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Comparative Physical Fitness Profiles of Indonesian Futsal Players Across Two National Games Preparation Cohorts

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ABSTRACT

This study aimed to compare the physical fitness profiles of East Java futsal players from two Indonesian National Games preparation cohorts. A quantitative descriptive-comparative design was employed using secondary physical assessment data from 33 male players, comprising 13 athletes in the 2020 cohort and 20 in the 2024 cohort. Physical fitness indicators were evaluated against standards established by the East Java National Sports Committee. The 2020 cohort demonstrated faster 20-m sprint performance (3.0 vs. 3.1 s), better Illinois agility test results (15.43 vs. 16.00 s), and greater sit-and-reach flexibility (22 vs. 18 cm). Conversely, the 2024 cohort achieved higher chin-up performance (10 vs. 9.25 repetitions) and single-leg squat loading (11 vs. 10 kg). Both cohorts recorded identical triple-jump distances (7.0 m), below the institutional target of 8.0 m. Aerobic endurance could not be directly compared because different assessment protocols were used. These findings demonstrate component-specific differences in physical fitness profiles between preparation cohorts and highlight the importance of standardized assessment protocols for longitudinal program evaluation.

Keywords: futsal, physical fitness, athlete monitoring, comparative analysis, national games

INTRODUCTION

Futsal is a high-intensity intermittent team sport characterized by repeated accelerations, decelerations, rapid changes of direction, and frequent technical–tactical interactions within a restricted playing area. These demands require players to integrate muscular strength, explosive power, sprint speed, change-of-direction ability, and aerobic endurance to maintain effective performance throughout competitive matches. Previous investigations have demonstrated that futsal involves substantial cardiovascular and metabolic demands, with players repeatedly alternating between high-intensity movements and short recovery periods (Barbero-Alvarez et al., 2008; Castagna et al., 2009). A systematic review by Spyrou et al. (2020) further highlighted the multidimensional physical and physiological characteristics of competitive futsal, emphasizing the importance of comprehensive physical preparation. Consequently, physical fitness assessment represents an essential component of athlete monitoring and conditioning programs aimed at supporting the specific demands of futsal competition.

Physical fitness characteristics in futsal are influenced by the interaction of neuromuscular capabilities, aerobic conditioning, and individual athlete attributes. Muscular strength and explosive power contribute to force production during acceleration, jumping, and rapid directional transitions, whereas aerobic fitness supports recovery between repeated high-intensity efforts. Barbero-Alvarez et al. (2009) identified differences in aerobic fitness among futsal players competing at different levels, indicating the relevance of physiological conditioning to competitive preparation. Similarly, Naser and Ali (2016) examined performance characteristics across competitive

levels, demonstrating the importance of evaluating multiple physical attributes when assessing futsal players. Research examining age, body mass index, and physical fitness has also highlighted the variability of physical characteristics within futsal populations (Nikolaidis et al., 2019). These findings support the use of multidimensional assessment batteries to identify specific physical strengths and limitations rather than relying on isolated performance indicators.

Systematic monitoring of physical fitness provides valuable information for evaluating athlete preparedness and informing training decisions across different preparation periods. Changes in physical performance may reflect the combined influence of training exposure, recovery, and individual characteristics; however, such interpretations require consistent assessment procedures and appropriate longitudinal data. Oliveira et al. (2013) investigated seasonal variations in physical performance and heart rate variability among high-level futsal players, illustrating the relevance of repeated physiological monitoring. Likewise, Miloski et al. (2016) examined seasonal training load distribution and its associations with physical fitness and physiological responses in professional futsal players. From a training perspective, periodization principles emphasize the systematic organization of conditioning loads to develop physical qualities according to competitive requirements (Bompa & Buzzichelli, 2019). Collectively, these studies indicate that standardized physical assessment is necessary to generate meaningful information for athlete monitoring and training evaluation.

