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Physical Condition Profile of Male Archery Athletes in Bengkalis Regency

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ABSTRACT

Purpose of the study: This study aimed to determine the physical condition level of male archery athletes in Bengkalis Regency by assessing several physical fitness components, including muscular strength, muscular endurance, and cardiovascular endurance, as the basis for evaluating athlete readiness and supporting future training programs.

Methodology: This study employed a descriptive quantitative research design involving 12 male archery athletes from Bengkalis Regency selected through total sampling. Data were collected using Leg Dynamometer, Hand Dynamometer, Back Dynamometer, Pull-Up Test, Wall Squat Test, and the 15-Minute Balke Run Test (VO_2Max). Data analysis utilized descriptive statistics and percentage calculations based on established physical fitness norms.

Main Findings: The findings revealed that the overall physical condition of male archery athletes in Bengkalis Regency was categorized as poor. Most athletes demonstrated inadequate performance in muscular strength, muscular endurance, and cardiovascular endurance components. The overall assessment indicated that 58.33% of the athletes were classified within the poor physical condition category, highlighting the need for systematic physical conditioning programs.

Novelty/Originality of this study: This study provides a comprehensive physical condition profile of regional archery athletes by simultaneously evaluating six essential physical fitness components relevant to archery performance. The findings offer practical baseline data for coaches and sports organizations in designing evidence-based training programs and contribute to the limited literature on physical condition assessment among Indonesian regional archery athletes.

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1. INTRODUCTION

The pursuit of national development in Indonesia places significant emphasis on enhancing the quality of human resources, where sports achievement acts as a tangible indicator of a nation's progress. The government's commitment to fostering athletic excellence is legally mandated by Law of the Republic of Indonesia Number 3 of 2005 and Government Regulation of the Republic of Indonesia of 2007 regarding the National Sports System, which stipulates that sports are systematic activities to develop physical, spiritual, and social potential. Within this framework, achievement sports are intended for individuals with inherent talent, ability, and potential, necessitating planned, tiered, and continuous development supported by sports science and technology [1]-[3].

Consequently, every sport, including archery, requires holistic coaching that integrates physiological, psychological, and technical aspects to produce high-achieving athletes at both national and international levels. However, a persistent challenge remains in optimizing the physical conditioning of athletes, which serves as the foundational element upon which technical and tactical skills are built [4].

Archery is often misperceived as a simplistic sport that relies predominantly on skill and precision, with many assuming that physical fitness is of secondary importance. Contrary to this belief, competitive archery demands a complex integration of visual coordination, kinesthetic sense, muscular strength and endurance, aerobic capacity, draw length consistency, concentration, and emotional balance [5], [6]. The duration of competition is notably long, often ranging from three to six hours, as regulated by the Persatuan Panahan Nasional Indonesia (PERPANI) and FITA (World Archery) rules, where athletes shoot multiple ends each consisting of six arrows within a four-minute time limit across distances such as 90, 70, 50, and 30 meters for men. This extended exposure to physical and mental load requires robust physical conditioning, particularly in the components of leg strength, arm and shoulder strength, back strength, muscular endurance of the arms and back, and cardiovascular endurance (VO2 Max). Without these attributes, archers cannot maintain proper shooting form, execute consistent release techniques, or withstand the fatigue induced by prolonged training and competition [7].

The Bengkalis Regency archery team, established in 2006 under the auspices of PERPANI Riau Province, has shown progressive development by earning opportunities to represent Riau at major national events, including the Pekan Olahraga Nasional (PON) XVII in East Kalimantan (2008), PON XVIII in Riau (2012), and PON XIX in West Java (2016). This achievement indicates that the regional government, through the Komite Olahraga Nasional Indonesia (KONI) Bengkalis, has provided support in the form of coaching and athlete development. Despite these opportunities, the team has yet to contribute optimal medal-winning performances. Observations during the PON XIX 2016 in West Java and the 2017 National Championships in Aceh revealed a declining trend in monthly scoring results and inconsistent technical execution. Specifically, during scoring sessions, several athletes exhibited tremors in the bow-holding arm, incomplete shooting cycles, and inconsistent arrow grouping, leading to declining scores from one end to the next.

A deeper observational analysis conducted by the researcher on the Bengkalis archery athletes during field training and scoring sessions identified critical weaknesses in physical conditioning. During a standard round where an athlete releases six arrows per end within four minutes, it was observed that athletes repeatedly drew the bow due to a lack of self-confidence in their technique and insufficient physical capacity [8], [9]. The act of drawing and holding the bow string was often rushed, resulting in premature releases that compromised accuracy. This phenomenon is directly attributable to inadequate muscular endurance in the arm and shoulder regions, as well as poor lower back stability. Furthermore, the lack of general endurance (cardiovascular fitness) was evident as athletes exhibited early signs of fatigue, which negatively impacted their concentration and shot consistency. These empirical observations suggest that the physical conditioning of the Bengkalis archery athletes is suboptimal and requires immediate and systematic improvement [10].

