Publisher: Centre for Behaviour and Wellness Advocacy, Ghana
Co-publisher: Cherkas Global University, USA
Has been issued since 2014
ISSN 2410-4981. E-ISSN 2508-1055
2025. 12(2): 136-147

DOI: 10.13187/jare.2025.2.136

Journal homepage:
http://kadint.net/our-journal.html

Analysing Positional Efficiency of Winning and Losing Male Handball Teams of National Colleges of Education Sports Association (COESA) Games – Kumasi, 2022

Alexander Kweku Eshun [a], Kodwo Owusu [b, *], Charles Inkum [c]

[a] Seventh-Day Adventist College of Education, Agona-Ashanti, Ghana
[b] University of Cape Coast, Cape Coast, Ghana
[c] Our Lady of Apostles College of Education, Cape Coast, Ghana

Abstract

The aim of this study was to analyse the positional efficiency of winning and losing men's handball teams that participated in the National Colleges of Education games held at Kumasi in 2022. Five handball teams, one from each zone, participated in the tournament, which was on an "all play all" basis, each team playing four matches. Data were collected on 12 different positional efficiency variables using observation and videotape. An independent sample t-test (two-tailed) was used for analysis. Results showed that, of the 12 positional efficiency variables compared, there was a statistically significant difference for Wing Attack Shots Unsuccessful, $t(1) = 1.00$, $p = .005$, Fast Break Shots Unsuccessful, $t(1) = -5.46$, $p = .002$ and Total Shots Saved by Goalkeepers, $t(1) = 7.14$, $p = .003$. These three positional efficiency variables primarily contributed to the differences between the teams, placing one far ahead of the others and ultimately determining the tournament winner. Meanwhile, the researchers can conclude that goalkeeping was also a significant factor in determining the game's results. Although there was no significant difference, the mean values for goalkeeping in winning teams were higher than those in losing teams. In effect, teams with good goalkeepers, who make many saves in games, are likely to win their matches. Coaches are therefore encouraged to focus more on improving areas where their teams are most efficient and to adequately prepare their goalkeepers before competitions.

Keywords: Positional efficiency, Team handball, Team performance, Technical play, Transition of Play.

1. Introduction

Team Handball is a highly technical and tactical game that requires players to execute various tactical manoeuvres, including running at top speed with intermittent jogging (Fransson et al., 2018; Struzik, 2020). All these technical and tactical actions are aimed at enhancing a team's chances of winning a particular game. The Colleges of Education Sports Association comprises all 46 public Colleges of Education in Ghana and organises biannual games, rotated among the five zones. The organisation of the Colleges of Education Games is such that, due to the limited number of colleges in a particular region, colleges from two regions combine to organise competitions and form a team to represent the two regions at the national games. Thus, the Central and Western

* Corresponding author
E-mail addresses: kodwo.owusu@ucc.edu.gh (K. Owusu)
Received: 20 November 2024 Revised: 04 December 2024, 30 April 2025
Accepted: 02 August 2025 Published: 31 August 2025

Regions combine to make a team known as CENWEST, the Ashanti Region and Brong Ahafo Regions combine to form ASHBA, the Eastern and Greater Accra Regions combine to form EGA, the three northern regions Northern, Upper East, and West also combine to form NORTH and because the Colleges in the Volta Region were quite a good number it stands as one zone known as VOLTA.

It is worth noting that this occurred when Ghana had ten regions. At the games, men and women compete in various sporting activities for medals. The categories of sporting events are athletics, handball, netball, volleyball, and soccer. Past game records indicate that in handball, the game of interest in this study, ASHBA, CENWEST, and VOLTA have consistently dominated the first three positions for a long time. At the same time, EGA and NORTH have also occasionally performed well, as noted in the 2022 COESA Report.

Structural efficiency indicators in hierarchically organised games can be derived from dimensional, zonal, or positional analyses of players (Gryko et al., 2018). This is primarily a combination of factors that do not stand alone but are interrelated, each building on the others for a successful game analysis. Key among them is the player's preparation capacity, specifically the handball player's preparation before and during competitions (Durlević et al., 2025). This primarily consists of the player's fundamental anthropometric characteristics, which serve as the basis for developing the specific abilities necessary for successful performance during play. In Ghana, few studies have been conducted to enhance handball players' performance (Apaak et al., 2021; Tosho, 2020). Most studies on handball players focus on fitness variables and other parameters, with very few centred on the technical and tactical aspects of the game. Additionally, in our part of the world, there is no established or unified method for collecting data during games.

This study precedes other similar studies that aim to establish certain standards for analysing handball games, particularly in the Colleges of Education and University handball competition settings in Ghana, due to their peculiar nature. Additionally, since very few coaches are willing to make time for such activities during competitions due to their cumbersome nature, the researchers have a view of simplifying them compared to the already established standards (McLean, Mallett, 2012). Observation and video tape analysis of matches play a key role in assessing players and games. This enables coaches to critically examine the games from the point of positional efficiency during play, and it goes a long way in making a comprehensive assessment and informed judgment at the end of games. There has been analysis to assess technical and tactical play during most of a game, but with positional elements of the game in mind, researchers hope to make it a comprehensive activity (Andrienko et al., 2019; Popovych et al., 2021). During the game, coaches and technical teams can record every successful and unsuccessful move players makes such as the total number of goals scored, from different playing positions, percentage use of six-metre shots, fast breaks, goalkeeper save per game, shots from seven-metre and also technical mistakes made like balls passed to opponents, poor defensive recoveries and many others (Memmert, König, 2024). That is how objectively positional indicators of games, as well as the efficiency of players and teams, can be measured. This minimises the subjective assessment of the conditions under which the coach or coaching staff can competently evaluate the contribution of each player in offence or defence to the success or failure of a particular player or the team (Mujika et al., 2018).