Despite growing evidence regarding the physiological demands and physical characteristics of futsal players, interpreting physical fitness profiles across different athlete preparation cohorts remains methodologically challenging. Comparisons between independent cohorts may reveal differences in measured physical attributes, but they cannot establish individual longitudinal adaptations or the effectiveness of specific training programs. Furthermore, physical performance indicators are not interchangeable because sprint speed, planned change-of-direction ability, and reactive agility represent related but distinct constructs (Sheppard & Young, 2006). Research comparing change-of-direction performance across team sports further demonstrates the importance of considering sport-specific movement requirements when interpreting assessment outcomes (Loturco et al., 2022). Within Indonesian provincial athlete development programs, comparisons across National Games preparation periods may provide useful descriptive evidence for identifying conditioning priorities. However, the available East Java futsal assessment records have not been systematically presented as a component-specific comparison between the 2020 and 2024 preparation cohorts.

Therefore, this study aimed to compare the physical fitness profiles of East Java male futsal players from two Indonesian National Games preparation cohorts using available secondary assessment data. The investigation examined muscular strength, explosive power, sprint speed, change-of-direction performance, endurance, and flexibility in relation to institutional performance targets established by the East Java National Sports Committee. The principal contribution of this study is its component-specific evaluation of physical fitness characteristics across two independent cohorts within the same provincial development program. Particular attention was given to differences in assessment availability and protocol comparability to avoid unsupported interpretations of longitudinal changes. The findings are expected to provide practical information for physical fitness monitoring, identify conditioning priorities, and support the development of more standardized assessment procedures in provincial futsal preparation programs.

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METHODS

Study Design

This study employed a quantitative descriptive-comparative design using secondary physical fitness assessment data from two independent cohorts of East Java male futsal players preparing for the Indonesian National Games. The comparison involved the 2020 preparation cohort associated with PON XX Papua and the 2024 preparation cohort associated with PON XXI Aceh–North Sumatra. The study examined differences in reported group-level physical fitness indicators and their correspondence with performance targets established by the East Java National Sports Committee (KONI). No experimental intervention was implemented, and the analysis was not intended to evaluate individual longitudinal changes or establish the effectiveness of specific training programs.

Participants and Data Sources

The study included assessment records from 33 male futsal players affiliated with the East Java Regional Training Center (*Pusat Latihan Daerah*, Puslatda). The 2020 cohort comprised 13 athletes, whereas the 2024 cohort comprised 20 athletes. Data were obtained from secondary records of physical fitness assessments conducted under the KONI East Java athlete monitoring program. The available documentation contained group-level results for several physical fitness indicators but did not provide individual participant characteristics, including age, body mass, playing position, or training experience. Accordingly, the analysis was restricted to the reported assessment outcomes for the two preparation cohorts.

Physical Fitness Assessment

Physical fitness was evaluated using assessment indicators grouped into six components: muscular strength, explosive power, speed, agility-related performance, endurance, and flexibility. Strength-related assessments included sit-ups, chin-ups, single-leg squats, front planks, and Russian twists. Explosive power was evaluated using the triple-jump test, while sprint performance was assessed through a 20-m sprint. Change-of-direction performance and lower-limb movement capacity were evaluated using the Illinois agility test and square jump, respectively. Endurance assessments included the multistage fitness test and Bronco test, whereas flexibility assessments comprised sit-and-reach, ankle flexibility, and overhead leg touch measurements. Assessment results were interpreted against the institutional targets reported in the KONI East Java records. The available documentation did not specify all testing protocols, measurement reliability coefficients, or the procedures used to standardize testing conditions across cohorts.

Data Processing and Statistical Analysis

The analysis was based on reported group-level assessment values for the 2020 and 2024 cohorts. Descriptive comparisons were performed for physical fitness indicators measured using corresponding tests and units. For timed assessments, lower values represented better performance, whereas higher values generally indicated better results for repetition-based, distance-based, and load-based assessments. The reported values were also compared with KONI East Java performance targets to identify component-specific discrepancies. Assessment entries recorded as 0.0 for tests not administered were treated as unavailable data rather than actual performance scores. Because individual-level observations and measures of variability were not provided, inferential statistical tests and effect-size estimates were not calculated. Consequently, between-cohort differences were interpreted descriptively without claims of statistical significance.

