

# The Knowledge and Use of Blood Flow Restriction Therapy in a Sample of Physical Therapists in the United States

Original Research

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## Abstract

**Purpose:** Blood flow restriction therapy (BFRT) is a rehabilitation technique that seems to elicit hypertrophy gains similar to heavy resistance training. Despite increased popularity of BFRT, the extent it is used in physical therapy (PT) is unknown. The purpose of the study was to examine the knowledge, and utilization, of BFRT by practicing Physical Therapists (PTs).

**Methods:** PTs were recruited to complete an online survey on their knowledge and use of BFRT.

**Results:** From 159 participants, it was found that 88.1% (n=140) of participating PTs had heard of BFRT, with age and gender disparities, though only 38.6% (n=54) reported using BFRT on a patient. There was a significant difference between male and female PTs knowledge (98% vs 81%,  $p < 0.001$ ) and use (48% vs 24%,  $p = 0.016$ ) of BFRT. 98% of PTs who reported using BFRT indicated it was beneficial or very beneficial for their patients.

**Conclusions:** There were apparent gaps between PTs knowledge of BFRT and inclusion in practice, though most of these clinicians would be open to consider use of BFRT. Nearly all BFRT practitioners believed it was efficacious and will continue using it. Education and training of PTs could improve utilization of BFRT and perhaps, ultimately clinical outcomes.

**Key Words:** blood flow restriction; survey; sports medicine

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## Introduction

Physical therapy (PT) approaches have evolved over time aiming to follow evidence-based practices that maximize positive musculoskeletal outcomes for each patient. Resistance training using heavy external loads is a very effective method of increasing muscle mass and improving function, yet may not be appropriate or tolerated in those with recent surgical repairs or joint issues. Increasing or preserving muscle mass may be critical, such as in the elderly population who are often characterized by sarcopenia and increased fall risk <sup>2</sup>, or in those post-surgery. While strength training is beneficial for the muscle and function in a variety of populations,

it also poses a risk of injury or re-injury, and simply may not yet be tolerated by patients' joints. As in the case of total knee arthroscopy, systematic reviews of post-surgical exercise interventions indicated varying results suggesting the need for additional therapeutic modalities or therapeutic adjuvants that may enhance adaptations <sup>7,14</sup>.

Blood flow restriction therapy (BFRT), while a relatively new technique, originates back to 1966, and only recently has gained attention due to the positive outcomes in both rehabilitation and physical performance. This technique involves



external pressure over the extremities via a tourniquet or cuff while performing resistance training or movement. The applied pressure is sufficient to maintain arterial inflow while occluding venous outflow distal to the occlusion site<sup>11,12</sup>. Blood flow restriction training in conjunction with low resistance exercise is associated with similar hypertrophic effects to those of conventional high-load training, and patients are able to make greater strength gains without lifting higher loads and potentially subjecting themselves to injury and damaged tissues<sup>5,8</sup>. BFRT has been documented in past studies to resist the effects of atrophy due to disuse of the muscle and restore the muscle to preinjury levels<sup>1,2,9,10</sup>. BFRT has been shown to elicit similar effects as strength training for both athletes and elderly people without subjecting patients to increased risk of injury<sup>2-4,15</sup>. While this is a treatment option that needs to be further investigated, many studies have demonstrated that this is a safe and effective method to increase quadricep and hamstring muscle strength post-surgery<sup>6,9,12</sup>. BFRT appears to be a promising, efficacious, and safe new technique for physical therapists to employ; however, there is a lack of data regarding the usage rates and perceptions of BFRT in the domain of physical therapy.

With no current studies revealing the clinical use of BFRT, our study looks to identify the use and/or knowledge of BFRT among practicing physical therapists. The purpose of the study was to examine the knowledge, perceived utility of BFRT by clinicians, and actual use of BFRT by physical therapists working in the clinical setting. In addition, we wanted to assess the potential reasons BFRT was or was not used, and identify potential strategies to overcome these concerns. It was hypothesized that BFRT is not commonly used in physical therapy clinics due to one or more of the following three factors: lack of knowledge and awareness about BFRT, concern about the safety of BFRT, and/or efficacy of BFRT.

