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Impact of Six-Week Strength Training on Muscular Power in Youth Female Baseball Players

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Abstract: *The present study investigates the effect of a structured six-week strength training program on muscular power in youth female baseball players. A total of 20 female athletes aged 14–18 years were selected and divided into experimental and control groups. The experimental group underwent a progressive resistance training program focusing on lower and upper body explosive strength, while the control group continued regular practice without additional training. Pre- and post-tests were conducted using vertical jump test, medicine ball throw, and sprint performance (30 m). Results revealed a significant improvement in muscular power variables in the experimental group compared to the control group ($p < 0.05$). The study concludes that six-week strength training significantly enhances muscular power and athletic performance in youth female baseball players.*

Keywords: Strength training, muscular power, female athletes, baseball, resistance training, explosive strength

I. INTRODUCTION

Muscular power is a critical component of performance in baseball, especially for actions such as batting, throwing, sprinting, and fielding. Female athletes in youth categories often show lower baseline strength levels compared to male counterparts, making structured resistance training essential for performance enhancement.

Strength training improves neuromuscular coordination, motor unit recruitment, and rate of force development. Previous studies have indicated that even short-term training interventions (4–8 weeks) can significantly improve power output in adolescent athletes. However, limited research focuses specifically on youth female baseball players, which highlights the need for this study.

OBJECTIVES OF THE STUDY

- To evaluate the effect of six-week strength training on lower body power.
- To examine changes in upper body explosive strength.
- To assess improvement in sprint performance after training intervention.
- To compare pre-test and post-test performance between experimental and control groups.
- To determine the effectiveness of resistance training in youth female baseball athletes.
- To provide practical training recommendations for coaches.

METHODOLOGY

Research Design

A randomized controlled experimental design was used.

Sample

Total participants: 20 female baseball players
Age: 14–18 years

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Groups:
Experimental Group (n = 10)
Control Group (n = 10)

TRAINING PROTOCOL (EXPERIMENTAL GROUP)

The training protocol designed for the experimental group in this study was a systematically structured six-week progressive strength training program aimed at enhancing muscular power in youth female baseball players. The protocol was developed based on the principles of overload, specificity, progression, and recovery, ensuring that the participants experienced gradual adaptation without excessive fatigue or injury risk. The experimental group consisted of female athletes aged between 14 and 18 years who were already engaged in regular baseball practice; however, they were additionally subjected to the structured resistance and power training intervention four days per week, with each session lasting approximately 60 minutes.

The program was divided into three distinct phases of two weeks each, with a progressive increase in intensity and complexity of exercises. The first phase (Weeks 1–2) primarily focused on neuromuscular adaptation and foundational strength development. During this phase, exercises were primarily bodyweight-based to ensure proper technique acquisition and injury prevention. The training sessions included movements such as bodyweight squats, push-ups, lunges, planks, glute bridges, and basic core stabilization exercises. Emphasis was placed on correct posture, controlled movement execution, and breathing patterns.

The intensity during this phase ranged from 50% to 60% of perceived exertion, ensuring that athletes developed muscular endurance and joint stability before progressing to external resistance. Each session began with a structured warm-up routine consisting of 10–15 minutes of light jogging, dynamic stretching, mobility drills, and sport-specific activation exercises such as high knees, butt kicks, arm circles, and lateral shuffles. The warm-up was essential for increasing muscle temperature and reducing the risk of injury. The main training component lasted approximately 35–40 minutes, followed by a cool-down phase involving static stretching and breathing exercises for 5–10 minutes to facilitate recovery and reduce muscle soreness. The second phase (Weeks 3–4) marked the introduction of moderate resistance training aimed at developing muscular strength and improving force production capacity. In this phase, external loads such as dumbbells, resistance bands, and light barbells were introduced.

Exercises included goblet squats, dumbbell lunges, bench press, bent-over rows, shoulder press, Romanian deadlifts, and resistance band exercises for rotational strength, which is particularly important in baseball for batting and throwing performance. Core strengthening exercises such as Russian twists, leg raises, and medicine ball twists were also incorporated to enhance trunk stability and rotational power. The training intensity was gradually increased to 60–75% of estimated one-repetition maximum (1RM), depending on the athlete's capability and adaptation level. Repetitions ranged from 8 to 12 per set with 2–3 sets per exercise, and rest intervals of 60–90 seconds were provided to ensure partial recovery while maintaining training stimulus.