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RESULTS AND DISCUSSION

Results

1.Strength and Explosive Power Profiles

The descriptive comparison revealed differences in strength-related performance between the 2020 and 2024 preparation cohorts. As presented in Table 1, the 2024 cohort demonstrated slightly higher average sit-up performance (45 vs. 44 repetitions), chin-up performance (10.00 vs. 9.25 repetitions), and front plank duration (118 vs. 117 s). The 2024 cohort also recorded a higher single-leg squat load (11 vs. 10 kg), although both cohorts remained below the institutional target of 15 kg under the reported testing conditions. In contrast, the triple-jump assessment showed identical results for both cohorts, with an average distance of 7.0 m, representing a 1.0-m deficit relative to the institutional target. Russian twist performance was reported as 11 repetitions in the 2020 cohort and 12 repetitions in the 2024 cohort. However, conflicting target values were presented for this assessment in the original records, preventing a definitive interpretation of target attainment.

Table 1. Comparison of Strength and Explosive Power Indicators Between the 2020 and 2024 Futsal Cohorts

Physical fitness indicator	Unit	2020 (n = 13)	2024 (n = 20)	KONI target
Sit-up	Repetitions	44	45	50
Chin-up	Repetitions	9.25	10.00	10
Single-leg squat	Load (kg)	10	11	15
Front plank	Seconds	117	118	120
Russian twist	Repetitions	11	12	Requires verification
Triple jump	Meters	7.0	7.0	8.0

The 2020 cohort demonstrated better average performance in the 20-m sprint and Illinois agility test than the 2024 cohort. The mean 20-m sprint time was 3.0 s in 2020 and 3.1 s in 2024, indicating a descriptive difference of 0.1 s. The 2020 cohort met the institutional sprint target, whereas the 2024 cohort recorded a slightly slower average time. A similar pattern was observed in the Illinois agility test, with the 2020 cohort recording 15.43 s compared with 16.00 s in the 2024 cohort. Both values exceeded the institutional target of 15.00 s. Square jump performance was also higher in the 2020 cohort, with 28 repetitions compared with 24 repetitions in 2024. Neither cohort achieved the target of 30 repetitions.

Table 2. Comparison of Sprint Speed and Change-of-Direction Indicators

Assessment	Unit	2020	2024	KONI target
20-m sprint	Seconds	3.00	3.10	≤3.00
Illinois agility test	Seconds	15.43	16.00	≤15.00
Square jump	Repetitions	28	24	≥30

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2.Endurance and Flexibility Profiles

Endurance assessments differed between the two preparation cohorts. The 2020 cohort completed the Bronco test, recording an average time of 6.11 min against an institutional target of 6.00 min. Conversely, the 2024 cohort completed the multistage fitness test, with a reported estimated VO_2max of 49.3 $mL \cdot kg^{-1} \cdot min^{-1}$, below the institutional target of 54.1 $mL \cdot kg^{-1} \cdot min^{-1}$. Because different endurance tests were administered, direct between-cohort comparisons of aerobic fitness were not possible. Flexibility assessments revealed component-specific differences. The 2020 cohort achieved a higher sit-and-reach score than the 2024 cohort (22 vs. 18 cm), exceeding the institutional target of 20 cm. In contrast, ankle flexibility measurements were slightly higher in the 2024 cohort, with bilateral values of 13 cm compared with 12 cm in 2020. Nevertheless, both cohorts remained below the reported ankle flexibility target of 15 cm. The overhead leg touch assessment also showed differences between cohorts, although inconsistencies in the reported values and target criteria prevented a reliable interpretation of this indicator.

Table 3. Comparison of Endurance and Flexibility Indicators

Assessment	Unit	2020	2024	KONI target
Multistage fitness test (estimated VO_2max)	$mL \cdot kg^{-1} \cdot min^{-1}$	NA	49.3	54.1
Bronco test	Minutes	6.11	NA	≤6.00
Sit and reach	cm	22	18	≥20
Ankle flexibility — right	cm	12	13	15
Ankle flexibility — left	cm	12	13	15
Overhead leg touch — right	cm	30.42	16	Requires verification
Overhead leg touch — left	cm	36.75	13	Requires verification