It also informs the coaching and technical staff about players who can fit and compete well in a particular game, as opined by Vuleta et al. (2015). The criteria used to assess the actual quality of handball players must provide a positional assessment of the success or effectiveness of the game by each player in relation to the positions of the various phases of the game. Various typical and atypical situations characterise the handball game during play, and for that matter, the need for an objective recognition of certain situations in the game and the parameters of positional effectiveness for each player in competitive conditions (Gryko et al., 2018). By this, we can obtain objective indicators of conditions or the efficiency of players and teams, ensuring that there is minimal or no subjectivity during evaluations.

This study aims to determine the differences between winning and losing male handball teams that participated in the 2022 national COESA games, using indicators of situational efficiency. The research questions which will help to achieve the objectives of this study are:

1. What are the indicators of positional efficiency that differentiated winning and losing men's handball teams during the COESA games in Kumasi 2022?
2. Did the contribution of individual indicators of positional efficiency in the game account for the winning and losing teams during the COESA games in Kumasi 2022?

2. Materials and Methods

Ethical Considerations

Permission was sought from the National Executive of the Colleges of Education Sports Association (COESA), which has oversight responsibility for the games, and was duly granted before the competition. All team coaches and players were informed about the nature of the research and the mode of data collection, including the fact that it would not affect their play, and they provided consent for the researchers to collect the data.

Study Design and Rationale

The study employed a descriptive cross-sectional survey design. This design is suitable because, unlike other observational designs, it offered the researchers the opportunity to achieve our aim of collecting data at a single point to establish preliminary evidence in planning future, advanced studies. Data were collected during the ten days of the games through live match observation and videotape. Four research assistants were placed at positions around the court, where observation would be easy, to use a checklist to assess situational performance during the attack. Two assistants were at different positions, checking for a team at a time. Meanwhile, all games were videotaped, so after each match, the researchers reviewed the footage to cross-check and confirm the data collected in real time.

Population and Sample

The population of this study consisted of all games played by male handball players who participated in the 2022 edition of the National Colleges of Education games, hosted at the Kwame Nkrumah University of Science and Technology campus. There were five zones, each represented by 14 players; teams selected two players for each playing position. The total number of participants was 70 players aged 18 to 24 years, with a range of playing experience of 6 to 9 years. Table 1 below shows the details of participants for each zone. All players had the opportunity to participate, as they either started the game or joined in as substitutes on many occasions.

Table 1. Participants' demographics

Zone	Number	Age	Playing	Playing Positions
ASHBA	14	19-23yrs	6-8yrs	2GK,2LW,2LB,2MB,2LP,2R
CENWEST	14	18-24yrs	7-8yrs	2GK,2LW,2LB,2MB,2LP,2R
EGA	14	19-22yrs	7-9yrs	2GK,2LW,2LB,2MB,2LP,2R
NORTH	14	19-24yrs	6-8yrs	2GK,2LW,2LB,2MB,2LP,2R
VOLTA	14	17-23yrs	7-9yrs	2GK,2LW,2LB,2MB,2LP,2R

Notes: GK-Goalkeeper, LW-Left Wing, LB-Left Back, MB-Middle Back, LP-Line Player, RB-Right Back, RW-Right Wing

Inclusion and Exclusion Criteria

All matches played by the various teams were analysed. Players who played for various teams, regardless of the number of minutes played, were also included as long as they had an opportunity to go on an attack. The study aimed to analyse positional efficiency on attack; for that matter, no consideration was made of defence.

Measures

The research assistants were trained using the checklist. The female group games were used for the training. The researchers took the assistants through data collection with the observation checklist during the female group games of the tournament. Additionally, a series of videotaped matches was shown to the research assistants for them to assess the various positional efficiencies during attack. The research assistants and the researchers were placed in vantage positions during each men's game for data collection. Two research assistants and one researcher collected data for each of the teams while they were on attack. All games were also videotaped, so after each day, the team of researchers reviewed the footage to confirm the data collected during the live matches. Because the games were played on an all-play-all basis, each team played four games, from which various positional efficiency parameters were recorded and analysed. The data concerning the number of successful shots (total number of goals scored) in the competition was confirmed by the

official results presented by the games secretariat. The table below presents the variables and their corresponding measurement methods.

