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Evaluation of Goalkeepers' Performance via Grey Relational Analysis Method: Example of Africa Cup of Nations

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Abstract

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Aim: The aim of the study is to evaluate the technical performance of goalkeepers via the gray relational analysis method. **Materials and Method:** The sample of the study consisted of 21 goalkeepers competing in the African Cup of Nations 2023. Data was obtained from the official website of the Confederation of African Football and Transfermarkt. Technical performance indicators were determined as "save percentage", "claimed crosses" and "passing accuracy". The data were evaluated by the grey relational analysis method among the quantitative research methods. In this context, six steps of the grey relational analysis method were applied respectively. These are "preparation of the data set and generation of the decision matrix", "normalization of the data", "generation of the reference series", "generation of the absolute value table", "generation of the grey relational coefficient matrix", "calculation and ranking of the grey relational degrees". **Results:** According to the analysis results, the highest technical performance value was calculated as 0.7654, while the lowest technical performance value was calculated as 0.3949. Thus, the top 3 goalkeepers were determined as Ronwen Williams (South Africa), Edouard Mendy (Senegal), and Babacar Niass (Mauritania). The last 3 goalkeepers were determined as Richard Ofori (Ghana), Ibrahim Koné (Guinea), and Baboucarr Gaye (Gambia). **Conclusion:** According to the results of the research, Ronwen Williams (South Africa), who won the Golden Glove Award and was selected for the team of the tournament at the Africa Cup of Nations, was determined as the goalkeeper with the highest performance. His national team South Africa completed the tournament in 3rd place, despite being ranked 19th among 24 teams in terms of market value. Similar conclusions were obtained for the remained goalkeepers. It is expected that this conclusion will provide significant contributions for stakeholders such as researchers, goalkeepers, coaches, scouts, and trainers.

Kaleci Performanslarının Gri İlişkisel Analiz Yöntemiyle Değerlendirilmesi: Afrika Uluslar Kupası 2023 Örneği

Özet

Yayın Bilgisi
Gönderi Tarihi: 16.02.2024
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Kaleci Performansı, Afrika Uluslar Kupası, Performans Değerlendirme

Amaç: Çalışmanın amacı, kalecilerin teknik performanslarının gri ilişkisel analiz yöntemiyle değerlendirilmesidir. **Gereç ve Yöntem:** Çalışmanın örneklemini Afrika Uluslar Kupası 2023'te mücadele eden 21 kaleci oluşturmuştur. Veriler Afrika Futbol Konfederasyonu'nun resmî web sitesinden ve Transfermarkt üzerinden elde edilmiştir. Teknik performans göstergeleri "kurtarış yüzdesi", "karşılanan orta sayısı" ve "başarılı pas yüzdesi" olarak belirlenmiştir. Veriler nicel araştırma yöntemleri arasından gri ilişkisel analiz yöntemiyle değerlendirilmiştir. Bu bağlamda, gri ilişkisel analiz yönteminin altı adımı sırasıyla uygulanmıştır. Bunlar; "veri setinin hazırlanması ve karar matrisinin oluşturulması", "verilerin normalize edilmesi", "referans serisinin oluşturulması", "mutlak değer tablosunun oluşturulması", "gri ilişkisel katsayı matrisinin oluşturulması", "gri ilişkisel derecelerin hesaplanması ve sıralanması"dır. **Bulgular:** Analiz sonuçlarına göre en yüksek teknik performans değeri 0,7654 iken en düşük performans değeri 0.3949 olarak hesaplanmıştır. Böylece ilk 3 kaleci Ronwen Williams (Güney Afrika), Edouard Mendy (Senegal) ve Babacar Niass (Moritanya) olarak belirlenmiştir. Son 3 kaleci Richard Ofori (Gana), Ibrahim Koné (Gine) ve Baboucarr Gaye (Gambiya) olarak tespit edilmiştir. **Sonuç:** Araştırma sonucuna göre Afrika Uluslar Kupası'nda Altın Eldiven Ödülü'nü kazanan ve turnuvanın takımına seçilen Ronwen Williams (Güney Afrika) en yüksek performansa sahip kaleci olarak belirlenmiştir. Güney Afrika milli takımı piyasa değeri açısından 24 takım arasında 19. sırada yer almasına rağmen turnuvayı 3. sırada tamamlamıştır. Kalan kaleciler için de benzer sonuçlar elde edilmiştir. Bu sonucun araştırmacılar, kaleciler, antrenörler, gözlemciler ve antrenörler gibi paydaşlara önemli katkılar sağlaması beklenmektedir.