## Scientific Methods

### *Participants*

Physical Therapists (PTs) based in the United States were recruited to participate in this study. To be included, survey respondents must have been a licensed physical therapist who was practicing clinically (inpatient or outpatient) and must be English speaking. Anyone who did not meet these criteria was excluded from the survey. We intended to recruit 5% of the estimated physical therapist population of the United States (n=348). A spreadsheet was created that contained a list of publicly available physical therapy clinics contact information across the United States. States were chosen randomly, with the only criteria being trying to reach all regions of the US (the Eastern Region, Mid-Western, South-Eastern, South Western, and Western). By using a combination of calling and emailing, we spoke to receptionists and/or physical therapists who provided us with an email address with which to send the survey or sent the survey directly. Respondents provided informed consent prior to completing the survey by checking a box on the first page of the electronic survey. This study was reviewed and approved by the Institutional Review Board at Skidmore College (#2102-942). This study was conducted during the COVID-19 pandemic, potentially limiting the recruitment or availability of participating PTs.

### *Protocol*

Google Forms (Google, Mountain View, CA) was used to develop and administer the survey electronically. Identifying criteria such as names of clinicians and/or institutions were omitted and thus the survey data was anonymous. There was an option to skip any question as well as a choice to withdraw from the study without submitting responses.

After providing electronic informed consent, respondents were asked demographic information: gender, age, state where they practice, their workplace setting, and whether they completed a fellowship, to characterize the sample and determine if there were any differences with the participants' knowledge and use of BFRT across these demographic parameters. The next section asked whether or not physical therapists had heard of BFRT. If the physical therapist responded with "no," then the PT was given a small excerpt of what BFRT is.

Participating PTs were then asked if they would consider using BFRT with a patient (Likert scale), what population they believe it would benefit, and if they would want to learn more information about BFRT. However, if the PT responded with "yes" to the question of "if they have heard of BFRT before," they would be asked a few questions about their familiarity with BFRT (Likert scale), where they had heard about it, and where they learned about BFRT. The last question in that section was if they have ever used BFRT with a patient. If they answered "yes," they were asked about the extent to which they used BFRT (Likert scale), the effects of BFRT on their patient (Likert scale), any side effects they would consider, if they would continue to use BFRT, and what population they use it on and the primary reason it was used. If the PT responded with "no" to the question of "if they have used BFRT before" then

they were asked why they have not used BFRT, would they be interested in learning more or implementing it into their practice, and what they believe BFRT would be beneficial for.

#### *Statistical Analysis*

Descriptive statistical analyses on respondent rates and scores were performed using Google Forms. Inferential statistical analyses were performed using open source software (JASP). Comparisons between physical therapist sexes, age groups, and geographical regions were utilized for demographic characteristics and were conducted using independent samples t-tests (e.g. gender) or one-way analysis of variance (ANOVA) (geographic regions were utilized for demographic characteristics, as appropriate. Tests of normality were performed, and if a significant violation was found, the Welch correction was applied to the degrees of freedom. Estimates of effect size are reported (Cohen's  $d$  or partial eta squared,  $\eta^2$ ) in accordance with the model. The level of significance was established at  $p < 0.05$ . Data are presented as percent of respondents or mean and standard deviation (SD), as appropriate.

