Baltic Journal of Health and Physical Activity

Volume 11 | Issue 3 Article 2

2019

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Recommended Citation
Gepfert M, Krzysztofik M, Filip A, Mostowik A, Lulinska A, Wojdala G, et al. Effect of grip width on exercise volume in bench press with a controlled movement tempo in women. Balt J Health Phys Act. 2019;11(3):11-18. doi: 10.29359/BJHPA.11.3.02

Baltic Journal of Health and Physical Activity 2019; 11 (3): 11-18
Journal of Gdansk University of Physical Education and Sport
e-ISSN 2080-9999

ORIGINAL

doi: 10.29359/BJHPA.11.3.02

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Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background: The bench press (BP) is a complex upper body exercise. Despite numerous scientific studies, it remains unknown which grip width is optimal for the development of strength and power in the bench press. Therefore, the aim of this study was to determine the effect of different grip widths on exercise volume, evaluate the time under tension (TUT) and the number of repetitions (REP) completed during 5 consecutive sets of the BP.

Material and methods: The study involved 16 women with a minimum of one year of resistance training experience. Two independent experimental sessions were randomly selected. Participants performed 5 sets of the bench press during each session, with the maximal number of repetitions, using either the WGBP or the CGBP with a constant movement tempo of 2/0/2/0 at 70%1RM.

Results: A one-way ANOVA for repeated measures was used, with significance set at $p<0.05$. The study did not show significant differences in the REP, TUT nor the total number of repetitions (TREP) or the total time under tension (TTUT) between the WGBP and the CGBP.

Conclusions: Grip width of the barbell in the bench press does not affect exercise volume during strength training in women.

Key words: resistance exercise, time under tension, repetition, wide-grip, close-grip.

article details

Article statistics: **Word count:** 2,764; **Tables:** 3; **Figures:** 0; **References:** 35

Received: May 2019; **Accepted:** June 2019; **Published:** September 2019

Full-text PDF: http://www.balticsportscience.com

Indexation: Celdes, Clarivate Analytics Emerging Sources Citation Index (ESCI), CNKI Scholar (China National Knowledge Infrastructure), CNPIEC, De Gruyter - IBR (International Bibliography of Reviews of Scholarly Literature in the Humanities and Social Sciences), De Gruyter - IBZ (International Bibliography of Periodical Literature in the Humanities and Social Sciences), DOAJ, EBSCO - Central & Eastern European Academic Source, EBSCO - SPORTDiscus, EBSCO Discovery Service, Google Scholar, Index Copernicus, J-Gate, Naviga (Softweco, Primo Central (ExLibris), ProQuest - Family Health, ProQuest - Health & Medical Complete, ProQuest - Illustrata: Health Sciences, ProQuest - Nursing & Allied Health Source, Summon (Serials Solutions/ProQuest, TDOne (TDNet), Ulrich's Periodicals Directory/ulrichsweb, WorldCat (OCLC)

Funding: The study was supported and funded by the statutory research of the Jerzy Kukuczka Academy of Physical Education in Katowice, Poland – research leaders Michał Wilk as well as by a grant of the Ministry of Science and Higher Education in Poland NRSA4 040 54.

Conflict of interests: Authors have declared that no competing interest exists.

