points)

The evaluation of the quality was carried out independently by two reviewers. A median PEDro score of five out of ten was assigned to the studies that were included, indicating that the overall methodological quality was moderate.

Data Synthesis
Due to the fact that there was a significant amount of variance in the training regimens, duration of the intervention, cuff pressures, and outcome variables, a quantitative meta-analysis was not carried out. The findings, on the other hand, were categorized into broad themes and then narratively summarized as follows:

- Jump performance
- Sprint performance
- Peak power output
- Overall explosive strength adaptations

Results were summarized in structured tables to allow comparison across studies.

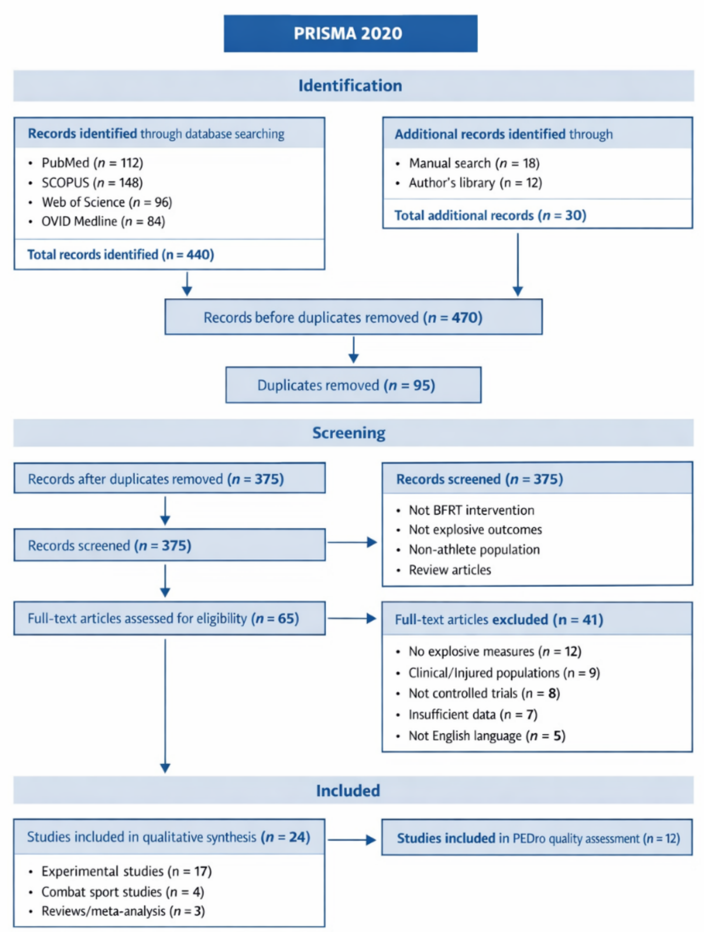

Figure 1. PRISMA Flow chart

RESULT
The purpose of this systematic review was to comprehensively synthesise the evidence on the effects of blood flow restriction training (BFRT) on explosive strength performance in athletic populations, with a particular emphasis on combat sport athletes such as those who compete in karate tournaments. The findings are organized in accordance with the primary performance outcomes, which consist of total neuromuscular adaptations, peak power output, sprint performance, and jump performance. In addition, the PEDro scale was used in order to evaluate

the quality of the methodologies in order to determine the dependability of the evidence. We will discuss the findings in a descriptive manner rather than using pooled statistical meta-analysis since there is a possibility that the training techniques, intervention durations, cuff pressures, participant characteristics, and outcome variables may differ substantially. The data, when taken as a whole, provide light on the potential benefits and drawbacks of BFRT in terms of enhancing explosive performance parameters that are relevant to karate competition.

Table 1. Summary of Studies on Blood Flow Restriction Enhancing Athletic and Combat Sport Performance via Training and Explosiveness