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Introduction

The market size of the goalkeepers (GKs) has become a significant amount. Currently, the total market value of the top 40 GKs is around 1 billion €. When the accumulated transfer fee history of the GKs was examined, the total amount is also 1 billion € for the top 25 up to now. Only the top 10 transfer fees were paid to GKs in the transfer season of 2023/2024 around 220 million € (URL-1). These stats show the crucial importance and value of the GKs in football.

The goalkeeper (GK) is a unique position in football teams because it is the position only permitted to handle the ball (White et al., 2018). It effects the rhythm and direction of the team (West, 2018), onfinal result of the game (Perez-Arroniz et al., 2023; Tienza-Valverde et al., 2023), , and the team's success directly by any minor mistake (Seaton & Campos, 2011). There are several duties of the GK in football. The GK should perform in both defensive and offensive ways. On one hand, the GK aims to save the shots and claim the crosses, on the other hand, endeavors to distribute the ball accurately (Ziv & Lidor, 2011). In other words, the purposes of the goalkeeper are to defend (Shilton, 1998) and prevent the goal (Santos et al., 2022), distribute the ball (Seaton and Campos, 2011) and construct the attack (Shafizadeh et al., 2015).

There are various studies in the literature that evaluate the technical performances of goalkeepers. (e.g. Gavião, 2021; Mikikis et al., 2021; Sainz de Baranda et al., 2019; Serrano et al., 2019; West, 2018; Liu et al., 2015). Tienza-Valverde et al. (2023) examined these studies evaluating the performances of goalkeepers in terms of technical way and indicated that the variables such as percentage of goals prevented, number of successful passes, passing effectiveness, percentage of successful passes, number of saves, passing accuracy, effectiveness of ball distribution were used in these studies. Studies have shown that the variables shots on goal, crosses, and successful passes affect the match outcome (win, draw, loss) in the UEFA Champions League (Lago-Peñas et al., 2011) and the Spanish Football League (Lago-Peñas et al., 2010). Based on this information, the performances of the goalkeepers were evaluated by using the variables "save percentage", "claimed crosses" and "passing accuracy" in this study.

Although there are some studies mentioned above that evaluate the technical performances of GKs, the number of studies that used grey relational analysis (GRA) for this purpose is very few (e.g. Karaatlı & Dağ, 2015). GRA was generally used in the football field for purposes such as evaluation of technical performance of teams (Ecemiş et al., 2021; Bin et al., 2011) or financial performance of clubs (Aydoğan, 2022; Kevser & Doğan, 2022; Pradhan et al., 2017; Oral, 2016; Ecer & Böyükaslan, 2014; Sakınç, 2014). In this context, it was tried to fill this gap in the literature through this study which applied the GRA to more specific units such as players rather than teams.

The unique value of this study is the evaluation of GKs performances using grey relational analysis (GRA) and the ranking of goalkeepers. Moreover, the selection of the sample (AFCON 2023) also contributes to uniqueness because it is an international tournament that is current and organized quadrennially. As a matter of fact, the Grey System Theory, developed by Deng (1982), proposes a new methodology for solving problems involving small samples and incomplete information. (Deng, 1989). One of the application areas of this theory, which adopts the GRA method, is sports sciences. (Zhang, 1986). In

this context, “What are the performance levels of the goalkeepers competing in AFCON 2023?” was determined as the research question of the study.

Materials and Method

In this descriptive research, a general survey design, one of the quantitative research designs, was used. The data are longitudinal and the unit of analysis is the individual. In the general survey design, the characteristics of the sample included in the research on a specific subject can be determined. (Gürbüz & Şahin, 2018).

Research Group

The population of the research consisted of 31 GKs competing in the African Cup of Nations (AFCON). Each team that competed in AFCON played three matches in the group stage. The inclusion criteria for this study have thus been defined as goalkeepers having participated in a minimum of three matches. Additionally, although a GK (Neblú) played three matches, he was excluded from the scope of the research because he received a red card in the 17th minute of the fourth match. Thus, a total of 10 GKs were excluded from the scope and the sample of the research consisted of 21 GKs. Descriptive information about GKs is included in Table 1. Accordingly, the average age of goalkeepers is 29 and the average market value is 2,500,000€. In addition, the market values of the GKs’ national teams are also included in the relevant table.

