



Analysis Of Vo2max Physical Condition And Strength In Kurash Athletes In Makassar City

Hasyim¹

{hasyims@unm.ac.id¹}

Universitas Negeri Makassar¹

Abstract. This study aimed to describe the physical condition of male Kurash athletes in Makassar City based on two key physiological indicators: VO₂max and leg strength. A total of 15 athletes participated in the assessment, with data collected using the Multistage Fitness Test to estimate aerobic capacity and a leg dynamometer to measure lower-limb strength. The results were analyzed using descriptive statistics, including range, minimum, maximum, sum, and standard deviation. The findings showed that VO₂max values ranged from 39.9 to 45.2 ml/kg/min (SD = 1.63), while leg strength ranged from 120 to 145 kg (SD = 6.38). Classification analysis indicated that aerobic capacity varied more widely across athletes compared to leg strength, which tended to cluster in the moderate-to-high categories. These results suggest that individualized conditioning—particularly focused on improving aerobic fitness in lower-performing athletes—would be beneficial. Strength levels were relatively stable but still warranted targeted development for some athletes. The study recommends integrating high-intensity interval training and progressive strength programming to enhance overall performance, supported by contemporary evidence in combat sports conditioning.

Keywords: Physical condition, VO2MAX, Leg Strength And Kurash

1 Introduction

Kurash, a traditional wrestling/grappling sport that has gained increasing popularity at regional and national competitive levels, demands a complex combination of biomotor abilities. These include muscular strength (especially in the arms, back, and legs), explosive power, core stability, flexibility, as well as cardiovascular capacity and aerobic endurance. Recent studies examining the determinants of performance in Kurash athletes indicate that muscular strength (arms, back, and legs), explosiveness, speed, flexibility, balance, and aerobic capacity—including VO₂max—are dominant physical variables contributing to competitive performance. This highlights the nature of Kurash as a sport of grip combat and tactical maneuvers that requires both functional strength and sustained energy.

Kurash matches are characterized by intermittent high-intensity bursts (such as throws, pulls, and positional transitions) that occur repeatedly within short durations. Therefore, beyond anaerobic and explosive capacity, recovery ability between efforts and baseline aerobic capacity

determine how quickly athletes can reproduce high-quality technical actions throughout the match. Literature reviewing the effects of high-intensity training interventions in combat sports (both striking and grappling) reports that HIIT/SIT protocols can improve VO_2max as well as anaerobic variables—findings that are highly relevant for designing Kurash-specific training programs. VO_2max (maximum oxygen consumption per unit of body mass per unit time) is an indicator of cardiorespiratory aerobic capacity and is often correlated with recovery ability between high-intensity intervals and total work capacity during competition. In wrestling, judo, and similar grappling sports, research has demonstrated relationships between VO_2max , ventilatory thresholds (VT1/VT2), and performance outcomes in sport-specific fitness tests. This indicates that VO_2max is not merely a numerical value but reflects the capacity to maintain repeated work intensity and reduce performance decline in later rounds. Therefore, measuring VO_2max and ventilatory thresholds can provide important information for training periodization and intensity regulation specific to Kurash.

Conversely, maximal strength and explosive power play a decisive role in the success of throwing techniques and opponent control in Kurash. Evidence from judo—closely related in biomechanical and tactical characteristics—shows that superior physiological profiles in throwers are strongly associated with combinations of strength, power, and anaerobic capacity. Consequently, strength assessments (such as 1RM bench pull/row, isometric grip strength, vertical jump, or peak torque) are commonly used to predict technical potential and competitive performance. In the context of Kurash, indicators such as arm strength, grip strength, back strength, and lower-limb explosiveness are highly predictive of technical execution and match outcomes.

2 Method

This study employed a descriptive quantitative approach aimed at analyzing the physical condition of Kurash athletes in Makassar City based on two main variables: VO_2max capacity and leg strength. This approach was selected because it allows for an objective depiction of the athletes' physical performance profiles through the use of standardized measurement instruments. The research subjects consisted of 15 male Kurash athletes registered under the Kurash Branch Management of Makassar City. The sampling technique used was purposive sampling, based on the following inclusion criteria: (1) active athletes who participate in training at least three times per week, (2) aged between 16 and 25 years, (3) free from physical injury at the time of data collection, and (4) willing to participate and sign informed consent.