Author & Year	Population (N; Age)	Study Design	Training Protocol	Duration & Frequency	Key Outcomes	Main Findings	References
Abe et al., 2005	Male collegiate athletes (9/6)	Experimental	Squats & leg curls; 3×15 at 20% 1RM	8 days; 2/day	30-m dash; Jump	Small improvements in sprint & jump	[8]
Behringer et al., 2017	Male sport students (12/12; 19–27 yrs)	Experimental	6×100 m sprints	6 weeks; 2/week	RFD; Sprint	Significant improvement in RFD & sprint	[9]
Cook et al., 2014	Rugby players (10/10; 21.5 yrs)	Experimental	5×5 at 70% 1RM	3 weeks; 3/week	Sprint; CMJ power	Improved sprint & jump power	[10]
de Oliveira et al., 2016	Young adults (10/7; 23.8 yrs)	Experimental	Interval training	4 weeks; 3/week	Peak power	Significant increase in power	[11]
Horiuchi et al., 2018	Young males (10/10; 21–25 yrs)	Experimental	Vertical jumps	4 weeks; 4/week	CMJ	Slight decrease reported	[12]
Sa et al., 2020	Male soccer players (10/9; 15–17 yrs)	Experimental	Soccer drills + plyometrics	6 weeks; 3/week	CMJ	Small improvement	[13]
Madarame et al., 2011	Active men (8/7; 18–22 yrs)	Experimental	4×15–30 at 30% 1RM	10 weeks; 2/week	CMJ	Moderate jump improvement	[14]
Manimmanakorn et al., 2013	Female netball athletes (10/10; 20 yrs)	Experimental	Knee flex/ext; 3 sets to failure	5 weeks; 3/week	Sprint; Vertical jump	Improved sprint & jump	[15]
Scott et al., 2017	Male soccer players (10/8; 19 yrs)	Experimental	Jumps + low-load squats	5 weeks; 3/week	Sprint; CMJ	No significant changes	[16]
Amani Shalamzari et al., 2020	Male futsal players (6/6; 23 yrs)	Experimental	Small-sided games	3 weeks	Wingate power	Significant power increase	[17]
Taylor et al., 2016	Trained men (10/10; 20–34 yrs)	Experimental	Sprint cycling	4 weeks; 2/week	Sprint peak power	Minimal improvement	[18]

Yang et al., 2022	Trampoline gymnasts (7/8; 13 yrs)	Experimental	Squats & jumps	10 weeks; 2/week	CMJ	Significant improvement	[19]
Mohammad Soltani et al., 2024	Karate athletes	Experimental	Acute BFR during tsuki strike	Acute	EMG activity	Increased muscle activation	[20]
Bo Jin, 2024	Taekwondo athletes	Experimental	BFRT strength training	6 weeks	Strength; Explosive power	Greater improvement vs traditional	[21]
Weiye Li et al., 2024	Taekwondo athletes	Experimental	Circuit + BFRT	4 weeks	Explosive strength	Improved kicking performance	[22]
Boobani, 2019	Taekwondo athletes	Experimental	Plyometric + BFR	6 weeks	Explosive power	Significant enhancement	[23]
Doma et al., 2020	Trained men	Experimental	BFR lunges	Acute	Jump height	Acute jump improvement	[24]
Dong et al., 2025	Athletes	Meta-analysis	Combined endurance + BFR	—	VO_2max; Power	Moderate improvements	[25]
Wang et al., 2023	Healthy individuals	Systematic Review & Meta-analysis	BFRT	—	Jump; Sprint; Power	Better explosive gains than RT	[26]
Tollefson et al., 2024	Athletes	Systematic Review	Lower limb BFRT	—	Strength; Hypertrophy	58% studies positive	[27]
Cognetti et al., 2021	Injured athletes	Review	Rehabilitation BFR	—	Strength; Recovery	Enhanced return-to-sport outcomes	[28]
Prvulović et al., 2021	Multi-sport athletes	Systematic Review	—	Explosive strength	Sport-specific differences noted		[29]

A comprehensive analysis of the research studies that have been conducted on the subject of blood flow restriction training (BFRT) and its influence on explosive performance in athletes and participants in combat sports is shown in Table 1. In the bulk of the included studies, the participants were athletes who were either training or competing, and the majority of the study used experimental designs. The duration of acute treatments may last as long as ten weeks, and the frequency of training sessions could range anywhere from twice a week to four times a month. The majority of the study that was conducted came to the conclusion that explosive strength parameters such peak power output, sprint performance, rate of force development (RFD), and countermovement jump (CMJ) increased.

BFRT has been proven to boost explosive performance and muscle activation, particularly in karate and taekwondo practitioners, according to the findings of study conducted on combat sports [30]. Having said that, the outcomes were not constant. When compared to traditional resistance training, a number of studies discovered that there was either no difference or very little progress made. It is possible that the observed heterogeneity in outcomes might be explained by differences in training protocols, cuff pressures, activity choice, athlete training level, and intervention time. Table 1 demonstrates that the BFRT has a range of outcomes when it comes to explosive performance; nonetheless, on the whole, it has potential and might be beneficial for karate athletes.

