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The Influence of Physical Condition Quality on Chess Athletes' Performance in the National Paralympiad Week

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Abstract

This study aims to analyze the influence of physical condition quality on the performance of chess athletes with disabilities at the 2024 National Paralympic Games (PEPARNAS) in West Java. Employing a quantitative approach, the study involved 21 chess athletes competing in individual and team categories. Physical condition data were collected through the Sit and Reach test for flexibility and the Balke test for aerobic endurance, while performance was measured based on medal achievements. Linear regression analysis revealed that flexibility and aerobic capacity accounted for only 0.1% of the variation in individual performance ($R^2 = 0.001$, $p = 0.991$) and 5.9% of the variation in team performance ($R^2 = 0.059$, $p = 0.576$), indicating that these variables had no significant impact on chess performance. These findings confirm that chess relies more on cognitive and strategic abilities than physical condition. Nevertheless, physical fitness still plays a supportive role in maintaining mental endurance during tournaments. The study recommends training focused on developing cognitive and strategic skills, while considering light physical exercise to support athletes' health and stamina. Future research should involve larger samples and include additional physical variables, such as reaction speed or eye-hand coordination, for a more comprehensive analysis.

Keywords: Physical Condition, Chess Performance, National Paralympic Games, Athletes with Disabilities, Cognitive.

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Introduction

Disability is often defined as a condition in which a person has physical, mental, intellectual, or sensory limitations that may affect their daily life activities (Baart et al., 2023; Martin Ginis et al., 2021; Sterkenburg et al., 2022). Disabilities are also categorized into several groups, namely, tuna daksa (physical abnormalities), tunanetra (visual impairments), tunarungu (hearing impairments), and tunagrahita (speech impairments) (Nurhayati et al., 2023). The existence of rights that provide space for people with disabilities to participate in sports has a positive impact, one of which is helping those with disabilities rediscover hope or meaning in their lives. The National Paralympiad Week (PEPARNAS) is a concrete manifestation of providing sports-related rights for people with disabilities; even in its history, this forum continues to bring positive changes from year to year for the maximization of sports rights for people with disabilities (Rohmawati et al., 2025). At the National Paralympiad Week, there are many sports branches competed in, one of which is the chess sport (Magfiroh & Jannah, 2021). Chess is a cognitive sport, meaning it is dominated by thinking. How players must devise strategies to win the game (Sari et al., 2023; Setiawan & Pratama, 2021). Even chess is often known as a war simulation game. Although chess is a cognitive sport, some studies show that good physical condition can support mental endurance, especially in long tournaments that require sustained concentration. Thus, the relationship between physical condition quality and performance in chess becomes an important aspect that needs further research, particularly in the context of athletes with disabilities at Peparناس.

In sports, many also say that physical condition has a significant influence on athletes (Andica et al., 2024; Apriyano et al., 2025; Arifan et al., 2024; Falaahudin et al., 2025, 2025; Hasibuan et al., 2025). Physical condition is an important component that athletes must possess to support more optimal performance (Oktadinata et al., 2024; Sepriani et al., 2024). By engaging in regular physical activity, it can increase the production of new brain cells and improve blood flow to the brain (Bhattacharya et al., 2023; Martin Ginis et al., 2021). Therefore, physical activity can help improve thinking ability and cognitive performance. The physical training done by athletes can also affect mental quality, which is very necessary in the sport of chess. Both to maintain focus and to assist in making the right decisions during the match. However, the aspect of physical condition for chess athletes often receives less attention compared to athletes from physical sports branches such as athletics, swimming, or badminton. In chess training, the main focus is usually on developing strategy, tactics, and analytical skills, while physical training is considered secondary. Physical fitness can improve mental endurance, but this aspect is often overlooked in chess training programs (Apriyano et al., 2025; Hambali et al., 2024; Syahrastani et al., 2025). This lack of attention is especially evident in chess athletes with disabilities, who may require a physical training approach tailored to their conditions.

This research aims to analyze the influence of physical condition quality on the performance of chess athletes at the National Paralympic Games. By examining the relationship between physical fitness and competitive performance, this study is expected to provide new insights into the importance of physical training in chess, particularly for athletes with disabilities. The results of this research are hoped to serve as a basis for developing more holistic training programs that not only focus on mental and strategic aspects but also consider physical condition as a supporting factor for success in the Peparناس event.