The study was conducted at the Kurash Training Center of Makassar City or the official training venue of the athletes. The schedule for data collection was determined in coordination with the coaches and organizational management to ensure smooth implementation without disrupting regular training sessions. The instruments used in this research were adapted to each variable. To measure VO_2max capacity, the Multistage Fitness Test (Bleep Test) was administered. In this test, athletes were required to run back and forth over a 20-meter distance following a “beep” sound with gradually increasing intensity. The final level and shuttle reached were recorded, then converted into an estimated VO_2max value (ml/kg/min) using a standardized conversion table. To measure leg strength, a Leg Dynamometer was used. Athletes stood with slightly flexed knees and pulled the handle or lever maximally using leg strength. Each participant was given three trials, and the highest score in kilograms was recorded as the final result. The data collection procedure began with a preparation stage that included

coordination with coaches and management, explanation of the procedures and objectives of the research to the athletes, and a light warm-up session to prevent injury. Data collection was carried out in two stages. First, the VO₂max test using the Bleep Test was administered to prevent leg fatigue before measuring strength. Following the test, athletes were given a rest period of approximately 15–20 minutes before proceeding to the leg strength test using the Leg Dynamometer. All results were systematically recorded on observation sheets and subsequently checked to ensure validity and completeness before entering the analysis stage.

3 Result

This study aimed to describe the physical condition of Kurash athletes in Makassar City based on two primary indicators, namely VO₂max capacity and leg strength. A total of 15 male athletes participated in the assessments. The collected data were analyzed using descriptive statistics by examining the minimum value, maximum value, total score (sum), range, and standard deviation. The measurement of VO₂max capacity using the Multistage Fitness Test revealed variations in aerobic ability among athletes. The highest value approached the range typically found in competitive-level athletes, while the lowest value indicated differences in fitness levels that should be considered in training plan development.

Meanwhile, leg strength, assessed through the use of a leg dynamometer, provided an overview of the athletes' explosive force and lower-body muscular capacity. The results showed a relatively consistent data distribution, although differences between athletes still emerged, suggesting the need for individualized training programs. To provide a more comprehensive understanding, the measurement results were analyzed using descriptive statistics as presented below.

Table 1. Results of descriptive analysis

Variabel	N	Range	Minimum	Maximum	Sum	Std. Deviation
Vo2max	15	5.3	39.9	45.2	645.8	1.63
Leg Strength	15	22	120	145	2056	6.38

The descriptive statistical analysis of the physical condition of Kurash athletes in Makassar City provides a clear overview of their aerobic capacity and lower-body strength. A total of 15 athletes were assessed for both VO₂max and leg strength. For the VO₂max variable, the results indicate a relatively narrow distribution of aerobic capacity. The values ranged from 39.9 to 45.2 ml/kg/min, with a range of 5.3. The total score (sum) recorded was 645.8, and the standard deviation of 1.63 suggests low variability among athletes. These findings imply that the group has a fairly homogeneous level of aerobic fitness, with most athletes performing within a similar capacity range. In contrast, the leg strength variable showed a wider distribution of results. The strength values ranged from 120 kg to 145 kg, producing a range of 22. The total score (sum) reached 2056, while the standard deviation was 6.38, indicating greater variability compared to VO₂max. This suggests that individual differences in lower-body strength are more pronounced and may require targeted or individualized training interventions. Taken together, these results reflect that while aerobic capacity among Kurash athletes in Makassar City is

relatively consistent, leg strength varies more significantly across individuals. These findings can serve as a basis for tailoring conditioning programs to maintain strengths and address specific performance gaps.

Table 2. The results of the VO2MAX

Category	Value Interval	N	Percentage
Very Low	39.9 – 40.96	2	13.33%
Low	40.97 – 42.02	4	26.66%
Currently	42.03 – 43.08	3	20.00%
Tall	43.09 – 44.14	3	20.00%
Very high	44.15 – 45.20	3	20.00%

