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Comparison of Olympic and Safety Squat Bar Barbells on Force, Velocity, and Rating of Perceived Exertion During Acute High-Intensity Back Squats in Recreationally Trained Men

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ABSTRACT

International Journal of Exercise Science 17(7): 1120-1133, 2024. This study examined using a traditional Olympic (OL) or safety squat bar (SSB) barbell on force, velocity, and perceived exertion during an acute session of high-intensity back squats in adults. Twelve recreationally trained men (23.0±2.6 years; 88.3±19.1 kg) randomly completed two sessions of 3 sets of 6 repetitions at the same absolute load using the OL barbell or SSB barbell. Force and velocity were measured on every repetition and rating of perceived exertion (RPE) was assessed for each set. A two-way ANOVA (set x barbell) with repeated measures and Sidak post-hoc test (repetitions set-by-set) or paired t-test (repetitions independent of set) were used ($p<0.05$). Compared to a traditional OL barbell, using a SSB barbell resulted in no significant differences in peak force (2443.0±46.6 vs 2622.9±65.8 N, respectively; d=0.28) or average set RPE (7.8±0.8 vs 8.0±1.2, respectively; d=0.15) during an acute multi-set high-intensity back squat session. In contrast, compared to a traditional OL barbell, using a SSB barbell resulted in significantly ($p<0.05$) lower average velocity (0.42±0.04 vs 0.38±0.05 m/s, respectively; d=0.27) during the same parameters. When performing the back squat exercise recreationally resistance-trained adults exhibit similar peak force and perceived effort with OL or SSB barbells, but greater velocities can be achieved with the OL barbell. Practitioners working with adults to develop lower body strength and power with the back squat exercise across multiple sets can interchangeably use the OL or SSB barbells to similarly train force, but training velocity is trivially better with the OL barbell acutely.

KEY WORDS: Velocity-based training, muscle strength

INTRODUCTION

A main resistance exercise widely used to develop lower body muscular strength of the hip, knee, and ankle extensors in athletic and rehabilitation settings is the back squat (8, 33). The current National Strength and Conditioning Association (NSCA) evidence-based technique recommendation for the back squat involves a full depth squat, using a natural foot position that is about shoulder-width wide, with no restrictions on anterior displacement of the knees, keeping an upright trunk, and using a forward and upward gaze (8). The back squat using a traditional Olympic (OL) barbell has a preponderance of evidence to support its utility in enhancing athletic performance, such as improving jumping, sprinting, and agility performance

(1, 8, 33, 39), as well as preventing injuries (8, 33), making it a key focus in many strength and conditioning settings.

For the back squat exercise much research has examined squat variations [e.g., front squat, box squat, unilateral variants (3, 8, 22, 24, 33–35, 37)], placement of the barbell [e.g., high-bar and low-bar (13, 21)], body positioning [e.g., variances in the hip, knees, feet, torso, depth (5, 6, 8, 33)], muscle activation (7, 8, 33), and even squat visual cues (2, 8), to name a few. However, much less is known about the effects of the loading implement itself on back squat outcomes, especially regarding specific barbell variations beyond the traditional OL barbell (16, 22). One such variation with limited empirical evidence despite anecdotal widespread use in the back squat (4, 22) is the safety squat bar (SSB) barbell (10, 19, 21, 22, 26, 38).

As recently reviewed by Lincoln and colleagues (22), the SSB barbell was invented in 1981 by Jesse Hoagland, a US weightlifting champion. The typical SSB barbell has 3 distinct features, including 1) cambers or projections on each end of the bar that are anterior and/or inferior to the shaft of the bar, 2) two handles that extend anterior to the barbell shaft, and 3) a central "yoke" with padding around the two handles and in the interval between the two handles (22). The rationale for the use of the SSB barbell during the back squat exercise is that it can provide variation within programming, can be used in instances where precautions are needed around shoulder or elbow orthopedic issues, or when considering flexibility limitations in the hips, ankles, or torso/lower back (10, 22, 26). Regarding training outcomes with the SSB barbell during the back squat exercise, some studies have examined biomechanical aspects (21) and muscle activation, but very few have explored muscle strength or barbell velocity outcomes (10, 19, 21, 38), and none have reported perceived exertion between OL and SSB barbells.