Method

This research uses a quantitative method to analyze the influence of the quality of chess athletes' physical condition on their performance in the National Paralympic Week (Peparناس). The quantitative method was chosen because it provides an objective evaluation and accurate measurement of the variables being studied, thereby yielding reliable data for drawing conclusions. According to a systematic study on biomechanical analysis in sports, quantitative methods are used to provide information to coaches and athletes about sports skill techniques that can help them achieve the highest level of athletic performance. Additionally, quantitative methods provide a permanent record of performance data, which helps overcome the limitations of human memory, where coaches and athletes can only accurately recall about 30% of

performances. Thus, the quantitative approach is expected to provide deep insights into the relationship between chess athletes' physical condition and their performance in the championship. However, some studies suggest that a mixed approach (a combination of quantitative and qualitative) can provide richer information for better decision-making in the sports context. The population in this research consists of all West Java chess athletes participating in the National Paralympic Week (Peparnas). The sample used comprises 21 West Java Peparnas chess athletes, divided into two categories: doubles and individual. The selection of this sample is based on representation from both categories, with the aim of obtaining a comprehensive picture of the influence of physical condition on performance in the championship. This sample was chosen to ensure that the collected data reflects variations in the types of competitions followed by the athletes, thereby enabling a broader analysis of the relationship between physical condition and championship outcomes.

Data in this research was collected from the physical condition of West Java Peparnas chess athletes. Data collection was conducted through pre-tests and post-tests using two types of tests: the Hip Flexibility Test (Sit and Reach) to measure lower body flexibility and the Aerobic Endurance Test (Balke) to evaluate the athletes' aerobic capacity. In addition, championship chess results from Peparnas were also obtained to evaluate whether physical condition affects performance in the championship. This method allows for a comparative analysis between physical condition before and after training with performance outcomes in the championship, thereby demonstrating the relationship between those variables. The use of technology such as biomechanical measuring devices or performance analysis tools can support accurate data collection, as explained in research on biomechanical analysis in sports.

10 Result

This research aims to evaluate the influence of physical condition quality, measured through the Hip Flexibility Test (Sit and Reach) and Aerobic Endurance (Balke), on the medal achievements of chess athletes at the National Paralympic Week (Peparnas) in West Java. Data was collected from 21 chess athletes competing in individual and team categories. The complete data of the analyzed athletes can be seen in Table 1 below:

Table 1. Physical Condition Data and Medal Achievements of West Java Peparnas Chess Athletes

Nama	Fleksibilitas S&R (cm)	Balke (detik)	VO2 Max (ml/kg/min)	Norma Kondisi Fisik	Medali Beregu	Medali Perorangan
AH	12.2	1680	29.7	1	2	1
Y	13.0	1570	28.4	1	2	0
D	26.4	520	16.4	3	3	0
MH	22.0	1580	28.5	3	0	0
DH	10.2	770	19.3	1	2	0
IY	20.0	1750	30.5	3	0	0
BG	0.0	520	16.4	1	3	2
BH	24.0	1300	25.3	3	3	0
AM	-5.0	820	19.8	1	2	0
MJ	17.0	1550	28.2	2	0	0
E	2.0	1350	25.9	1	1	0
MK	30.0	830	19.9	3	2	0
SO	29.0	850	20.2	3	1	2
SZ	22.8	1190	24.1	2	3	3
MSR	15.8	1070	22.7	1	0	2
TP	22.1	1080	22.8	2	0	1
S	21.0	1180	24.0	2	3	3
YTA	15.8	1800	31.1	2	0	0
DS	24.1	1070	22.7	3	1	0
HP	26.4	1180	24.0	3	3	0
IR	30.0	900	0.0	5	1	0

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25 Linear regression analysis was conducted to evaluate the influence of flexibility (Sit and Reach) and aerobic capacity (VO2 Max) on medal achievements in the individual and team categories. For more details, see the table below.