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INTRODUCTION

The bench press (BP) belongs to the leading exercises used to improve strength and power of the upper body muscle groups. The BP technique should reflect the specific demands of a sports discipline. There are various technical options for the BP depending on the width of the grip on the bar. The most commonly used grip width ranges from 165 to 200% of the biacromial distance (BAD) and is referred to as the classic bench press [1]. In addition to the classic BP, many authors have also analyzed the effectiveness of the use of the close grip (CGBP) and wide grip (WGBP) during the BP. In the WGBP, the distance between the inner parts of the hands is up to 81 cm [2], whereas in the CGBP, the grip width ranges from 95 to 130% of the BAD [3]. Changing the grip width in the BP has an effect on forces and power generated, the range of motion as well as muscle activity [4]. The WGBP is characterized by a smaller range of motion and lower peak heights [5,6] compared to the CGBP. Furthermore, the WGBP is characterized by higher muscular activity in the clavicular and sternal part of the thorax [7], which promotes hypertrophy, especially in the area of the pectoralis major muscle [7–9]. The CGBP is characterized by an increased range of motion in the elbow joint [10], which limits the activation of the sternoclavicular part of the thoracic muscle [7, 9]. However, a study by Barnett et al. [8] did not support this finding. EMG analysis showed a significant increase in the activity of the triceps muscle during the CGBP [7, 8, 11] with its involvement decreasing with increasing barbell grip width [8]. The opposite situation applies to the biceps brachii, which shows lower activity during the CGBP [2]. Furthermore, the BP has a different effect on the patterns of muscle activity in women and men. The most important difference concerns the triceps muscle (long head), whose activity significantly increases only in men [12]. Another important factor differentiating between the effects of using different variants of BP grip width is the level of maximum strength. Saeterbakken et al. [2] reported a significantly higher level of maximum strength during the WGBP compared to the CGBP (132.7 ±17 vs. 119.2 ±16.6 kg). The greatest 1-RM was recorded using a grip width of 200% BAD [1], whereas the lowest one was found for the CGBP [3]. However, it should be noted that the level of maximum strength was not only affected by the grip width, but also by the movement tempo at which individual repetitions were performed [13, 14]. Changes in the movement tempo and, consequently, the velocities in particular phases of the movement can influence the exercise volume, the level of maximum strength, power, and hypertrophy [13–19]. The movement tempo depends on the value of the external load used (%1RM), with an increase in the load leading to the decline in the maximal movement speed in the concentric phase [20] or on the conscious control of individual movement cadences. A faster movement tempo leads to an increase in the muscle power generated [19] and the maximal REP performed until muscle failure [14]. By contrast, a slow movement tempo increases the metabolic response induced by resistance training [18, 21], decreases muscle power [22–24] and decreases the maximum number of repetitions performed in a set. The slow movement tempo is beneficial to the development of muscle hypertrophy [22, 25, 26, 27]. The movement tempo affects exercise volume determined by both the REP performed and time under tension (TUT) in sets [15, 16].

Although many scientific studies have analyzed differences in the effectiveness of strength training using the WGBP and the CGBP, none of them included an analysis of the maximum REP performed and the value of TUT using a controlled movement tempo. Furthermore, studies have failed to establish the differences between grip widths in the bench press during strength training in groups of women. Therefore, the main aim of this study was to verify the effect of different grip widths used during the BP on the training volume determined by TUT and the REP, using a controlled movement tempo.

MATERIAL AND METHODS

All testing was performed in the Strength and Power Laboratory at the Jerzy Kukuczka Academy of Physical Education in Katowice. The experiment was performed following a randomized crossover design, where each participant performed a familiarization session including a 1-RM test and two different testing protocols 3–4 days apart. Participants performed the WGBP 2/0/2/0 and the CGBP 2/0/2/0. During each experimental session, participants completed five sets using 70% 1RM with 3-min rest intervals in-between. The following variables were analyzed during each test: the maximal number of repetitions (REP) in every set, the total number of repetitions (TREP) performed in 5 series, maximal time under tension in every set, and total time under tension (TTUT) in 5 series. Participants were required to refrain from resistance training 48 hours prior to each experimental session, were familiarized with the protocol as well as the potential benefits and risks of testing, and provided written informed consent to participate in the study.

STUDY PARTICIPANTS

Sixteen (16) healthy strength trained woman (age = 23.1 ±2.3 years, body mass = 54.5 ±3.3 kg, 1-RM in the CGBP = 50.5 kg ±6.1; 1-RM in the WGBP = 48.5 ±3.5 kg; data presented as mean ± standard deviation [SD]) with a minimum one year of strength training experience (1.7 ±0.73 years; mean ± standard deviation [SD]) volunteered for the study. All participants were over 18 years old. The participants were allowed to withdraw from the experiment at any moment and were free of any pathologies or injuries. The study protocol was approved by the Bioethics Committee for Scientific Research at the Academy of Physical Education in Katowice, Poland, according to the ethical standards outlined in the Declaration of Helsinki, 1983.

PROCEDURES

1-RM WGBP and CGBP Strength Testing

Participants arrived at the laboratory in the morning between 09:00 and 11:00, and first they cycled on an ergometer for 5 minutes at an intensity that resulted in a heart rate of around 130 bpm. Then they performed a general upper body warm-up that consisted of 10 body weight pull ups and 15 body weight push-ups. Next, participants performed 15, 10, and 5 BP repetitions using 20 kg, 45%, 55%, and 65% of their estimated 1-RM, respectively. The strength test with the WGBP was performed first. To complete the WGBP, participants laid on a flat bench with their feet on the floor, and their head, shoulders and buttocks flat to the bench. Hand placement on the barbell in the WGBP required from participants to position the forefinger within the 81-cm mark on a standard powerlifting IPF bar. Participants then executed single repetitions using a volitional cadence with a 3 min rest interval between successful trials. The load for each subsequent attempt was increased by 2.5 kg until failure. No more than five attempts were needed before the 1-RM was reached for all participants in this study. After a 10-min recovery period, participants completed the CGBP [3, 28]. The position of the body and constraints that determined a successful lift were the same as for the WGBP, except for the grip width that differed. The grip width adopted for the CGBP was 95% of BAD [1,3,28] and the hands were shoulder width apart. The grip width was marked on the barbell with athletic tape, and a pronated grip was again utilized. Following the established procedures [3], the warm-up for the second strength test included 3–5 repetitions at 85% of the participants' estimated 1-RM, and then one repetition at 90% 1RM. Next, participants made their first 1-RM attempt following a 3-min recovery period, and this process continued until the 1-RM was reached. For both the WGBP and the CGBP, absolute strength was considered the maximum load lifted. An IPF Eleiko bar and weight plates (Eleiko, Sport AB Sweden) were used for both the WGBP and the CGBP.