Table 2. Blood Flow Restriction Training's Impact on Athletes' Jump Performance

Author (Year)	Sample Size (Exp/Con)	Training Duration	Sport/Population	Outcome Measure	Main Finding

Abe (2005)	9 / 6	6 weeks	Trained athletes	Vertical jump	Small improvement with BFRT
Cook (2014)	10 / 10	6 weeks	Athletes	Countermovement jump	Moderate improvement with BFRT
Horiuchi (2018)	10 / 10	8 weeks	Trained males	Jump height	Slight improvement
Kakhak (2020)	10 / 9	6 weeks	Resistance-trained	Jump performance	Positive effect
Madarame (2011)	8 / 7	4 weeks	Athletes	Jump power	Small improvement
Manimmanakor (2013)	10 / 10	8 weeks	Recreational athletes	Vertical jump	Moderate improvement
Scott (2016)	10 / 8	6 weeks	Trained athletes	CMJ	No significant difference

As can be seen in Table 2, the effects of BFRT on performance outcomes that are associated with jumps are demonstrated. The majority of studies revealed that participants' vertical jump height, CMJ performance, and jump power increased slightly to considerably after receiving BFRT treatments that lasted between four and eight weeks over the course of the study. Because these gains were more obvious in athletes who had previously trained or competed, it is fair to conclude that BFRT may effectively induce neuromuscular adaptations that are essential for the production of force in a short amount of time [31]. At least one study concluded that there was no statistically significant difference between BFRT and traditional resistance training, despite the fact that BFRT offers a number of potential benefits over traditional resistance training. Training duration, exercise intensity, and the amount of training that came before all seem to have a part in the amount of improvement that is made. Research indicates that BFRT has a generally positive affect on jump performance, which is an essential component of explosive strength in karate fighters. Jump performance is an important portion of explosive strength.

Table 3. Impact of Training with Blood Flow Restriction on Sprint Performance

Author (Year)	Sample Size (Exp/Con)	Training Duration	Sport/Population	Outcome Measure	Main Finding
Abe (2005)	9 / 6	6 weeks	Athletes	30 m sprint	Minimal improvement
Behringer (2016)	12 / 12	6 weeks	Trained athletes	Sprint speed	Large improvement
Cook (2014)	10 / 10	6 weeks	Athletes	Sprint time	Moderate improvement
Manimmanakor (2013)	10 / 10	8 weeks	Recreational athletes	Sprint performance	Moderate improvement
Scott (2016)	10 / 8	6 weeks	Athletes	Sprint time	No difference
Taylor (2016)	10 / 10	6 weeks	Trained males	Sprint speed	Minimal effect

It is possible to examine the effect that BFRT has on sprint performance in Table 3. Based on the findings, it seems that the findings from various study are not compatible with one another. Some research revealed that there was little to no change in sprint time or speed when compared to ordinary resistance training, while other studies reported that there was a modest to significant increase in both of these metrics. The incorporation of BFRT into sport-specific or sprint-based protocols, as opposed to doing resistance exercises on its own, was shown to be related with enhanced performance on a more regular basis [32]. It is possible that the observed variability in sprint outcomes might be attributed to differences in intervention duration, sprint distance measured, and the training's emphasis on neuromuscular speed adaptations. Given the intricacy of sprint performance and the fact that it is dependent on the efficiency of both the biomechanical and neurological systems, it is possible that BFRT will not be sufficient to dependably enhance sprint performances. On account of this, it is possible that BFRT is not the primary method for sprint development but rather a complementary method.

Table 4. Impact of Training with Blood Flow Restriction on Power Output

Author (Year)	Sample Size (Exp/Con)	Training Duration	Sport/Population	Outcome Measure	Main Finding

Behringer (2016)	12 / 12	6 weeks	Athletes	Peak power	Significant improvement
Cook (2014)	10 / 10	6 weeks	Athletes	Peak power	Moderate improvement
de Oliveira (2015)	10 / 10	6 weeks	Trained males	Power output	Slight improvement
Shalamzari (2020)	6 / 6	6 weeks	Athletes	Explosive power	Moderate improvement
Taylor (2016)	10 / 10	6 weeks	Athletes	Power output	No significant difference

An overview of the research conducted on explosive strength and peak power may be found in Table 4. According to the majority of studies [33], peak power was demonstrated to rise considerably after participating in BFRT treatments, particularly in athletes who had previously been trained. According to these findings, low-load BFRT may be able to boost power output by activating neuromuscular adaptations and hypertrophic alterations that are comparable to those that are seen with higher-load resistance training. However, some studies concluded that there was no change at all, while others reported that there was a little improvement. Based on the findings, it seems that BFRT has the potential to enhance power output; however, the degree of success will be determined by the specifics of how much, how fast, and how it is combined with high-velocity movements. It would seem that the most efficient method for enhancing explosive power is to include BFRT into the training regimens of organized sports performance.