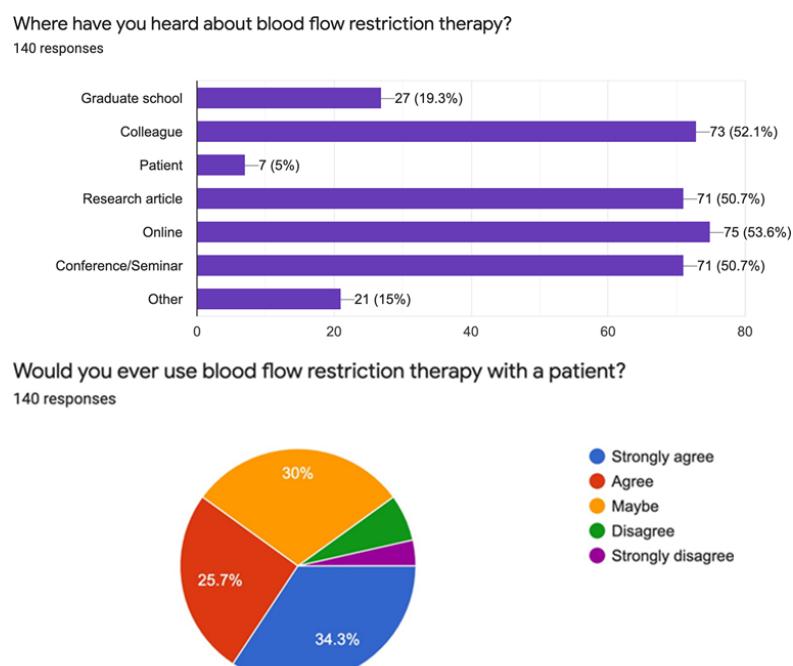
## Results

### *Response Rate and Respondent Demographics*

159 physical therapists responded to the survey. There were 93 females who participated in the study and 66 males who participated. The participants who were between the age of 21-30 years old consisted of 19.5% ( $n=31$ ) of the study, while the 31-40-year-old age group made up 32.1% ( $n=51$ ) of the study. The 41-50-year-old age group comprised 27% ( $n=43$ ) of the study, while the 51-60-year-old age range comprised 16.4% ( $n=26$ ) of the study. Lastly, the age group of 61+ years old made up 5% ( $n=8$ ) of the study. There was representation from all five geographical regions: North-East ( $n=70$ ), South-East ( $n=26$ ), South-West ( $n=4$ ), Mid-West ( $n=14$ ), and Western ( $n=26$ ), though the coastal regions were more heavily represented.

### *Knowledge and Use of BFRT*

There was a large discrepancy between physical therapists' knowledge of BFRT and the actual implementation of this rehabilitation technology. With the descriptive data, it was found that 88.1% ( $n=140$ ) of the physical therapists who took the survey had heard of BFRT; however, of those 140 PTs, only 38.6% ( $n=54$ ) had ever used BFRT on a patient. There was no significant impact of geographical region on use of BFRT by physical therapists ( $p=0.578$ , partial  $\eta^2 = 0.025$ ). Of the PT's who had heard of BFRT, only 19% of respondents reported hearing of BFRT during their graduate education, most common responses were colleagues, research articles, conferences or other online sources (Figure 1, top). Interestingly, the majority (60%) of responding PT's would agree to using BFRT on a patient (Figure 1, bottom), with only a minority (10%) reporting they disagree.