Theoretical frameworks from sports science consistently affirm that physical condition is an indispensable prerequisite for athletic achievement. According to Tomas [11], physical condition is a fundamental requirement that cannot be postponed or negotiated in efforts to enhance athlete performance. It comprises an integrated unity of components including strength, endurance, speed, flexibility, and coordination that must be developed simultaneously, albeit with priority given to specific components based on the demands of the sport. In archery, the predominant physical components include the strength of the leg muscles for a stable stance, arm and shoulder strength for drawing the bow, back strength for maintaining posture, local muscular endurance for repeated contractions, and cardiovascular endurance to sustain energy systems over extended periods [12]. When these components fall below the required threshold, technical mastery becomes unattainable, tactical execution is compromised, and the risk of injury increases, ultimately hindering the athlete's ability to achieve peak performance [13].

Despite the recognition of the importance of physical conditioning in archery, systematic evaluations of the physical status of archers at the regional level, particularly in Bengkalis Regency, are scarce. The available literature primarily focuses on the technical and tactical aspects of archery, with limited empirical studies dedicated to measuring the physical profile of archers in developing regions. Preliminary evidence from this study indicates that the physical condition of male archers in Bengkalis Regency is predominantly in the "poor" category, with a percentage of 58.33%. However, these findings are based on a small sample size (n=12) and lack comparative analysis with established normative standards from national sport governing bodies. Therefore, a systematic and comprehensive evaluation is urgently needed to establish baseline data that can inform evidence-based training interventions and talent development programs..

A review of three previous studies reveals a significant research gap. First, Rusdiawan et al. [14] conducted a standardization of physical condition status for individual sports athletes under KONI Yogyakarta but did not specifically focus on archery, leaving the unique physical demands of archery unaddressed. Second, Rizal et al. [15] measured physical condition status among university students (PJKR UNTAD) using general anthropometric and physical tests, but their population was not specific to competitive archery athletes, limiting

the applicability of their findings to sport-specific contexts. Third, Prasetyo [16] examined the standardization of physical condition for Bali PORPROV athletes across multiple sports, yet again, archery was not isolated for detailed analysis, and the study did not employ archery-specific test batteries such as back dynamometer or wall squat tests. Consequently, no prior research has systematically assessed the multi-component physical condition (leg strength, arm/shoulder strength, back strength, local muscular endurance, and cardiovascular endurance) of archery athletes in the Bengkalis Regency using the comprehensive KONI-endorsed testing protocol. This study addresses that void.

The novelty of this research lies in its comprehensive and sport-specific assessment approach. Unlike previous studies that relied on generalized fitness tests, this research employs a full battery of six validated instruments leg dynamometer, hand dynamometer (both push and pull), back dynamometer, pull-ups, wall squat (for both left and right legs), and the 15-minute Balke run test (VO2 Max) as recommended by Mcrtty [17] et al. and aligned with KONI Pusat standards. Furthermore, this study is the first to provide a detailed, component-by-component physical profile of archery athletes in Bengkalis Regency, generating a baseline database that does not currently exist. The integration of both static strength (isometric) and dynamic endurance (isotonic) measurements specifically tailored to the kinematic chain of archery movements represents a methodological advancement over prior descriptive studies in the region [18].

The findings of this research have several critical implications. For coaches and trainers, the study provides empirical evidence that can be used to design targeted periodized training programs focused on the weakest physical components, such as low back strength (as measured by back dynamometer) and arm muscle endurance (as measured by pull-ups). For the Bengkalis Regency sports governing bodies (KONI and PERPANI), the results serve as a decision-support tool for resource allocation, including the provision of appropriate strength-training equipment, nutritional support, and recovery facilities. For athletes, the assessment results offer individualized feedback that can motivate self-directed conditioning efforts and help set realistic, measurable performance goals. Additionally, for future researchers, this study establishes a replicable methodological framework for physical condition assessments in other archery populations across Indonesia, enabling cross-regional comparisons and longitudinal monitoring [19].

The urgency of this research cannot be overstated. The Bengkalis archery team has demonstrated potential by qualifying for prestigious national multi-sport events, yet the absence of a systematic physical conditioning database prevents targeted improvements. With the upcoming national competitions (such as PON and Kejuaraan Nasional), there is a narrow window of opportunity to enhance athlete readiness. Delaying physical conditioning interventions would perpetuate the cycle of underperformance and wasted talent. Moreover, as archery is a sport of fine motor control and high precision, even marginal improvements in muscular strength and endurance can translate into significant increases in scoring accuracy and consistency. Therefore, conducting this research is a necessary first step in an evidence-based intervention strategy, ensuring that coaching efforts are neither arbitrary nor inefficient, but rather precisely calibrated to the actual physical needs of the athletes.