Table 2. Variables and operational definition

Variable	Code	Definition
Six Metre Shots Successful	SMSS	Shots that were taken from just behind the six-metre line and scored
Six Metre Shots Unsuccessful	SMSU	Shots that were taken from just behind the six-metre line that were either thrown out of the goal or saved by the goalkeeper
Seven Metre Shots Successful	SEMSS	Seven-metre (Penalty) shots were awarded during the game and scored
Seven Metre Shots Unsuccessful	SEMSU	Seven metre (Penalty) shots awarded during the game that were either thrown out of the goal post or saved by the goalkeeper
Nine Metre Shots Successful	NMSS	Shots taken from between the seven metre and around the nine metre line that were scored
Nine Metre Shots Unsuccessful	NMSU	Shots taken from between the seven metre and around the nine metre that were either thrown out of the goal post or saved by the goalkeeper
Wing Attack Shots Successful	WASS	Shots taken from either the left or right wing when the team form up there and prepares before shooting and scoring
Wing Attack Shots Unsuccessful	WASU	Shots taken from either the left or right wing when the team form up there and prepares before shooting, and either thrown out of the goal post or saved by the goalkeeper
Fast Break Shots Successful	FBSS	Shots taken from any part of the court as a result of fast breaks and scored
Fast Break Shots Unsuccessful	FBSU	Shots taken from any part of the court as a result of fast breaks, which were either thrown out of the goal post or saved by the goalkeeper
Total Shots Saved by Goalkeepers	TSSG	All unsuccessful shots which were a result of goalkeeper saves
Total Shots Thrown out of Goal	TSTG	All unsuccessful shots which were a result of balls thrown out of the goalpost (either over the top or any of the sides of the goalpost)

Notes: Marks were made with tape 3 metres from the goal line on the six metre line at each corner of the court to differentiate wing attack shots from six metre shots. Shots taken between the two marks were ticked as six-metre shots, while shots made between the goal line and the tape on each side of the court were ticked as wing attack shots.

Data Collection Instruments

Observation checklists in the form of tally sheets were used for data collection. The various positional efficiency variables were written, and spaces were provided for ticking. The research assistants accurately recorded the specific positional efficiency for each team as they completed an attack.

Reliability and Validity

Inter-rater reliability was used to measure the internal consistency of the observation. An inter-rater reliability coefficient of 0.85 indicates good reliability, as the number of agreement scores for the three observers for each team was compared. The researchers can also conclude that the data collected were valid due to the use of appropriate data collection instruments and statistical tests used for analysis. In effect, the researchers had sufficient data and employed the right statistical tools for analysis. Since videotapes and observational checklists are the primary

methods for measuring behaviour or performance, it can be stated that these tools accurately measure the outcomes they were designed to measure.

Competiton Setting

All the teams played on the same outdoor concrete court at the campus of Kwame Nkrumah University of Science and Technology. Morning games were played between 7:00 and 9:00 a.m., and evening games were played from 4:00 to 6:00 p.m. each day. The games were organised in such a way that each team played an equal number of games in the morning and in the evening. The competition was organised under the International Handball Federation rules and was officiated by the officials of the Handball Referees Association, Ghana. The games were played using the standard duration for handball matches, which is two halves of thirty minutes each, followed by a ten-minute rest period. Each team played only one game in a day.

Statistical Analysis

Data analysis was done using SPSS Version 26. A screening was conducted to check for the possibility of missing data and outliers, as well as a normality test, before selecting the analysis tool. The descriptive statistics were analysed using means and standard deviations, and the positional efficiency of the teams was analysed using an independent-samples t-test. All analyses were done with a statistical significance of $p < 0.05$.

3. Results

From Table 3, the results of the various zonal teams for the parametres are presented as follows; for SMSS, the means (M) and standard deviations (SD) are as follows: ASHBA [M = 5.50 and SD = 1.00], EGA [M= 2.25 and SD= 5.00], NORTH [M= 3.50 and SD = 1.00], VOLTA [M = 4.25 and SD = .957]. Considering SMSU, ASHBA had M = 5.75 and SD= .957, EGA had M = 11.00 and SD = .819, NORTH [M = 7.50 and SD = 2.08], VOLTA [M = 5.25 and SD = 5.71]. For SEMSS, ASHBA had M = 3.50 and SD = 1.00, EGA [M = 2.25 and SD = 1.71], NORTH [M = 2.00 and SD = .819], VOLTA [M = 3.00 and SD= 1.41]. With SEMSU, ASHBA had M = 2.25 and SD = .957, EGA had M = 11.00 and SD = .817, NORTH [M = 1.50 and SD = 1.29], VOLTA [M = 2.75 and SD = 1.50]. Also, regarding NMSS, ASHBA had M = 6.00 and SD = 1.16; EGA had M = 5.75 and SD = .957; NORTH had M = 3.75 and SD = .957; and VOLTA had M = 5.00 and SD = 1.41. For NMSU, ASHBA had M = 6.75 and SD = .957; EGA had M = 5.25 and SD = 2.21; NORTH had M = 10.75 and SD = 1.71; and VOLTA had M = 7.75 and SD = 1.26. For WASS, ASHBA had M = 5.50 and SD = 2.38; EGA had M = 7.75 and SD = .957; NORTH had M = 6.50 and SD = 1.29; while VOLTA had M = 5.75 and SD = 1.26.

The result for WASU also showed that ASHBA had M = 7.75 and SD = .957, EGA had M = 9.50 and SD = 1.92, NORTH had M = 11.25 and SD = .957, and VOLTA had M = 8.25 and SD = .957. With FBSS, ASHBA had M = 6.75 and SD = .500; EGA had M = 9.00 and SD = .871; NORTH had M = 7.75 and SD = .957; and VOLTA had M = 7.00 and SD = 1.63. For FBSU, ASHBA had M = 5.00 and SD = .817; EGA had M = 4.75 and SD = 1.71; NORTH had M = 11.50 and SD = 1.91; while VOLTA had M = 5.00 and SD = .817. TSSG, ASHBA had M = 9.25 and SD = .500; EGA had M = 10.25 and SD = .957; NORTH had M = 4.00 and SD = .817; VOLTA had M = 12.50 and SD = 2.38. Finally, TSTG, ASHBA had M = 10.50 and SD = 2.87; EGA had M = 12.25 and SD = 2.87; NORTH had M = 14.50 and SD = 2.08; and VOLTA had M = 8.25 and SD = .95.