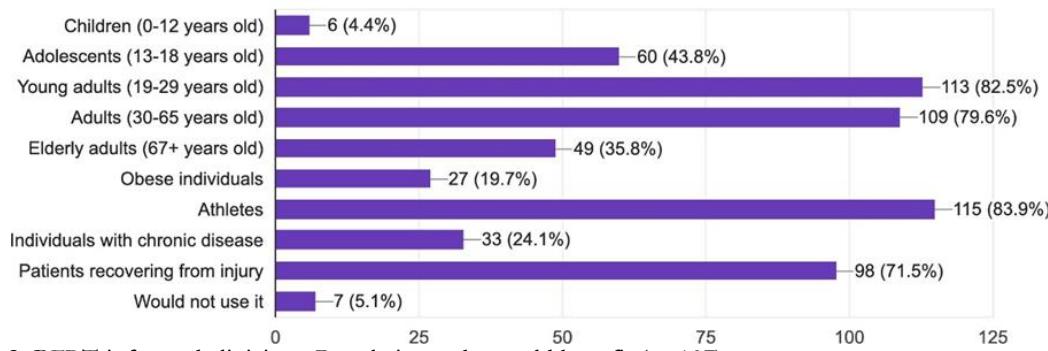


**Figure 1.** PT's reported source of awareness of BFRT (top) and willingness to use BFRT (bottom) ( $n=140$ ).

In terms of patient populations PTs think would benefit, most reported younger age groups (age 13-65, 44-80%), but less so in those with advancing age (>67 years of age, 36%) or in those with obesity (20%), irrespective of age.

**Which populations do you think it would benefit?**

137 responses

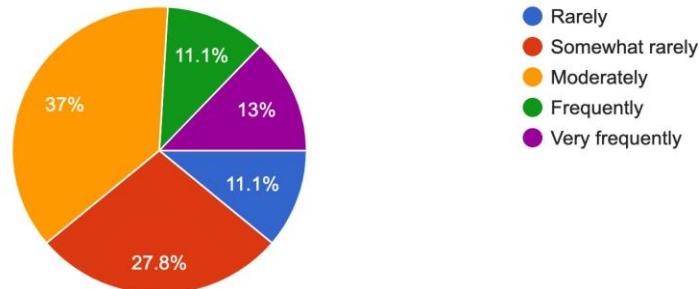


**Figure 2.** BFRT-informed clinicians: Populations who could benefit (n=137).

In those that reported no prior use of BFRT, the top three reasons for not utilizing BFRT were, not having a certification, not having enough information, and not having enough resources. Of this group with no prior history of BFRT, 44% agreed that they would implement BFRT if they had professional development in the technique, and another 40% indicated they were neutral.

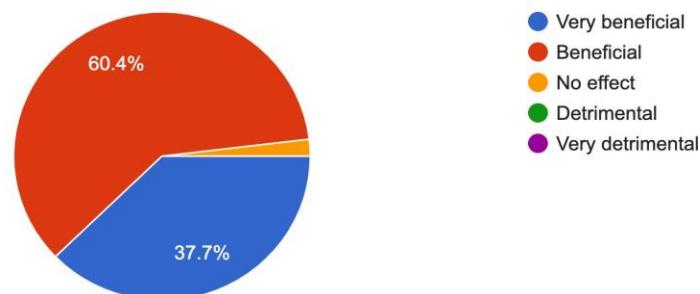
**To what extent have you used BFRT?**

54 responses



**What effect do you think BFRT had on your patients?**

53 responses

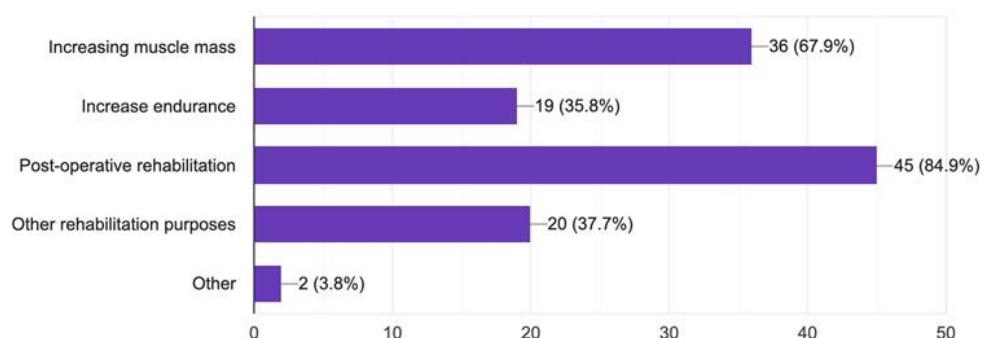


**Figure 3.** PT's who reported prior use of BFRT, the extent to which they reported using BFRT (top panel), and the perceived effect that PTs reported it had on the patients (bottom panel) (n=137).