Related to training outcomes, only two studies have examined chronic training with the SSB barbell (10, 26). Meldrum and DeBeliso (26) found that male athletes training with either the traditional OL barbell or SSB barbell showed similar improvements in lower body strength and power. Another study from our laboratory (10) reported significant gains in lower body strength and power using the SSB barbell in male athletes, but this study did not compare these results directly with the OL barbell. Three other studies have compared the OL and SSB barbells in acute back squat sessions (19, 21, 38). Hecker et al. (19) examined competitive powerlifters and Vantrease et al. (38) examined adult males and both found a lower (11.3% and 11.6%, respectively) 3RM back squat with the SSB barbell compared to the OL barbell. Similarly, Kristiansen et al. (21) found the SSB barbell had the lowest 3RM back squat compared to high-bar and low-bar positions with the OL barbell in recreationally trained men, with no differences in peak velocities between the barbells. These 3 acute studies also performed multiple sets of the back squat but mainly focused on barbell differences for muscle activation (EMG), joint kinematics, or velocity using relative loading (%1RM) for the respective barbell (19, 21, 38). None of these studies used the same absolute loading for both barbells or reported ground reaction forces or perceived exertion, although some aspects were measured (21).

Therefore, the purpose of this study was to determine the differences between a traditional OL barbell and the SSB barbell during an acute session of high-intensity back squats using the same absolute load on force, velocity, and perceived exertion in adults. We hypothesized that, compared to a traditional OL barbell, a SSB barbell would result in no differences in force, velocity, and perceived exertion during an acute session of high-intensity back squats in recreationally trained males. This study will help to elucidate how the use of a SSB barbell effects perceptions of effort and force and velocity outcomes compared to a traditional OL barbell using the same absolute load in recreationally trained adults.

METHODS

Participants

Twelve recreationally trained (consistently resistance training for 1-5 years (11)) men volunteered to participate in this study (Table 1). Although male and female participants were recruited, only male participants volunteered for this investigation. Participants were required to demonstrate proper technique of the back squat exercise with a traditional OL barbell (8) and SSB barbell (22) for participation in this study as assessed by a National Strength and Conditioning Association Certified Strength and Conditioning Specialist (CSCS). All participants were required to pass a physical activity pre-participation screening (Physical Activity Readiness Questionnaire [PAR-Q+]) before partaking in the study. Permission to conduct the study was granted from the Southern Utah University Institutional Review Board (IRB; #10-082022a). Further, informed consent was obtained (session 1) from all participants before study initiation. The study was conducted in accordance with the ethical standards set forth by the Declaration of Helsinki. This research was carried out fully in accordance to the ethical standards of the International Journal of Exercise Science (29).

Table 1. Recreationally trained male lifters (n=12) participant characteristics.

Variable	Mean ± SD
Age (yrs)	23.0±2.6
Height (cm)	177.2±8.3
Body Mass (kg)	88.3±19.1
Resistance Training Experience (yrs)	4.0±2.7
Back Squat 1RM (kg)	155.6±34.4
1RM/Body Mass (kg)	1.78±0.34

*SD = standard deviation, yrs = years, cm = centimeters, kg = kilograms.

A priori power analyses were conducted with G*POWER 3.1.9.4 (Universitat Kiel, Germany) software. For a between factors, within factors, or within-between interaction ANOVA with repeated measures, a statistical power of $1-\beta = 0.80$, $\alpha = 0.05$, and an effect size of 0.48 as meaningful can be achieved with 12 participants across 2 groups. The sample size in the current study was n = 12 across 2 within-subject's groups. Further, the effect size of 0.48 (from a reported partial $\eta^2 = 0.19$) came from previous work (21) examining mean force output in OL and SSB barbells in the same individuals during an acute multi-set back squat session. We also report effect sizes (Cohen's *d*) for all dependent variables measured across both barbells using the averages across all repetitions independent of sets. The following interpretations for the magnitude of <0.35 as trivial, 0.35-0.80 as small, 0.80-1.50 as moderate, and >1.50 as large, based on the training status classification of recreationally trained as previously described (11).

Protocol
This study followed a randomized within-subjects cross-over design (Figure 1). All participants participated in 3 testing sessions with at least 48-72 hours between sessions (Figure 1). Session 1 consisted of obtaining informed consent, familiarization with the OL and SSB barbells during the back squat exercise, determination of a 1RM in the back squat with the traditional OL barbell, and a RPE anchoring procedure (Figure 1). Then, in sessions 2 and 3, in a randomized order participants completed 3 sets of 6 repetitions at the same absolute load (80% 1RM of OL barbell 1RM) in the back squat exercise with 2 minutes rest between sets using either the OL or SSB barbell. Peak force and average velocity were measured for every repetition and RPE was measured following every set (Figure 1). Participants were instructed to maintain normal nutritional, sleep, and recovery habits, but to refrain from strenuous exercise for a minimum of 48 hours before a testing session.