2. RESEARCH METHOD

2.1. Research Design

This study employs a quantitative descriptive research design [20], which is specifically intended to describe existing phenomena, situations, or conditions without manipulating variables or testing causal hypotheses. According to Arikunto , descriptive research aims to depict the reality of a particular variable, symptom, or state as it naturally occurs. In alignment with Sugiyono, quantitative descriptive research is grounded in positivist philosophy, focuses on specific populations or samples, collects data using standardized instruments, and analyzes data statistically to describe the characteristics of the 研究对象.

The choice of this design is appropriate for the present study because the objective is to ascertain the level of physical condition of archery athletes in Bengkalis Regency objectively, without any experimental treatment or intervention. This design allows the researcher to capture a "snapshot" of the athletes' current physical status across multiple components, including strength, muscular endurance, and cardiovascular endurance, and then categorize these findings based on established normative standards. The research does not seek to establish cause-and-effect relationships but rather to provide a comprehensive descriptive account that can serve as a foundation for subsequent coaching interventions.

2.2. Subjects and Sample

The population of this study consists of all archery athletes registered under the auspices of PERPANI (Persatuan Panahan Nasional Indonesia) Bengkalis Regency as of the 2018 training year, totaling 12 athletes. This population is relatively small, which necessitated a total sampling technique. According to Arikunto (2015), when the population size is less than 100 individuals, it is preferable to take the entire population as the sample to ensure the representativeness and comprehensiveness of the research findings. Therefore, the researcher employed

purposive sampling based on specific criteria: only male archery athletes who were actively training and competing under the Bengkalis Regency PERPANI were included. The final sample comprised 12 male archery athletes. The decision to focus exclusively on male athletes was made to control for gender-based physiological differences in strength and endurance parameters, ensuring homogeneity within the sample and allowing for a more accurate interpretation of results against normative tables that are often gender-specific.

2.3. Data Sources and Data Collection Techniques

The data sources for this research are primary data obtained directly from the 12 male archery athletes through direct physical testing and measurement [21]. The data collection techniques employ three approaches: observation, library research, and standardized testing. First, observation was conducted to directly survey the research location, understand the training environment, identify the athletes, and ensure that all testing equipment and facilities were adequately prepared. Second, library research was utilized to gather theoretical foundations, expert opinions, and normative standards from textbooks, journal articles, and official PERPANI and KONI documents, which served as the scientific basis for instrument selection and data interpretation. Third, and most importantly, standardized physical tests and measurements were administered as the primary data collection method. Each athlete underwent a series of six physical tests administered in a controlled sequence to minimize fatigue effects. The testing protocol followed the standardized procedures established and endorsed by KONI Pusat. All tests were conducted on the same day after a standardized warm-up period, with sufficient rest intervals between each test component to ensure that performance on subsequent tests was not compromised by residual fatigue from previous tests.

2.4. Research Instruments

The instruments employed in this research consist of six validated physical tests designed to measure the specific components of physical condition required for archery. Table 1 presents the mapping between each physical component, the corresponding test instrument, and the measurement unit [22].

Table 1. Research Instruments and Measured Physical Components

Physical Component	Instrument	Measurement Unit
Leg Muscle Strength	Leg Dynamometer	Kilograms (kg)
Arm and Shoulder Muscle Strength (Push & Pull)	Hand Dynamometer	Kilograms (kg)
Lower Back Muscle Strength	Back Dynamometer	Kilograms (kg)
Arm and Shoulder Muscular Endurance	Pull-ups (Bar)	Number of repetitions
Lower Back Muscular Endurance (Left & Right Leg)	Wall Squat	Seconds
Cardiovascular Endurance (VO2 Max)	15-minute Balke Run Test	Meters (converted to score)

The Leg Dynamometer test requires the athlete to wear a waist belt attached to the dynamometer, stand with both knees bent at a 45-degree angle, and then maximally extend both legs. The resulting value in kilograms indicates leg strength. The Hand Dynamometer test measures both pushing and pulling strength of the arm and shoulder muscles, with each athlete given two attempts, and the highest score recorded. The Back Dynamometer test measures lower back strength by having the athlete stand on the platform, bend forward with straight arms holding the dynamometer handle, and then exert maximal effort to raise the body to an upright standing position. The Pull-ups test measures arm and shoulder muscular endurance by counting the maximum number of complete pull-ups (chin passing above the bar) performed without swinging or kicking. The Wall Squat test measures lower back muscular endurance by having the athlete maintain a 90-degree squat position against a wall with one leg lifted, timing how many seconds the position can be held (tested separately for left and right legs). Finally, the 15-minute Balke Run Test measures cardiovascular endurance (VO2 Max) by recording the maximum distance covered in meters during 15 minutes of continuous running.

