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# Intra- and Inter-day Reliability of Weightlifting Variables During Heavy Cleans

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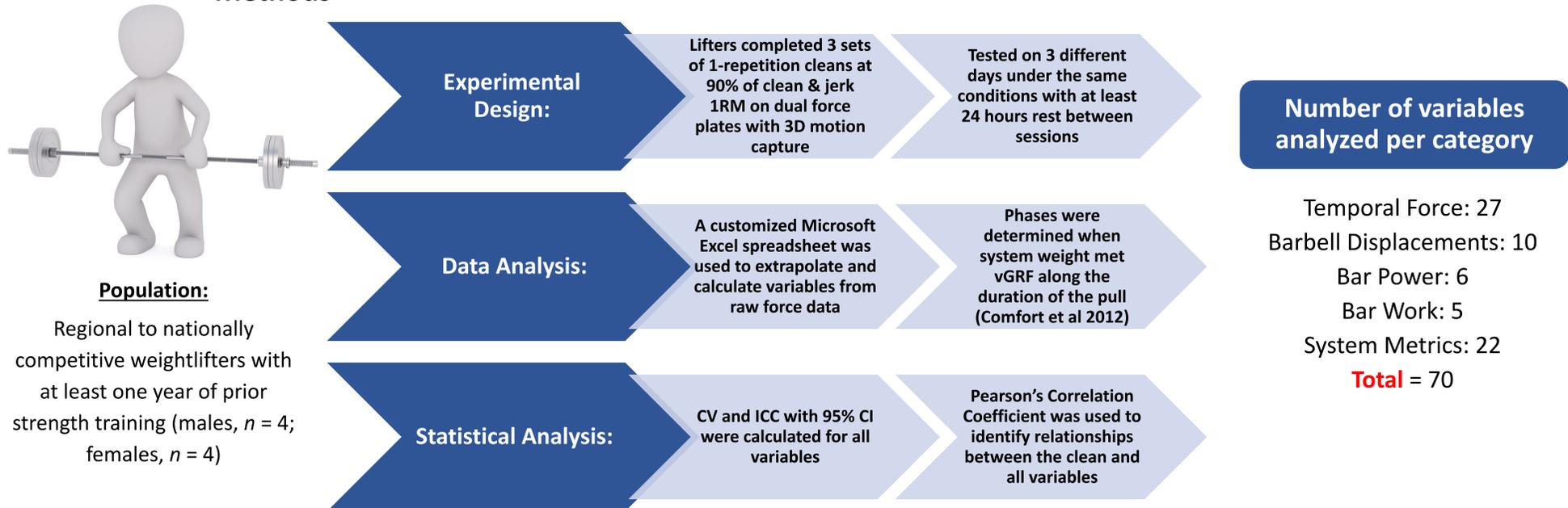
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Anthony N Turner <sup>1</sup>

## Introduction

- The pull in weightlifting has previously been categorized into 3 phases: weighting 1 (W1), unweighting (UW), and weighting 2 (W2) (Enoka 1979).
- Research into the examination of weightlifting has typically utilized pulling derivatives initiated at or above the knee (Suchomel et al 2015; Haff et al 2012), which excludes a detailed examination of W1 and UW phases.
- Weightlifting is a sport initiated from floor level, which would imply that performance of W1 and UW may impact overall performance outcomes and therefore this study aimed to examine which variables can be collected throughout the entire duration of the pull, which of those are reliable within and between days, and which can be monitored for performance.

## Methods



## Results

Table 1 – Intra- and inter-day reliability of weightlifting variables and correlation with 90% cleans.

Variable	Intra-day		Inter-day (best)		
	ICC (95% CI)	CV (%)	ICC (95% CI)	CV (%)	Pearson's R (clean kg)
W1 Vertical Impulse	0.932 (0.779 – 0.987)	5.53	0.964 (0.888 – 0.992)	5.06	0.903
W1 Average vGRF	0.952 (0.837 – 0.991)	6.42	0.961 (0.880 – 0.991)	7.06	0.882
<b>W1 Average Resultant Force</b>	<b>0.998 (0.994 – 1.000)</b>	<b>0.64</b>	<b>0.995 (0.983 – 0.999)</b>	<b>1.14</b>	<b>0.978</b>
UW Average Resultant Force	0.984 (0.946 – 0.997)	2.56	0.990 (0.957 – 0.998)	1.92	0.911
W2 Average Resultant Force	0.980 (0.929 – 0.996)	1.95	0.977 (0.929 – 0.995)	2.13	0.910
Peak Power	0.990 (0.962 – 0.998)	2.86	0.990 (0.969 – 0.998)	3.00	0.933
Average Power – Lift Off to W1 End	0.990 (0.965 – 0.998)	4.60	0.980 (0.937 – 0.996)	6.84	0.961
Average Power – W1 & UW	0.994 (0.980 – 0.999)	3.38	0.981 (0.939 – 0.996)	6.40	0.948
Average Power – Lift Off to Most Rear	0.993 (0.974 – 0.999)	3.22	0.976 (0.924 – 0.995)	6.75	0.922
<b>Average Power – Lift Off to PBH</b>	<b>0.989 (0.962 – 0.998)</b>	<b>2.99</b>	<b>0.981 (0.938 – 0.996)</b>	<b>5.02</b>	<b>0.985</b>
Average Power – UW to PBH	0.973 (0.907 – 0.995)	3.48	0.960 (0.874 – 0.991)	4.53	0.983
W1 Peak Power	0.902 (0.686 – 0.981)	6.89	0.964 (0.888 – 0.992)	5.62	0.896
<b>W1 Average Power</b>	<b>0.908 (0.712 – 0.982)</b>	<b>6.75</b>	<b>0.940 (0.822 – 0.986)</b>	<b>6.63</b>	<b>0.941</b>

ICC = Intraclass coefficient correlation, CI = Confidence interval, CV = Coefficient of variation, W1 = Weighting 1, vGRF = Vertical ground reaction force, UW = Unweighting, W2 = Weighting 2, PBH = Peak bar height.

## Conclusion & Practical Applications

- After removing variables based on multicollinearity, significant correlations were shown in W1 Average Power ( $r = 0.941$ ), W1 Average Resultant Force ( $r = 0.978$ ), and Average Power – Lift Off to PBH ( $r = 0.985$ ).
- Overall this demonstrates the importance of force and power outputs during W1 and should be considered when determining the overall impact in weightlifting performance especially as any change in W1 metrics could have an effect on subsequent phases of the pull.
- ❖ It can be suggested from a practical application standpoint that coaches can most easily track Average Power – Lift Off to PBH as a measure of performance through the use of readily available barbell tracking apps.
- ❖ While this study examined variable reliability, further research is needed to determine their sensitivity to change through interventions aimed at improving force and power.

### References

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