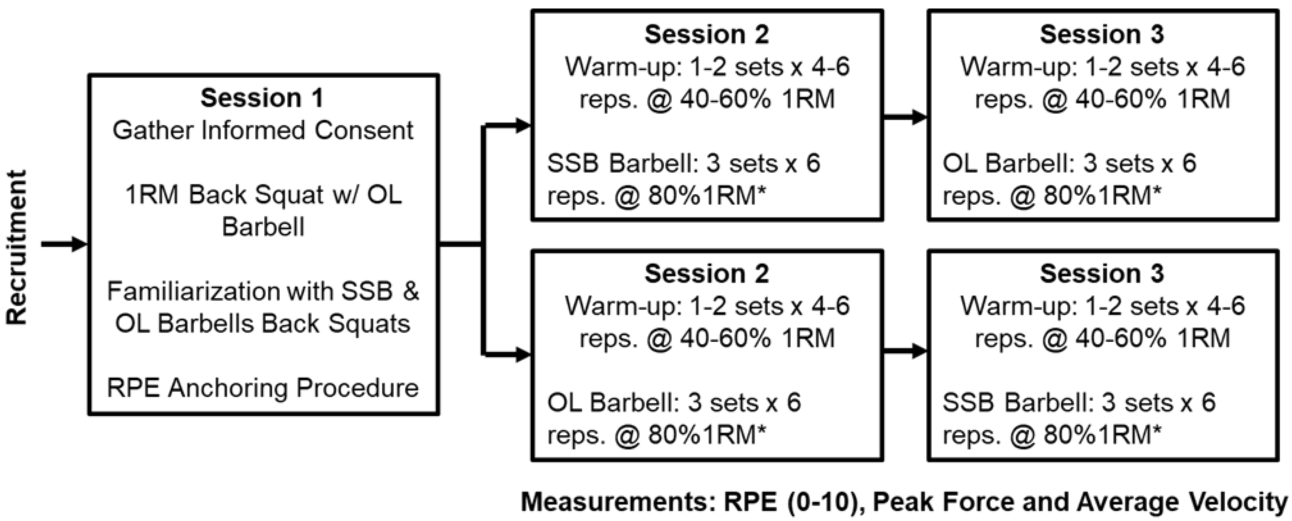

Figure 1. Overview of experimental within-subjects cross-over design. Recreationally resistance trained (1-5+ years experience) men (n=12) performed an initial familiarization session (1) where a 1 Repetition Maximum (1RM) back squat was determined using the traditional Olympic barbell (OL) and establishing anchor points for the rating of perceived exertion (RPE) scale. Then, in a randomized order, participants completed a second session using either the OL barbell or a safety squat bar (SSB) barbell for 3 sets of 6 repetitions at 80% 1RM* in the back squat (*OL barbell 1RM). For session 3, whichever barbell the participant hadn't completed was done (i.e., if session 2 = OL, session 3 = SSB).

Back Squat Exercise with traditional Olympic (OL) or Safety Squat Bar (SSB) Barbell: The back squat was performed using weight/tempo recommendations for training muscular strength (20, 30), and proper technique was required (8, 22) by the same NSCA CSCS-certified researcher. In sessions 2 and 3, participants first completed 1-2 warm-up sets of 4-6 repetitions of the back squat exercise at 40-60% 1RM (from the OL barbell 1RM), with the respective bar for that session. Participants then completed 3 sets of 6 repetitions of the back squat exercise at the same absolute load (80% 1RM of OL barbell 1RM) with at least 2 minutes rest between sets. The goal of this study was to use the same exact absolute load on the OL and SSB barbells, rather than relative loading based on each barbell's 1RM, thus 80% 1RM of the OL barbell 1RM was used as the load for both sessions 2 and 3 regardless of barbell. The OL barbell (The Ohio Bar, Rogue Fitness, Columbus, OH, USA) or the SSB barbell (SB-1, Rogue Fitness) were used (Figure 2). For the OL barbell all participants used a low-bar placement during the squat (Figure 2). For the SSB barbell all participants used a neutral and closed grip on the handles of the bar (Figure 2). Participants were allowed to use weightlifting belts or weightlifting shoes but were required to use the same devices during all sessions. Participants were instructed to perform a full depth squat with maximal concentric effort and to pause for at least 1 second at the top position between successive repetitions. Verbal encouragement was also provided by the research team for every repetition.

