Examination of Bar Velocity in Barbell Back Squat

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Examination of Bar Velocity in Barbell Back Squat

Description
The aim of the study was to examine repetition to repetition changes of bar velocity and its variations from barbell back squat. Participants (N=19) performed back squat with a relative intensity of 78-80% of 1 RM. Bar velocity was captured using wireless device (PUSHtm) placed on their forearm. Data were collected from 3 sets of 10 repetitions. One-way repeated measures ANOVA was used to identify the velocity changes over 10 repetitions. Statistical significance was found (F(1,17)=45.06,~ 0 . 0 0 0 1 )T.h is indicates that the bar velocity decreased significantly over the 10 repetitions. At the same time, coefficient of variance also increased as the repetitions went higher, indicating that there were differences in individual responses of bar velocity changes. Further examination will be aimed to investigate the bar velocity changes from various strength level of individuals.

Keywords
bar velocity, barbell back squat

Disciplines
Sports Sciences

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A comparison of bar velocity changes at different intensities has repetition maximum (RM), technique, and training experience. Alver, Evetoch, Housh, Kibler, Kraemer, & Triplett, 2009, important and necessary from a safety perspective (Ratamess, repetitions), possible velocity variations at given resistance has given intensity over relatively high repetitions (e.g., 10

The force-velocity curve described in the textbook is somewhat exercises at chosen intensity. The PUSH™ unit provides versatility to accommodate non-bar approaches with “no wires” in the testing environment. The PUSH™ unit has applications to accommodate non-bar exercises such as dumbbell, kettlebell, and medicine balls. This gives users the ability to test velocity in different types of exercises at chosen intensity.

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The primary purpose of this study was to examine the changes in bar velocity over the 10 repetitions at a relative intensity of 78%-80% of 1RM. It is obvious that the bar velocity started to decrease as the repetitions increased. There was a gradual decrease of velocity in group average and also from each individual, confirming that over the 10 repetitions bar velocity changes with a relative intensity of 78-80% of 1RM.

From a practical standpoint, a minimum threshold of back squat bar velocity from previous study was around 0.25-0.30 m/s to be considered of maximal strength at 77.84% of 1RM and absolute 1RM test (Carroll, 2015; Jovanovic & Flanagan, 2014). Based on the information, 0.69 m/s at the 10th repetition may be underestimated the 1RM.

This study also examined changes in bar velocity variations over the 10 repetitions. From the 19 participants, CV was relatively low (up to 14%), indicating the homogeneity of the athletes in this current study. The study also revealed gradual gain in CV from 7.88% to 14%, indicating that as the repetitions proceeded, individual responses differed. This may indicate a lack of sufficient strength to perform the back squat over 10 repetitions with consistent bar velocity as compared to those who displayed a relatively higher bar velocity. Further investigation in this measure is necessary. To bridge the gap between science and practice, ways to analyze the raw data seems to be next step. While average data as a trend of tested participants, is indeed important data reporting technique. It is also important to investigate each individual response to the stimulus. For example, in the current study, an individual who displayed high velocity had very small CV from repetition to repetition, indicating small to no changes in the bar velocity. In comparison, slow velocity individuals had higher CV, indicating inconsistency in the bar velocity (typically it was due to velocity decrease). Thus, the data must be shared with coaches and strength coaches to focus on technique and physical improvement to reduce the velocity variation during a relatively high repetition sets.

The authors would like to thank East Tennessee State University Research Development Committee for providing the funding to purchase wireless device to conduct data collection for the study.

REFERENCES


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EXAMINATION OF BAR VELOCITY IN BARBELL BACK SQUAT

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INTRODUCTION

Bar velocity measurement is increasing its popularity in strength and conditioning to measure how fast lifters are moving external loads in training. Instruments such as TENDO-unit™ and gymAware™ have been used to measure bar velocity with a wired connection to the bar (Cronin, Jones, & Hagstrom, 2007; Gonzalez, Hoffman, Rogowski, Burgos, Manalo, Weise, Fragala, & Stout, 2013). This type of measurements have focused on back squat, bench press along with some explosive lifts. In recent years, wireless instruments (via Bluetooth™ connection) such as PUSH™ and BarSensei™ are used for a similar purpose, but provide a user-friendly approach with “no wires” in the testing environment. The PUSH™ unit provides versatility to accommodate non-bar exercises such as dumbbell, kettlebell, and medicine balls. This gives users the ability to test velocity in different types of exercises at chosen intensity.

METHODS

Nineteen female collegiate-level athletes participated the study. Participants’ age ranged from 18 to 21, and in collegiate athletic experience at maximum of 3 years apart. All participants had been instructed by qualified (certified) strength and conditioning coaches to obtain proper technique to perform a barbell back squat. The data collection is a part of on-going athlete monitoring program and was obtained during regular training days. All participants signed informed consent in accordance with the University Institutional Review Board.

EXAMINATION OF BAR VELOCITY IN BARBELL BACK SQUAT

RESULTS

The average bar velocity decrease was statistically significant (F(1,17)=45.06, p<0.0001), indicating that the bar velocity decreased as the repetitions approached the 10th repetition (see Table 1).

As a post-hoc test, a pairwise t-test comparison was done to further examine the actual rep-to-rep differences. Although the back to back repetitions such as 1st and 2nd repetitions or 3rd and 4th repetitions did not show statistical difference, the further repetitions were away from each other, the greater the p values and t scores. Comparison of average 1st and 10th repetitions differed by 20.42%. Comparison between 2nd, 3rd, 4th, and 5th repetitions with the 10th repetition differed by 14.5%, 13.29%, 11.93%, 10.17%, respectively.

The current study further analyzed the coefficient of variance (CV) from each repetition to see changes over the 10 repetitions. The CV was increasing as the repetitions went towards 10 (see Table 1). Further analysis was done to investigate the CV changes over the repetitions from each individual. Interestingly, those participants who produced a faster bar velocity (top 6 out of 19, ranging from 1.74-2.96%) had relatively lower CV (ranging from 0.59-0.70 m/s) with the CV of 9.00-14.43%.

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Table 1: Descriptive data on bar velocity from repetition to repetition

<table>
<thead>
<tr>
<th>Rep</th>
<th>Mean</th>
<th>SD</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.83</td>
<td>0.73</td>
<td>7.80</td>
</tr>
<tr>
<td>2</td>
<td>0.79</td>
<td>0.73</td>
<td>7.76</td>
</tr>
<tr>
<td>3</td>
<td>0.77</td>
<td>0.73</td>
<td>7.64</td>
</tr>
<tr>
<td>4</td>
<td>0.74</td>
<td>0.73</td>
<td>7.57</td>
</tr>
<tr>
<td>5</td>
<td>0.73</td>
<td>0.73</td>
<td>7.57</td>
</tr>
<tr>
<td>6</td>
<td>0.70</td>
<td>0.70</td>
<td>6.90</td>
</tr>
<tr>
<td>7</td>
<td>0.70</td>
<td>0.70</td>
<td>6.90</td>
</tr>
<tr>
<td>8</td>
<td>0.68</td>
<td>0.68</td>
<td>6.57</td>
</tr>
<tr>
<td>9</td>
<td>0.68</td>
<td>0.68</td>
<td>6.57</td>
</tr>
<tr>
<td>10</td>
<td>0.68</td>
<td>0.68</td>
<td>6.57</td>
</tr>
</tbody>
</table>

DISCUSSION & CONCLUSION

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