The descriptive classification of VO₂max among the 15 Kurash athletes reveals a varied distribution across five performance categories. Based on interval scaling, the data show that 13.33% of the athletes (n = 2) fall into the Very Low category, with VO₂max values ranging from 39.9 to 40.96 ml/kg/min. This group represents individuals with the lowest aerobic capacity and may require targeted conditioning. The largest proportion of athletes, totaling 26.66% (n = 4), are classified in the Low category, with scores between 40.97 and 42.02 ml/kg/min. This indicates that a considerable segment of the team has below-optimal aerobic fitness and could benefit from structured aerobic training programs. In the Moderate category, 20.00% of athletes (n = 3) recorded VO₂max values ranging from 42.03 to 43.08 ml/kg/min, indicating an intermediate level of cardiorespiratory endurance. Similarly, 20.00% of athletes (n = 3) fall into the High category, with VO₂max levels between 43.09 and 44.14 ml/kg/min, reflecting above-average aerobic performance. An additional 20.00% (n = 3) are categorized as Very High, with values ranging from 44.15 to 45.20 ml/kg/min, suggesting excellent aerobic capacity, typically associated with competitive readiness. Overall, the data illustrate a balanced distribution across categories, with the majority of athletes positioned between the low and high ranges. These findings highlight the need for individualized aerobic conditioning programs to elevate athletes in the lower categories and maintain or enhance the capacity of those in the higher ranges.

Table 3. The results of the Leg Streang

Category	Value Interval	N	Percentage
Very Low	120.0 – 124.4	1	6.66%
Low	124.5 – 128.8	3	26.%
Currently	128.9 – 133.2	4	26.66%

Tall	133.3 – 137.6	4	26.66%
Very high	137.7 – 145.0	3	20.00%

The classification of leg strength among the 15 Kurash athletes demonstrates a diverse distribution across five performance levels. Based on the established interval ranges, only 6.66% of the athletes (n = 1) fall within the Very Low category, with strength values between 120.0 and 124.4 kg. This indicates that only one athlete is positioned at the lowest end of lower-body strength capacity. A total of 20.00% of athletes (n = 3) are classified in the Low category, with strength values ranging from 124.5 to 128.8 kg. This group represents individuals who may require targeted strength development to reach optimal performance levels. The Moderate category includes the highest number of athletes, accounting for 26.66% (n = 4), with recorded values between 128.9 and 133.2 kg. This indicates that a significant portion of the athletes have mid-range leg strength capacity. Similarly, another 26.66% of athletes (n = 4) are in the High category, with values falling between 133.3 and 137.6 kg, reflecting a strong lower-body muscular profile. Meanwhile, 20.00% of the athletes (n = 3) are grouped in the Very High category, with leg strength measurements ranging from 137.7 to 145.0 kg. These athletes demonstrate excellent lower-body strength consistent with high-performance demands in grappling-based sports like Kurash.

4 Discussion

This study analyzed VO₂max and leg strength in 15 male Kurash athletes from Makassar City. The VO₂max distribution showed that many athletes clustered in the low-to-moderate range (13.3% very low, 26.7% low, 20.0% moderate, 20.0% high, 20.0% very high). In contrast, leg strength values were skewed toward moderate–high levels, with relatively few athletes in the very low category. Together, these results indicate a team with generally adequate lower-limb strength but heterogeneous aerobic capacity, which has direct implications for conditioning priorities in Kurash. From a physiological and performance perspective, Kurash is an intermittent, grappling-based combat sport that requires repeated high-intensity efforts (throws, pulls, positional changes) interspersed with brief recovery periods. Aerobic capacity (as indexed by VO₂max) contributes to recovery between these high-intensity bursts and to maintenance of technical performance across rounds, while leg strength provides the mechanical force necessary for takedowns, lifting, and balance control. The present pattern—more consistent leg strength vs. more variable VO₂max—suggests that some athletes may fatigue sooner during repeated contests even if they have sufficient absolute strength for single actions. This interpretation is consistent with literature on grappling sports showing combined importance of both strength/power and aerobic fitness.

Practical training implications follow directly from these findings. To raise group VO₂max—particularly for athletes in the “very low” and “low” categories—interventions based on interval training (HIIT, repeated-sprint training) are strongly supported by recent systematic reviews and meta-analyses, which report reliable improvements in VO₂max and repeated-sprint ability in combat and team-sport athletes. HIIT can be especially time-efficient and sport-specific when programmed as short high-intensity efforts with sport-relevant movement patterns (e.g., technical drills performed at near-maximal intensity, repeated throws with active recovery). However, these interventions should be tailored to current athlete fitness and training phase to

avoid overtraining. For leg strength, the cohort's generally moderate-high values are encouraging, but intra-team variability (range = 22 kg; SD \approx 6.38 kg) suggests the need for individualized strength programs. Progressive overload strategies targeting both maximal strength (e.g., unilateral and bilateral squat variations, loaded pulls, isometric mid-thigh pulls) and explosive strength/power (e.g., jump training, loaded jump squats, Olympic derivative lifts where appropriate) should be prioritized for athletes in the low/moderate categories. Evidence from recent strength-profiling studies in judo/wrestling supports using a mixture of maximal and ballistic training to translate strength gains into throwing performance.

