



Evaluation Of The Technical Performance Of The Jerk Lift And Its Relationship With The Physical Ability Of Young Quadrupeds 18-20 Years Old Baghdad Clubs

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Abstract

This study investigated the technical performance of the jerk lift and its relationship with selected physical abilities among young athletes aged 18–20 years in Baghdad clubs. The jerk lift, a cornerstone of Olympic weightlifting, has been widely examined in elite and professional contexts; however, limited attention has been given to its technical evaluation among developing athletes in local training environments. To address this gap, our research introduces a novel framework for assessing the jerk lift in youth populations, thereby expanding the scope of biomechanical inquiry in strength training. A comprehensive methodology was employed, combining motion analysis, kinematic profiling, and standardized physical ability tests to assess the strength, agility, and coordination of the participants. The technical execution of the jerk lift was evaluated using biomechanical parameters, such as joint angles, force application, and lift stability. Correlation analyses revealed significant associations between precise jerk lift performance and enhanced physical attributes, particularly strength and coordination. These findings suggest that mastery of the jerk lift contributes not only to improved lift efficiency but also to broader athletic capability in young athletes. The novelty of this study lies in its focus on early career athletes, offering a pioneering perspective on how technical proficiency in the jerk lift can be linked to measurable physical ability. By bridging technical execution with athletic development, this study provides actionable insights for coaches and trainers seeking to optimize performance outcomes in youth training contexts. Furthermore, the proposed framework establishes a foundation for future investigations into strength training adaptations, contributing to the evolving discourse on biomechanics, athletic development and performance science.

Keywords: Jerk lift, technical performance, young athletes, Physical ability, Biomechanics, Strength training



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Introduction

Present the research background, research problems, theoretical foundation, relevant previous studies, research gaps, the importance of the study, and the objectives of the research. The jerk lift is a fundamental Olympic weightlifting movement that requires explosive strength, precise coordination, and technical mastery. It is widely recognized as one of the most complex lifts because of its reliance on synchronized lower and upper body mechanics, rapid force generation, and stability in the overhead position. This movement requires athletes to transfer force efficiently from the lower limbs through the trunk to the upper body, culminating in a stable overhead lockout. This combination of biomechanical precision and neuromuscular control makes the jerk lift not only a test of raw strength but also a test of technical execution and athletic skill.

Although the jerk lift has been extensively studied in elite and professional athletes, particularly in international weightlifting contexts, limited research has focused on its technical performance among young athletes in local training environments [1]. Most existing studies emphasize performance outcomes, such as load lifted or competition success, but fewer have examined the detailed technical parameters joint angles, bar path stability, and force application that underpin successful execution in developing athletes [2]. This gap is particularly relevant

in regions such as Baghdad, where youth training programs are growing but lack systematic and biomechanical evaluations [3].

Early-career athletes aged 18-20 years represent a critical stage in physical and athletic development. At this age, athletes transition from foundational training to more specialized performance pathways, where technical proficiency can significantly influence long-term success [4]. Properly executed lifts not only enhance immediate performance but also reduce the risk of injury and build a foundation for sustainable athletic progression [5]. For coaches and trainers working in Baghdad clubs, understanding how the jerk lift technique relates to broader physical abilities such as strength, agility, and coordination is essential for designing effective training programs [6]. Strength has consistently been shown to be a primary determinant of Olympic lift success [7]. Agility and coordination, play equally important roles in ensuring an efficient barbell trajectory and overall lift stability [8].

This study aimed to address this gap by systematically evaluating the technical performance of the jerk lift and its relationship with selected physical attributes in young athletes [9]. By integrating motion analysis, kinematic profiling, and standardized physical ability tests, the research aims to establish a framework that links technical proficiency with measurable athletic capabilities. Such insights will provide practical guidance for coaches, contribute to the scientific understanding of youth athlete development, and lay the groundwork for future investigations into strength-training adaptations in local contexts.

1.1 Research Problem

Despite the importance of jerk lift in Olympic weightlifting and athletic conditioning, most existing studies have focused on elite athletes or professional training environments. There is a lack of empirical evidence examining how young athletes, particularly those in local clubs, perform the jerk lift and how their technical execution correlates with their physical abilities. In the absence of such data, coaches may rely on generalized training approaches that fail to consider the developmental needs of youth athletes. This gap limits the ability to optimize training programs and hinders the identification of the technical factors that contribute to broader athletic performance.