In PT's who had responded that they had used BFRT (n=54), the majority reported that they use it at least moderately or more frequently (Figure 3, Top). Relatedly, in PTs who had used BFRT, 98% reported that they believed BFRT was beneficial or very beneficial in the treatment of their patients (Figure 3, Bottom), with less than 2% reporting no effect, and none reporting detrimental effects. Again, in PTs who reported prior use of BFRT, the population in which it was implemented varied, ranging from children to those over the age of 66, and from athletes to those with obesity or chronic disease (Figure 4, Top Panel). The primary reasons cited for implementing BFRT were increasing muscle mass, post-operative rehabilitation, and to a lesser extent improving endurance or other rehabilitative purposes. In the PTs who employed BFRT, the population that they reported using BFRT on was varied, but mostly was most prevalent in those under 65 years, athletes or post-injury, with children, the elderly and obese/chronic disease with lowest use of BFRT (Figure 4, Middle Panel). Safety concerns of using BFRT were noted, with pain ranking the most common concern, although blood clotting, fainting or dizziness, and blood pressure were also highly cited concerns (Figure 4 Bottom Panel).

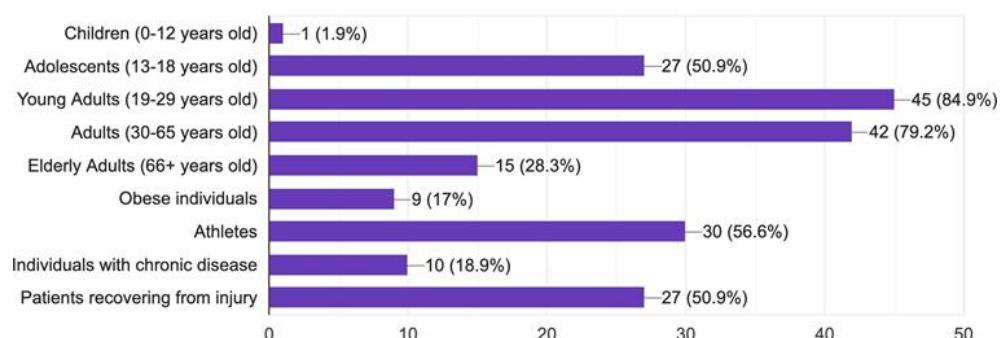
#### What was the primary reason you used BFRT?

53 responses



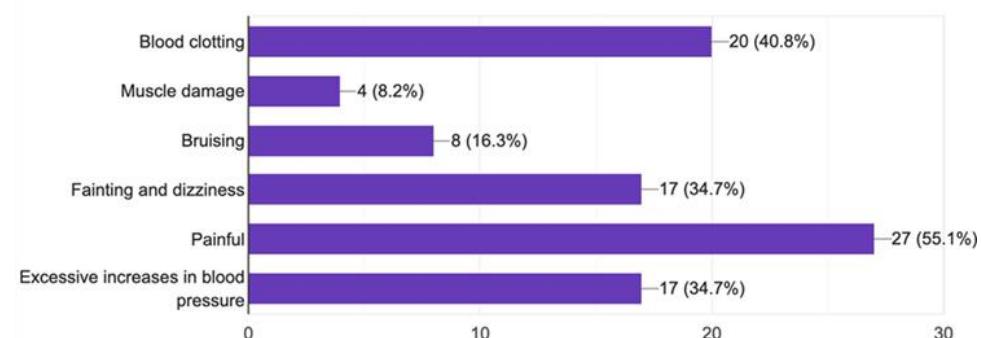
#### What population did you use it on?

53 responses



#### What, if any, possible side effects are you most worried about with BFRT?

49 responses



**Figure 4.** In PT's who reported prior use of BFRT, the rationale for use (top panel), the population(s) it was used on (middle panel), and the concerns of potential side effects (bottom panel).