Discussion

The present study identified distinct physical fitness profiles between the 2020 and 2024 preparation cohorts of East Java male futsal players, with neither cohort demonstrating consistent superiority across all assessed components. The 2020 cohort exhibited better sprint speed, change-of-direction performance, square jump results, and sit-and-reach flexibility, whereas the 2024 cohort showed slightly higher values in several muscular strength assessments and ankle mobility. These findings suggest that physical fitness characteristics differed according to the specific capacities evaluated rather than reflecting a uniform advantage associated with either preparation period. Such variation is consistent with the multidimensional demands of futsal, which requires players to repeatedly perform high-intensity movements involving acceleration, deceleration, directional transitions, and intermittent recovery. Barbero-Alvarez et al. (2008) and Castagna et al. (2009) demonstrated substantial cardiovascular and metabolic demands during competitive futsal, while Spyrou et al. (2020) emphasized the importance of integrating neuromuscular and physiological characteristics when evaluating player preparedness. Similarly, Naser and Ali (2016) highlighted differences in performance characteristics across competitive levels, supporting the relevance of comprehensive physical assessment. Nevertheless, the present findings should be interpreted as descriptive differences between independent cohorts rather than evidence of longitudinal adaptations or changes in training effectiveness.

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Muscular strength assessments revealed slightly higher average performance in the 2024 cohort, particularly in chin-ups (10.00 vs. 9.25 repetitions), single-leg squats (11 vs. 10 kg), and front planks (118 vs. 117 s). However, several indicators remained below the institutional performance targets, indicating that strength-related capacities warrant continued monitoring. Both cohorts also recorded identical triple-jump distances of 7.0 m, below the prescribed target of 8.0 m, suggesting a shared limitation in horizontal jumping performance relative to the institutional benchmark. These findings are relevant because lower-limb force production contributes to the execution of rapid accelerations, jumping movements, and directional transitions frequently performed during futsal competition. The systematic review conducted by Spyrou et al. (2020) identified muscular strength and power as important components of futsal players' physical profiles, while the principles of training periodization described by Bompa and Buzzichelli (2019) emphasize the progressive development and integration of sport-specific physical capacities. Furthermore, Nogueira et al. (2018) examined physical and physiological responses during futsal preseason preparation, highlighting the importance of structured conditioning programs. Nevertheless, the small numerical differences observed in several strength tests cannot be interpreted as meaningful training adaptations without individual-level data, measurement variability, and standardized testing procedures.

Sprint speed and change-of-direction performance demonstrated a different pattern, with the 2020 cohort recording faster 20-m sprint times (3.00 vs. 3.10 s) and better Illinois agility test results (15.43 vs. 16.00 s). Square jump performance was also higher in the 2020 cohort (28 vs. 24 repetitions), although both cohorts remained below the institutional target of 30 repetitions. These findings may be practically relevant because futsal players frequently execute short-distance sprints and rapid directional transitions during attacking and defensive situations. Caetano et al. (2015) characterized sprint and repeated-sprint sequences during professional futsal matches, demonstrating the importance of high-intensity locomotor actions within competitive play. Similarly, Loturco et al. (2022) examined change-of-direction performance among elite athletes from different team sports, supporting the relevance of sport-specific movement assessments. However, the Illinois agility test primarily evaluates planned change-of-direction speed rather than reactive agility involving perceptual and decision-making processes. Sheppard and Young (2006) emphasized the distinction between these constructs, indicating that physical assessments should be interpreted according to the specific abilities they measure. Therefore, the present results indicate differences in sprinting and planned directional movement performance but do not establish corresponding differences in tactical agility or competitive effectiveness.