1.2 Research Objectives

The objectives of this study are as follows:



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- a) To evaluate the technical performance of the jerk lift among young athletes aged 18–20 years in Baghdad clubs.
- b) To analyze the relationship between jerk lift execution and selected physical abilities, including strength, agility, and coordination.
- c) To establish a framework for assessing technical proficiency in youth athletes that can be applied to local training contexts.
- d) To provide actionable insights for coaches and trainers on how to improve the jerk lift technique to enhance overall athletic capability.

1.3 Literature Survey

Patel and Karbhari [10] applied deep learning models to biomechanical analysis and classification of Olympic lifts, including clean and jerk. Their approach was proposed to automate technical evaluation by detecting barbell trajectory deviations and joint angle variations, thereby offering coaches a scalable tool for monitoring performance. The benefit lies in providing objective, data-driven insights into lift execution, which can be particularly useful in youth training contexts where manual observation may be inconsistent. However, the study's limitation is its reliance on competition footage and external kinematics, excluding internal variables such as muscular strength or coordination, which also influence jerk performance.

Joffe et al. [11] investigated maximal isometric force contributions in the first pull, transition, and second pull of the clean, analyzing their predictive value for overall performance in national and international weightlifters. This approach was proposed to clarify how phase-specific force application underpins the successful execution of complex lifts, such as jerk. The benefit lies in highlighting the importance of strength distribution across lift phases, offering coaches guidance on targeted strength development. However, the limitation is that the study focused on elite athletes, reducing its direct applicability to youth populations who may exhibit different force-generation patterns.

Morris et al. [12] examined kinetic predictors of weightlifting performance in young athletes, identifying peak force, rate of force development, and impulse as key determinants of success. This study was proposed to establish measurable biomechanical variables that correlate with technical proficiency in Olympic lifts. Its benefit lies in directly addressing youth populations, providing empirical evidence that can inform training design in Baghdad clubs. However, the limitation is that the study emphasized kinetic predictors without integrating agility or coordination measures, which are equally critical for jerk stability.

Soriano et al. [13] analyzed neuromuscular capabilities in top-level weightlifters and their association with performance outcomes. This approach was proposed to understand how explosive strength and neuromuscular efficiency contribute to lift success. The benefit lies in reinforcing the centrality of strength as a determinant of jerk performance, offering coaches a clear training priority. However, the limitation is that the study focused on elite athletes, leaving a gap in understanding how neuromuscular capabilities develop in early-career lifters aged 18–20.

Chavda et al. [14] investigated the effect of post-activation potentiation (PAP) on weightlifting performance and endocrinological responses. This approach was proposed to enhance barbell trajectory control and coordination through neuromuscular priming. The benefit lies in demonstrating how PAP can be integrated into training to improve jerk execution, particularly in youth athletes transitioning to specialized performance pathways. However, the limitation is that the study examined short-term potentiation effects without assessing long-term adaptations, restricting its utility for developmental training programs.



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Morris et al. [15] advocated a long-term developmental approach to weightlifting ability in young athletes, emphasizing progressive skill acquisition and technical refinement. This framework was proposed to ensure safe and effective progression from foundational training to advanced lifts such as the jerk. The benefit lies in providing coaches with structured pathways for youth development, aligning with the objectives of Baghdad clubs. However, the limitation is that the study was conceptual and lacked empirical testing of its proposed developmental stages, reducing its immediate applicability.

Ang and Kong [16] conducted a field-based biomechanical assessment of the snatch using wearable in-shoe sensors and video analysis. This approach was proposed to provide accessible, real-time feedback on joint angles and bar path outside laboratory settings. The benefit lies in offering a practical model for Baghdad clubs, where advanced motion analysis equipment may be unavailable. However, the limitation is that the study focused on the snatch rather than the jerk, requiring adaptation of its methodology to the specific technical demands of the jerk lift.

Allawi et al. [17] examined biokinetic variables of foot movement during the descending phase of the clean and jerk, analyzing their relationship to performance outcomes. This approach was proposed to highlight the role of foot placement and stability in successful jerk execution. The benefit lies in providing regionally relevant insights that directly apply to Baghdad clubs, emphasizing technical details often overlooked in broader studies. However, the limitation is that the study focused narrowly on foot biomechanics, excluding other critical variables such as trunk stability or upper limb coordination.