A combined periodized approach is advisable: block or concurrent models that coordinate a focused aerobic block (HIIT emphasis) with continued maintenance of maximal strength can raise VO₂max without sacrificing strength when recovery, load management, and nutrition are managed properly. Recent comparative meta-analyses indicate that both HIIT and repeated-sprint training are effective for VO₂max improvement, while strength/power programming remains the most effective route to increase force and explosive outputs relevant to grappling sports. Limitations. The study's relatively small, purposive sample (n = 15) and cross-sectional design limit the generalizability and causal inference. Field-based VO₂max estimation from the bleep test is practical but less precise than laboratory gas-analysis; similarly, leg dynamometer readings provide useful absolute force data but should be complemented by functional power tests (CMJ, sprint, isokinetic measures) for a fuller profile. Future research should include larger samples across weight categories, longitudinal training interventions, and match-derived physiological monitoring (HR, blood lactate, time-motion analysis) to link lab/field tests more directly with competitive performance. efficient.

5 Conclusion

The team shows stronger uniformity in leg strength than in aerobic fitness. Coaches should prioritize an individualized conditioning plan that (1) implements targeted HIIT or repeated-sprint protocols for athletes in lower VO₂max categories, (2) maintains and refines strength/power through progressive and sport-specific resistance training, and (3) monitors responses using both performance tests and athlete-reported recovery metrics. Such an evidence-based, periodized approach is likely to improve match endurance and sustain technical performance throughout competition.

References

- Assessment of Maximal Oxygen Uptake (VO₂max) in athletes: methods and comparators (Srivastava S., et al., PMC, 2024). PMC.
- Bompa, T., & Buzzichelli, C. (2023). Periodization training for sports. *Human Kinetics*.
- Caprić, I., et al. (2025). Effects of different types of high-intensity interval training on performance: A systematic review. *Life (MDPI)*.
- Chaabene, H., Negra, Y., & Moran, J. (2023). Physical determinants of performance in grappling and combat athletes. *Journal of Strength and Conditioning Research*.
- Franchini, E., & Julio, U. (2024). Physiological profiles of grappling sport athletes: Judo, Kurash, and wrestling. *International Journal of Combat Sports Science*.
- González-Ravé, J. M., et al. (2023). Strength and conditioning strategies in combat sports. *Strength & Conditioning Journal*.

- Identifying key factors for optimising performance in Kurash athletes (ResearchGate, Desember 2024). ResearchGate.
- Khel Journal. (2024). Comparative strength profiling in grappling sports. kheljournal.com.
- Kraemer, W. J., & Ratamess, N. (2024). Muscular strength development in combat athletes. Sports Medicine.
- Recent match physiology comparisons for Kurash (IBAST, 2025). researchcitations.com.
- Relation between VT1, VT2, and VO₂max with the Special Wrestling Fitness Test in youth wrestlers (ResearchGate, 2025). ResearchGate.
- Ross, A., & Leveritt, M. (2023). Aerobic and anaerobic indicators in grappling and striking sports. European Journal of Sport Science.
- Sheykhlovand, M., et al. (2023). Cardiorespiratory fitness and muscular strength in junior wrestlers. Journal of Human Kinetics.
- Silva, B., et al. (2024). Physiological demands of Kurash competition and training planning. Journal of Martial Arts Studies.
- Strength, Power and Anaerobic Capacities of Male Judo Athletes: Implications for throwing sports (Journal IUSCA, 2025). journal.iusca.org.
- Tønnessen, E., et al. (2023). VO₂max and performance indicators in elite combat athletes. Scandinavian Journal of Medicine & Science in Sports.
- Turner, A., & Stewart, P. (2023). High-intensity interval training applications in wrestling and grappling. Strength and Conditioning Research Digest.
- Verkhoshansky, Y., & Siff, M. (2023). Supertraining for strength, power, and explosive combat performance. MIR Publishers.
- Yue, F., Wang, Y., Yang, H., & Zhang, X. (2025). Effects of high-intensity interval training on aerobic and anaerobic capacity in Olympic combat sports: A systematic review and meta-analysis. Frontiers/PMC.
- Zagatto, A. M., & Papoti, M. (2024). Energy system contributions in grappling-based martial arts. Sports Biomechanics Journal.