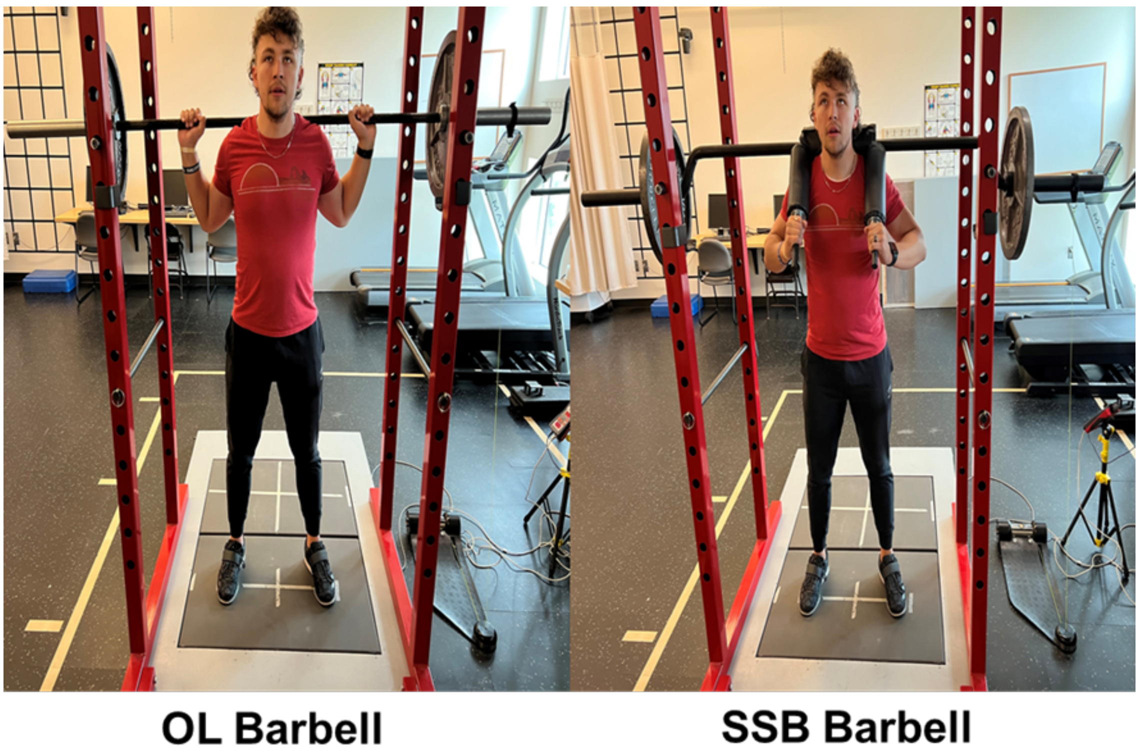

Figure 2. Overview of back squat exercise performed on a force plate (Bertec 6080D) and connected to a linear position transducer (TENDO) across multiple sets using a traditional Olympic (OL) or safety squat bar (SSB) barbell in recreationally trained males (n=12).

Lower body Muscular Strength 1RM Testing: Lower body maximal strength was determined using the traditional OL barbell following the published NSCA 1RM back squat protocol (10, 17). Specifically, participants performed a light warm-up set with 5-10 repetitions at ~40-60% of their estimated 1RM followed by a 1-minute rest. Then, participants performed an additional heavier warm-up set with 3-5 repetitions at ~60-80% of their estimated 1RM followed by 2 minutes of rest. The participants then performed 1RM attempts until a true 1RM was achieved. All participants completed a 1RM in 3-5 attempts. The NSCA recognizes 1RM as a reliable measure of muscle strength (10, 27). Published reliability coefficients ($r \geq 0.90$ and ICC ≥ 0.90) confirm that 1RMs are extremely reliable measures (36).

Ground Reaction Forces Testing: Participants stood with both feet on a force plate (Bertec 6080D, Bertec, Columbus, OH, USA) while they completed each set of squats for sessions 2 and 3 (Figure 2). Vertical force data were sampled digitally at 1000 Hz throughout each set using Bertec Digital Acquire software with standard filtering (bandwidth 500 Hz). Custom software (MATLAB, MathWorks, Natick, MA, USA) was used to analyze the ground reaction force. For each set the raw force time curve was plotted on a computer screen, and the beginning and end of each repetition were manually selected so that the peak force during each repetition could be obtained. The force plate is widely considered the gold standard for ground reaction force measurements during dynamic movements, like back squats (24, 25).