2.5. Data Analysis Technique

The data analysis technique used in this research is quantitative descriptive analysis employing percentage calculations and normative categorization. After all raw scores from the six tests were collected, each athlete's score was converted into a normative value based on the standard classification tables provided by Ramdan Pelana et al. (2017). The conversion used the following formula to calculate the percentage of athletes in each category. Equation 1. Percentage Calculation Formula

$$P = \frac{F}{N} X\ 100\% \qquad \ldots(1)$$

Where:

- P = Percentage
- F = Frequency (number of athletes achieving a particular score)
- N = Total number of respondents (12 athletes)

Each test result was initially classified into five categories: Sempurna (Perfect), Baik Sekali (Very Good), Baik (Good), Cukup (Sufficient), and Kurang (Poor), following the norms presented in Table 2. Subsequently, to determine the overall physical condition score for each athlete, the researcher converted the category of each component into numerical values based on Nurhasan's (2014) conversion scale: Sempurna = 10, Baik Sekali = 8, Baik = 6, Cukup = 4, Kurang = 2. The total sum of these six component values was divided by the number of components (6) to obtain a mean score. This mean score was then compared against the Physical Ability Norm Table (Table 3) to assign the final overall physical condition category for each athlete

Table 2. Normative Assessment Standards (Nurhasan, 2014)

Category	Converted Value
Sempurna (Perfect)	10
Baik Sekali (Very Good)	8
Baik (Good)	6
Cukup (Sufficient)	4
Kurang (Poor)	2

Table 3. Physical Ability Norm Classification (Nurhasan, 2014)

Category	Score Range
Sempurna (Perfect)	9.6 - 10.0
Baik Sekali (Very Good)	8.0 - 9.5
Baik (Good)	6.0 - 7.5
Cukup (Sufficient)	4.0 - 5.9
Kurang (Poor)	2.0 - 3.9

2.6. Research Procedure

The research procedure was systematically organized into four sequential phases: preparation, implementation, data processing, and reporting. This chronological flow is illustrated in Figure 1.Phase 1: Preparation. The researcher conducted a preliminary site survey at the Bengkalis Regency archery training ground to obtain permission from the PERPANI management and KONI Bengkalis. During this phase, the researcher identified the 12 active male athletes, obtained informed consent, scheduled the testing date, and prepared all instruments (Leg Dynamometer, Hand Dynamometer, Back Dynamometer, pull-up bar, stopwatch, and a marked 400-meter running track). The researcher also conducted a pilot test on two non-sample archers to ensure instrument reliability and researcher proficiency in administering the tests.

Phase 2: Implementation (Testing). On the scheduled testing day, all 12 athletes underwent a standardized 15-minute dynamic warm-up consisting of light jogging, dynamic stretching, and sport-specific movements. The tests were administered in the following order to minimize fatigue interference: (1) Hand Dynamometer (push and pull), (2) Leg Dynamometer, (3) Back Dynamometer, (4) Pull-ups, (5) Wall Squat (right leg followed by left leg), and (6) 15-minute Balke Run Test (administered last due to its high physiological demand). Each athlete was given two attempts for the dynamometer tests, with the highest score recorded. For the Wall Squat test, timing began when the athlete lifted one foot 5 cm off the ground and stopped when the foot was returned to the floor; this was performed twice per leg. For the 15-minute run, athletes were instructed to cover as much distance as possible within the time limit, with their total distance measured in meters. All scores were recorded on individual data sheets.

Phase 3: Data Processing**.** Raw scores were tabulated, checked for completeness, and then classified according to the normative tables. Each athlete's six component scores were converted into values (2,4,6,8,10) based on the category achieved. The sum of these values was divided by six to obtain the final score, which was then categorized using Table 3. Percentages were calculated to determine the proportion of athletes in each overall category.

Phase 4: Reporting. The analyzed data were interpreted descriptively, comparing findings with theoretical literature. Conclusions were drawn, and recommendations were formulated for coaches, athletes, and future researchers. The entire research procedure was designed to ensure validity and reliability. Validity was achieved

by using standardized instruments that have been previously validated for use in Indonesian sports science contexts (Ramdan Pelana et al., 2017). Reliability was ensured by having the same researcher administer all tests using identical protocols, maintaining consistent environmental conditions (morning hours, dry track, stable temperature), and providing clear, standardized instructions to all athletes. The total duration of data collection for all 12 athletes was approximately 4 hours, including warm-up, testing, and cool-down periods. All procedures complied with ethical research standards, including respect for athlete welfare, voluntary participation, and confidentiality of individual results.

3. RESULTS AND DISCUSSION

3.1. Description of Research Results

The research was conducted on 12 male archery athletes of Bengkalis Regency using six standardized physical tests: Hand Dynamometer (pull and push), Leg Dynamometer, Back Dynamometer, Pull-ups, Wall Squat (right and left legs), and the 15-minute Balke Run Test (VO2 Max). The raw data obtained from each test were analyzed descriptively to determine the frequency distribution, mean, median, mode, and percentage of athletes falling into each normative category. The following subsections present the results for each physical component.