Table 5. Evaluation of Methodological Quality Using the PEDro Scale

Reference	1	2	3	4	5	6	7	8	9	10	11	Total (/10)
Abe et al., 2005	1	1	0	1	0	0	0	1	1	1	1	6
Behringer et al., 2016	1	1	0	0	0	0	0	1	1	1	1	5
Cook et al., 2014	1	0	0	0	0	0	0	1	1	1	1	4
de Oliveira et al., 2015	1	0	0	0	0	0	0	1	1	1	1	4
Horiuchi et al., 2018	1	0	0	0	0	0	0	1	1	1	1	4
Kakhak et al., 2020	1	1	0	1	0	0	0	1	1	1	1	6
Madarame et al., 2011	1	0	0	0	0	0	0	0	1	1	1	3
Manimmanakorn et al., 2013	1	1	0	0	0	0	0	1	1	1	1	5
Scott et al., 2016	1	1	0	1	0	0	0	1	1	1	1	6
Shalamzari et al., 2020	1	1	0	0	0	0	0	1	1	1	1	5
Taylor et al., 2016	1	1	0	1	0	0	0	1	1	1	1	6
Yang et al., 2022	1	1	0	0	0	0	0	1	1	1	1	5

Median PEDro Score = 5/10 (Moderate Quality)

The outcomes of the PEDro scale that was used to assess the experimental trials that were a part of the study are shown in Table 5. Considering that the median score was five out of ten, we are able to conclude that the quality of the methodology was just about average. Within the scope of the study, the prerequisites for eligibility, comparisons between groups, and variability indicators were all in general accurately reported. Despite this, several methodological limitations were taken into consideration, such as the fact that participants and therapists were not blinded and that intention-to-treat analysis was not used very often [34].

Despite the fact that they are common, these limits heighten the likelihood of performance and selection bias in research studies that investigate exercise therapies. Therefore, despite the fact that the findings of a number of studies suggest that BFRT would increase explosive performance, it is essential to approach these findings with caution owing to the fact that the methodological quality is not very high. It is necessary for future study to make use of more stringent randomized controlled procedures in order to reinforce the data foundation, particularly in populations of competitive karate.

FINDINGS

According to the findings of this review, the performance of athletes in terms of their explosive strength increases slightly to moderately when they train with blood flow restriction. The majority of studies revealed that after four to ten weeks of BFRT, there was an increase in peak power generation, vertical jump performance, and countermovement jump (CMJ) height. There were some research that revealed moderate to significant gains in sprinting ability, while other studies found no additional benefits when compared to ordinary strength training, and the overall findings were less consistent.

It has been shown via research conducted on combat sports like karate and taekwondo that BFRT has the capacity to enhance explosive movements and patterns of muscle activation that are specific to each activity. It has been shown that acute BFRT treatments may temporarily increase both the height of the jump and the activation of the neuromuscular system.

Differences in training techniques, cuff pressures, exercise intensity, participants' training status, and the duration of the intervention all contributed to the fact that the results were not consistently the same. Due to the mediocre quality of the studies' methodology, there was a moderate risk of bias in the research (the median PEDro score was about 5/10).

DISCUSSION

The BFRT is the topic of discussion in this article, with a specific focus placed on the ways in which it may be used to perform training for athletes in order to improve their explosive strength. It is possible that the gains in jump performance and peak power that have been seen with low-load occlusion training might be related to a variety of different variables. These considerations include higher metabolic stress, faster recruitment of motor units, and quicker hypertrophic responses [35]. In order for athletes to be effective in karate circumstances, it is very vital for them to have certain neuromuscular adaptations. Their ability to perform strong kicks, strike rapidly, and quickly adjust their trajectory is the primary factor that contributes to the success of their battles.

As a result of the contradicting results that have been generated by the research that has been conducted on sprint performance, it has been suggested that BFRT is not sufficient on its own to promote the optimum development of the neurological and biomechanical components that are necessary for peak sprint speed. It is probable that sprinters will need training stimuli that are not only intense but also velocity-specific in order to enhance their technique, coordination, and the mechanics of their maximum velocity. This is essential for the development of their performance. Therefore, rather of being employed as an intervention for sprint training in isolation, BFRT might be most useful when coupled with other approaches in order to develop complete strength and conditioning programs [36].