Tablo 1. Demographics of the goalkeepers (GKs).

No	Team	Team Value (€)	Name – Surname	Age	Market Value (€)
1	Côte d'Ivoire	335.000.000	Yahia Fofana	23	2.500.000
2	Guinea-Bissau	26.000.000	Ouparine Djoco*	25	300.000
3	Nigeria	332.000.000	Stanley Nwabali	27	250.000
4	Equatorial Guinea	10.000.000	Jesús Owono	22	200.000
5	Egypt	136.000.000	Mohamed El-Shenawy	35	2.500.000
6	Mozambique	25.000.000	Ernani*	25	75.000
7	Ghana	196.000.000	Richard Ofori	30	800.000
8	Cabo Verde	27.000.000	Vozinha	37	75.000
9	Senegal	263.000.000	Edouard Mendy	31	10.000.000
10	Gambia	42.000.000	Baboucarr Gaye	25	200.000
11	Cameroon	140.000.000	Fabrice Ondoa	28	300.000
12	Guinea	89.000.000	Ibrahim Koné	34	150.000
13	Algeria	190.000.000	Anthony Mandrea	27	2.000.000
14	Angola	22.000.000	Neblú*	30	250.000
15	Burkina Faso	100.000.000	Kouakou Koffi	27	1.300.000
16	Mauritania	12.000.000	Babacar Niass	27	400.000
17	Tunisia	63.000.000	Bechir Ben Said	29	1.000.000
18	Namibia	6.000.000	Lloyd Kazapua	34	25.000
19	Mali	142.000.000	Djigui Diarra	28	200.000
20	South Africa	23.000.000	Ronwen Williams	32	1.100.000
21	Morocco	348.000.000	Yassine Bounou	32	11.000.000
22	Tanzania	7.000.000	Aishi Manula	28	150.000
23	Congo DR	111.000.000	Lionel M'Pasi N'Zau	29	700.000
24	Zambia	34.000.000	Lawrence Mulenga	25	100.000
25	Cameroon	140.000.000	André Onana*	27	40.000.000
26	Guinea-Bissau	26.000.000	Jonas Mendes*	34	75.000
27	Mozambique	25.000.000	Ivane*	27	75.000
28	Angola	22.000.000	Antonio Signori*	29	200.000
29	Nigeria	332.000.000	Uzoho*	25	450.000
30	Egypt	136.000.000	Mohamed Abou Gabal*	35	800.000
31	Congo DR	111.000.000	Dimitry Bertaud*	25	1.200.000

Note: the sign of “*” was used to indicate excluded GKs.

Data Collection

Within the scope of the research data, the ages of the GKs, their market values, and the total market values of the national teams were obtained through Transfermarkt. GKs information and performance indicators (save percentage, claimed crosses, and passing accuracy per match) were collected on the website of the Confederation of African Football between 12 and 13 February.

Data Collection Tools

The above-mentioned websites (Transfermarkt and Cafonline) were used as the primary data source in the research (URL-1; URL-2). Thus, the required data for the analysis was obtained and these data were recorded through Word and Excel documents by the author. The criteria determined as performance indicators are shown in Table 2.

Table 2. Performance criteria

No	Code	Criteria	Aim
1	SP	Save percentage per match	Maksimum
2	CC	Claimed crosses per match	Maksimum
3	PA	Passing accuracy per match	Maksimum

Analysis of the Data

The GRA method was used to analyze the data. The steps taken within the scope of the analysis are as follows: (Tutak & Brodny, 2023; Chen et al., 2022; Rehman & Rehman, 2022; Özdemir & Kılıçarslan, 2021)

- *Step 1:* "Preparation of the data set and generation of the decision matrix",
- *Step 2:* "Normalization of the data",
- *Step 3:* "Generation of the reference series",
- *Step 4:* "Generation of the absolute value table",
- *Step 5:* "Generation of the grey relational coefficient matrix",
- *Step 6:* "Calculation and ranking of the grey relational degrees".