The Hand Dynamometer pull test measured the pulling strength of the arm and shoulder muscles. The results showed that the highest score achieved was 41 kg, while the lowest was 13 kg, with a mean of 26.58 kg, a median of 29.5 kg, and a mode of 13 kg and 32 kg. The frequency distribution presented in Table 4 reveals that 4 athletes (33.33%) scored in the 13-18 interval, 1 athlete (8.33%) in the 19-24 interval, 2 athletes (16.67%) in the 25-30 interval, 3 athletes (25%) in the 31-36 interval, and 2 athletes (16.67%) in the 37-42 interval. When classified according to normative standards for pull strength, 50% of athletes were in the (Poor) category, 33.33% in (Sufficient), and only 16.67% in (Good). This indicates that the majority of athletes lack the necessary pulling strength required for drawing the bow string effectively.

The Hand Dynamometer push test measured pushing strength. The results indicated the highest score was 31 kg, the lowest was 5 kg, with a mean of 20.25 kg, a median of 21 kg, and a mode of 21 kg. Table 5 shows that 1 athlete (8.33%) scored in the 5-10 interval, 2 athletes (16.67%) in the 11-16 interval, 5 athletes (41.67%) in the 17-22 interval, 3 athletes (25%) in the 23-28 interval, and 1 athlete (8.33%) in the 29-34 interval. Normative classification revealed that 83.33% of athletes were in the (Poor) category, while only 16.67% achieved (Sufficient). No athletes reached the (Good) or higher categories. This finding is particularly concerning because push strength contributes to the stability of the bow-holding arm during the aiming and release phases.

Table 4. Frequency Distribution of Arm and Shoulder Strength (Pull)

Interval	Frequency (Fa)	Percentage (Fr %)
13-18	4	33.33%
19-24	1	8.33%
25-30	2	16.67%
31-36	3	25.00%
37-42	2	16.67%
Total	12	100%

Table 5. Frequency Distribution of Arm and Shoulder Strength (Push)

Interval	Frequency (Fa)	Percentage (Fr %)
5-10	1	8.33%
11-16	2	16.67%
17-22	5	41.67%
23-28	3	25.00%
29-34	1	8.33%
Total	12	100%

The Leg Dynamometer test assessed leg muscle strength, which is critical for maintaining a stable shooting stance. The results showed a highest score of 115 kg, a lowest score of 42 kg, a mean of 81 kg, a median of 80 kg, and a mode of 105 kg. Table 6 presents the frequency distribution: 3 athletes (25%) scored in the 42-57 interval, 2 athletes (16.67%) in the 58-73 interval, 2 athletes (16.67%) in the 74-89 interval, 4 athletes (33.33%) in the 90-105 interval, and 1 athlete (8.33%) in the 106-121 interval. Strikingly, 100% of athletes fell into the(Poor) category for leg strength. This universal deficiency indicates that no athlete in the sample possesses adequate leg strength according to the normative standards, which has direct implications for postural stability during shooting.

Table 6. Frequency Distribution of Leg Muscle Strength

Interval	Frequency (Fa)	Percentage (Fr %)
42-57	3	25.00%
58-73	2	16.67%
74-89	2	16.67%
90-105	4	33.33%
106-121	1	8.33%
Total	12	100%

The Back Dynamometer test measured lower back strength, essential for maintaining proper trunk position throughout the shooting cycle. The results indicated a highest score of 119 kg, a lowest score of 45 kg, a mean of 88.5 kg, a median of 87.5 kg, and a mode of 85 kg. Table 7 shows that 2 athletes (16.67%) scored in the 45-60 interval, 1 athlete (8.33%) in the 61-76 interval, 4 athletes (33.33%) in the 77-92 interval, 2 athletes (16.67%) in the 93-108 interval, and 3 athletes (25%) in the 109-124 interval. Normative classification revealed that 25% of athletes were in the Less (Poor) category, 33.33% in "Cukup" (Sufficient), and 41.67% in "Baik" (Good). This distribution is more varied compared to other strength components, with a notable proportion of athletes achieving adequate back strength.

Table 7. Frequency Distribution of Lower Back Muscle Strength

Interval	Frequency (Fa)	Percentage (Fr %)
45-60	2	16.67%
61-76	1	8.33%
77-92	4	33.33%
93-108	2	16.67%
109-124	3	25.00%
Total	12	100%

The Pull-ups test measured local muscular endurance of the arms and shoulders. The results showed a highest score of 20 repetitions, a lowest score of 2 repetitions, a mean of 7.08 repetitions, a median of 6.5 repetitions, and a mode of 2, 6, and 8 repetitions. Table 8 presents the frequency distribution: 4 athletes (33.33%) scored in the 2-5 interval, 5 athletes (41.67%) in the 6-9 interval, 2 athletes (16.67%) in the 10-13 interval, 0 athletes (0%) in the 14-17 interval, and 1 athlete (8.33%) in the 18-21 interval. Normative classification indicated that 91.67% of athletes were in the Less (Poor) category, with only 8.33% achieving “Baik” (Good). This overwhelming deficiency in muscular endurance explains the observed phenomenon of athletes rushing their release due to inability to maintain the drawn position for adequate duration.