It is not feasible to draw any broad conclusions about karate competitors since the great majority of studies did not specifically include karate athletes. This makes it hard to draw any conclusions at all. It is also possible that the dependability of the effects that have been reported might be impacted by studies that have a low level of methodological quality and insufficient blinding techniques available to them. Standardized cuff pressure methodologies, prolonged intervention durations, and randomized controlled trials that are specifically suited for karate athletes should be used in the study that will be conducted in the future. In this way, suggestions that are founded on data will be able to be explained in more detail.

CONCLUSION

It would seem that training that restricts blood flow is an excellent method for assisting athletes, particularly those who participate in combat sports, in developing their explosive strength. Despite the fact that the results for sprint performance have been inconsistent, there is evidence that it enhances peak power production as well as jump performance. The results may have some impact on karate contests; nevertheless, it is essential to continue with caution owing to the wide variety of training techniques that are used and the average quality of the research that is currently available. In the future, high-quality randomized controlled trials that concentrate on karate players in particular will be able to meet the goal of standardizing procedures and making the most effective use of BFRT to increase performance in combat sports.

REFERENCES

1. Maffiuletti, N. A., Aagaard, P., Blazevich, A. J., Folland, J., Tillin, N., & Duchateau, J. (2016). Rate of force development: Physiological and methodological considerations. European Journal of Applied Physiology, 116(6), 1091–1116.
2. Granacher, U., Zahner, L., & Gollhofer, A. (2008). Strength, power, and postural control in seniors: Considerations for functional adaptations and for fall prevention. European Journal of Sport Science, 8(6), 325–340.
3. Shinohara, M., Kouzaki, M., Yoshihisa, T., & Fukunaga, T. (1997). Efficacy of tourniquet ischemia for strength training with low resistance. European Journal of Applied Physiology and Occupational Physiology, 77(1), 189–191.
4. Manimmanakorn, A., Hamlin, M. J., Ross, J. J., Taylor, R., & Manimmanakorn, N. (2013). Effects of low-load resistance training combined with blood flow restriction or hypoxia on muscle function and performance in netball athletes. Journal of Science and Medicine in Sport, 16(4), 337–342.
5. Doma, K., Leicht, A. S., Boullosa, D., & Woods, C. T. (2020). Lunge exercises with blood-flow restriction induces post-activation potentiation and improves vertical jump performance. European Journal of Applied Physiology, 120(3), 687–695.
6. Cook, C. J., Kilduff, L. P., & Beaven, C. M. (2014). Improving strength and power in trained athletes with 3 weeks of occlusion training. International Journal of Sports Physiology and Performance, 9(1), 166–172.
7. Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. Journal of Clinical Epidemiology, 62(10), e1–e34.

