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The Development of Students' Lower Limb Strength through the Implementation of a Functional Training Program Using Aqua-Fit Equipment

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Abstract: *The aim of this study was to develop explosive strength in the lower limbs of students by implementing an experimental functional training program using Aqua-Fit equipment, specifically targeting university students enrolled in non-sports-related academic programs. This study was conducted over 14 weeks, structured: the first week of the initial test, 12 weeks of training, and the last week of the final test. A total of 40 students, aged 19-25, specializing in general medicine, participated in functional training sessions as part of their physical education classes, conducted twice a week over 12 weeks, with one 60-minute session per week. The evaluation focused on the Squat Jump test on both the right and left leg, using OptoJump technology, quantifying parameters such as contact time, flight time, jump height, power, and student progress. The results indicated a statistically significant $p<0.05$ improvement in all test parameters: maximum contact time, maximum flight time, maximum jump height, and maximum power. The most remarkable progress was observed in the jump height parameter for both the right and left leg. The Cohen's d values were all < 0.8, indicating a very large effect size, demonstrating the effectiveness of the experimental training program using Aqua Fit equipment. The findings suggest that the functional training program utilizing Aqua-Fit equipment contributes to improving lower limb strength parameters.*

Keywords: *functional training, strength, power, Aqua-Fit, medicine students, motor capacity.*

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Literature Review

From the perspective of modernizing university physical education, we believe that using innovative and diversified equipment can optimize students' activity and level of physical fitness. The trend of using current technologies and increasing the attractiveness of physical education lessons requires reconsidering physical training methodologies according to students' preferences and the modernization of education.

Functional training is a type of physical conditioning aimed at developing motor capacity by improving strength, mobility, balance, coordination, and agility through natural movements similar to those performed in daily or sports activities (Myers et al., 2017; Ben-Zeev et al., 2021). Through complex exercises that engage multiple muscle groups and movement planes, functional training optimizes the body's ability to execute movements efficiently, in a controlled manner, and adapt to the demands of various activities, thus enhancing physical performance, reducing the risk of injury, and optimizing overall health (Feito et al., 2018; Posnakidis et al., 2021).

Functional training originates from medical rehabilitation methods and the physical conditioning of elite athletes. Boyle (2016), one of the leading experts in strength training, fitness, and functional training, states in his studies that function means purpose; therefore, this type of training is designed with a well-defined goal. Functional training also focuses on and incorporates stabilizing muscles, as these muscle groups are often the source of injuries (Boyle, 2016; Myers et al., 2017; Ene-Voiculescu & Ene-Voiculescu, 2018). Resende-Neto (2016) highlights that functional training is currently defined by the organization of training programs for the neuromuscular system, in which exercises and movements specific to daily life are implemented.

As researchers and experts in the field assert, functional training originates from kinesiotherapy and represents a new approach to traditional training. It significantly impacts all age groups and components of physical fitness (Posnakidis et al., 2022; Myers et al., 2017). Functional training aims to improve overall health in relation to the development of motor skills (Klimek et al., 2018; Surana et al., 2019; Catanescu, 2019; Gäbler et al., 2018).

Limb strength is important in many of these functional movements (Nechita, 2020; Mentiplay et al., 2015; Sasaki, 2019). In addition to strength, vertical jump ability, which refers to the capacity to jump high or perform explosive movements, is an essential component of motor capacity (Torres-Banduc et al., 2024; Mendez-Rebolledo et al., 2023). Vertical jump performance depends on the power and speed of the lower limb muscles and can be improved through plyometric exercises such as box jumps or

jump squats. Specific functional training exercises enhance explosive power and improve coordination and agility (Strand et al., 2021; Yang et al., 2018).

The novelty aspects of this study lie in the design and adaptation of a functional training program aimed at optimizing motor capacity in general, focusing on developing lower limb strength. The experimental program was tailored for Aqua-Fit equipment (bag, ball, kettlebell, and dumbbells). The innovative Aqua-Fit equipment consists of inflatable materials that can be filled with water based on the student's physical condition. These materials are designed to provide a more efficient and challenging workout by utilizing the principle of instability, which is particularly beneficial for developing strength and balance (Mur-Gimeno et al., 2024; Rolfe et al., 2010; Kuster, 2002). The use of inflatable Aqua-Fit equipment is relatively new, and studies incorporating these tools are still limited (Wilson et al., 2022).

Based on the aforementioned considerations, we believe that our study will contribute to the specialized literature and provide evidence on the impact of implementing a functional training program adapted for students and incorporating Aqua-Fit equipment. The aim of this study was to develop explosive strength in the lower limbs of students by implementing an experimental functional training program using Aqua-Fit equipment, specifically targeting university students enrolled in non-sports-related academic programs.