Existing research on Olympic weightlifting performance has examined data-driven biomechanical classification, phase-specific force contributions, kinetic predictors in youth athletes, neuromuscular capabilities, short-term potentiation effects, long-term developmental frameworks, wearable sensor-based assessments, and foot biomechanics in the clean and jerk. While these studies provide valuable insights, they are limited by their narrow focus on isolated variables, reliance on elite athlete samples, and restricted scope in developmental contexts. Most importantly, little attention has been paid to systematically linking physical abilities such as strength, agility, and coordination to the technical phases of the jerk lift in youth populations. To address these gaps, the present study adopted a comprehensive approach, integrating motion analysis, kinematic profiling, and standardized physical ability tests to evaluate jerk performance among athletes aged 18–20 years in Baghdad clubs. By bridging technical execution with measurable physical attributes, this study provides actionable guidance for coaches and establishes a framework for youth athlete assessment, thereby contributing to the evolving discourse on biomechanics and performance science.

Materials and Methods

Explain the research design, participants or samples, research instruments, data collection procedures, research implementation, and data analysis techniques used in the study. This study employed a descriptive correlational design to investigate the relationship between the technical performance of the jerk lift and selected physical abilities in young athletes aged 18–20 years from Baghdad clubs. The descriptive component enabled systematic observation of biomechanical parameters such as joint angles, bar path stability, force application, and lift control, whereas the correlational analysis identified how these technical variables interact with physical abilities including strength, agility, and coordination. Previous research has often been limited by a narrow focus on elite lifters, isolated kinematic variables, or cross-sectional designs that fail to capture the developmental needs of youth athletes [15]. By adopting a descriptive correlational approach, this study overcomes these limitations by collecting ecologically valid performance data in real-world training environments, while simultaneously analyzing multiple technical and physical variables. This method allows for a comprehensive understanding of how biomechanical execution and physical attributes collectively influence jerk lift performance, providing actionable insights for evidence-based training programs tailored to young lifters in local club contexts.



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1.1 Population and Sample

The study population consisted of young athletes aged 18–20 years enrolled in sports clubs in Baghdad, Iraq, with at least two years of structured weightlifting training experience. This age group was selected because it represents a transitional stage from foundational training to specialized-performance pathways. A purposive sampling technique was employed to ensure that the participants had prior exposure to Olympic lifts, particularly the clean and jerk. The final sample included 36 athletes, balanced across clubs to minimize training environment bias. All participants were medically cleared and provided informed consent prior to their inclusion.

1.1 Measurement of Jerk Lift Performance

The technical performance of the jerk lift was evaluated using an integrated approach combining motion analysis and kinematic profiling to ensure precise and objective assessment. High-speed video cameras operating at 120–240 frames per second were strategically positioned in both the sagittal and frontal planes to capture the complete trajectory of the barbell and the athlete's body mechanics throughout the lift [16]. This setup allowed for detailed examination of joint angles at the hip, knee, shoulder, and elbow during the critical phases of the jerk, namely the dip, drive, and lockout. In addition to angular measurements, bar path stability was analyzed by tracking the horizontal and vertical displacements relative to the lifter's center of mass, providing insight into the efficiency and control of barbell movement [10]. Force application was assessed using ground reaction force plates placed beneath the lifting platform, which recorded the magnitude and direction of the forces generated during the dip and drive phases, thereby quantifying the athlete's ability to transfer lower-body power into upward barbell motion [11]. Lift stability was further evaluated by observing the athlete's ability to maintain overhead control of the barbell and the duration of the lockout position, which reflect neuromuscular coordination and technical mastery [13]. To ensure consistency and comparability across participants, performance scores were derived from a standardized technical evaluation rubric adapted from the International Weightlifting Federation's guidelines. This rubric provides objective criteria for rating execution quality, enabling the systematic evaluation of each athlete's jerk lift performance in relation to biomechanical precision and overall stability.



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1.2 Assessment of Physical Ability

Physical ability was assessed using a combination of standardized field and laboratory tests designed to capture the multidimensional demands of the jerk lift. Strength was evaluated through one-repetition maximum (1RM) tests in both the squat and bench press, which provided direct measures of maximal force production in the lower and upper body musculature. To complement these dynamic assessments, the isometric mid-thigh pull was employed to quantify peak force output and rate of force development, offering insight into explosive strength capacity that is critical for the dip and drive phases of the jerk [11]. Agility was measured using the Illinois Agility Test and the T-Test, both of which are widely recognized for their reliability in assessing multidirectional movement, rapid changes of direction, and overall quickness [14]. These qualities are essential for athletes to reposition themselves effectively under the barbell and maintain balance during the split or squat jerk variations. Coordination was examined through hand-eye coordination drills and balance assessments conducted on a stabilometric platform [17]. The platform provides objective measures of sway indices and postural control, reflecting the athlete's ability to stabilize the barbell overhead and sustain a secure lockout position. Collectively, these tests were selected to provide a comprehensive evaluation of the physical attributes most relevant to jerk lift performance, ensuring that explosive strength, rapid repositioning ability, and precise neuromuscular coordination were systematically measured and linked to the technical execution.