In those that reported no prior use of BFRT, the top three reasons for not utilizing BFRT were, not having a certification, not having enough information, and not having enough resources. Of this group with no prior history of BFRT, 44% agreed that they would implement BFRT if they had professional development in the technique, and another 40% indicated they were neutral.

#### *Impact of Demographic Factors on Knowledge and Use of BFRT*

There was a significant difference between male and female physical therapists in the knowledge of BFRT, where males demonstrated a greater knowledge (98%) of BFRT in PT clinics compared to female PTs (81%) ( $p=<0.001$ , Cohen's  $d=-0.607$ ). There was a significant difference between male and female physical therapists on the use of BFRT, where males demonstrated a greater use of BFRT (48%) compared to female PTs (24%) ( $p=0.016$ , Cohen's  $d=-0.413$ ).

No significant effect of physical therapists' age group was observed on their knowledge of BFRT, however, there was a trend of younger age groups having a greater knowledge of BFRT compared to the older age groups. ( $p=0.080$ , partial  $\eta^2=0.088$ ). This trend can be seen with the data analysis of the frequency table where 97% of the 21-30 age group ( $n=31$ ) had heard of BFRT and 90% of the 31-40 age group ( $n=51$ ) had heard of BFRT. 93% of the 41-50 age group ( $n=43$ ) had heard of BFRT and 73% of the 51-60 age group ( $n=26$ ) had heard of BFRT. Lastly, only 63% of the age group 61+ ( $n=8$ ) had heard of BFRT.

Relatedly, there wasn't a significant effect of physical therapists' age group on their use of BFRT; however, there was a trend of younger age groups having a greater use of BFRT compared to the older age groups. ( $p=0.085$ , partial  $\eta^2=0.066$ ). This trend can also be seen in the data analysis of age groups and their use of BFRT. For the 21-30 age group ( $n=30$ ), 58% had used BFRT, and for the 31-40 age group ( $n=46$ ) 31% had used BFRT. For the 41-50 age group ( $n=40$ ), 35% had used BFRT, and for the 51-60 age group ( $n=19$ ), 15% had used BFRT. For the 61+ age group ( $n=5$ ) 13% had used BFRT.

#### **Discussion**

The purpose of the study was to examine the knowledge and utilization of BFRT in physical therapy clinics and the potential role of demographics. Additionally, the purpose was to assess the reasons why or why not BFRT is used, and the potential willingness to utilize BFRT. The main findings from this study are that most clinicians who have heard of BFRT would like to practice it, and of those who have not heard of it, many would like to learn more. Almost all PTs who have used BFRT reported that it was beneficial or very beneficial. From these findings, it can be suggested that PT education programs might include BFRT, as it is an adjuvant treatment that could bolster patient outcomes, but needs to be implemented with proper training to reduce risk of potential side effects, such as using intermittent BFRT. Further study is needed on the inclusion of BFRT in therapeutic modalities applied in physical therapy settings to ascertain whether practitioner perception of benefit translates into meaningful patient and/or clinical outcomes.

#### *Implications*

The majority of participants in this study (88.1%) had previously heard of BFRT, however, only 38.6% of responders had practiced it. Furthermore, 40.7% of responders who had heard of BFRT would like to know more, 60% of participants who had heard of it would be willing to practice it, and 44.2% of participants who had not previously heard of it would be willing to use it if they had the means to. This may suggest that there is a general interest in the technique, but a lack of education or certification necessary to employ it. The two most cited barriers to use in our survey were: not enough information on it, and don't have the certification for it, which is consistent with this suggestion. If this is indeed the case, it begs the question, should BFRT education become more widely implemented, and should certification become more encouraged and the means to do so become more easily available? The third most cited barrier to practice was a lack of resources, though compared to heavy weights and machines, BFRT equipment is actually relatively inexpensive and easy to store and implement, so if BFRT were to become more commonplace, this issue will likely dissipate. 92.6% of participants who had used BFRT wished to continue using it and 98.1% thought it would be effective, had they used it. The overwhelming support shown by practitioners who employ it and will continue employing it, coupled with the interest in and willingness to practice BFRT endorsed by professionals who have not used it, suggests that BFRT is an effective treatment that would be well received and have much uptake by physical therapists.