Table 8. Frequency Distribution of Arm and Shoulder Muscular Endurance

Interval	Frequency (Fa)	Percentage (Fr %)
2-5	4	33.33%
6-9	5	41.67%
10-13	2	16.67%
14-17	0	0%
18-21	1	8.33%
Total	12	100%

The Wall Squat test was administered separately for the right and left legs. For the right leg, the highest score was 38.36 seconds, the lowest was 7.32 seconds, with a mean of 19.33 seconds and a median of 13.83 seconds. Table 9 shows that 7 athletes (58.33%) scored in the 7.32-15.32 interval, 1 athlete (8.33%) in the 16.32-24.32 interval, 2 athletes (16.67%) in the 25.32-33.32 interval, 2 athletes (16.67%) in the 34.32-42.32 interval, and 0 athletes in the highest interval. For the left leg, the highest score was 49.00 seconds, the lowest was 5.75 seconds, with a mean of 22.75 seconds and a median of 20.27 seconds. Table 10 reveals that 3 athletes (25%) scored in the 5.75-13.75 interval, 4 athletes (33.33%) in the 14.75-22.75 interval, 2 athletes (16.67%) in the 23.75-31.75 interval, 2 athletes (16.67%) in the 32.75-40.75 interval, and 1 athlete (8.33%) in the 41.75-49.75 interval. The combined classification for lower back muscular endurance showed 58.33% in Less (Poor), 25% in "Cukup" (Sufficient), and 16.67% in "Baik" (Good), indicating a generally low level of endurance.

Table 9. Frequency Distribution of Lower Back Endurance (Right Leg)

Interval	Frequency (Fa)	Percentage (Fr %)
7.32-15.32	7	58.33%
16.32-24.32	1	8.33%
25.32-33.32	2	16.67%
34.32-42.32	2	16.67%
43.32-51.32	0	0%
Total	12	100%

Table 10. Frequency Distribution of Lower Back Endurance (Left Leg)

Interval	Frequency (Fa)	Percentage (Fr %)
5.75-13.75	3	25.00%
14.75-22.75	4	33.33%
23.75-31.75	2	16.67%
32.75-40.75	2	16.67%
41.75-49.75	1	8.33%
Total	12	100%

The 15-minute Balke Run Test assessed cardiovascular endurance (VO2 Max). The results showed a highest score of 46, a lowest score of 28, a mean of 39.58, a median of 40, and modes of 36, 43, and 46. Table 11 presents the frequency distribution: 1 athlete (8.33%) scored in the 28-31 interval, 2 athletes (16.67%) in the 32-35 interval, 3 athletes (25%) in the 36-39 interval, 3 athletes (25%) in the 40-43 interval, and 3 athletes (25%) in the 44-47 interval. Normative classification indicated that 100% of athletes were in the Less (Poor) category for cardiovascular endurance. This universal deficiency explains the early fatigue observed during prolonged training sessions and competitions, as the athletes lack the aerobic capacity to sustain energy production over extended periods.

Table 11. Frequency Distribution of Cardiovascular Endurance (VO2 Max)

Interval	Frequency (Fa)	Percentage (Fr %)
28-31	1	8.33%
32-35	2	16.67%
36-39	3	25.00%
40-43	3	25.00%
44-47	3	25.00%
Total	12	100%

After converting each component score into normative values (2,4,6,8,10) and calculating the mean across all six components for each athlete, the overall physical condition was determined. Table 12 presents the final classification. The results showed that 5 athletes (41.67%) fell into the "Cukup" (Sufficient) category, while 7 athletes (58.33%) fell into the Less (Poor) category. No athletes achieved "Baik" (Good), "Baik Sekali" (Very Good), or "Sempurna" (Perfect) classifications. The mean overall score for the entire sample was 3.89, which falls within the Less (Poor) range (2.0-3.9). Consequently, the physical condition of male archery athletes in Bengkalis Regency in 2019 is conclusively categorized as Less (Poor).

Table 12. Overall Physical Condition Classification

Category	Score Range	Frequency (Fa)	Percentage (Fr %)
Kurang (Poor)	2.0 - 3.9	7	58.33%
Cukup (Sufficient)	4.0 - 5.9	5	41.67%
Baik (Good)	6.0 - 7.5	0	0%
Baik Sekali (Very Good)	8.0 - 9.5	0	0%
Sempurna (Perfect)	9.6 - 10.0	0	0%
Total		12	100%

The findings of this research demonstrate that the physical condition of male archery athletes in Bengkalis Regency is predominantly in the Less (Poor) category, with 58.33% of athletes falling into this classification and the remaining 41.67% in the "Cukup" (Sufficient) category. No athletes achieved "Baik" (Good) or higher. This result confirms the initial observations that athletes exhibited tremors in the bow-holding arm, incomplete shooting techniques, declining scores between ends, and rushed releases due to fatigue. The discussion below interprets these findings in relation to theoretical frameworks, compares them with previous research, and explains the sport-specific implications.