1. Step: Preparation of the data set and generation of the decision matrix: First, alternatives and criteria are determined. Then, a matrix consisting of the determined criteria and alternatives is prepared. In the decision matrix, m is the alternative and n is the number of criteria.

$$X = \begin{bmatrix} x_1(1) & x_1(2) & \dots & x_1(m) \\ x_2(1) & x_2(2) & \dots & x_2(m) \\ \dots & \dots & \dots & \dots \\ x_n(1) & x_n(2) & \dots & x_n(m) \end{bmatrix}$$

2. Step: Normalization of the data: In normalization of the data, in other words, in standardization, equation (1) is used for benefit-based criteria, equation (2) is used for cost-based criteria, and equation (3) is used for optimal-based criteria.

$$X_{ij} = \frac{y_{ij} - \mathrm{Min}\{y_{ij},\, i=1,2,\dots,m\}}{\mathrm{Max}\{y_{ij},\, i=1,2,\dots,m\} - \mathrm{Min}\{y_{ij},\, i=1,2,\dots,m\}} \quad (1)$$

$$X_{ij} = \frac{\mathrm{Max}\{y_{ij},\, i=1,2,\dots,m\} - y_{ij}}{\mathrm{Max}\{y_{ij},\, i=1,2,\dots,m\} - \mathrm{Min}\{y_{ij},\, i=1,2,\dots m\}} \quad (2)$$

$$X_{ij} = 1 - \frac{|y_{ij} - y_j^*|}{\mathrm{Max}\left\{\mathrm{Max}\{y_{ij},\, i=1,2\dots,m\} - y_{ij}^*, y_{ij}^* - \mathrm{Min}\{y_{ij}, i=1,2,\dots,m\}\right\}} \quad (3)$$

i= 1,2, …., m. j= 1,2, …., n

3. Step: Generation of the reference series: The reference series is generated by considering the maximum value for benefit-indexed criteria and minimum value for cost-indexed criteria in the relevant column in the decision matrix.

4. Step: Generation of the absolute value table: The absolute value Δ_{ij} between x_0 and x_i is calculated with the help of equation (4).

$$\Delta_{ij} = |x_{0j} - x_{ij}| \quad (4)$$
$$\Delta_{min} = Min\{\Delta_{ij}, i = 1,2,\dots,m; j = 1,2,\dots,n\}$$
$$\Delta_{max} = Max\{\Delta_{ij}, i = 1,2,\dots,m; j = 1,2,\dots,n\}$$

5. Step: Generation of the grey relational coefficient matrix: The grey relational coefficient is used to determine how close X_{ij} is to x_{0j}. The larger the grey relational coefficient, the closer X_{ij} and x_{0j} are. The grey relational coefficient can be calculated with the help of equation (5).

$$\gamma(x_{0j}, x_{ij}) = \frac{\Delta_{min} + \zeta\Delta_{max}}{\Delta_{ij} + \zeta\Delta_{max}} \quad (5)$$

$$i = 1,2, \dots, m; \; j = 1,2, \dots, n$$

Here ζ (0) is known as the discriminant coefficient or discriminability index. The smaller ζ is, the higher its discriminability. In most cases, ζ takes the value 0.5 because this value is generally a medium level of discrimination and provides good stability.

6. Step: Calculation and ranking of the grey relational degrees: If the evaluation is made considering the criteria are of equal importance, the grey relational degree is calculated and ranked with the help of equation (6).

$$\Gamma_{oi} = \frac{1}{n}\sum_{j=1}^{n}\gamma_{oi}(j) \quad (6)$$

Results

The findings of the research are presented in six steps applied within the scope of GRA. These steps are “preparation of the data set and generation of the decision matrix”, "normalization of the data", "generation of the reference series", "generation of the absolute value table", "generation of the grey relational coefficient matrix" ve "calculation and ranking of the grey relational degrees.

Step 1: Preparation of the data set and generation of the decision matrix

First, the data set was prepared with the alternatives and criteria presented in Table 1 and Table 2 above. Then, the decision matrix was generated with this data set. The relevant decision matrix is presented in Table 3.

Table 3. Decision matrix

Alternatives	Maximum SP	Maximum CC	Maximum PA
Yahia Fofana	56,00	0,40	71,00
Stanley Nwabali	75,00	0,70	63,00
Jesús Owono	76,00	1,30	51,00
Mohamed El-Shenawy	22,00	0,00	93,00
Richard Ofori	53,00	0,70	59,00
Vozinha	68,00	1,40	67,00
Edouard Mendy	69,00	2,00	78,00
Baboucarr Gaye	52,00	0,30	44,00
Fabrice Ondoa	57,00	0,30	65,00
Ibrahim Koné	17,00	1,20	59,00

Anthony Mandrea	40,00	0,30	82,00
Kouakou Koffi	68,00	0,50	66,00
Babacar Niass	76,00	2,00	44,00
Bechir Ben Said	58,00	0,00	72,00
Lloyd Kazapua	69,00	0,80	59,00
Djigui Diarra	62,00	0,20	67,00
Ronwen Williams	93,00	1,70	71,00
Yassine Bounou	61,00	0,80	76,00
Aishi Manula	77,00	0,70	77,00
Lionel M'Pasi N'Zau	52,00	0,50	76,00
Lawrence Mulenga	72,00	0,00	78,00

Step 2: Normalization of the data

Equation (1) was utilized to normalize the criteria (performance indicators). The normalized decision matrix is shown in Table 4.