As with all new techniques, clinicians have a degree of wariness over what side effects the method in question may entail. 55.1% of clinicians who had previously heard of BFRT were worried about it being painful for their clients, 40.8% were worried about blood clots, 34.7% were worried about fainting/dizziness, and another 34.7% were worried about excessive increases in blood pressure. These concerns are likely caused by a common misconception based upon the different implementations of BFRT. There are two primary methods of employing BFRT: continuous and intermittent. The former involves keeping the pressure cuff inflated throughout the entire workout, including rest periods, thus stifling participants' ability to reduce their heart rate during rest as they normally would. According to recent studies, most negative side effects regarding pain, rate of perceived exertion, increased heart rate, increased risk of cardiovascular events, etc., are associated with this method of training<sup>14, 15, 17, 18</sup>. In fact, some studies have even found that BFRT may induce less muscle damage than heavy resistance training<sup>6,7</sup>. It would be recommended that physical therapists to instead use intermittent BFRT, which involves decreasing cuff pressure during rest periods, which allows for participants' heart rate to return to normal. Intermittent BFRT has been shown to elicit the same benefits as the previous, but without the aforementioned negative consequences. Overall, barriers to adopting new techniques in the evolving field of PT are availability of training (certification) and equipment, as well as safety concerns. These factors may explain the apparent gap between interest and use of BFRT and other potential new therapeutic practices in physical therapy clinics.

#### *The Role of Demographics in Knowledge and Use of BFRT*

Our findings indicate that males are more likely to have knowledge about and use BFRT than women. The explanation for this is not clear. This is a surprising finding because we had more female responses than male and physical therapists are more commonly female<sup>13</sup>. We theorize this could potentially be due to larger societal gender constructs encouraging men to be more involved in muscular development, where this technique has been implemented for years. Qualitative research would be necessary to determine why male PTs were more likely to report knowing about and utilizing BFRT. This indicates a need to examine educational opportunities and potential gender disparities in the field.

We also saw a trend that younger populations tended to have greater knowledge of BFRT and more commonly had used it. Although the exact reason is not known, we theorize this is due to younger populations having finished their education more recently. BFRT is still fairly new and incorporation of a new technique into curriculums is slow. We attribute this difference between age groups to BFRT only recently being added to curriculums, therefore the younger population would have the opportunity to learn about the subject, whereas older populations would have to make an active choice to educate themselves on the topic. This indicates a need to direct educational opportunities to those further from their initial education. A more broad and logical question to potentially be researched is if there is evidence that older clinicians are less likely to introduce new procedures or new techniques as compared to younger ones? The current data might suggest that if provided the resources (time, training, equipment, etc.) most PTs would be willing to adopt new techniques.

#### **Conclusions**

The purpose of the study was to examine the knowledge and utilization of BFRT by practicing PTs. Most participating PTs had heard of BFRT, but only a fraction had reported using BFRT on a patient. In those that did report use of BFRT, nearly all indicated it was beneficial and will continue its use. Of the clinicians who had heard of BFRT, but reported no history of use, many would like to practice it, and would engage in professional development opportunities, as many cited lack of information or certification as leading reasons for not employing the technique. Interestingly, there were some differences in age and gender with younger and male PTs more likely to have heard of, and used BFRT. Incorporating BFRT education in PT programs could improve utilization of BFRT potentially improving healthcare outcomes in physical therapy.

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#### **Conflict of Interest**

The authors declare that there is no conflict of interest.