During this phase, greater attention was given to movement mechanics under load, ensuring that athletes maintained proper form even as resistance increased. The progression principle was strictly followed, meaning that load or complexity was increased only when athletes demonstrated proficiency in the preceding workload. The third phase (Weeks 5–6) was designed as the power development phase, focusing on explosive strength, rate of force development, and sport-specific power transfer. This phase integrated plyometric exercises, Olympic-style movement patterns, and high-velocity training drills.

Exercises included jump squats, box jumps, depth jumps, medicine ball overhead throws, rotational throws, sprint acceleration drills, and resistance sprinting using bands or light sleds. Upper-body explosive movements such as medicine ball chest passes and overhead slams were included to simulate batting and throwing actions in baseball. The intensity during this phase increased to approximately 75–85% of maximal effort, with lower repetitions (4–8 per set) and increased rest intervals (90–120 seconds) to ensure maximal power output in each repetition.

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The emphasis was placed on speed of movement rather than load alone, encouraging athletes to generate maximal force in minimal time. Sprint training was also incorporated twice weekly, focusing on acceleration mechanics, starting position, stride length, and stride frequency over 10–30 meter distances. In addition to resistance and power training, injury prevention and recovery strategies were integrated throughout all phases. These included dynamic stretching routines, proprioceptive balance exercises, and core stabilization work to enhance joint integrity and reduce the risk of overuse injuries commonly seen in adolescent athletes. Hydration and basic nutritional guidance were also provided to ensure adequate energy availability and recovery support. The training load was carefully monitored using subjective exertion scales and coach feedback to avoid overtraining and ensure optimal adaptation. Progression across the six weeks was carefully individualized based on athlete response, with adjustments made for fatigue levels, performance improvement, and technical proficiency.

Overall, the experimental training protocol was designed not only to improve muscular power but also to enhance neuromuscular coordination, movement efficiency, and sport-specific performance qualities required in female baseball players. The structured combination of foundational strength, resistance training, and explosive power development created a comprehensive adaptation environment, leading to significant improvements in athletic performance outcomes observed in post-intervention testing.

Week	Focus	Exercises	Intensity
1–2	Basic Strength	Bodyweight squats, push-ups, planks	50–60%
3–4	Progressive Resistance	Dumbbell squats, lunges, bench press	60–75%
5–6	Explosive Strength	Jump squats, medicine ball throws, sprint drills	75–85%

Frequency: 4 days per week
Duration: 60 minutes/session

PERFORMANCE TESTS

Vertical Jump Test (cm) – Lower body power
Medicine Ball Throw (m) – Upper body power
30-meter Sprint (sec) – Speed and explosive power

RESULTS AND DATA ANALYSIS

Table 1: Pre-Test and Post-Test Comparison (Experimental Group)

Variable	Pre-Test Mean ± SD	Post-Test Mean ± SD	% Improvement
Vertical Jump (cm)	28.4 ± 2.3	34.8 ± 2.5	22.5%
Medicine Ball Throw (m)	6.2 ± 0.5	7.8 ± 0.6	25.8%
30 m Sprint (sec)	5.12 ± 0.21	4.78 ± 0.18	6.6%

Table 2: Comparison Between Experimental and Control Group (Post-Test)

Variable	Experimental Group	Control Group	Significance
Vertical Jump (cm)	34.8 ± 2.5	29.1 ± 2.2	$p < 0.05$
Medicine Ball Throw (m)	7.8 ± 0.6	6.4 ± 0.5	$p < 0.05$
30 m Sprint (sec)	4.78 ± 0.18	5.05 ± 0.20	$p < 0.05$

DISCUSSION

The findings clearly indicate that six weeks of structured strength training significantly improves muscular power in youth female baseball players. The improvements in vertical jump and medicine ball throw suggest enhanced lower and upper body explosive strength, respectively. Sprint performance also improved, indicating better neuromuscular coordination and acceleration ability.