Table 4. Normalized decision matrix

Alternatives	Maximum SP	Maximum CC	Maximum PA
Yahia Fofana	0,5132	0,2000	0,5510
Stanley Nwabali	0,7632	0,3500	0,3878
Jesús Owono	0,7763	0,6500	0,1429
Mohamed El-Shenawy	0,0658	0,0000	1,0000
Richard Ofori	0,4737	0,3500	0,3061
Vozinha	0,6711	0,7000	0,4694
Edouard Mendy	0,6842	1,0000	0,6939
Baboucarr Gaye	0,4605	0,1500	0,0000
Fabrice Ondoa	0,5263	0,1500	0,4286
Ibrahim Koné	0,0000	0,6000	0,3061
Anthony Mandrea	0,3026	0,1500	0,7755
Kouakou Koffi	0,6711	0,2500	0,4490
Babacar Niass	0,7763	1,0000	0,0000
Bechir Ben Said	0,5395	0,0000	0,5714
Lloyd Kazapua	0,6842	0,4000	0,3061
Djigui Diarra	0,5921	0,1000	0,4694
Ronwen Williams	1,0000	0,8500	0,5510
Yassine Bounou	0,5789	0,4000	0,6531
Aishi Manula	0,7895	0,3500	0,6735
Lionel M'Pasi N'Zau	0,4605	0,2500	0,6531
Lawrence Mulenga	0,7237	0,0000	0,6939
Reference Series	1,0000	1,0000	1,0000

Step 3: Generation of the reference series

A reference series was created by taking the maximum value in the column for the benefit-indexed criteria in the normalized decision matrix. The created reference series is located in the bottom row of Table 4.

Step 4: Generation of the absolute value table

The absolute value table was generated with the help of equation (4). The absolute value table obtained by subtracting normalized values from reference values is presented in Table 5.

Table 5. Absolute value table

Alternatives	Maximum SP	Maximum CC	Maximum PA
Yahia Fofana	0,4868	0,8000	0,4490
Stanley Nwabali	0,2368	0,6500	0,6122
Jesús Owono	0,2237	0,3500	0,8571
Mohamed El-Shenawy	0,9342	1,0000	0,0000
Richard Ofori	0,5263	0,6500	0,6939
Vozinha	0,3289	0,3000	0,5306
Edouard Mendy	0,3158	0,0000	0,3061
Baboucarr Gaye	0,5395	0,8500	1,0000
Fabrice Ondoa	0,4737	0,8500	0,5714
Ibrahim Koné	1,0000	0,4000	0,6939
Anthony Mandrea	0,6974	0,8500	0,2245

Kouakou Koffi	0,3289	0,7500	0,5510
Babacar Niass	0,2237	0,0000	1,0000
Bechir Ben Said	0,4605	1,0000	0,4286
Lloyd Kazapua	0,3158	0,6000	0,6939
Djigui Diarra	0,4079	0,9000	0,5306
Ronwen Williams	0,0000	0,1500	0,4490
Yassine Bounou	0,4211	0,6000	0,3469
Aishi Manula	0,2105	0,6500	0,3265
Lionel M'Pasi N'Zau	0,5395	0,7500	0,3469
Lawrence Mulenga	0,2763	1,0000	0,3061

Step 5: Generation of the grey relational coefficient matrix

The grey relational coefficient matrix was calculated with the help of equation (5). The coefficient matrix generated as a result of the relevant calculations is presented in Table 6.