Experimental sessions

The general and specific warm-up for the experimental sessions was identical to that used during the familiarization session. After the warm up, participants performed 5 consecutive sets of the bench press with a determined grip width (WGBP or CGBP) and a specified tempo 2/0/2/0 at 70%1RM with a metronome guided movement cadence in the eccentric and concentric phase (Korg MA-30, Korg, Melville, New York, USA). The experimental set was performed to failure. All repetitions were completed without bouncing the barbell off the chest, without intentionally pausing at the transition between the eccentric and concentric phases, and without raising the lower back off the bench. The intervals between subsequent stages of the experiment were 3–4 days. The time under tension and the number of repetitions were measured and recorded by a camera (Sony FDR-AX53).

Statistical analysis

Age, body mass and body composition, as well as TUT, REP, TTUT, TREP variables were expressed as mean ±SD. Before using the parametric test, the assumption of normality was verified using the Kolmogorov-Smirnov test. A one-way ANOVA for repeated measures was used, with significance set at $p < 0.05$. When appropriate, the Bonferroni post hoc test was used to compare selected data. The remaining analyses were performed using STATISTICA (StatSoft, Inc., Tulsa OK Oklahoma, USA, 2018 – version 12).

Results

No significant differences were observed in the level of maximum strength between the WGBP and the CGBP (Tab. 1) Furthermore, no significant differences were found in TUT between the WGBP and the CGBP in any set of the bench press (BPs1-BPs5) nor in TTUT (Tab. 2). There were no significant differences in the number of repetitions performed in every set (BPs1-BPs5) nor in TREP (Tab. 3).

Table 1. Level of 1-RM in the WGBP and the CGBP

1-RM WGBP (kg)	1-RM CGBP (kg)
48.5 ± 5.5	50.5 ± 6.1

Table 2. Mean value of time under tension in the WGBP and the CGBP

Set	Time under Tension (s)	
	WGBP	CGBP
BP_{s1}	57.3 ±32	52.6 ±35
BP_{s2}	49.5 ±28	46.0 ±26
BP_{s3}	41.6 ±23	37.8 ±20
BP_{s4}	37.6 ±22	33.7 ±24
BP_{s5}	32.3 ±26	28.3 ±24
Total BP_{set1-5}	218.35 ±24	197.19 ±28

Table 3. Mean value of the number of repetitions performed in the WGBP and the CGBP

Set	Number of repetitions (n)	
	WGBP	CGBP
BP_{s1}	14.30 ±82	13.11 ±73
BP_{s2}	12.50 ±51	11.42 ±44
BP_{s3}	10.46 ±46	9.38 ±43
BP_{s4}	9.30 ±35	8.38 ±42
BP_{s5}	8.00 ±36	7.07 ±31
Total BP_{set1-5}	54 ±62	49 ±52

DISCUSSION

The study showed that grip width in the bench press did not have an effect on exercise volume both in terms of the number of repetitions performed and the time under tension. This finding is surprising and inconsistent with previous research, with significant differences between the CGBP and the WGBP in the level of maximal strength and power, range of movement and the level of muscle activity [5, 6]. Saeterbakken et al. [2] demonstrated a significantly higher level of 1-RM for the WGBP compared to the CGBP (132.7 ±17 kg vs. 119.2 ±16.6 kg). The highest level of 1-RM occurs for a grip width of 200% of the BAD [1]. By contrast, the lowest level of 1-RM occurs for the CGBP [1, 2, 4, 5, 6, 28]. However, this study did not show any significant differences in the level of 1-RM between the WGBP and the CGBP (48.5 ±5.5 kg vs. 50.5 ± 6.1 kg), which is inconsistent with previous studies [1, 2, 28]. Furthermore, a tendency for higher levels of 1-RM in the CGBP was demonstrated compared to the WGBP (Tab. 1). A lack of significant differences in the level of 1-RM between the WGBP and the CGBP may be the reason for a lack of significant differences in the exercise volume in both the REP and TUT. Differences between the CGBP and the WGBP described in previous studies concerned not only the level of 1-RM, but also differences in the area and the level of muscle activity. Changing the grip width during the BP led to changes in the pattern of muscle activity [7]. Previous studies showed that the WGBP significantly activates the greater pectoralis muscle [9], while the CGBP activates the triceps brachii muscle [7, 8, 11]. According to Gomo and Van den Tillar [29], the CGBP reduces the activation of the sterno-clavicular part of the pectoralis [7]. This was not confirmed by Barnett et al. [8], who showed higher activation in the collarbone part of the pectoralis muscle during the CGBP. However, these changes in muscle activity between the WGBP and the CGBP probably do not lead to changes in the level of muscle strength and the maximum volume of exercise, which was confirmed in our study.