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These results align with previous studies stating that resistance training enhances rate of force development in adolescent athletes. The control group showed minimal or no improvement, confirming that regular practice alone is insufficient for significant power development.

II. CONCLUSION

The study concludes that a six-week structured strength training program is highly effective in improving muscular power in youth female baseball players. Coaches should incorporate progressive resistance and explosive training methods into regular training programs to enhance athletic performance.

The present study clearly demonstrates that a structured six-week strength training program has a significant and positive impact on muscular power among youth female baseball players. The findings of the study indicate that even a relatively short-duration training intervention, when properly designed with progressive overload principles, can produce meaningful improvements in both upper and lower body explosive power. Muscular power, which is a critical determinant of performance in baseball-related skills such as batting, throwing, sprinting, and fielding, showed marked enhancement in the experimental group compared to the control group. The improvement observed in vertical jump performance, medicine ball throw distance, and sprint speed confirms that neuromuscular adaptations occur rapidly in adolescent female athletes when exposed to systematic resistance training.

The results of the study strongly suggest that the six-week training program led to significant improvements in motor unit recruitment, intermuscular coordination, and rate of force development. These physiological adaptations are essential for improving explosive strength, which directly translates into better athletic performance on the field. The increase in vertical jump height indicates improved lower body power, which is crucial for rapid acceleration, jumping catches, and base running. Similarly, the enhanced medicine ball throw performance reflects better upper body strength and throwing efficiency, both of which are vital components of baseball performance. The improvement in sprint performance further confirms that strength training contributes not only to power development but also to overall speed and agility.

Another important observation of the study is that youth female athletes respond positively to resistance training when it is introduced in a structured and progressive manner. Traditionally, there has been hesitation in incorporating strength training into youth sports, particularly for female athletes, due to misconceptions about injury risk or lack of necessity. However, the findings of this study align with modern sports science literature, which supports the inclusion of resistance training in youth athletic development programs. The absence of any reported injuries or negative effects during the training period further strengthens the argument that properly supervised strength training is safe and beneficial for adolescent female athletes.

The comparison between the experimental and control groups further highlights the effectiveness of the intervention. While the experimental group showed substantial improvements across all measured variables, the control group, which continued regular practice without additional strength training, showed minimal or no significant changes. This clearly indicates that traditional skill-based training alone may not be sufficient to maximize physical performance outcomes in youth baseball players. Instead, integrating strength and conditioning programs into regular training schedules is essential for holistic athletic development.

From a practical coaching perspective, the findings emphasize the importance of incorporating structured resistance training programs early in an athlete's development. Coaches should focus on progressive overload, proper technique, and age-appropriate exercises to maximize performance gains while minimizing injury risk. Exercises such as squats, lunges, push-ups, medicine ball throws, and plyometric drills should be systematically included in training routines to develop both strength and explosive power. Additionally, adequate recovery, nutrition, and supervision are critical components that support optimal adaptation to training stimuli.

The study also highlights the role of short-term training interventions in producing rapid performance improvements. A six-week duration, though relatively short, proved sufficient to induce significant neuromuscular adaptations. This is particularly important in competitive sports environments where seasonal training cycles often require quick

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performance enhancements. The findings suggest that even off-season or pre-season conditioning programs of limited duration can yield substantial benefits if designed effectively.

Furthermore, the improvement in muscular power among youth female baseball players has broader implications for long-term athletic development. Enhanced strength and power at a young age contribute to better performance trajectories, increased confidence, and reduced injury risk in later stages of athletic careers. Strength training during adolescence also supports bone density development, joint stability, and overall physical fitness, making it a critical component of youth sports programs.

The six-week strength training program proved to be highly effective in improving muscular power in youth female baseball players. The study confirms that structured resistance training is a valuable tool for enhancing athletic performance and should be integrated into regular training regimens. The significant improvements observed in explosive strength, speed, and overall power output demonstrate that even short-term interventions can produce meaningful physiological and performance benefits. Therefore, it is recommended that coaches, trainers, and sports educators adopt scientifically designed strength training protocols to optimize the development of young female athletes in baseball.

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