Table 3. Descriptive statistics of the positional efficiency variables

Zone	Variable	N	Min	Max	Mean	+/_ Score
ASHBA	SMSS	4	4	6	5.50	1.00
	SMSU	4	5	7	5.75	.957
	SEMSS	4	2	4	3.50	1.00
	SEMSU	4	1	3	2.25	.957
	NMSS	4	5	7	6.00	1.16
	NMSU	4	6	8	6.75	.957
	WASS	4	4	9	5.50	2.38
	WASU	4	7	9	7.75	.957
	FBSS	4	6	7	6.75	.500
	FBSU	4	4	6	5.00	.817

Zone	Variable	N	Min	Max	Mean	+/_ Score
	TSSG	4	9	10	9.25	.500
	TSTG	4	8	12	10.50	1.73
EGA	SMSS	4	2	3	2.25	5.00
	SMSU	4	10	2	11.00	.817
	SEMSS	4	0	4	2.25	1.71
	SEMSU	4	2	4	3.00	.817
	NMSS	4	5	7	5.75	.957
	NMSU	4	3	8	5.25	2.21
	WASS	4	7	9	7.75	.957
	WASU	4	7	11	9.50	1.92
	FBSS	4	8	10	9.00	.871
	FBSU	4	3	7	4.75	1.71
	TSSG	4	9	11	10.25	.957
	TSTG	4	10	10	12.25	2.87
NORTH	SMSS	4	3	5	3.50	1.00
	SMSU	4	5	10	7.50	2.08
	SEMSS	4	1	3	2.00	.817
	SEMSU	4	0	3	1.50	1.29
	NMSS	4	3	5	3.75	.957
	NMSU	4	9	13	10.75	1.71
	WASS	4	5	8	6.50	1.29
	WASU	4	10	12	11.25	.957
	FBSS	4	7	9	7.75	.957
	FBSU	4	10	14	11.50	1.91
	TSSG	4	3	5	4.00	.817
	TSTG	4	13	17	14.50	2.08
VOLTA	SMSS	4	3	5	4.25	.957
	SMSU	4	3	7	5.25	1.71
	SEMSS	4	1	4	3.00	1.41
	SEMSU	4	1	4	2.75	1.50
	NMSS	4	3	6	5.00	1.41
	NMSU	4	6	9	7.75	1.26
	WASS	4	7	7	5.75	1.26
	WASU	4	7	9	8.25	.957
	FBSS	4	5	9	7.00	1.63
	FBSU	4	4	6	5.00	.817
	TSSG	4	10	15	12.50	2.38
	TSTG	4	7	9	8.25	.957

Based on Table 4, the independent-samples t-test was used to compare the results for the first pair of winning and losing teams: the first-placed zone, VOLTA, and the bottom-placed zone, NORTH. The results showed a statistically significant difference between the two zones for WASU, t(1) = 1.00, p = .005 [VOLTA, M = 8.25; NORTH, M = 11.25], FBSU, t(1) = -5.46, p = .002 [VOLTA, M = 5.00; NORTH, M = 11.50], and TSSG, t(1) = 7.14, p = .003 [VOLTA, M = 12.50; NORTH, M = 4.00]. Meanwhile, there was no statistically significant difference for all the other positional variables: SMSS, t(1) = 1.00, p = .391 [VOLTA, M = 4.25; NORTH, M = 3.50]; SMSU, t(1) = -1.45, p = .242 [VOLTA, M = 5.25; NORTH, M = 7.50]; NMSS, t(1) = 2.61, p = .080 [VOLTA, M = 5.00; NORTH, M = 3.75]; NMSU, t(1) = -2.04, p = .134 [VOLTA, M = 7.75; NORTH, M = 10.75]; WASS, t(1) = -1.57, p = .251 [VOLTA, M = 5.75; NORTH, M = 6.50]; FBSS, t(1) = -0.600, p = .591 [VOLTA, M = 7.00; NORTH, M = 7.75]; and finally, TSTG, t(1) = -4.25, p = .018 [VOLTA, M = 8.25; NORTH, M = 14.50].

Table 4. Independent sample *t*-test for VOLTA and NORTH

Zones	Variable	Mean	+/- Score	t	Sig.
VOLTA/NORTH	SMSS	.750	1.50	1.00	.391
	SMSU	-2.25	3.10	-1.45	.242
	SEMSS	1.00	1.63	1.22	.308
	SEMSU	1.25	1.71	1.46	.239
	NMSS	1.25	.957	2.61	.080
	NMSU	-3.00	.817	-2.04	.134
	WASS	-.750	.957	-1.57	.251
	WASU	-3.00	.817	-7.35	.005
	FBSS	-.750	2.50	-.600	.591
	FBSU	-6.50	2.38	-5.46	.002
	TSSG	8.50	2.38	7.14	.003
	TSTG	-6.25	2.63	-4.75	.018

