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EXISTING RELATIONSHIP BETWEEN THE PERFORMANCE ACHIEVED IN TWO TESTS OF LOWER LIMB STRENGTH

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Abstract: Muscle condition and joint mobility are essential for the undertaking in conditions of safety and at an adequate level of performance of all physical activity, be it every day physical tasks, physical leisure activities or sporting performance activities. Testing muscle strength is used to determine the maximum weight muscles or muscle groups are capable of lifting. In testing muscle strength there must be present a constant concern for safety and reducing the risk of injury. Weighted squats are one of the most used test of lower limb muscle strength, but it can lead to an elevated risk of injury, especially for persons with a reduced experience of working with free weights or coming back to strength training after a prolonged break. The horizontal leg press may represent a safer alternative for some. This study aims to show the relationship between the performance achieved in the context of two tests of lower limb strength, specifically weighted squats and horizontal legs press.

Key words: muscle strength; strength testing; association.

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INTRODUCTION

Muscle condition and joint mobility are essential for the undertaking in conditions of safety and at an adequate level of performance of all physical activity, be it every day physical tasks, physical leisure activities or sporting performance activities.

Muscular strength is defined as ”the maximal force that can be generated by a specific muscle or muscle group” (ACSM, 2010; p.322; Marinău et al. 2022; Huțanu et al. 2024;). The measurement of muscle force generation is used to determine the importance of strength to performance in other physical tasks (Winter, et al. 2007), to monitor longitudinal adaptations to training and rehabilitation, to identify weaknesses in muscle groups, and in measuring the effectiveness of training programs (Winter, et al. 2007; ACSM, 2010; Șandra et al. 2023).

This information regarding a person’s strength is often sought in order to compare the strength levels of individuals who might have different levels of resistance training (Winter, et al. 2007). According to Edward M. Winter et al. (2007), to determine the best battery of tests, it is

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important to consider issues of test specificity and reliability, the safety of subjects, and the ease of test administration. The gold standard of dynamic strength testing is the one repetition maximum (1RM), which can be performed with free weights and machines (Ratamess, 2012; Cardinale et al., 2011; Kraemer et al., 2007). The 1RM test consists of the maximum weight that can be moved through the full range of motion in a controlled manner (ACSM, 2010; Ratamess, 2012; Horváth et al. 2025). The most common tests for evaluating lower limb muscle strength found in the specialized literature are the Barbell Back Squat and the Leg Press. Weighted squats are one of the most used tests of lower limb muscle strength (particularly for athletes), but they can lead to an elevated risk of injury, especially for individuals with a reduced experience of working with free weights or coming back to strength training after a prolonged break. The horizontal leg press can represent a safer alternative and may be much easier to administer.

AIM

This study aims to show the relationship between the performance achieved in the context of two tests of lower limb strength, specifically weighted squats, and the horizontal leg press.

MATERIALS AND METHODS

As part of the research, we started from the premise that there is a good correlation between the performances achieved in the squat test with the barbell resting on the back and the leg press performed while lying. Secondly, we believe that based on an association we can establish a ratio between the performance achieved in the two tests, a ratio by which the maximum force can be estimated in the barbell squat test starting from the performance achieved in the leg press.

The subjects of the study were 19 students (14 male and 5 female), aged between 20 and 22, from the Physical and Sports Education program of the University of Oradea. Firstly, we performed anthropometric measurements related to height and weight, subsequently, administering the two maximal strength tests, Barbell Back Squat and Horizontal Leg Press, at an interval of seven days.

The analysis and interpretation of the data were done with the statistical software SPSS (Statistical Package for the Social Sciences), version 20.

RESULTS

The analysis of the distribution of the values obtained in the two lower limb strength assessment tests shows a distribution relatively close to the normal distribution for both samples. The values for asymmetry and arching show a slight positive asymmetry in the Leg Press test and a slight flattening for the distribution of values in the squat test (table 1).

Table 1. Descriptive Statistics

	Squat	**Leg Press**	**Height**	**Weight**
Mean	86.0526	129.4737	175.7895	71.7895
Median	80.0000	125.0000	176.0000	70.0000
Std. Deviation	26.38281	39.18385	11.51125	15.51551
Variance	696.053	1535.374	132.509	240.731
Skewness	.225	.518	.482	.381
Std. Error of Skewness	.524	.524	.524	.524
Kurtosis	-1.052	-.568	1.258	-.924
Std. Error of Kurtosis	1.014	1.014	1.014	1.014
Minimum	40.00	77.00	155.00	50.00
Maximum	130.00	213.00	205.00	100.00

To check the assumption of normality, we used the P-P plot diagram, which compares the distribution function of the distribution of an empirical variable with the distribution function of a specified theoretical distribution, in this case, the normal distribution function. In the P-P plot diagram it can be observed that the recorded values are very slightly deviated from the straight line that shows the normal distribution and at the same time, a very high similarity can be observed between the values distributions of the two samples (figure. 1).

