

Concentric-Only Versus Touch-and-Go Bench Press One-Repetition Maximum in Men and Women

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Background: One-repetition maximum (1RM) tests are time-consuming, and they might not always be logistically possible or warranted due to increased risk of injury when performed incorrectly or by novice athletes. Repetitions-to-failure tests are a widespread method of predicting the 1RM, but its accuracy may be compromised by several factors such as the type of exercise, sex, training history, and the number of repetitions completed in the test.

Hypothesis: The touch-and-go bench press would provide a higher 1RM than the concentric-only bench press for both genders regardless of whether the 1RM was obtained by the direct or repetitions-to-failure method and the error in the 1RM prediction would be positively correlated with the number of repetitions performed to failure and negatively correlated with the 1RM strength and resistance training experience.

Study Design: Cross-sectional study.

Level of Evidence: Level 3.

Methods: A total of 113 adults (87 men and 26 women) were tested on 2 sessions during the concentric-only and touch-and-go bench press. Each session consisted of an incremental loading test until reaching the 1RM load, followed by a repetitions-to-failure test.

Results: The 1RM was higher for the touch-and-go bench press using both the direct (men, 7.80%; women, 7.62%) and repetitions-to-failure method (men, 8.29%; women, 7.49%). A significant, although small, correlation was observed between the error in the estimation of the 1RM and the number of repetitions performed ($r = 0.222$; $P < 0.01$), 1RM strength ($r = -0.169$; $P = 0.01$), and resistance training experience ($r = -0.136$; $P = 0.05$).

Conclusion: The repetitions-to-failure test is a valid method of predicting the 1RM during the concentric-only and touch-and-go bench press variants. However, the accuracy of the prediction could be compromised with weaker and less experienced individuals and if more than 10 repetitions are completed during the repetitions-to-failure test.

Clinical Relevance: The repetitions-to-failure test does not require any sophisticated equipment and enables a widespread use in different training environments.

Keywords: 1RM prediction; maximum strength; resistance training; upper-body exercise.

Resistance training (RT) is commonly prescribed taking into account the results of a one-repetition maximum (1RM) test.²⁸ The prescription of the loads as a percentage of the 1RM (%1RM) enables practitioners to target specific neuromuscular adaptations and optimize training adaptation and recovery.³ Although 1RM tests are reliable and

easy to implement,^{1,8} they are time-consuming and they might not always be logistically possible or warranted due to increased risk of injury when performed incorrectly or by novice athletes.^{9,14} To overcome the limitations of a direct 1RM testing, alternative prediction methods have been proposed to estimate the 1RM from the maximum number of repetitions

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performed to failure with a given load (ie, repetitions-to-failure [RTF] tests) or through the assessment of the load-velocity relationship.^{7,18,26}

The load-velocity relationship is now commonly established during the warm-up sets of RT sessions.^{31,32} Practitioners need to record the mean concentric velocity against 2 to 5 loads and then the 1RM can be estimated through a linear regression as the load linked to the velocity of the 1RM (V1RM).⁹ Although some studies have shown that the same V1RM can be used for all individuals to accurately predict the 1RM during upper-body exercises,^{7,8,26} other researchers have used an individualized V1RM to estimate the 1RM.^{1,13} Therefore, it is important to note that this method of predicting the 1RM could require a direct 1RM assessment to obtain the individual's V1RM. In addition, the acquisition of devices that are able to measure movement velocity with a high reliability is important to obtain accurate 1RM estimations,²⁵ and these devices may be cost prohibitive for nonprofessional athletes, especially in team sports where multiple devices would be necessary, thus limiting its use by coaches and athletes. Therefore, there is a need of alternative and more heuristic methods of predicting the 1RM that would allow a widespread use in different training environments.