Barbell Velocity Testing: During the back squat sessions (sessions 2 and 3), average concentric velocity for every repetition was measured using a linear position transducer (Tendo™ Weightlifting Analyzer System, TENDO Sports Machines, Slovak Republic) attached to the barbell (Figure 2). The Tendo™ Weightlifting Analyzer System connects to the lifted load via a Velcro strap attached to a Kevlar cable which instantly transmits the vertical velocity of the bar to the analysis software (Tendo Weightlifting Analyzer 7.1.3) (12). The Tendo™ Weightlifting Analyzer System cord was attached to the outer edge of the barbell (Figure 2). The Tendo™ Weightlifting Analyzer System has been shown to be valid ($r > 0.85$) and reliable (ICC > 0.90) during the back squat exercise in measuring average concentric velocity (12, 14, 15), but not valid for measuring peak velocity (14), compared to a motion capture criterion reference. Further, the force plate and linear position transducer were not integrated (i.e., using an interface box with an analog-to-digital card) and thus only peak force (from the force plate) and average concentric velocity (from the linear position transducer) are reported, and not power (9, 24).

Rating of Perceived Exertion (RPE): RPE was measured using the OMNI-Resistance Exercise scale (OMNI-RES) as previously described (18, 28, 32). Specifically, familiarization to the OMNI-RES took place during session 1 when the 1RM back squat measurement took place and low and high anchor points were established (18, 32). On the day participants performed the back squat 1RM, participants experienced the low ("0") anchor point while sitting quietly in a chair as well as the high ("10") anchor point once they achieved their true 1RM back squat. Moreover, participants were shown the OMNI-RES 0-10 scale in a figure form printed on a piece of paper (Figure 1 in (28)) and explicitly instructed during each session that "0" was "extremely easy" exertion such as during maximal rest and that a "10" was "extremely hard" exertion such as lifting a maximal effort weight (28). During sessions 2 and 3, following the last repetition in each set RPE was obtained using the 0-10 OMNI-RES scale. Robertson et al. (32) reported RPE of the overall body across multiple sets of RT using the OMNI-RES scale to be highly valid ($r \geq 0.87$) compared to the criterion-references of total weight lifted or blood lactate concentrations.

Statistical Analysis

To account for instances where participants were unable to successfully complete 6 full repetitions for a set, the average values of the repetitions completed across the individual sets for each variable were used for set-by-set analyses. We also looked at averages across all repetitions completed as a secondary analysis independent of set. There were only four participants (n = 3 for SSB barbell and n = 1 for OL barbell) who were unable to complete the final 1-2 repetitions of set 3, which again is why we used repetition averages by set as well as repetition averages independent of sets as described above. Further, we used repetition averages by set and independent of sets rather than repetition by repetition analysis to avoid a type II error in instances where participants did not successfully complete 6 full repetitions, as our study was powered based on only 12 participants. A two-way (barbell x set) ANOVA with repeated measures across repetitions completed averaged by set were used for multiple set comparisons. Post-hoc comparisons were accomplished via a Sidak test for multiple comparisons. A paired samples t-test was used for any comparisons between barbells where all repetitions completed were analyzed independent of set. Significance was a priori at $p < 0.05$. Data are reported as means ± SD. We also calculated effect sizes using Cohen's *d* with the following interpretations using participants resistance training status of <0.25 = trivial, 0.25-0.50 = small, 0.50-1.0 = moderate, >1.0 = large (16, 39). Data were tested for equal variances and normal distribution to determine the appropriate statistical test. All statistical analyses and graphs were made using GraphPad Prism 9 (GraphPad, San Diego, CA, USA).

RESULTS

All participants completed all 3 sessions, and no injuries were incurred during their participation in this study. Compared to a traditional OL barbell, using a SSB barbell resulted in no significant ($p > 0.05$) differences in absolute ($d = 0.28$) and normalized ($d = 0.38$; for body mass and strength – 1RM/BM) peak force by set (Figure 3A and 3B, respectively) and across all repetitions independent of sets (Figure 3C and 3D, respectively).