#### **References**

1. Baker BS, Stannard MS, Duren DL, Cook JL, Stannard JP. Does Blood Flow Restriction Therapy in Patients Older Than Age 50 Result in Muscle Hypertrophy, Increased Strength, or Greater Physical Function? A Systematic Review. *Clinical Orthopaedics and Related Research* 478: 3: 593-606, 2020.



2. Centner C, Centner C, Wiegel P, Wiegel P, Gollhofer A, Gollhofer A, König D, König D. Effects of Blood Flow Restriction Training on Muscular Strength and Hypertrophy in Older Individuals: A Systematic Review and Meta-Analysis. *Sports Medicine* 49: 1: 95-108, 2019.
3. Cook SB, LaRoche DP, Villa MR, Barile H, Manini TM. Blood flow restricted resistance training in older adults at risk of mobility limitations. *Experimental Gerontology* 99: 138-145, 2017.
4. Curty VM, Melo AB, Caldas LC, Guimarães-Ferreira L, de Sousa NF, Vassallo PF,
5. Vasquez EC, Barauna VG. Blood flow restriction attenuates eccentric exercise-induced muscle damage without perceptual and cardiovascular overload. *Clinical Physiology and Functional Imaging* 38: 3: 468-476, 2018.
6. Day B. Personalized Blood Flow Restriction Therapy: How, When and Where Can It Accelerate Rehabilitation After Surgery? *Arthroscopy* 34: 8: 2511-2513, 2018.
7. DePhillipo NN, Kennedy MI, Aman ZS, Bernhardson AS, O'Brien LT, LaPrade RF. The Role of Blood Flow Restriction Therapy Following Knee Surgery: Expert Opinion. *Arthroscopy* 34: 8: 2506-2510, 2018.
8. Henderson KG, Wallis JA, Snowdon DA. Active physiotherapy interventions following total knee arthroplasty in the hospital and inpatient rehabilitation settings: a systematic review and meta-analysis. *Physiotherapy* 104: 1: 25-35, 2018.
9. Hughes L, Paton B, Rosenblatt B, Gissane C, Patterson SD. Blood flow restriction training in clinical musculoskeletal rehabilitation: a systematic review and meta-analysis. *British Journal of Sports Medicine* 51: 13: 1003-1011, 2017.
10. Hughes L, Paton B, Rosenblatt B, Gissane C, Patterson SD. Blood flow restriction training in clinical musculoskeletal rehabilitation: a systematic review and meta-analysis. *British Journal of Sports Medicine* 51: 13: 1003-1011, 2017.
11. Lixandrão ME, Ugrinowitsch C, Berton R, Vechin FC, Conceição MS, Damas F, Libardi CA, Roschel H. Magnitude of Muscle Strength and Mass Adaptations Between High-Load Resistance Training Versus Low-Load Resistance Training Associated with Blood-Flow Restriction: A Systematic Review and Meta-Analysis. *Sports Medicine* 48: 2: 361-378, 2018.
12. Loenneke JP, Abe T, Wilson JM, Ugrinowitsch C, Bemben MG. Blood flow restriction: How does it work. *Frontiers in Physiology* 3: 392, 2012.
13. Patterson SD, Hughes L, Warmington S, Burr J, Scott BR, Owens J, Abe T, Nielsen JL, Libardi CA, Laurentino G, Neto GR, Brandner C, Martin-Hernandez J, Loenneke J. Blood Flow Restriction Exercise: Considerations of Methodology, Application, and Safety. *Front Physiology* 10: 533, 2019.
14. "Physical Therapists." Data USA. Accessed April 27, 2021. <https://datausa.io/profile/soc/physical-therapists>.
15. Pozzi F, Snyder-Mackler L, Zeni J. Physical Exercise after Knee Arthroplasty: A Systematic Review of Controlled Trials. *European Journal of Physical and Rehabilitation Medicine*. 49: 3: 877-892, 2013.