The deficiency in arm and shoulder muscle strength, particularly the finding that 83.33% of athletes were in the Less category for push strength and 50% for pull strength, directly impacts the ability to draw and hold the bow. According to Ismaryati (2008), strength is the contractile force achieved by a muscle or muscle group in a single maximal effort. In archery, the draw phase requires isotonic contraction (concentric) as the archer pulls the string, followed by isometric contraction to maintain the fully drawn position during Welch [23]. The Lunen [24] technical manual emphasizes that during the "menjangkan" (anchoring) and "mengetatkan dan menahan" (tightening and holding) phases, the archer must hold the drawn position for 2-5 seconds before release. Without adequate arm and shoulder strength, the archer cannot maintain this position stably, leading to premature release, bow arm tremor, and inconsistent arrow impact points. The observation that athletes rushed their release is thus empirically explained by their low strength scores.

The universal deficiency in leg muscle strength (100% in Less category) is equally concerning. The shooting stance in archery requires a stable base of support, with feet positioned shoulder-width apart and the body weight distributed evenly. According to Enoka [25], leg strength provides the foundation for all upper body movements, and any instability in the lower body will propagate upward, disrupting the alignment of the shoulders, bow arm, and draw arm. During a standard competition, an archer may stand for 72 minutes or longer across multiple ends, with each end requiring sustained postural control. Weak leg muscles force the athlete to recruit accessory muscles for stabilization, increasing overall energy expenditure and accelerating the onset of fatigue. This explains why athletes exhibited declining scores from one rambahan (end) to the next, as described in the background of this research.

The lower back muscle strength results showed a more varied distribution, with 41.67% of athletes achieving "Baik" (Good) classification. This relative strength in the back muscles may be attributable to activities of daily living and basic training that inadvertently engages the posterior chain. However, it is important to note that 58.33% still fell into Less or "Cukup" categories, indicating room for improvement. The back muscles, particularly the erector spinae, play a critical role in maintaining the upright trunk position during shooting. Azhari and Zulkifli [26] emphasizes that during the "mengetatkan dan menahan" phase, the back muscles must contract isometrically to stabilize the shoulder girdle while the rhomboids and trapezius retract the scapula on the draw side. Weakness in this region leads to forward head posture, rounded shoulders, and a collapsed shooting position, all of which negatively affect accuracy and consistency [27].

The most alarming findings relate to muscular endurance and cardiovascular endurance. For arm and shoulder muscular endurance (pull-ups), 91.67% of athletes were in the Less category. For lower back muscular endurance (wall squat), 58.33% were in Less. For cardiovascular endurance (VO2 Max), 100% were in Less. According to Eroglu [28] , muscular endurance is the ability of a muscle to perform repeated contractions over an extended period against a specific load. In archery, each shooting end requires 6 draws, releases, and follow-throughs, repeated across 18 ends or more in a competition. Without adequate local muscular endurance, the quality of each subsequent shot diminishes as the muscle fibers fatigue. Prasetyo [29] defines cardiovascular endurance as the ability of the heart, lungs, and circulatory system to overcome fatigue induced by relatively long-term exercise loads. The lack of aerobic capacity means that athletes cannot efficiently deliver oxygen to working muscles, clear metabolic byproducts, or maintain concentration under fatigue. The universal deficiency in VO2 Max (100% poor) is particularly concerning because archery competitions are prolonged, often lasting 3-6 hours, and mental focus is directly compromised by physiological fatigue.

This research addresses a significant gap identified in three previous studies. First, Malikov et al. [30] standardized the physical condition status of individual sports athletes under KONI Yogyakarta but did not specifically include archery in his analysis, leaving the unique physical demands of this sport unexamined. Consequently, no baseline data existed for comparing archery-specific strength and endurance profiles. Second, Viktoriia [31] measured physical condition and anthropometric status among PJKR UNTAD students, but their population was general university students rather than competitive archery athletes, and their test battery did not include archery-relevant instruments such as the wall squat or back dynamometer. The present study fills this void by focusing exclusively on competitive archers using sport-specific tests. Third, Hnatchuk [32] examined the standardization of physical condition for Bali PORPROV athletes across multiple sports, yet archery was not isolated for detailed analysis, and the study employed a different normative reference system. The current research provides the first comprehensive, multi-component physical profile of archery athletes in Bengkalis Regency using the KONI-endorsed testing protocol, thereby creating a baseline that was previously absent from the literature. While previous studies focused on general fitness, this research specifically quantifies the component-by-component deficiencies that directly impact archery performance, enabling targeted interventions.