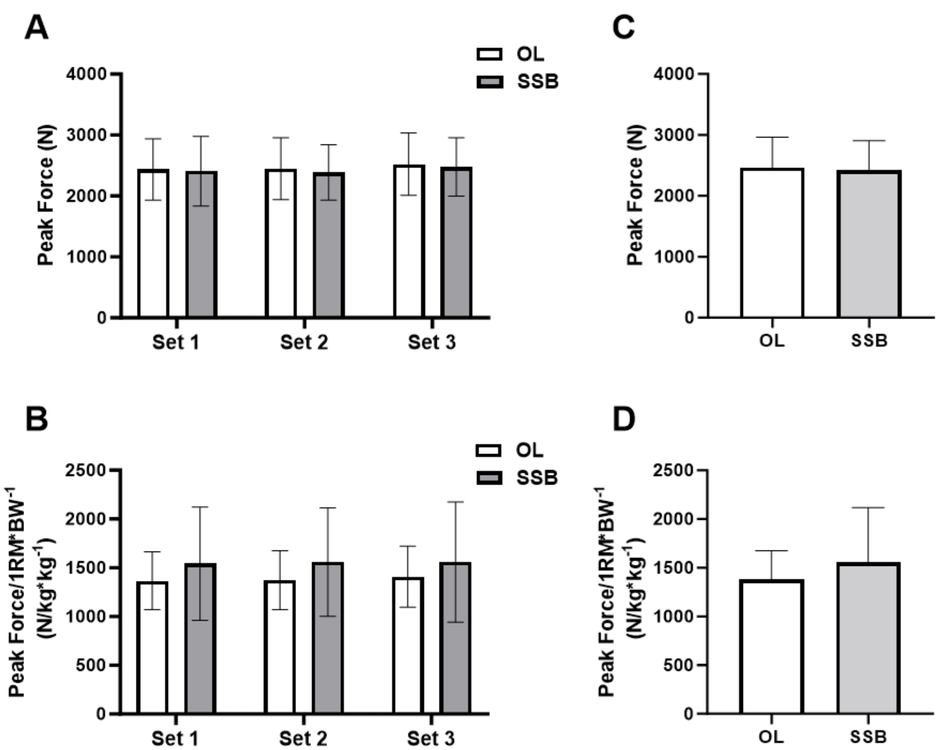

Figure 3. Differences in traditional Olympic (OL) barbell and safety squat bar (SSB) barbell absolute (**A**) and normalized (**B**, 1 repetition maximum, 1RM per body weight, BW) peak force repetition average by set as well as repetition average independent of sets (**C** and **D**, respectively) across multiple sets of the back squat exercise using the same absolute load in recreationally resistance trained males (n=12). Data are mean ± SD. A two-way ANOVA (set x barbell) with repeated measures was used for set-by-set analyses and a paired t-test was used for independent of set analyses, with significance set at p < 0.05.

In contrast, compared to the OL barbell, the SSB barbell displayed significantly ($p < 0.05$) lower average concentric velocity during set 1 (Figure 4A) and across sets (Figure 4A and 4B, $d = 0.27$). Also, in the OL barbell only, there was a significant decrease in average concentric velocity from set 1 to set 3, with no other differences seen between sets (Figure 4A), but the same decreases seen across all repetitions independent of set (Figure 4B).

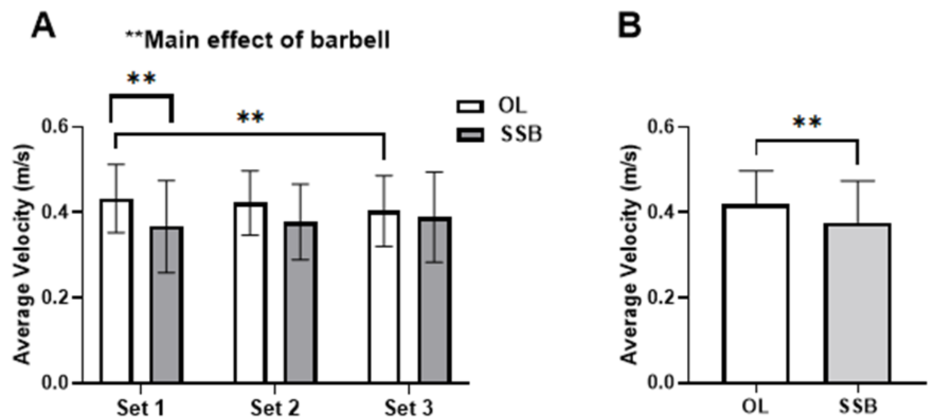

Figure 4. Differences in traditional Olympic (OL) barbell and safety squat bar (SSB) barbell (**A**) average velocity repetition average by set and (**B**) average velocity repetition average independent of set across multiple sets of the back squat exercise using the same absolute load in recreationally resistance trained males (n=12). Data are mean ± SD. A two-way ANOVA (set x barbell) with repeated measures was used for set-by-set analyses and a paired t-test was used for independent of set analyses, with significance set at $p < 0.05$; **$p<0.01$.