Table 2. Linear Regression Analysis for Individuals

Model Summary								
R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
.032 ^a	.001	-.110	1.122	.001	.009	2	18	.991

Table 3. Individual Linear Regression ANOVA

ANOVA ^a					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	.023	2	.012	.009	.991 ^b
Residual	22.643	18	1.258		
Total	22.667	20			

Table 4. Individual Category Regression Coefficients

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.758	1.078		.704	.491
Flexibilitas	.001	.026	.008	.032	.975
Aerobic_Capacity	-.005	.037	-.030	-.124	.902

Based on the analysis results, it is known that flexibility and aerobic capacity have almost no relationship with individual chess athletes' performance. The very small R Square value, namely only 0.001 or 0.1%, indicates that these two variables can only explain a very small portion of the variation in performance. In fact, the negative Adjusted R Square calculation result indicates that the model is very weak and may not be suitable for use in this context. In addition, testing using analysis of variance (ANOVA) shows that this model is not significant. The significance value (p-value) of 0.991 is far above the 0.05 threshold, meaning there is not enough evidence to state that flexibility and aerobic capacity statistically affect individual performance. The coefficient values for each variable are also very small, and none show a real influence on performance. Overall, these results indicate that physical factors such as flexibility and aerobic capacity are likely not the main determinants of individual success in the sport of chess. For more details, see the table below.

Table 5. Summary of Ridge Linear Regression Model

Model Summary								
R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
.244 ^a	.059	-.045	1.236	.059	.568	2	18	.576

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Table 6. ANOVA for Multiple Linear Regression

ANOVA ^a					
Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1.736	2	.868	.568	.576 ^b
Residual	27.502	18	1.528		
Total	29.238	20			

Table 7. Regression Coefficients for the Beregu Category

Coefficients ^a					
13 Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.706	1.188		2.278	.035
Flexibilitas	-.011	.029	-.085	-.367	.718
Aerobic_Capacity	-.043	.041	-.245	-1.052	.307

In the team performance analysis, the results obtained indicate that flexibility and aerobic capacity only explain about 5.9% of the variation in team performance. This means that most factors influencing team performance come from other aspects beyond those two variables. The negative Adjusted R Square value also indicates that this regression model is weak and not suitable for explaining the relationship between the variables. The ANOVA statistical test shows insignificant results, with a p-value of 0.576. This means there is no statistically strong relationship between flexibility and aerobic capacity and team performance. The coefficient values for each variable show a very small influence, even tending to be negative. This reinforces the conclusion that physical qualities such as flexibility and aerobic capacity do not have a significant impact on team performance.

Discussion

This research aims to analyze the influence of physical condition quality on the performance of chess athletes in the 2024 National Paralympiad Games (PEPARNAS). Data collection was conducted through pre-test and post-test using two types of tests: the Hip Flexibility Test (Sit and Reach) to measure body flexibility and the Aerobic Endurance Test (Balke) to evaluate athletes' aerobic capacity. In addition, data from the chess championship results at PEPARNAS 2024 was also collected to evaluate whether physical condition affects performance in the championship. The results of this research indicate that flexibility and aerobic capacity do not have a significant influence on the performance of chess athletes, either in the individual or team categories, at PEPARNAS 2024. The statistical analysis conducted on the data shows that for individual performance, the regression model only explains 0.1% of the variation in performance ($R^2 = 0.001$), with a p-value on the ANOVA test of 0.991, which is far above the significance threshold of 0.05. This indicates that the regression model is not strong enough to explain the relationship between the independent variables (flexibility and aerobic capacity) and individual chess performance. Similarly, for team performance, the regression model only explains 5.9% of the variation in performance ($R^2 = 0.059$), with a p-value on the ANOVA test of 0.576, which is also not significant. These findings are consistent with the literature stating that chess is a sport that relies more on cognitive and mental abilities, such as tactical intelligence, playing experience, concentration, and game strategy, rather than physical fitness. The ability to analyze the chessboard position, plan moves, and manage time is more determining of success than physical factors such as flexibility or cardiovascular endurance. These findings have important implications for the training and preparation of chess athletes, especially in the context of athletes with disabilities. In chess, physical limitations do not appear to be a major obstacle because the nature of the game relies more on mental abilities. Therefore, training for chess

athletes with disabilities should be more focused on developing cognitive and strategic abilities, such as chessboard position analysis, move planning, and time management. Techniques such as studying classic games, practicing with chess puzzles, and participating in simulated matches can be more beneficial than intensive physical training programs.