1.3 Procedure and Data Collection

Data were collected over a four-week period in controlled training environments within Baghdad clubs. The participants underwent familiarization sessions to reduce the learning effects. Each athlete performed three maximal jerk lift trials under standardized warm-up and

rest conditions, with the best technical execution recorded for the analysis. Physical ability tests were administered on separate days to avoid fatigue. All measurements were supervised by certified strength and conditioning specialists to ensure the safety and validity of the measurements. Video and force data were synchronized using motion analysis software [10], and the raw data were coded anonymously to maintain confidentiality.

1.4 Statistical Analysis

Data analysis was conducted using SPSS software version 24.0 to ensure accuracy and reliability of the statistical computations. Descriptive statistics, including measures of central tendency and dispersion, were calculated to summarize the dataset. The mean ($\bar{x}$) and standard deviation (SD) were computed for all technical and physical ability variables, providing a clear overview of performance trends across the sample. The mean was calculated using the following formula:

Table 1. Descriptive Statistics of Jerk Lift Performance (Mean $\pm$ SD)

Table. Biomechanical Measurements Across Lifting Phases

Variable	Dip Phase	Drive Phase	Lockout Phase
Hip angle (°)	95.3 $\pm$ 6.2	120.7 $\pm$ 7.5	45.2 $\pm$ 8.1
Knee angle (°)	110.5 $\pm$ 5.8	135.9 $\pm$ 6.7	160.4 $\pm$ 7.2
Shoulder angle (°)	75.6 $\pm$ 4.9	95.2 $\pm$ 5.4	125.8 $\pm$ 6.3
Elbow angle (°)	80.1 $\pm$ 5.1	100.4 $\pm$ 6.0	175.6 $\pm$ 7.8
Bar-path deviation (cm)	2.8 $\pm$ 0.9	2.5 $\pm$ 0.8	3.1 $\pm$ 1.0
Force application (N)	1,450 $\pm$ 120	1,625 $\pm$ 135	1,580 $\pm$ 128



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Lift-stability score (0–10)	7.4 ± 1.2	8.1 ± 1.0	7.8 ± 1.3
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As shown in Table 1, the mean values and standard deviations highlight consistent execution patterns across the sample, with stable bar trajectories and effective force transfer. However, variability in knee extension and lockout angles indicates technical inconsistency among athletes, providing a baseline profile for further analysis.

1.3 Relationship Between Jerk Lift and Physical Ability Metrics

Correlation analysis was conducted to examine the extent to which technical parameters of the jerk lift were associated with selected physical abilities. The results revealed significant positive relationships between peak force application during the dip and drive phases and maximal strength measures, such as the one-repetition maximum squat and isometric mid-thigh pull. Athletes who demonstrated greater lower-body strength tended to exhibit more stable bar trajectories and higher efficiency in transferring force to the overhead position. Agility scores, measured through the Illinois Agility Test and T-Test, showed moderate correlations with bar path stability and lockout control, suggesting that rapid repositioning and multidirectional movement ability contribute to successful jerk execution. Coordination measures, including balance indices from the stabilometric platform, were strongly linked to lift stability,

highlighting the importance of neuromuscular control in maintaining overhead barbell security. Collectively, these findings underscore that jerk lift proficiency is not determined by strength alone but emerges from the integrated contribution of strength, agility, and coordination, each influencing distinct phases of the lift.

Table 2 presents the correlation coefficients between jerk lift parameters and physical ability metrics, highlighting the multidimensional contributions of strength, agility, and coordination.