Further, no significant differences were observed between OL and SSB barbells for RPE ($d = 0.15$) by set (Figure 5), although RPE significantly increased (main effect) across sets for both barbells (Figure 5).

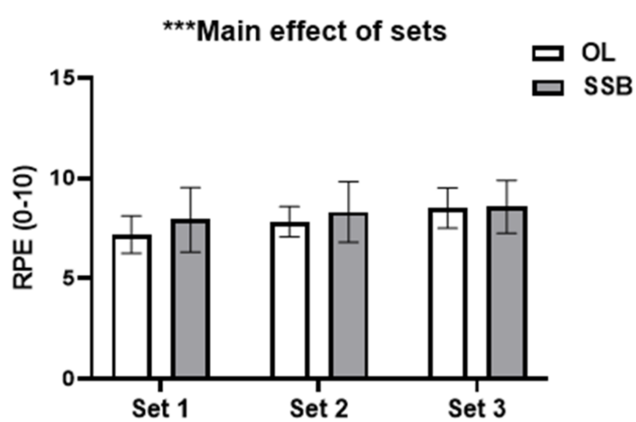

Figure 5. Differences in traditional Olympic (OL) barbell and safety squat bar (SSB) barbell rating of perceived exertion (RPE) using the OMNI-RES 0-10 scale across multiple sets of the back squat exercise using the same absolute load in recreationally resistance trained males (n=12). Data are mean ± SD. A two-way ANOVA (set x barbell) with repeated measures was used. Post-hoc comparisons were accomplished via a Sidak test, with significance set at $p < 0.05$; ***$p<0.001$.

DISCUSSION

The purpose of this study was to determine if there were any differences between traditional OL and SSB barbells in force, velocity, and perceived exertion in recreationally trained adult males during an acute, high intensity workout session of back squats. Each participant used the same absolute load, established with their 1RM with the OL barbell. We hypothesized that there would be no difference in these variables between the two barbells. The results partially support this hypothesis, showing no differences in peak force and perceived exertion between the SSB and OL barbells. However, this study did find that the average concentric velocity was lower in the SSB barbell compared to the OL barbell. Thus, individuals using the SSB barbell for programming can factor in these findings when the goal is to train strength or velocity with either barbell.

The current investigation adds to the literature by providing novel and supporting evidence for the utility of the SSB barbell in training force and velocity using respective barbell absolute and relative loads. Our findings support that while the peak vertical force used to lift a specific load in SSB barbell squats does not differ from OL barbell squats, the mechanics of the squat may be different. All previous studies (19, 21, 38) examining acute SSB versus OL barbell kinetics and kinematics used relative loads (i.e., loading corresponding to the 1RM of the respective barbell) and reported lower (~11-12%) 1RM/3RM results in the SSB barbell compared to the OL barbell in the same subjects. These previous findings suggested that the loading stimulus may have to be reduced when utilizing a SSB barbell compared to the OL barbell during back squat exercises, and this might limit force/strength development when using the SSB barbell (19). However, our findings of no differences in multi-set peak force using the same absolute loading between SSB and OL barbells instead suggest that force/strength can be similarly developed between the two barbells in the back squat exercise.

Our acute findings also support two studies on chronic training (8-9 weeks) with a SSB barbell (10, 26). Both chronic studies found significant improvements in muscle strength and power in Division I collegiate athletes (football and baseball) when using SSB or OL barbells. In particular, Meldrum & DeBeliso (26) suggested that the SSB barbell may result in greater strength improvements than the OL barbell, although their study used between subjects groups without randomization. Although our previous study (10) did not directly compare the SSB barbell to the traditional OL barbell, the results were the first to show training outcomes using a SSB barbell variation (i.e., unilateral upper-extremity assisted or Hatfield). Lincoln et al. (22) recently highlighted that one programming advantage of the SSB barbell is the exercise variations this unique barbell can provide, such as regular SSB barbell squats, hands-free SSB barbell squats, and upper-extremity assisted (i.e., Hatfield) SSB barbell squats. Despite the anecdotal popularity of the SSB exercise variations (4, 22), to our knowledge, only two empirical studies currently exist examining chronic training outcomes with SSB: standard SSB barbell squats (26) or unilateral upper-extremity assisted SSB squats (10). This highlights a need for empirical evidence on barbell exercise variations and various training outcomes. Considered with the current findings, data to date support the interchangeability of the SSB and OL barbells to develop lower body strength.