Nevertheless, physical condition still plays a supporting role in chess. Athletes with good aerobic capacity may be able to maintain focus and reduce mental fatigue during long tournaments, which often last for several hours or days. Flexibility can also help athletes maintain a comfortable posture during matches, which can affect physical comfort and concentration. However, the results of this study indicate that the contribution of both of these factors to chess performance is very minimal in the context of PEPARNAS 2024. In the context of athletes with disabilities, these findings affirm that chess is an inclusive sport and one of the Paralympic sports least affected by physical limitations. This aligns with the spirit of the Paralympic movement, which aims to provide opportunities for athletes with disabilities to compete fairly. Chess, as a mind sport, is recognized by the International Olympic Committee as an activity that relies more on cognitive function than physical strength or endurance. Therefore, chess training programs for athletes with disabilities should emphasize improving analytical abilities, pattern recognition, and decision-making.

In addition, overall physical health still plays a role in supporting mental performance (Salsabila et al., 2025). Regular physical activity, although not directly related to chess performance, can contribute to better mental health, reduced stress, and improved sleep patterns, all of which can indirectly support better performance in chess. Therefore, although physical condition is not the main determining factor in chess performance, athletes are still advised to maintain overall physical health to support their mental performance. This study has several limitations that need to be acknowledged. First, the sample size used is relatively small, which may limit the generalization of results to a broader population of athletes with disabilities in chess. Second, this study only included flexibility and aerobic capacity as independent variables, whereas other physical aspects such as reaction speed or hand-eye coordination may also be relevant. In addition, other factors such as playing experience, confidence level, and training quality may also influence chess performance but were not included in this analysis.

Future research can be expanded to include more comprehensive physical and non-physical variables to provide a more holistic picture of the determinants of chess performance. For example, it would be interesting to investigate whether there are specific types of physical exercise that can enhance cognitive functions relevant to chess. Some studies show that aerobic exercise can improve executive functions such as planning and problem-solving, which are key skills in chess. Investigating whether such exercises can enhance chess performance could provide new insights into training methodologies. Additionally, the role of technology in chess training for athletes with disabilities could also be a promising area of research. Adaptive technology and software can further level the playing field, enabling athletes with various disabilities to train effectively and compete at high levels. Longitudinal research could also be conducted to understand how factors such as playing experience and long-term training affect chess performance over time.

In summary, this research confirms that chess performance, both in individual and team categories, is more determined by cognitive and strategic abilities than by physical conditions such as flexibility and aerobic capacity. These findings have important implications for chess athlete training, particularly in the context of athletes with disabilities, where the focus on developing mental and strategic abilities should be the top priority. Nevertheless, physical condition still plays a supportive role in supporting athletes' health and mental resilience during long tournaments. Future research can further explore the interaction between physical and cognitive conditions in the context of chess performance, as well as consider other factors that may influence athlete performance. This research makes an important contribution to sports science, particularly in the context of Paralympic sports, and provides valuable insights for athletes, coaches, and policymakers involved in chess programs and similar mind sports. By understanding the factors that truly influence chess performance, we can develop more effective

and inclusive training approaches, ensuring that all athletes, regardless of their physical abilities, have the opportunity to reach their full potential in this sport.

Conclusion

This research shows that the quality of physical condition, particularly flexibility and aerobic capacity, does not have a significant influence on the performance of chess athletes in the 2024 National Paralympic Week (EPARNAS), either in the individual or team categories. The results of the regression analysis indicate that the contribution of these two physical variables to the variation in performance is very low and statistically insignificant. These findings affirm that chess is a sport that relies more on cognitive and mental abilities, such as strategy, concentration, planning, and decision-making, rather than physical condition. Nevertheless, physical condition still plays a supportive role, especially in maintaining mental health and endurance during long tournaments. The implications of this research suggest that chess training programs, particularly for athletes with disabilities, should be more focused on developing cognitive, analytical, and strategic abilities. Physical condition remains important for supporting overall mental performance, but it is not the primary determining factor in chess achievement. This research provides an important contribution to the development of a more holistic and inclusive training approach, and encourages the need for further research exploring the interaction between physical, cognitive, and psychological factors in enhancing chess athlete performance, particularly in the Paralympic context.

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