Aerobic endurance represented an important methodological limitation because different assessment protocols were administered across the two preparation cohorts. The 2020 cohort completed the Bronco test, recording an average time of 6.11 min, whereas the 2024 cohort performed the multistage fitness test and achieved an estimated VO_2max of 49.3 $mL \cdot kg^{-1} \cdot min^{-1}$. Although both results were below their respective institutional targets, direct comparisons of aerobic capacity between cohorts were not possible because the tests involved different protocols and outcome measures. Aerobic conditioning remains essential in futsal because players must sustain repeated high-intensity activities while recovering between successive efforts. Barbero-Alvarez et al. (2009) investigated aerobic fitness across different competitive levels, demonstrating the relevance of endurance capacity to futsal preparation. Similarly, Milanez et al. (2011) examined the relationship between aerobic fitness and perceived training exertion, highlighting the potential role of aerobic capacity in managing training demands. More recently, Parnow

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et al. (2024) investigated associations between aerobic performance and physiological responses during different intermittent endurance assessments in trained futsal players, reinforcing the importance of test-specific interpretation. Accordingly, the present findings support continued monitoring of aerobic fitness but do not permit conclusions regarding between-cohort differences in endurance capacity.

Flexibility assessments revealed contrasting characteristics between the two preparation cohorts. The 2020 cohort demonstrated higher sit-and-reach performance (22 vs. 18 cm), whereas the 2024 cohort recorded slightly greater ankle flexibility measurements (13 vs. 12 cm). These findings indicate that flexibility characteristics varied according to the anatomical region assessed rather than demonstrating a consistent advantage for either cohort. However, flexibility measurements alone cannot determine functional movement efficiency, technical performance, or injury susceptibility. In futsal, physical fitness profiles should be interpreted alongside individual characteristics and sport-specific movement demands. Nikolaidis et al. (2019) examined relationships between age, body mass index, and physical fitness among futsal players, illustrating the importance of considering individual characteristics when interpreting assessment outcomes. Furthermore, Spyrou et al. (2020) emphasized the multidimensional nature of futsal performance, supporting the integration of complementary physical assessments rather than reliance on isolated indicators. The inconsistencies identified in the overhead leg touch measurements and institutional targets further demonstrate the need for standardized procedures and clearly defined assessment criteria. Therefore, future evaluations should incorporate consistent flexibility protocols and additional movement assessments to improve the practical interpretation of joint mobility characteristics.

The principal contribution of this study lies in identifying component-specific physical fitness characteristics across two independent preparation cohorts within the same provincial futsal development program. The findings indicate that horizontal jumping performance, change-of-direction capability, aerobic fitness, and selected flexibility indicators deserve continued attention within athlete monitoring and conditioning programs. Previous research has demonstrated the relevance of systematic training monitoring in futsal, with Oliveira et al. (2013) documenting seasonal changes in physical performance and physiological indicators, while Miloski et al. (2016) examined associations between training load distribution, physical fitness, and physiological responses. Milanez et al. (2020) further investigated relationships between match-related variables and running performance, highlighting the importance of integrating physical assessment with competitive performance information. Nevertheless, several limitations should be acknowledged. First, the study relied on secondary group-level data without individual observations or measures of variability, preventing inferential statistical analysis and effect-size estimation. Second, differences in sample size, athlete characteristics, and training backgrounds may have influenced the observed outcomes. Third, inconsistencies in endurance testing protocols and selected flexibility measurements restricted direct comparisons. Finally, the absence of objective match-performance indicators prevented examination of associations between physical fitness and competitive outcomes. Future investigations should employ standardized testing protocols, longitudinal athlete monitoring, and comprehensive match-performance indicators to strengthen evidence-based conditioning strategies in competitive futsal.

CONCLUSION

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This study identified component-specific differences in physical fitness profiles between the 2020 and 2024 preparation cohorts of East Java male futsal players. The 2020 cohort demonstrated better sprint speed, change-of-direction performance, square jump results, and sit-and-reach flexibility, whereas the 2024 cohort showed slightly higher performance in several strength-related assessments and ankle mobility. Both cohorts recorded identical triple-jump distances below the institutional target, indicating a shared limitation in horizontal jumping performance. Differences in endurance testing protocols prevented direct comparisons of aerobic fitness between cohorts. These findings emphasize the importance of multidimensional physical fitness monitoring and consistent assessment procedures in evaluating athlete preparation across competition periods. Coaches should consider component-specific conditioning priorities while maintaining standardized testing protocols. However, the descriptive design and absence of individual-level data prevent conclusions regarding statistical significance, training effectiveness, or competitive performance. Future studies should incorporate longitudinal assessments and objective match-performance indicators to strengthen evidence-based futsal conditioning strategies.

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