Another unique finding of the current investigation was the significantly lower average concentric velocity with the SSB barbell compared to the OL barbell using the same absolute load. In the only two acute studies (21, 38) to examine concentric velocity between the SSB and OL barbells in the back squat exercise, both found no differences between barbells. However, these results can likely be attributed to the differences in the relative loading used between the SSB and OL barbells. Thus, our current findings provide novel insight using absolute loads and suggest that the SSB barbell does not allow for similar concentric velocities as the OL barbell during the back squat when using the same load. Our current findings help support previous acute findings (19, 21, 38) that have consistently shown significantly lower maximal strength (1RM/3RM) outcomes when using the SSB barbell versus the OL barbell. The slower concentric velocity we observed in our current study might indicate that 80% 1RM of the OL barbell is greater than 80% 1RM of the SSB barbell (19, 21, 38). Regardless, our data along with others (19, 21, 38) suggest that concentric velocities can be mimicked between OL and SSB barbells when the load is relative, and not absolute, to the barbell 1RM. This is an important consideration when programming with the SSB barbell with training velocity as a goal.

This study is the first to compare RPE between the SSB and OL barbells during any exercise. We found no significant differences in RPE between the two barbells across multiple sets of high-intensity back squats. Both barbells showed a significant increase from the first to last set (main effect), supporting the existing literature that shows RPE rises from the first to last set when volume and intensity are constant (23, 28, 32). To our knowledge, only one other study (21) examined RPE with the SSB and OL barbells but did not report RPE findings, they only used the repetitions in reserve (RIR) method to ensure a true 3RM. Our findings are interesting as RPE did not differ between barbells, even though the SSB barbell had a significantly lower average concentric velocity. Indeed, others (40) found a strong inverse relationship (r = -0.88) between RPE and concentric velocity during back squats, with predictive variance higher in more experienced (2+ years) squatters. The lack of RPE barbell differences in our study, despite the lower SSB barbell velocity, may be due to the varied training experience in our sample (1-5+ years). Our sample size, though sufficiently powered for the study's intent, was too small to assess RPE differences by experience level. Overall, RPE increased similarly from the first to last set for both barbells, with no differences between barbells when using the same absolute loading. Since the SSB barbell has a lower reported 1RM than the OL barbell, future work should examine RPE using the same relative load (%1RM) across both barbells.

This study has several limitations. First, familiarity/regular use with the SSB barbell was not required for participant inclusion, which might affect the results compared to a sample of SSB barbell experienced squatters. Notably, more participants struggled to complete the third set with the SSB (n=3) compared to the OL barbell (n=1), suggesting lack of experience with SSB. However, our participants were resistance trained, familiarized with squatting with both barbells, and performed the training sessions with both barbells in random order. Therefore, our study still provides novel insights into the parameters measured using the SSB and OL barbells with the same absolute load. Second, the average strength of our subjects was not the strongest (~1.7x bodyweight OL barbell back squat) or most well-trained (~4 years of RT experience), which may limit generalizability to stronger or more well-trained individuals, but still provides insight into recreationally trained individuals. Third, this real-world study could not control for inter-individual variances in squat mechanics due to anthropometry, which might affect the ease of using the OL or SSB barbells. Nevertheless, the within-subject design allowed us to report meaningful results. Moreover, differences in lifting mechanics between SSB and OL barbells suggest varying muscle activation, which we did not measure. Future research should investigate muscle activation at the same absolute load, as previous studies using relative loads have been inconclusive (19, 21, 38). Fourth, we only analyzed repetition averages by set and across all sets to avoid a type II error; future studies should examine repetitions across each set. Fifth, we did not measure the 1RM of the SSB barbell, only the OL barbell, which may limit interpretations. Prior studies indicate (19, 21, 38) the SSB barbell back squat 1RM is lower than the OL barbell 1RM. The goal of this study was to examine the same SSB and OL absolute loading, rather than relative loading, during acute high-intensity back squats. Finally, our study included only resistance trained males due to volunteer availability. Since other studies have found sex differences with the SSB and similar barbells (16, 19, 21), future research should include females to explore the same parameters.

In conclusion, this study looked to examine the differences in force, velocity, and RPE between the OL and SSB barbells using the same absolute loading during multiple sets of acute high-intensity back squats in resistance trained individuals. Our results support the interchangeability of the SSB and OL barbells to similarly develop force/strength, while also having a similar perceived effort. However, when the goal is to train average concentric velocity during the back squat exercise, using a lower load with the SSB barbell is required to achieve similar velocity speeds as the OL barbell.

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