Table 5 shows the test results for the second pair of winning and losing teams, which included the first-placed zone for the tournament, VOLTA, and the second-placed team from the bottom-placed zone, EGA. Results indicated a statistically significant difference between the two zones: SMSU, t(1) = -5.17, p = .004 [VOLTA had M = 5.25, EGA had M = 11.00]. Similarly, TSTG, t(1) = -1.67, p = .003 [VOLTA had M = 8.25, EGA had M = 12.25], and TSTG again, t(1) = 1.67, p = .003. No statistically significant difference was found between the teams: SMSS, t(1) = 1.00, p = .391 [VOLTA had M = 4.25, EGA had M = 2.25], SMSS, t(1) = 1.22, p = .308 [VOLTA had M = 3.00, EGA had M = 2.25], NMSS, t(1) = -1.57, p = .215 [VOLTA had M = 5.00, EGA had M = 5.75], NMSU, t(1) = 1.73, p = .182 [VOLTA had M = 7.75, EGA had M = 5.25], WASS, t(1) = -1.85, p = .161 [VOLTA had M = 5.75, EGA had M = 7.75], WASU, t(1) = -1.67, p = .194 [VOLTA had M = 8.25, EGA had M = 9.50], FBSS, t(1) = -2.19, p = .116 [VOLTA had M = 7.00, EGA had M = 9.00], FBSU, t(1) = 1.32, p = .278 [VOLTA had M = 5.00, EGA had M = 4.75], and TSSG, t(1) = 1.06, p = .367 [VOLTA had M = 12.50, EGA had M = 10.25].

Table 5. Independent Sample t-test for VOLTA and EGA

Zones	Variable	Mean	+/_ Score	T	Sig.
VOLTA/EGA	SMSS	2.00	.817	4.90	.016
	SMSU	-5.75	2.22	-5.17	.004
	SEMSS	.750	2.22	.676	.457
	SEMSU	-.250	2.06	-.234	.824
	NMSS	-.750	.957	-1.57	.215
	NMSU	2.50	2.89	1.73	.182
	WASS	-2.00	2.16	-1.85	.161
	WASU	-1.25	1.50	-1.67	.194
	FBSS	-2.00	1.83	-2.19	.116
	FBSU	1.25	1.90	1.32	.278
	TSSG	1.75	3.30	1.06	.367
	TSTG	-3.50	4.20	-1.67	.003

Table 6 also presents the test results for the third pair of winning and losing teams and compares the second-placed zone for the tournament, ASHBA, with the bottom-placed zone, NORTH. Results showed that there was a statistically significant difference between the two zones for NMSS, $t(1) = 9.00$, $p = .003$ [ASHBA had M = 6.00, NORTH had M = 3.75] and NMSU, $t(1) = -9.80$, P = .002 [ASHBA had M = 6.75, NORTH had M = 10.75], WASU, $t(1) = -4.04$, $p = .002$ [ASHBA had M = 7.75, NORTH had M = 11.25], FBSU, $t(1) = -10.98$, $p = .002$ [ASHBA had M = 5.00, NORTH had M = 11.50], TSSG, $t(1) = 8.88$, p = .003, [ASHBA had M = 9.25, NORTH had M = 4.00].

Conversely, no statistically significant difference was observed between the teams as follows: SMSS, t(1) = 3.46, p = .041 [ASHBA had M = 5.50, NORTH had M = 3.50]; SMSU, t(1) = -5.77, p = .604 [ASHBA had M = 5.75, NORTH had M = 7.50]; SEMSS, t(1) = 5.20, p = .014 [ASHBA had M = 3.50, NORTH had M = 2.00]; SEMSU, t(1) = .676, p = .547 [ASHBA had M = 2.25, NORTH had M = 1.50]; WASS, t(1) = -.679, p = .546 [ASHBA had M = 5.50, NORTH had M = 6.50]; FBSS, t(1) = -2.45, p = .092 [ASHBA had M = 6.75, NORTH had M = 7.75]; and finally, TSTG, t(1) = -2.75, p = .069 [ASHBA had M = 10.50, NORTH had M = 14.50].

Table 6. Independent Sample t-test for ASHBA and NORTH

Zones	Variable	Mean	+/- Score	t	Sig.
ASHBA/NORTH	SMSS	2.00	1.16	3.46	.041
	SMSU	-5.00	1.73	-5.77	.604
	SEMSS	1.50	.577	5.20	.014
	SEMSU	.250	2.22	.676	.547
	NMSS	2.25	.500	9.00	.003
	NMSU	-4.00	.816	-9.80	.002
	WASS	-1.00	2.94	-.679	.546
	WASU	-3.50	1.73	-4.04	.002
	FBSS	-1.00	.817	-2.45	.092
	FBSU	-5.52	.957	-10.98	.002
	TSSG	4.24	.957	8.88	.003
	TSTG	-3.00	2.16	-2.78	.069

From Table 7, the test results for the fourth pair of winning and losing teams, the second-placed zone for the tournament, ASHBA, and the second-placed from the bottom, EGA, are presented. The table shows a statistically significant difference between the two zones only for SMSU, t(1) = -21.00, p < .001, where ASHBA had a mean of 5.75, and EGA had a Mean of 11.00. Similarly, for SMSS, t(1) = 6.79, p = .005, with means of 5.50 for ASHBA and 2.25 for EGA. No statistically significant differences were found between the teams in other comparisons: SEMSS, t(1) = 1.00, p = .391, with means of 3.50 for ASHBA and 2.25 for EGA; SEMSU, t(1) = -0.878, p = .444, with means of 2.25 and 3.00 respectively; NMSS, t(1) = 1.00, p = .391, with means of 6.00 and 5.75; NMSU, t(1) = 1.72, p = .182, with means of 6.75 and 5.25; WASS, t(1) = -1.45, p = .242, with means of 5.50 and 7.75; WASU, t(1) = -1.33, p = .275, with means of 7.75 and 9.50; FBSS, t(1) = -4.70, p = .018, with means of 6.75 and 9.00; FBSU, t(1) = .212, p = .846, with means of 5.00 and 4.75. For TSSG, the results were t(1) = -1.41, p not specified, with means of 9.25 for ASHBA and 10.25 for EGA. Lastly, the Total TSTG showed t(1) = -1.22, p = .310, with means of 10.50 for ASHBA and 12.25 for EGA.