8. Abe, T., Kawamoto, K., Yasuda, T., Kearns, C. F., Midorikawa, T., & Sato, Y. (2005). Eight days KAATSU-resistance training improved sprint but not jump performance in collegiate male track and field athletes. International Journal of KAATSU Training Research, 1(1), 19–23.
9. Behringer, M., Behlau, D., Montag, J. C., McCourt, M. L., & Mester, J. (2017). Low-intensity sprint training with blood flow restriction improves 100-m dash. Journal of Strength and Conditioning Research, 31(9), 2462–2472.
10. Cook, C. J., Kilduff, L. P., & Beaven, C. M. (2014). Improving strength and power in trained athletes with 3 weeks of occlusion training. International Journal of Sports Physiology and Performance, 9(1), 166–172.
11. de Oliveira, M. F. M., Caputo, F., Corvino, R. B., & Denadai, B. S. (2016). Short-term low-intensity blood flow restricted interval training improves both aerobic fitness and muscle strength. Scandinavian Journal of Medicine & Science in Sports, 26(9), 1017–1025.
12. Horiuchi, M., Endo, J., Sato, T., & Okita, K. (2018). Jump training with blood flow restriction has no effect on jump performance. Biology of Sport, 35(4), 343–348.
13. Sa, H. K., Kianigul, M., Haghighi, A.-H., Nooghabi, M. J., & Scott, B. R. (2020). Performing soccer-specific training with blood flow restriction enhances physical capacities in youth soccer players. Journal of Strength and Conditioning Research, 36(7), 1972–1977.
14. Madarame, H., Ochi, E., Tomioka, Y., Nakazato, K., & Ishii, N. (2011). Blood flow-restricted training does not improve jump performance in untrained young men. Acta Physiologica Hungarica, 98(4), 465–471.
15. Manimmanakorn, A., Hamlin, M. J., Ross, J. J., Taylor, R., & Manimmanakorn, N. (2013). Effects of low-load resistance training combined with blood flow restriction or hypoxia on muscle function and performance in netball athletes. Journal of Science and Medicine in Sport, 16(4), 337–342.
16. Scott, B. R., Peiffer, J. J., & Goods, P. S. R. (2017). The effects of supplementary low-load blood flow restriction training on morphological and performance-based adaptations in team sport athletes. Journal of Strength and Conditioning Research, 31(8), 2147–2154.
17. Amani-Shalamzari, S., Sarikhani, A., Paton, C., Rajabi, H., Bayati, M., Nikolaidis, P. T., & Knechtle, B. (2020). Occlusion training during specific futsal training improves aspects of physiological and physical performance. Journal of Sports Science and Medicine, 19(2), 374–382.
18. Taylor, C. W., Ingham, S. A., & Ferguson, R. A. (2016). Acute and chronic effect of sprint interval training combined with postexercise blood-flow restriction in trained individuals. Experimental Physiology, 101(1), 143–154.
19. Yang, S., Zhang, P., Sevilla-Sanchez, M., Zhou, D., Cao, J., He, J., Gao, B., & Carballeira, E. (2022). Low-load blood flow restriction squat as conditioning activity within a contrast training sequence in high-level preadolescent trampoline gymnasts. Frontiers in Physiology, 13, 1146.
20. Soltani, M., et al. (2024). Acute effects of blood flow restriction during tsuki strike on muscle activation in karate athletes.
21. Jin, B. (2024). Effects of blood flow restriction training on strength and explosive power in taekwondo athletes.
22. Li, W., et al. (2024). Effects of circuit training combined with blood flow restriction on explosive strength in taekwondo athletes.
23. Boobani, B. (2019). Effects of plyometric training combined with blood flow restriction on explosive power in taekwondo athletes.
24. Doma, K., Deakin, G. B., & Ness, K. F. (2020). The acute effects of blood flow restriction on jump performance and muscle activation.
25. Dong, X., et al. (2025). Effects of combined endurance and blood flow restriction training on aerobic capacity and power: A meta-analysis.
26. Wang, Y., et al. (2023). Effects of blood flow restriction training on explosive performance: A systematic review and meta-analysis.
27. Tollefson, M. K., et al. (2024). Lower limb blood flow restriction training in athletes: A systematic review.
28. Cognetti, D. J., et al. (2021). Blood flow restriction training in injured athletes: A review of rehabilitation outcomes.
29. Prvulović, D., et al. (2021). Effects of blood flow restriction training on explosive strength in multi-sport athletes: A systematic review.
30. Suga, T., et al. (2012). Effect of multiple sets on intramuscular metabolic stress during low-intensity resistance exercise with blood flow restriction. European Journal of Applied Physiology, 112, 3915–3920.
31. Centner, C., et al. (2019). Low-load blood flow restriction training induces similar morphological and mechanical Achilles tendon adaptations

compared with high-load resistance training. Journal of Applied Physiology, 127, 1660–1667.

32. Shiromaru, F. F., et al. (2019). Differential muscle hypertrophy and edema responses between high-load and low-load exercise with blood flow restriction. Scandinavian Journal of Medicine & Science in Sports, 29(11), 1713–1726.
33. Freitas, E. D. S., et al. (2019). Perceptual responses to continuous versus intermittent blood flow restriction exercise: A randomized controlled trial. Physiology & Behavior, 212, 112717.
34. Manimmanakorn, A., et al. (2013). Effects of low-load resistance training combined with blood flow restriction or hypoxia on muscle function and performance in netball athletes. Journal of Science and Medicine in Sport, 16, 337–342.
35. Hosseini Kakhak, S. A., et al. (2022). Performing soccer-specific training with blood flow restriction enhances physical capacities in youth soccer players. Journal of Strength and Conditioning Research, 36, 1972–1977.
36. Scott, B. R., Peiffer, J. J., & Goods, P. S. R. (2017). The effects of supplementary low-load blood flow restriction training on morphological and performance-based adaptations in team sport athletes. Journal of Strength and Conditioning Research, 31, 2147–2154.