Table 6. The grey relational coefficient matrix

Alternatives	Maximum SP	Maximum CC	Maximum PA
Yahia Fofana	0,5067	0,3846	0,5269
Stanley Nwabali	0,6786	0,4348	0,4495
Jesús Owono	0,6909	0,5882	0,3684
Mohamed El-Shenawy	0,3486	0,3333	1,0000
Richard Ofori	0,4872	0,4348	0,4188
Vozinha	0,6032	0,6250	0,4851
Edouard Mendy	0,6129	1,0000	0,6203
Baboucarr Gaye	0,4810	0,3704	0,3333
Fabrice Ondoa	0,5135	0,3704	0,4667
Ibrahim Koné	0,3333	0,5556	0,4188
Anthony Mandrea	0,4176	0,3704	0,6901
Kouakou Koffi	0,6032	0,4000	0,4757
Babacar Niass	0,6909	1,0000	0,3333
Bechir Ben Said	0,5205	0,3333	0,5385
Lloyd Kazapua	0,6129	0,4545	0,4188
Djigui Diarra	0,5507	0,3571	0,4851
Ronwen Williams	1,0000	0,7692	0,5269
Yassine Bounou	0,5429	0,4545	0,5904
Aishi Manula	0,7037	0,4348	0,6049
Lionel M'Pasi N'Zau	0,4810	0,4000	0,5904
Lawrence Mulenga	0,6441	0,3333	0,6203

Step 6: Calculation and ranking of the grey relational degrees

Equation (6) was utilized to calculate grey relational degrees. The performance ranking of the alternatives (GKs), where all criteria (performance indicators) are of equal importance without any weighting, is presented in Table 7.

Table 7. Grey relational degrees and ranking

Rank	National Team	Goalkeeper	Grey Relational Degree
1	South Africa	Ronwen Williams	0,7654
2	Senegal	Edouard Mendy	0,7444
3	Mauritania	Babacar Niass	0,6747
4	Tanzania	Aishi Manula	0,5811
5	Cabo Verde	Vozinha	0,5711
6	Egypt	Mohamed El-Shenawy	0,5607
7	Equatorial Guinea	Jesús Owono	0,5492
8	Zambia	Lawrence Mulenga	0,5326
9	Morocco	Yassine Bounou	0,5293
10	Nigeria	Stanley Nwabali	0,5210
11	Namibia	Lloyd Kazapua	0,4954
12	Burkina Faso	Kouakou Koffi	0,4930
13	Algeria	Anthony Mandrea	0,4927
14	Congo DR	Lionel M'Pasi N'Zau	0,4905
15	Ivory Coast	Yahia Fofana	0,4727
16	Mali	Djigui Diarra	0,4643
17	Tunisia	Bechir Ben Said	0,4641
18	Cameroon	Fabrice Ondoa	0,4502
19	Ghana	Richard Ofori	0,4469

20	Guinea	Ibrahim Koné	0,4359
21	Gambia	Baboucarr Gaye	0,3949

The performance scores of the goalkeepers were between 0.7654 and 0.3949 as seen in Table 7. According to the results of the ranking, the top 5 highest-performing GKs who competed in AFCON are Ronwen Williams, Edouard Mendy, Babacar Niass, Aishi Manula, and Vozinha, while the lowest-performing goalkeepers are Baboucarr Gaye, Ibrahim. Koné, Richard Ofori, Fabrice Ondoa, and Bechir Ben Said.

Discussion and Conclusion

In this study, where the performances of GKs competing in AFCON were evaluated using the GRA method, the best-performing goalkeeper was determined to be Ronwen Williams. As a result of the tournament, Ronwen Williams was awarded the "Ecobank The Best Goalkeeper" and he was selected for the team of the tournament (URL-2). This situation supports the research result. In addition, Ronwen Williams was the GK with the highest save rate with 93% per match and ranked third place with 1.7 claimed crosses per match in this field. His national team South Africa completed the tournament in 3rd place, despite being ranked 19th among 24 teams in terms of market value.

Edouard Mendy ranked 2nd place according to the results of the research. He shared the first place with Babacar Niass with 2 claimed crosses per match in this field. He ranked third place with %78 in passing accuracy per match. His national team Senegal completed the group stage in first place with 9 points and was eliminated by Ivory Coast (winner of the tournament) on penalties. Furthermore, Mendy was the second most valuable GK in AFCON with his €10,000,000 market value.

Babacar Niass ranked 3rd place according to the results of the research. He shared the first place with Edouard Mendy with 2 claimed crosses per match in this field. His national team Mauritania ranked 21st with a total market value of €12,000,000 among 24 teams. Although Mauritania competed with opponents with a huge amount of market value in the group stage (Burkina Faso-100,000,000€ and Algeria-190,000,000€), they succeeded in qualifying from the group stage.

