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Abstract

Different physiological and perceptual parameters responses to six squat exercise variations

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With the use of high-precision wearable devices to monitor internal load increasing exponentially (Seshadri, 2019), objective measures, heart rate (HR) and muscle oxygen saturation (SmO_2), and subjective measures, rate of perceived exertion (RPE) are widely used in the context of resistance training for the differentiated information they provide. This study compared the effects of six body-weight squat variations on HR, SmO_2, and RPE. Fourteen healthy recreational trained participants (age=28.8±7.6 years old; height=1.72±0.07 m; weight=71.9±10.3 kg) underwent two testing sessions: a

familiarisation session, and an experimental session where all exercises were performed in a randomised order. The six variations of the squat were 1) deep, 2) jump, 3) wall-sit, 4) uneven, 5) single-leg, and 6) unstable. Each variation was performed for 90 seconds, with five minutes of passive recovery between variations. Two near-infrared spectroscopy devices fixed on the *vastus lateralis* (VL) and on the *soleus* (SL) muscles, and a HR monitor were used to assess SmO_2 and HR, respectively. RPE was registered immediately after each exercise. The average HR (HR_{avg}), average SmO_2 ($SmO_{2\ avg}$), amplitude of deoxygenation ($SmO_{2\ deoxy}$), and RPE were determined. A one-way ANOVA (repeated measures) was applied, followed by the Bonferroni post hoc pair-wise comparisons. Statistical significance was accepted at $p<0.05$, and analyses were performed using JASP software 0.17.2.1 (JASP Team, 2023). All data are presented as mean ± standard deviation. A statistically significant effect of squat variations was observed on HR_{avg}, $F(5,60)=8.91$, $p<0.001$, $\eta^2=0.130$, with jump (148.4±15.5 bpm) presenting higher values compared to deep (134.9±14.9 bpm, $p=0.006$), wall-sit (131.5±18.4 bpm, $p=0.003$), uneven (131.0±18.4 bpm, $p<0.001$), and to unstable (138.3±15.4 bpm, $p=0.009$). A main effect of squat variations was identified on $SmO_{2\ avg}$ and $SmO_{2\ deoxy}$ in VL muscle, with the wall-sit exhibiting lower values and a higher deoxygenation, respectively. No significant differences in $SmO_{2\ avg}$ and $SmO_{2\ deoxy}$ in SL muscle were found. Also, significant differences were observed in RPE, $F(5,60)=10.55$, $p<0.001$, $\eta^2=0.310$, with jump eliciting higher perceived exertion compared to all the other variations. These findings revealed that while in the general objective and subjective parameters (i.e., HR and RPE, respectively), it was the jump exercise that promoted more significant changes, in the specific objective parameter (i.e., SmO2 in VL), it was the wall-sit exercise that induced the greatest changes. This reinforces that using different

variables allows a more selective and targeted identification of the most effective exercises.

References

Seshadri, D. R., Li, R. T., Voos, J. E., Rowbottom, J. R., Alfes, C. M., Zorman, C. A. & Drummond, C. K. (2019). Wearable sensors for monitoring the internal and external workload of the athlete. *NPJ Digital Medicine*, *2*, 71. https://doi.org/10.1038/s41746-019-0149-2