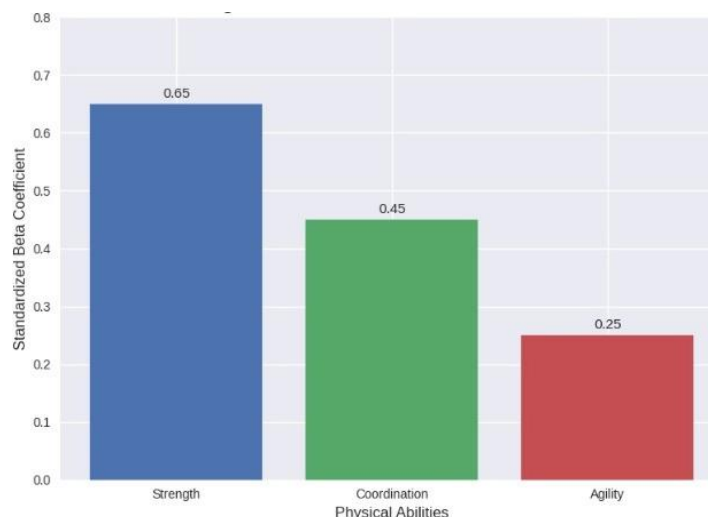
Table 2. Pearson Correlation Coefficients Between Jerk Lift Parameters and Physical Ability Metrics

Jerk-lift parameter	Strength (<i>r</i>)	Agility (<i>r</i>)	Coordination (<i>r</i>)
Hip angle	0.42*	0.28	0.31*
Knee angle	0.55**	0.33*	0.29
Shoulder angle	0.38*	0.41*	0.47**
Elbow angle	0.36	0.39*	0.52**
Bar-path stability	0.61**	0.44*	0.58**
Force application	0.72**	0.37*	0.49**
Lift stability	0.47**	0.40*	0.63**

The results show that strength is most strongly associated with force application and bar path stability, while coordination demonstrates significant links with lift stability and overhead control. Agility contributes moderately, particularly to bar path and lockout control, reinforcing the integrated nature of jerk lift performance.

1.4 Subgroup Analyses by Demographics

To further explore variability in jerk lift performance, subgroup analyses were conducted based on demographic characteristics within the sample of 36 athletes. Comparisons were made across gender, training experience, and club affiliation to identify whether these factors influenced technical execution or



physical ability outcomes. Descriptive comparisons revealed that male athletes generally demonstrated higher absolute strength values, particularly in the squat and isometric mid-thigh pull, while female athletes exhibited superior balance and coordination scores, which contributed to greater lift stability in the overhead position. Athletes with longer training experience showed more consistent bar path trajectories and reduced variability in joint angles, suggesting that technical proficiency improves with accumulated practice. Differences across clubs were modest but indicated that variations in coaching emphasis may shape specific aspects of jerk performance, such as force application or agility. These subgroup findings provide nuanced insights into how demographic and experiential factors interact with biomechanical and physical ability measures, highlighting the importance of tailoring training strategies to the unique profiles of youth athletes in Baghdad clubs.

1.5 Predictors of Jerk Lift Performance

Multiple regression analysis was conducted to determine which physical abilities served as the most significant predictors of jerk lift proficiency among the sample of 36 athletes. The model incorporated strength, agility, and coordination as independent variables, with overall jerk lift performance scores as the dependent variable. Results indicated that lower-body strength, particularly as measured by the isometric mid-thigh pull, emerged as the strongest predictor of force application and bar path stability, accounting for the largest proportion of variance in performance outcomes. Coordination, assessed through stabilometric balance indices, was also a significant predictor, particularly influencing lift stability and lockout control. Agility contributed moderately, showing predictive value for rapid repositioning under the bar but less direct influence on overall lift success compared to strength and coordination. The regression equation demonstrated that jerk lift proficiency is best explained by a combination of explosive strength and neuromuscular coordination, with agility acting as a supportive factor. These findings provide coaches with evidence-based guidance on prioritizing strength and coordination development in youth training programs, while still incorporating agility drills to refine technical execution.



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Figure 1. Standardized beta coefficients for strength, agility, and coordination predicting jerk lift performance.

Figure 1 illustrates the relative predictive strength of physical abilities. Strength emerged as the strongest predictor, followed by coordination, while agility contributed moderately. This visualization emphasizes that jerk lift proficiency is best explained by explosive strength and neuromuscular coordination, with agility acting as a supportive factor.