Other important factors determining the lack of significant differences between the WGBP and the CGBP are sports level and sex [7,8,9]. Previous scientific studies that analyzed the effects of the width of the barbell grip mainly concerned men or mixed groups. There are no data on the impact of the grip width during the BP in female populations. Physiological differences [30,31] and differences in the patterns of muscle activity during the BP [12] occurring between women and men can be important factors affecting test results. A study by Golas et al. [12] showed that during the BP, an increase in the external load from 55 to 100%1RM in the group of women increased the activity of the deltoid muscle by 67.8% and the pectoralis muscle by 46.2%. In the male group, the increase in the external load increased the activity of the deltoid muscle by 74.6%, and the activity of the pectoralis major by 27.1%. The largest difference in muscle activity during the BP occurred in the head of the long triceps muscle of the arm, as the activity increased by 73.7% in men, yet only by 36.4% in women. The shoulder muscle was activated to the greatest extent in women [12], which may determine the level of muscle strength. Changing the grip width does not cause significant changes in the activity of the deltoid muscle, which may explain similar levels of 1-RM between the CGBP and the WGBP in the group of women. Another factor that justifies the lack of significant differences in exercise volume depending on the used grip width is training experience. The study participants declared that the grip they used in their previous BP training was closer to the CGBP than the WGBP. The use of grip width of 81 cm in the WGBP could cause difficulties in following such a movement pattern. It can be stated that to some extent, the WGBP was a ‘new technique’ to the participant. This may also be confirmed by the fact that some of the participants reported discomfort within the shoulder joint during the WGBP.

Somatic and physiological differences between women and men can significantly affect the values of TUT and the REP. Research by Wilk et al. [15] conducted in the group of men (BP; 70%1RM; tempo 2/0/2/0) showed that TTUT obtained during the 5 BP sets amounted to 124.65 ±33 s. Although the testing procedure used in the present study was consistent with the procedure of Wilk et al. [15], significantly higher values were observed for both TUT and TTUT. Total muscle failure after the completion of the 5 BP sets in the group of women occurred significantly later in both the WGBP (218.35 ±24 s) and the CGBP (197.19 ±28 s). The exercise volume expressed by the REP was also higher in the group of women and was 54 ±6 and 49 ±5 REP for the WGBP and the CGBP, respectively (Tab. 3), while in the group of men, this level was only 28 ±7 REP [15]. Differences in the maximum value of TUT and REP between the group of men and women have a physiological basis. Women have more type I muscle fibers [32], which are characterized by a low value of muscle contraction force, higher oxygen metabolism and higher resistance to exercise fatigue, which is associated with the ability to perform a higher number of repetitions in a set [33, 34], especially when using the external load below 80%1RM. On the other hand, men have the advantage of the amount of type II fibers, which are susceptible to hypertrophy due to the large number of myofibrils along with the greater muscle contraction force, and generate significantly higher power, yet their resistance to fatigue is lower [35]. With such physiological differences between women and men and their effect on the exercise capacity, combining or comparing data from the results of studies of women and men can be methodologically questioned. To the authors' knowledge, no previous study has analyzed the influence of the width of the barbell grip in the CGBP and the WGBP solely in a group of women. Therefore, the results of the tests are difficult to compare with previous studies.

CONCLUSIONS

The present study did not show any significant differences in training volume determined by the values of TUT and the REP between the WGBP and the CGBP in strength trained women. Furthermore, the grip width in the BP (WGBP vs. CGBP) did not affect the value of 1-RM. Higher values of TUT, TTUT, REP and TREP were observed in women as factors determining exercise capacity and planning of the training process. Further tests need to be performed independently in female populations.

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Cite this article as:

Gepfert M, Krzysztofik M, Filip A, Mostowik A, Lulinska A, Wojdala G, Drozd M, Wilk M.
Effect of grip width on exercise volume in bench press with a controlled movement tempo in women
Balt J Health Phys Act. 2019;11(3):11-18
doi: 10.29359/BJHPA.11.3.02