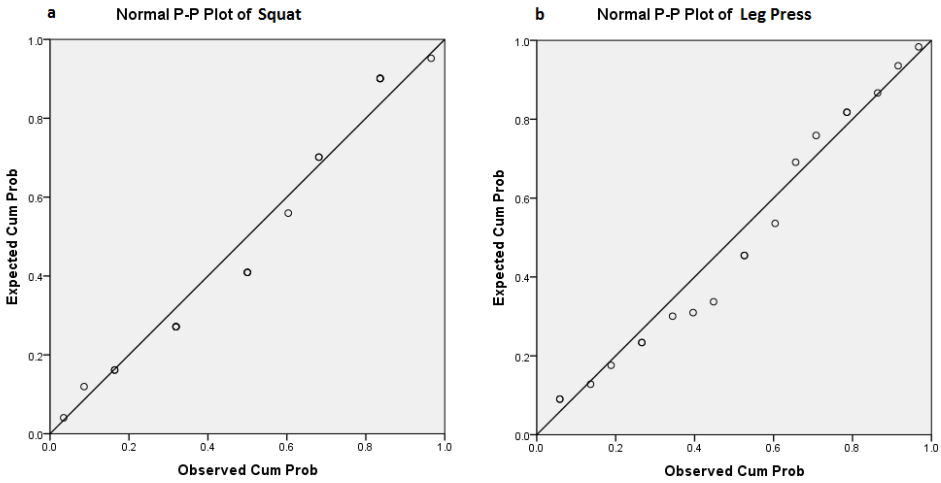

Figure 1. Graphical representation of normality: a) P-P plot of Squat; b) P-P plot of Leg Press.

Examining the relationship between the performance in the two tests was done by calculating the Pearson correlation coefficient (figure 2). Thus, the correlation between the maximum weight lifted in the Squat and Leg Press tests is very strong, having a correlation coefficient r=0.857, at a significance threshold of p<0.01.

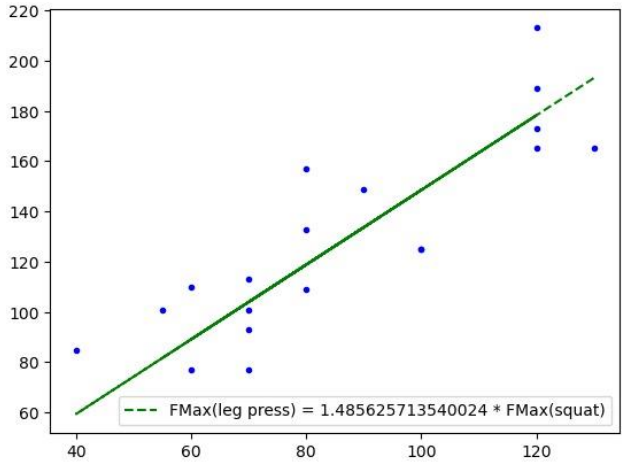

Figure 2. Graphical representation of linear regression line (Ox-Squat; Oy-Leg Press)

We believe that the close association between the performance achieved in the two samples allows us to establish a relationship using regression analysis. The linear regression finds a coefficient of determination $R^2 = 0.734$, while the ANOVA analysis shows that there is a fairly close linear relationship between the maximum weight lifted in the two samples, F=46.98; Sig.F=0.000. Starting from the regression equation y=mx + b, when we calculate the regression equation starting from the assumption that the constant b will take the value 0, the equation becomes:

$$Fmax(LegPress) = 1.49 \bullet Fmax(Squat)$$

The slope of the regression line m=1.49 shows how much the dependent variable y (leg press) increases for each one-unit increase in the independent variable x (squat). The equation allows us to estimate the maximum weight that can be lifted in the leg press based on the squat performance and vice versa.

CONCLUSIONS

The statistical analysis shows a close relationship between the performance achieved in the two tests for the evaluation of maximum lower limb strength. However, the use of this correlation to estimate performance in one test starting from the maximum weight lifted in another test must be done with some caution because the maximum weight that can be lifted in the squat test is influenced by the level of muscle training, the technique of execution, the discrepancy between the degree of development of some muscle groups, and the discomfort created (the stress experienced) by supporting the weight of the barbell. However, the equation allows us to compare the results obtained from different studies when one of the two tests is used.

In practice, we can use this ratio of 1:1.5 to compare lower limb strength testing performance at the beginning of an athletic training program (especially in inexperienced or less experienced individuals in resistance training), when 1RM leg press testing is more appropriate to reduce the risk of injuries, with the performance at the end of training, when we will predominantly use the squat test. Estimation of squat performance can also be used to grade the intensity of effort in training and can be corroborated with the multiple repetition test.

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