Table 7. Independent Sample t-test for ASHBA and EGA

Zones	Variable	Mean	+/- Score	t	Sig.
ASHBA/EGA	SMSS	3.25	.957	6.79	.005
	SMSU	-5.25	.500	-21.00	<.001
	SEMSS	1.25	2.50	1.00	.391
	SEMSU	.750	1.71	-.878	.444
	NMSS	.250	.500	1.00	.391
	NMSU	1.50	1.73	1.72	.182
	WASS	-2.25	3.10	-1.45	.242
	WASU	-1.75	2.63	-1.33	.275
	FBSS	-2.25	.957	-4.70	.018
	FBSU	.250	2.36	.212	.846
	TSSG	-1.00	1.41	-1.41	.252
	TSTG	-1.75	2.87	-1.22	.310

4. Discussion

The study examined the positional efficiency of winning and losing men's handball teams that participated in the Colleges of Education Sports Association Games held in September 2022. The objective was to identify indicators of positional efficiency for both winning and losing teams, as well as the contribution of these individual indicators to the teams' victories or defeats during the competition. Analysis revealed that, for the first pair of winning and losing teams, three out of the twelve positional indicator variables contributed to the difference between them: Wing Attack Shots Unsuccessful, Fast Break Shots Unsuccessful, and Total Shots Saved by Goalkeepers. This finding contradicts the results of Milanović et al. (2018) and Sporiš et al. (2015), who analysed 80 matches of the World Handball Championship (Egypt 1999) and found a significant relationship between match outcome and all positional efficiency variables.

Meanwhile, the current study concurs with that of Vuleta and Spurious (2015), who found that only variables associated with positional efficiency, specifically the frequency of shots at certain positions, had a significant impact on match results. These variables included the position of external attackers, ranging from individual actions to passing and counterattacks. Rogul (2000) analysed differences between successful and unsuccessful teams in 80 matches from the same competition, using 27 positional-efficiency parameters in the defence and attack stages. A statistically significant difference was found in only two discriminatory factors (Number of Goals Scored, Efficiency of the implementation of attack, Efficiency of players in the defence, and Positional Performance of Goalkeeper Defence). He stated that the variable that most affected the negative outcome of the matches was the number of unsuccessful shots.

Knowledge of the handball player, positional or situational and action efficiency parameters of the handball player, which are determined by all situations that occur in the game or a whole competition, and finally, the handball player's competitive impact have also been identified as a contributory factor to best results during competitions (Foreti et al., 2013). Data for parameters related to positional efficiency can be collected using various methods during the competition. It can also be done subsequently after the game if a videotape of the match is taken. When two teams meet in a contest, the game may produce similar but not identical development or outcomes (Vuleta et al., 2015). By analysing the indicators arising from a particular handball game, we can assess the positional or situational effectiveness of the game and its players.

This finding will enable coaches to identify elements that produce good results and are likely to contribute to improved performance in future games. Conversely, it allows coaches to identify factors that hinder performance by analysing such indicators (Callinan et al., 2023). Researchers therefore examine various positional efficiencies, for instance, during attack, defence, and the entire transition of play in a particular handball match. Based on recorded indicators, coaches can effectively assess the contributions of each player's successful and unsuccessful actions during attack or defence (Fasold, Redlich, 2018). Þorgeirsson (2024) analysed the differences between successful and unsuccessful teams in 80 matches of the same competition by using 27 parameters of positional efficiency in defence and attack stages. A statistically significant difference was found in two discriminatory factors (Number of Goals Scored, Efficiency of attack implementation, Efficiency of players in defence, and Positional Performance of Goalkeeper Defence). A variable that particularly influenced the negative outcome in most matches was the number of unsuccessful shots from the external position. Rogulj et al. (2004) examined the contribution of individual parameters of situational and positional efficiency to the outcome of handball matches at the 1999 World Handball Championship for men in Egypt. Ten official situational efficiency parameters in defence showed a statistically significant difference in distinguishing successful from unsuccessful teams.

In this sense, the authors specifically highlighted the efficiency of goalkeepers' shot defences from an external position. Rogulj et al. (2004) analysed the efficiency parameters of 19 elements of the collective skill games in the attack phase for both successful and unsuccessful men's teams competing in the Croatian championship during the 1998/99 season. The duration, continuity, systematic organisation, and spatial orientation of different attacks were found to have contributed to the success of collective tactics in both successful and unsuccessful teams (Ferrari et al., 2020).