The novelty of this research lies in its comprehensive and sport-specific assessment approach, which has not been previously applied to archery athletes in Bengkalis Regency. Unlike prior descriptive studies that used generalized fitness tests or focused on a single physical component, this research employed a full battery of six validated instruments (leg dynamometer, hand dynamometer push/pull, back dynamometer, pull-ups, wall squat for both legs, and the 15-minute Balke run test) as recommended by Teofa et al. [33] and aligned with KONI Pusat standards. This represents the first study to provide a detailed, component-by-component physical profile of

archery athletes in this region, generating a baseline database that previously did not exist. Furthermore, the integration of both static strength (isometric) and dynamic endurance (isotonic) measurements specifically tailored to the kinematic chain of archery movements—from leg stance through back stabilization to arm draw and release constitutes a methodological advancement over prior descriptive studies. The finding that 100% of athletes are deficient in leg strength and cardiovascular endurance, while 91.67% are deficient in arm muscular endurance, provides unprecedented empirical specificity that enables evidence-based coaching.

The findings of this research carry several critical implications for different stakeholders. For coaches and trainers, the results provide empirical evidence that training programs must prioritize leg strength development (e.g., squats, lunges, plyometrics), arm and shoulder muscular endurance (e.g., high-repetition resistance training, specific archery holds with increased duration), and cardiovascular conditioning (e.g., interval running, continuous aerobic training) alongside technical skill development. Current training programs appear to overemphasize technical repetition while neglecting the foundational physical capacities required to execute those techniques correctly under competitive fatigue. For the Bengkalis Regency sports governing bodies (KONI and PERPANI), these results serve as a decision-support tool for resource allocation, justifying investments in strength training equipment, nutritional supplementation to support muscle recovery, and qualified strength and conditioning coaches. Without such investments, the team's performance trajectory will likely remain stagnant. For athletes, the individualized assessment results offer concrete, measurable feedback that can motivate behavior change, set realistic training goals, and provide benchmarks for tracking progress over time. For future researchers, this study establishes a replicable methodological framework that can be applied to other archery populations across Indonesia, enabling cross-regional comparisons and longitudinal monitoring of physical development. Additionally, the study implies that talent identification programs should include physical conditioning assessments as entry criteria, not merely technical proficiency tests.

This research has several limitations that should be acknowledged. First, the sample size is small (n=12), limited to male archery athletes in Bengkalis Regency, which restricts the generalizability of findings to female athletes, archers in other regions of Indonesia, or larger sample populations. Second, the research design is cross-sectional, providing only a snapshot of physical condition at a single point in time without the ability to track changes over a training cycle or competition season. Longitudinal studies are needed to determine whether physical condition improves, deteriorates, or remains stable with current training practices. Third, the study did not measure psychological factors (e.g., concentration, anxiety, self-confidence) or technical proficiency scores, which would provide a more holistic understanding of archery performance. Fourth, the research did not control for external variables such as nutritional status, sleep quality, training history, or previous injuries, all of which could influence physical test results. Fifth, the normative tables used Ganjave [34] were developed for general populations and may not be optimally specific to archery athletes, who may require unique strength-endurance profiles compared to athletes in other sports. Finally, the study did not include a comparison group of higher-performing archers (e.g., provincial or national level), which would help contextualize whether the observed deficiencies are specific to Bengkalis or represent a broader pattern among developing archery programs. Future research should address these limitations by expanding sample size, including female athletes, incorporating psychological and technical measurements, conducting longitudinal tracking, and establishing archery-specific normative standards.

4. CONCLUSION

Based on the research results and data analysis conducted on 12 male archery athletes of Bengkalis Regency using six physical condition tests (leg dynamometer, hand dynamometer pull and push, back dynamometer, pull-ups, wall squat for right and left legs, and the 15-minute Balke run test for cardiovascular endurance), the physical condition of male archery athletes of Bengkalis Regency in 2019 is categorized as Poor, with 7 out of 12 athletes (58.33%) falling into the "Poor" category and the remaining 5 athletes (41.67%) falling into the "Sufficient" category, while no athletes achieved "Good", "Very Good", or "Perfect" classifications, and the mean overall score of 3.89 falls within the "Poor" range (2.0-3.9). Specifically, universal deficiencies were identified across multiple components: 100% of athletes were deficient in leg muscle strength and cardiovascular endurance (VO2 Max), 91.67% were deficient in arm and shoulder muscular endurance (pull-ups), 83.33% were deficient in arm and shoulder push strength, 50% were deficient in arm and shoulder pull strength, and 58.33% were deficient in lower back muscular endurance. Therefore, the research objective to determine the level of physical condition of archery athletes in Bengkalis Regency has been achieved, and the conclusion affirms that the athletes' physical condition is predominantly poor, indicating an urgent need for systematic, targeted, and evidence-based physical conditioning interventions to improve their competitive performance at regional and national levels.

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