Methodology

The study, conducted between January and June 2024, involved an initial and final test, and implementing an experimental functional training exercise program using Aqua-Fit equipment. The program, structured to optimize all components of motor capacity, was carried out over 12 weeks, with one 60-minute session once a week. The structure of the training session: a general warm-up, the main part with Aqua-Fit exercises, and a cool-down. The content of each physical education lesson included exercises for the main muscle groups using dumbbells, balls, and inflatable bags filled with water according to the motor and somatic characteristics of the practitioners. The dosage of the exercises was done in minutes to facilitate the individualization of the executions regarding the rhythm of execution.

The study included 40 male and female participants (20 males, 20 females), aged between 19 and 25. The participants were students from the "G.E. Palade" University of Medicine, Pharmacy, Science, and Technology of Targu Mures, specializing in General Medicine. Inclusion criteria were good health status, active students, full participation in the experimental program, and completion of initial and final tests. The study approved no

3216 / 10.06.2024 of the Ethics Commission of "G.E. Palade" University of Medicine, Pharmacy, Science, and Technology of Targu Mures.

Data Analysis

For this study, we selected the standardized Squat Jump Test, performed on both the right and left leg. The evaluated parameters included: maximum contact time, maximum flight time, maximum jump height, and maximum power. An explosive strength assessment was conducted using OptoJump technology. The Single-Leg Squat Jump Test involved performing a single jump with bent arms and hands on the hips, starting from a squat position (knees bent at 90 degrees) without counter-movement. The objective of the test was to evaluate lower limb strength.

The statistical analysis of the study results was performed using SPSS 24 software, calculating the following parameters: mean, standard deviation (SD), minimum and maximum values, variance, and coefficient of variation (CV). To identify differences between the means of the two tests, we calculated the paired Student's t-test and Cohen's d, which measures the effect size. The effect size was interpreted as < 0.3 – small effect; 0.3 – 0.5 – medium effect; 0.5 – 0.8 – Large effect and > 0.8 – Very large effect. The significance threshold was set at $p < 0.05$.

Results

Table 1 presents the descriptive results of the Squat Jump Test, while Table 2 displays the inferential statistical parameters.

Table 1. Descriptive Statistics for the Squat Jump Test

Parameter	Leg	Contact Time T.I.	Contact Time T.F	Flight Time T.I	Flight Time T.F	Height T.I	Height T.F	Power T.I	Power T.F
Mean	Right	0,510	0,540	0,425	0,442	13,4	14,55	11,950	12,25
	Left	0,338	0,358	0,299	0,313	11,580	13,976	6,820	7,482
SD	Right	0,019	0,018	0,016	0,014	0,247	0,261	0,403	0,395
	Left	0,017	0,020	0,029	0,030	0,756	0,319	0,450	0,406
Minim	Right	0,330	0,360	0,230	0,250	12,00	13,6	10,8	11,3
	Left	0,300	0,380	0,240	0,250	10,50	13,25	6,10	6,80
Maxim	Right	0,690	0,720	0,620	0,635	14,8	15,50	13,1	15,2
	Left	0,400	0,450	0,340	0,350	12,70	14,80	7,60	8,10
Variation	Right	0,014	0,014	0,00	0,00	0,061	0,068	0,163	0,57
	Left	0,00	0,00	0,001	0,001	0,573	0,102	0,203	0,166
CV %	Right	3,725	3,333	3,764	3,167	1,843	1,793	3,372	3,224
	Left	6,583	5,247	8,301	6,737	7,448	7,250	8,493	6,267

CV – Coefficient of Variation, Min – Minimum, Max – Maximum, SD – Standard Deviation, IT – Initial Test, FT – Final Test.

According to Table 1, the mean values increased compared to the initial test for all test parameters, indicating the subjects' progress. The fact that the coefficient of variation is below 9% and decreased in the final test shows that the subjects' results are very close to each other, suggesting a homogeneous group. When comparing the results between the lower limbs, we observe that the initial and final values for the right leg were higher than those for the left leg, particularly in terms of maximum jump height and power in the Squat Jump Test.

Table 2. Paired Samples T-Test and Cohen's Effect Size for the Squat Jump Test

Parameter	Leg	Dif. (XTF-XTI)	SD	95% CI Lower	95% Ci Upper	t	p	Effect size
Contact Time Max.	Right	0,038	0,001	0,004	0,003	14,830	0,00	1,240
	Left	0,020	0,016	0,002	0,025	7,704	0,00	0,827
Flight Time Max.	Right	0,056	0,002	0,004	0,003	10,157	0,00	1,963
	Left	0,014	0,007	0,001	0,011	11,823	0,00	1,525
Height Max.	Right	1,074	0,302	1,171	0,977	22,442	0,00	1,308
	Left	0,590	0,093	2,585	2,207	25,661	0,00	1,308
Power Max.	Right	1,342	0,396	1,469	1,215	21,403	0,00	1,00
	Left	0,204	0,032	0,727	0,597	20,472	0,00	1,544