Modern, organised parameters of competitive activities in sports serve as the basis for comparative analysis of athletes and teams, and this is very important because they provide a comprehensive understanding that informs coaches on how to prepare for the off-season, pre-

season, and in-season. It also enables coaches to identify the best positions for their players to achieve effective performance and how to rotate players for specific games, especially in competitions that span a long period (Fernandez-Echeverria et al., 2017). Consequently, it will create a clear picture for the coach of the part of the court where his or her team is most effective, thereby utilising it to achieve success in competitions. Applying positional analysis to the processes of modern handball training regimes, competitions, and other team sports is crucial and indispensable in achieving better results for players and teams (Holenco, 2020; Masanovic et al., 2018; Shalar et al., 2018).

5. Conclusion

In a team handball game, the outcome of a match depends on several factors, including players' characteristics and the nature of the competition. The characteristics of players on a specific team determine how efficient they are at certain parts of the court, thereby enhancing efficiency in one position or another. During the competition that is being discussed, researchers observed that the key positional efficiency that made a difference in most matches was goalkeeping. The goalkeeper's success in saving shots determines most match results, with teams having the most goalkeeper saves winning their games (Hatzimanouil et al., 2022; Hatzimanouil et al., 2017). The next positional efficiency that determined game results was the success rate of fast-break shots. Teams that were observed not to be utilising this particular variable successfully lost most of their games. Coaches who handle handball teams for the various zones and handball coaches in general must therefore plan well to maximise the particular position(s) where they are more efficient to have the best out of their teams in subsequent tournaments to win most games to annex the ultimate trophy.

6. Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki and was approved by the National Colleges of Education Association, the organising body of the competition. Additionally, coaches of the various teams and their players were informed of the research's nature before data collection during the matches.

Consent for publication

All authors read through and approved the final copy of this manuscript and agree to be accountable for every aspect of the work. We are therefore confident that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved before it is submitted for publication.

Availability of data and materials

Data and materials for the study can be obtained from the corresponding author.

Conflict of interest

The authors declare that they have no conflict of interest.

Funding

The authors received no funding for the production, presentation, and publication of this paper. However, the authors sincerely thank the Centre for Behaviour and Wellness Advocacy, Ghana, for providing financial support through the Institutional Open Access Publication Fund.

Authors' Contributions

AKE: conceptualisation, methodology, data analysis, original draft, review and editing.
KO: data curation, review and editing, supervision, funding,
CI: methodology, data curation, writing, review and editing.

Acknowledgment

The authors would like to express their appreciation to all coaches and research assistants who helped in conducting this study.

Authors' ORCID

Alexander Kweku Eshun https://orcid.org/0000-0001-7701-8186
Kodwo Owusu https://orcid.org/0000-0002-4054-8551
Charles Inkum https://orcid.org/0009-0001-0584-1971

References

Andrienko et al., 2019 – *Andrienko, G., Andrienko, N., Anzer, G., Bauer, P., Budziak, G., Fuchs, G., ... , Wrobel, S.* (2019). Constructing spaces and times for tactical analysis in football. *IEEE Transactions on Visualization and Computer Graphics*. 27(4): 2280-2297.

Apaak et al., 2021 – *Apaak, D., Anim, S., Sorkpor, R. S.* (2021). Relationship between physical fitness variables and playing ability among handball players in Senior High Schools in Central Region, Ghana. *International Journal of Sports Science and Physical Education.* 6(4): 80-86.

Callinan et al., 2023 – *Callinan, M.J., Connor, J.D., Sinclair, W.H., Leicht, A.S.* (2023). Exploring rugby coaches perception and implementation of performance analytics. *PloS One:* 18(1): e0280799.

Durlević et al., 2025 – *Durlević, S., Marković, I., Durlević, M.* (2025). Physical preparation of handball players. *Journal of Anthropology of Sport and Physical Education*. 9(2): 9-14.

Fernandez-Echeverria et al., 2017– *Fernández-Echeverría, C., Conejero, M., Claver, F., González-Silva, J., Moreno, P.* (2017). Match analysis within the coaching process: A critical tool to improve coach efficacy. *International Journal of Performance Analysis in Sport*. 17(1-2): 149-163.

Fasold et al., 2018 – *Fasold, F., Redlich, D.* (2018). Foul or no foul? Effects of permitted fouls on the defense performance in team handball. *Journal of Human Kinetics*. 63: 53. DOI: 10.2478/hukin-2018-0006

Ferrari et al., 2020 – *Ferrari, W., Dias, G., Sousa, T., Sarmento, H., Vaz, V.* (2020). Comparative analysis of the offensive effectiveness in winner and losing handball teams. *Frontiers in Psychology*. 11: 547110.

Forreti et al., 2013 – *Foreti, N., Rogulj, N., Papi, V.* (2013). An empirical model for evaluating situational efficiency in top-level handball. *International Journal of Performance Analysis in Sport*. 13(2): 275-293. DOI: 10. 1080/24748668.2013.11868648

Foretic et al., 2010 – *Foretic, N., Rogulj, N., Trninic, N.* (2010) The influence of situation efficiency on the result of a handball match. *Sport Sci.* 3: 45-51.

Fransson et al., 2018 – *Fransson, D., Vigh-Larsen, J.F., Fatouros, I.G., Krustrup, P., Mohr, M.* (2018). Fatigue responses in various muscle groups in well-trained competitive male players after a simulated soccer game. *Journal of Human Kinetics*. 61(1): 85-97. DOI:10.1515/hukin-2017-0129

Gryko et al., 2018 – *Gryko, K., Mikołajec, K., Maszczyk, A., Cao, R., Adamczyk, J.G.* (2018). Structural analysis of shooting performance in elite basketball players during FIBA Euro Basket 2015. *International Journal of Performance Analysis in Sport*. 18(2): 380-392 DOI:10.1080/ 24748668.2018.1479923

Hatzimanouil et al., 2022 – Performance analysis of goalkeepers and final team rankings in men's international handball championships. *Journal of Physical Education and Sport*. 22(8): 1905-1914.