One method is the RTF test, which consists of previously proposed regression equations that estimate the 1RM from the maximal number of repetitions performed with a submaximal load.^{15,18,29} This method does not require sophisticated equipment (such as linear position transducers or inertial sensors) to estimate the 1RM, making it a convenient choice in practical settings. Although useful, the amount of repetitions performed in RTF tests, training history, and sex of an individual can all affect the precision of an estimated 1RM, but the research on these effects is scarce.^{19,29} Moreover, other studies indicated that the accuracy of RTF equations could be exercise-dependent.³⁴ For example, LeSuer et al¹⁵ highlighted the Mayhew equation to be the most accurate for predicting the bench press 1RM, while the Wathan equation was the most appropriate for predicting the back squat 1RM.

Although the load-velocity relationship has been found to differ between variants of the same exercise,^{10,23} no study has explored whether the prediction accuracy of RTF equations could differ between variants of the same exercise (eg, concentric-only bench press vs touch-and-go bench press). Exercises using the stretch shortening cycle generally enable the production of greater values of concentric force, velocity, and power than concentric-only exercises.^{2,22} The 1RM has also been found to be greater for the touch-and-go bench press in comparison with the concentric-only variant.^{10,33} However, both variants of the bench press exercise are commonly used in training because each of them allow a greater force production at different points of the lift (touch-and-go bench press—higher force at the beginning of the lift; concentric-only bench press—higher force at the end of the lift).²² Therefore, it would be important to examine whether the validity of RTF tests to predict the bench press 1RM is affected by the execution mode.

The aims of the present study were (1) to compare the 1RM between the concentric-only and touch-and-go bench press

variants assessed by the direct method and the RTF method using the Mayhew equation in men and women and (2) to determine the effect of the maximum number of repetitions performed to failure, maximum strength values, and RT experience on the accuracy of the 1RM prediction. We hypothesized that (1) the touch-and-go bench press would provide a higher 1RM than the concentric-only bench press for both men and women regardless of whether the 1RM was obtained by the direct or RTF method and (2) the error in the 1RM prediction would be positively correlated with the number of repetitions performed to failure and negatively correlated with the 1RM strength and RT experience.

METHODS

Participants

A total of 113 healthy participants (87 men [age = 20.8 ± 4.2 years; body height = 1.70 ± 0.20 m; body mass = 74.3 ± 15.4 kg; concentric-only bench press 1RM = 61.3 ± 17.6 kg; touch-and-go bench press 1RM = 66.1 ± 18.4 kg] and 26 women [age = 19.5 ± 1.9 years; body height = 1.60 ± 0.06 m; body mass = 63.8 ± 10.9 kg; concentric-only bench press 1RM = 30.0 ± 5.9 kg; touch-and-go bench press 1RM = 32.3 ± 6.7 kg]) participated in this study. We recruited a heterogeneous sample with regard to the maximal strength capacity and RT experience (1.3 ± 2.4 years [range = 0-10 years]) to elucidate the effect of both variables on the accuracy of the bench press 1RM prediction from a RTF test. Prior to testing and after detailed explanation of the procedures, participants gave their written consent to participate in the study. Participants were instructed to avoid any strenuous exercise for the duration of the study. The study protocol adhered to the tenets of the Declaration of Helsinki and was approved by the institutional review board of the University of Granada.

Study Design

A randomized crossover design was used to compare the 1RM performance between the concentric-only and touch-and-go bench press variants and to identify factors that influence the accuracy of the Mayhew 1RM prediction equation. For these purposes, 113 young adults (87 men and 26 women) were tested at the faculty research laboratory on 2 occasions separated by 72 to 96 hours. A single bench press variant (concentric-only bench press or touch-and-go bench press) was evaluated on each session in a randomized order. Each session consisted of an incremental loading test until reaching the 1RM, followed by an RTF test. The loads of the RTF test were randomly assigned and ranged from the 75% to 90% of the previously determined 1RM. Different relative loads were used during the RTF test to explore the effect of the number of completed repetitions on the accuracy of the 1RM prediction. Therefore, 4 1RM values were obtained in the present study for each participant (2 bench press variants [concentric-only bench press and touch-and-go bench press] × 2 methods [direct and RTF]). The 2 sessions for the same participants were held at the same time of the day (±1 hour) to minimize the influence of the circadian rhythm on physical performance.