Baboucarr Gaye was the GK with the lowest performance according to the results of the research. He had the lowest passing accuracy with 44%. He ranked 17th place in the save percentage field with 52%, and 16th place in claimed crosses with 0.3 per match. His national team Gambia was defeated in all group matches and completed the group stage in last place. Ibrahim Koné was the second GK with the lowest performance according to the results of the research. He ranked last in the save percentage field with 17%. He ranked 18th in the field of passing accuracy with 59%. Richard Ofori was the third GK with the lowest performance according to the results of the research. He ranked 16th in the save percentage field with 53% and 18th in the passing accuracy field with 59%. Even though his national team Ghana was the fifth most valuable team participating in the tournament with a market value of €196,000,000, but was eliminated in the group stage.

In addition to ranking GKs' performance and interpretation of its connection with national team performances, it is important to compare this study with similar studies in the literature. In this context, Karaatlı and Dağ (2018) selected the goalkeepers from the Turkish National Team pool for the National Team squad. In their study, the GRA method was also used and the data contained the years between 2011

and 2017. Accordingly, the goalkeeper with the highest ranking was determined as Volkan Demirel. Volkan Demirel is the second goalkeeper with the most caps in the history of the Turkish National Team, after Rüştü Reçber (who was not included in the scope of the research because he retired in 2012) with 63 caps (URL-3). This shows that their results support this study in terms of methodological way. Therefore, GRA can be considered as a useful analysis to rank or select GKs.

Alp (2005) ranked the performances of the goalkeepers who competed in the 2002 World Cup by using the data envelopment analysis method. According to the efficient GKs ranking generated according to the results of his research, Tunisian National team goalkeeper "Ali Boumnıjel" ranked first. However, the Tunisian National Team completed the group stage in the last position and was eliminated from the tournament with only 1 point. Although German National Team goalkeeper Oliver Kahn, who was awarded the Golden Ball by the International Federation of Association Football (FIFA) as a result of the tournament (URL-4) and his team completed the tournament in 2nd place, he was the 5th GK in the efficient GKs ranking list according to the results of his study. Moreover, Oliver Kahn was ranked second in the top 10 players list published by Four Four Two magazine (URL-5). This shows a significant difference between the results obtained in his study and the opinions of football authorities. However, in this study conducted with the GRA method, there is harmony between the results obtained and the opinions of football authorities. The difference in the criteria and analysis methods used in both studies may be the reason for this contrast.

In this study, the performances of the GKs who competed in AFCON 2023 were ranked by using the GRA method. According to the results obtained, the focus was on the three goalkeepers with the highest performance and the three goalkeepers with the lowest performance. As a result of this analysis, various convergencies were revealed in terms of variables such as the performance ranking of GKs and the individual awards given, the performances of national teams and market values. Thus, the suitability of the determined performance indicators was also supported.

This study provides significant contributions to the scientific field. Primarily, GRA was applied to a more specific unit (GKs) of football industry while previous studies were focused on units (Aydoğan, 2022; Kevser & Doğan, 2022; Ecemiş et al., 2021; Pradhan et al., 2017; Oral, 2016; Ecer & Böyükaslan, 2014; Sakınç, 2014; Bin et al., 2011) such as national teams or clubs as a whole. Secondarily, this study increases the limited number of studies that utilized GRA to evaluate and rank GKs (e.g. Karaatlı & Dağ, 2015). Finally, it paved the way for future studies to use GRA on the unit of players.

Recommendations

- The criteria in this study can be tested on different tournaments because the conclusion of the study is consistent with the football authorities' decisions.
- The number of matches examined can be increased by testing the study on leagues because the tournaments are short-term competitions. Data from longer-term competitions would provide solid results for the analysis.
- Various indicators can be added in addition to the performance indicators included in this study because this study is limited to three indicators which were provided by the official website of the

tournament as goalkeeping skills. However, there are also different factors that affect the performance of the players during the match.

- Performance indicators can be weighted by performing a similar study with different methods such as ENTROPY, SWARA, CRITIC, or Order techniques. Thus, different methods would be utilized such as MAIRCA, WASPAS, and so on as an analysis.
- Similar studies can be carried out by determining performance criteria for different positions (striker, midfielder, defender, etc.). In this way, the application field of the GRA in football would be enlarged and various performance indicators for different positions would be strengthened.

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