Max – Maximum, SD – standard deviation, IT – inital test, FT – final test, p – level of statistical significance, T – Student T value, CI – Confidence Interval

The interpretation of the Paired Student's T-test highlights that the differences between tests were statistically significant for all parameters of the Squat Jump Test, with $p < 0.05$. Analyzing the results in Table 2, we observe that the greatest progress between the initial and final tests was recorded for: Maximum contact time during execution on the right leg, with an improvement of 0.038 sec.; Maximum flight time during execution on the right leg, with an improvement of 0.056 sec.; Maximum jump height during execution on the right leg, increasing by 1.074 cm.; Power on the right leg, increasing by 1.342 W. The results obtained for the right leg were superior to those for the left leg across all evaluated parameters, as the right leg was the dominant leg for the athletes in the study. The Cohen's d values were all < 0.8, indicating a very large effect size, demonstrating the effectiveness of the experimental training program using Aqua Fit equipment.

Discussion

In this study, we aimed to develop lower limb strength in students by implementing a functional training program utilizing Aqua-Fit water-filled equipment. The results of our study highlighted that by engaging in a

functional training program incorporating the innovative Aqua-Fit Blaze equipment, the student's progress in the final test was significantly superior to that in the initial test. Through its relevant findings, this study will contribute to the conceptual and practical expansion of the fitness field.

The study results are confirmed by previous research and align with studies that have examined the impact of functional training on motor capacity in general, and lower limb strength in particular, in young individuals (Alpaslan et al., 2017; Dusa et al., 2017; Ganciu et al., 2015; Litoi, 2016a; Dumitrescu et al., 2017). The research conducted by Behm et al. (2010) demonstrated that training on unstable surfaces can significantly improve balance and strength, suggesting that instability-inducing equipment, such as water-filled training tools, may benefit training programs. In another study by Behm et al. (2015), the authors investigated the impact of training with unstable equipment on muscle strength and performance. Their findings showed that dynamic resistance equipment can enhance muscle activation and stability, essential for developing lower limb strength.

Functional training has shown effectiveness in optimizing physical conditions in several studies. These studies highlight the impact of using this training method by combining strength and aerobic exercises. Modern technologies and equipment allow real-time monitoring of effort parameters and precise quantifiable dosages of exercises (Posnakidis et al., 2022; Chicomban, 2020; Alecu & Ionescu-Bondoc, 2024). The current demands of advanced physical education require modernizing specific physical education methodologies through modern and innovative equipment and technologies that optimize lessons regarding content and physical benefits. A series of studies have shown that lower limb strength can be efficiently optimized through functional training exercises combined with jumping exercises compared to classic weightlifting or isometric exercises (Posnakidis et al., 2022; Alecu, 2023;

A study by Wezenbeek et al. (2022) examined the effects of using Aqua-Fit balls on muscle activity in functional strength training. This study aimed to evaluate the impact of Aqua-Fit ball implementation on core and lower limb muscle activity during three functional exercises. The results demonstrated that the 20 active young participants involved in the study exhibited significantly increased muscle activity (Wezenbeek et al., 2022). Numerous studies have demonstrated how functional training programs incorporating various sports equipment contribute to optimizing different components of motor capacity across different age groups (Wezenbeek et al., 2022; Wdowski et al., 2023; Litoi, 2016b; Nechita, 2012; Badau et al., 2007; Cojanu et al., 2021).

Study limits

However, several limitations should be noted: no control group was included to compare results; the implementation period was limited to 14 weeks; other strength parameters were not quantified using additional standardized tests; other age categories were not included in the study; a relatively small group of only 40 students; the selected students were only from the general medicine specialization and not from other university specializations; the social, modernization and motivational impact that the implementation of the experimental program has on the attractiveness and efficiency of physical education lessons compared to classic university physical education lessons was not taken into account.

Practical implications of the study

Based on our results, training progress can be further optimized by incorporating Aqua Fit equipment, which contributes to lower limb strength development when combined with functional training exercises. Modern training equipment plays a crucial role in optimizing physical capacities, and professionals in physical education and sports should stay updated with these innovations to enhance both effectiveness and attractiveness in physical education classes.

Conclusions

The study results regarding the Squat Jump test for evaluating lower limb strength highlight that the experimental functional training program using Aqua-Fit inflatable equipment improved the subjects' lower limb strength parameters. The most significant progress was observed in the jump height parameter, both for the right and left leg. The improvement of all parameters of the Squat Jump test, namely: maximum contact time, maximum flight time, maximum jump height, and maximum power, demonstrated the effectiveness of specific functional training exercises in optimizing the level of physical fitness. Modernizing university physical education lessons by diversifying sports training methodologies using innovative equipment and technologies is a current and future necessity to streamline students' activity and fitness levels. Functional trainer training can be attractive for dynamizing physical education lessons and proactively motivating students. Future research directions may focus on how functional training using different equipment and technologies can optimize other parameters of motor capacity with an impact on well-being and health.

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