Hatzimanouil et al., 2017 – *Hatzimanouil, D., Giatsis, G., Kepesidou, M., Kanioglou, A., Loizos, N.* (2017). Shot effectiveness by playing position with regard to goalkeeper's efficiency in team handball. *Journal of Physical Education and Sport*. 17(2): 656.

Ivasic-Kos et al., 2019 – *Ivasic-Kos, M., Pobar, M., Gonzàlez, J.* (2019). Active player detection in handball videos using optical flow and STIP-based measures. *13th International Conference on Signal Processing and Communication Systems (ICSPCS)* (1-8). IEEE.

McLean et al., 2012 – *McLean, K.N., Mallett, C.J.* (2012). What motivates the motivators? An examination of sports coaches. *Physical Education & Sport Pedagogy*. 17(1): 21-35.

Masanovic et al., 2018 – *Masanovic, B., Milosevic, Z., Corluka, M.* (2018). Comparative study of anthropometric measurement and body composition between junior handball and volleyball players from the Serbian National League. *International Journal of Morphology*. 39(1): 287-293. DOI: 10.4067/S0717-95022021000100287

Memmert et al., 2024 – *Memmert, D., König, S.* (2024). The Mental Game: Cognitive Training, Creativity, and Game Intelligence in Handball. Meyer & Meyer Sport.

Milanovic et al., 2018 – *Milanović, D., Vuleta, D., Ohnjec, K.* (2018). Performance indicators of winning and defeated female handball teams in matches of the 2012 Olympic Games tournament. *Journal of Human Kinetics*. 64(1): 247-253. DOI: 10.1515/hukin-2017-0198

Mujika et al., 2018 – *Mujika, I., Halson, S., Burke, L., M., Balague, G.* (2018). An integrated, multifactoral approach to periodization for optimal performance in individual and team sports.

International Journal of Sports Physiology and Performance. 13(5): 538-561 DOI: 10.1123/ijspp.2018-00093

Popovych et al., 2021 – *Popovych, I., Shcherbak, T., Kuzikova, S., Blynova, O., Nosov, P., Zinchenko, S.* (2021). Operationalization of tactical thinking of football players by main game roles. *Journal of Physical Education and Sport*. 21(5): 2480-2491.

Þorgeirsson, 2024 – Þorgeirsson, S. (2024). Game-related statistics: Comparing and predicting winners and losers in handball and beach handball (Doctoral dissertation, University of Split, Faculty of Kinesiology).

Rogulj, 2000 – *Rogulj, N*. (2000). Differences in situation-related indicators of the handball game about the achieved competitive results of teams at 1999 World Championship in Egypt. *Kinesiology*. 32(2): 63-74.

Rogulj, 2004 – *Rogulj, N., Srhoj, V., &Srhoj, L*. (2004). The contribution of collective attack tactics in differentiating handball score efficiency. Collegium antropologicum. 28(2): 739-746.

Shalar et al., 2020 – *Shalar, O., Strykalenko, Y., Huzar, V., Yuskiv, S., Silvestrova, H., Holenco, N*. (2020). The correlation between intelligence and competitive activities of elite female handball players. *Journal of Physical Education and Sport*. 20(1): 63-70. DOI: 10.7752/ jpes.2020.01008

Struzik, 2020 – *Struzik, A.* (2020). The handball goalkeeper–characteristics of the position, play, techniques, training. *Central European Journal of Sport Sciences and Medicine*. 32(4): 97-113. DOI: 10.18276/cej.2020.4-10

Tosho, 2020 – Tosho, S. (2020). Effects of anthropometric variables on sport performance of male university champion-handballers in West Africa (Nigeria). *Journal of Indonesian Physical Education and Sport*. 6(2): 26-35.

Vuleta et al., 2000 – *Vuleta, D., Milanović, D., Sertić, H., Jukić, I.* (2000). Latent structure of the spatial, phasic, positional, and movement characteristics of the handball game. Paper presented at the 5th Annual Congress of the European College of Sport Science.

Vuleta et al., 2003 – *Vuleta, D., Milanović, D., Sertić, H*. (2003). The relationship between variables of shooting on goal with the final result in a handball match of the European Champ. in 2000 for men. *Kinesiology*. 35(2): 168-183.

Vuleta et al., 2012 – *Vuleta, D., Sporiš, G., Purgar, B., Herceg, Z. Milanović, Z.* (2012). Influence of attacking efficiency on the outcome of handball matches in the preliminary round of men's Olimpic games 2008. *Sport Sci*. 5(2): 7-12

Vuleta et al., 2015 – *Vuleta, D., Sporiš, G., Milanović, D.* (2015). Indicators of situational efficiency of winning and defeated male handball teams in matches at the Olympic Tournament 2012. *Actakinesiologica*. 9(1): 40-49.

Vukosavljevic et al., 2015 – *Vukosavljevic, J., Kocić, M., Beric, D., Stojić, M*. (2015). The Situation Success in The Handball. *Facta*. 13(1): 97-105.