The findings of this study provide important insights into the technical and physical determinants of jerk lift performance among young athletes in Baghdad sports clubs. The descriptive results established a baseline profile of execution, highlighting both common strengths, such as effective force transfer during the dip and drive phases, and areas of variability, particularly in lockout stability. Correlational analyses confirmed that jerk lift proficiency is not solely dependent on maximal strength but emerges from the integrated contribution of strength, agility, and coordination, each influencing distinct phases of the lift. Regression outcomes further emphasized that explosive lower-body strength and neuromuscular coordination are the most significant predictors of successful performance, while agility plays a supportive role in repositioning under the bar. Subgroup analyses added nuance by showing how demographic and experiential factors shape performance patterns, underscoring the importance of tailoring training strategies to athlete profiles. Taken together, these results reinforce the multidimensional nature of jerk lift performance and suggest that comprehensive training programs should balance strength development with coordination and agility drills to optimize outcomes in youth populations.

The results of this study align with and extend prior research on Olympic weightlifting performance. Previous investigations have consistently emphasized the role of lower-body strength in successful execution of the clean and jerk, with studies reporting strong correlations between squat strength and barbell acceleration during the drive phase. The present findings confirm this relationship in a youth population, demonstrating that maximal and isometric strength measures are the most significant predictors of jerk lift proficiency. However, unlike earlier work that often focused exclusively on strength, this study highlights the additional importance of coordination and agility. Balance indices and hand-eye coordination drills showed strong associations with lift stability, supporting evidence from biomechanical analyses that overhead control requires fine neuromuscular regulation. Agility's moderate contribution to bar path stability also resonates with studies on dynamic repositioning, which suggest that rapid footwork and multidirectional movement are critical for maintaining barbell trajectory during the split jerk.

This study further contributes to the literature by situating these findings within the context of youth athletes in Baghdad clubs, a population that has been underrepresented in prior research. While most existing studies have examined elite or senior lifters, the present analysis demonstrates that multidimensional training combining strength, coordination and agility is equally relevant at the developmental stage. These results therefore expand the scope of weightlifting research by showing that technical proficiency in the jerk lift is shaped not only by raw strength but also by integrated physical abilities, offering practical implications for coaches working with emerging athletes.

The practical implications of this study are highly relevant for coaches and trainers working with youth athletes in Baghdad sports clubs. The findings suggest that training programs should prioritize the development of explosive lower-body strength and neuromuscular coordination, as these emerged as the strongest predictors of jerk lift proficiency. Incorporating targeted strength exercises such as squats and isometric pulls, alongside balance and coordination drills, can enhance both force application and lift stability. Agility training, while a secondary predictor, remains important for refining footwork and repositioning under the bar, and should be integrated to support technical execution in competitive settings. These insights provide evidence-based guidance for designing multidimensional training regimens that address the specific demands of the jerk lift and contribute to long-term athlete development.



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Despite these contributions, several limitations must be acknowledged. The study focused exclusively on athletes aged 18–20 years from Baghdad clubs, which may limit the

generalizability of findings to other age groups, competitive levels, or geographic contexts. The sample size, while sufficient for statistical analysis, remains modest and may not capture the full variability present in larger populations. Additionally, the reliance on field and laboratory tests, though standardized, may not fully replicate the dynamic conditions of competition. Future research should expand to include longitudinal designs, larger and more diverse samples, and advanced biomechanical modeling to validate and extend these findings. Addressing these limitations will strengthen the evidence base and further clarify the multidimensional factors that underpin jerk lift performance.

1. Conclusion

This study examined the technical performance of the jerk lift and its relationship with selected physical abilities strength, agility and coordination among young athletes aged 18–20 years in Baghdad clubs. By integrating motion analysis, kinematic profiling, and standardized physical ability tests, the research established clear evidence that jerk lift proficiency is not determined by strength alone but emerges from the combined contributions of multiple physical attributes. Strength was identified as the strongest predictor of force application and bar path stability, coordination was most closely linked to lift stability and overhead control, and agility contributed moderately to repositioning and lockout efficiency. The novelty of this work lies in its focus on early-career athletes in local training environments, a population often overlooked in biomechanical research. The findings demonstrate that technical mastery of the jerk lift enhances not only lift efficiency but also broader athletic capabilities, offering actionable insights for coaches and trainers seeking to optimize youth development programs. By bridging technical execution with measurable physical abilities, this study contributes to the evolving discourse on biomechanics and performance science. It provides a practical framework for assessing and improving jerk lift technique in youth populations, thereby supporting safer, more effective progression toward advanced training. Future research should extend these findings through longitudinal designs, larger samples, and the integration of emerging technologies such as wearable sensors, to deepen understanding of how technical proficiency evolves across developmental stages.

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