

GPS-based performance analysis in amateur football: Match evaluation relative to players' tactical roles

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Abstract

The aim of this study was to assess the physical performance of amateur football players based on their positional roles in official matches of the *Greek Amateur Regional League* 2022-2023. Eighteen players (mean age 25.8±5.3 years) from two teams were included, with data from 85 match-play instances across 18 official matches analyzed. Players were categorized according to their team's formation according to their team's formation, comprising of nineteen Center Backs (CB), nineteen (n=19) Full Backs (FB), seventeen Central Midfielders (CM), seventeen Forwards (F), and thirteen Wide Midfielders-Wingers (WM). The covered distances of the starting line-up outfield players who completed the 90min in their team's matches were recorded in five intensity zones. For the comparison of the independent variables ("positional role", "match location" and "match outcome" in relation to the "intensity zones"), the multivariate analysis of variance was used (GLM) along with the post-hoc *Bonferroni* test. The descriptive statistics presented that the amount of the covered distances by the amateur players were 8654±897m in home and 8900±844m in away matches. The MANOVA recorded significant differences in the covered distances in all match-play intensity zones in relation to the positional role of the studied players. In addition, the MANOVA showed no significant differences in amateur players' match-play performance in all intensity zones regarding the match location. Similarly, the statistics showed no significant differences in amateur players' match-play performance in all intensity zones regarding the match winning or losing outcome. In conclusion, the present study proved that the contextual variables, such as in-season match location or match outcome, could equally differentiate the match play performance across all positions of the studied amateur players.

Keywords: league, tactics, formation, goal.

Introduction

Football is considered the most popular sport in the world and is played by men, women and children within competitive and non-competitive environments throughout every continent. Traditionally, soccer training has tended to focus primarily on the technical and tactical development of players to the detriment of their physical profile. It has also been acknowledged that the soccer players' performance is complicated and multifactorial depending on factors such as the players' technics, physical conditioning and psychology (Bangsbo, 1999). Furthermore, in order to identify the soccer players' physical demands during the training and the match, the internal and external workouts regarding the players' position or in relation to the team formation must be assessed (Bradley & Noakes, 2013). Thus, science-based technology offers the opportunity for a more qualitative analysis, through internal (e.g heart rate) and external exertion records [through the recordings of covered distances with different running intensities, acceleration or deceleration, change of direction, energy cost, etc.] (Redwood-Brown, Cranton, & Sunderland, 2012).

Thus, several studies have attempted to detect these elements of exertion in soccer matches and training in order to highlight the necessary parameters for a more qualitative team's and individual preparation (Mujika et al., 2009; Hands & Janse De Jonge, 2020). Indeed, the work-rate profile of the contemporary match analysis is based on the positional roles of the players according to the team formation. The physiological parameter reflects the metabolic demands in soccer (Esposito et al., 2004) and can be used to determine the differences of the players' physical conditioning profile in relation to their team's playing style (Alli & Farraly, 1999; Drust, Atkinson, & Reilly, 2007). Thus, in modern soccer the most demanding positional role in internal and external loads during the match is the midfielders and the wingers (Lago-Penas, 2012). The in-season evaluation in elite clubs across European national leagues showed that the playing zones of the above players are supramaximal covering more than 12000m per official match (Gregson et al., 2010).

Nowadays, a great increase in Global Positioning System (GPS) technology has been applied in professional soccer. A great number of studies were applied in professional or elite soccer by using the GPS technology in order to record the team's individual competitive or training performance (Casamichana, Castellano, Castagna,

2012; Lago-Penas, 2012). In the contrary, limited bibliography exists regarding college or semi-professional players' internal and external loadings in training and in official match (Izzo & Varde'I, 2017; Izzo, De Vanna, & Varde'I, 2018). Furthermore, there are no studies regarding the amateur players' physical performance, possibly due to the high cost of the GPS equipment to buy from an amateur team. Nevertheless, it is of same importance with the professional players, to record the conditioning demands of the amateur players connecting with the contextual factor such as match location, match-status or level of opposition. In addition, there is limited data to analyze the training or match internal or external workouts relating to each separate tactical position of amateur players during in-season matches of their teams in a league (Izzo & Carrozzo, 2015).

Furthermore, there are recent studies that compare the match-play performance of professional players in Greek Leagues with the contextual factors, such as match status or match location (Ispyrlidis et al., 2020; Mitrotasios et al., 2021). According to our knowledge, there is not any study to record the performance of amateur players in a number of official matches in Greece in relation to their tactical position in real-time with the use of soccer-specific technology. Thus, the research hypothesis is based on the assumption that the match-play performance of the amateur players differs from the professional players' performance in relation to their tactical position, match location and match outcome. The aim of this study was to evaluate the match-play performance of the players in relation to their positional role and contextual factors in the official matches of their teams during the *Greek Amateur Regional League 2022-2023*.

Methods

Participants

Eighteen (n=18) amateur players, members of two teams aged 25.8±5.3 years, were recorded in this study. Their match-play performance was analyzed in 18 official matches (home & away) during the 1st division in *Greek Amateur Regional League* in 2022-2023. The studied players had at least 5 years of training experience and the majority of them were members of semi-professional Greek teams in the past. In addition, all the participants were notified about research design and its requirements along with the potential benefits and risks. In addition, the players signed a written consent that was based on the Declaration of Helsinki.

Data collection

The external loads of the starting line-up outfield players who completed the 90min in their team's matches were analyzed. In addition, the contextual factors of match location and match outcome were evaluated. Eighty-five (85) match-play measurements were recorded in relation to the players' positional role in their team. More specifically, their measurements per tactical positions during the *Greek Amateur Regional League* of the season 2022-2023 were 19 for Central Defenders, 19 for Full-Backs, 17 for Central Midfielders, 17 for Forwards and 13 for Wide Midfielders/Wingers. Each player wore a portable transmitter in a personal vest recording the match-play parameters during their official matches from the entire season of 20 weeks. The selected position-specific data from the amateur players were recorded electronically using the portable Polar Team Pro system ([©]*Polar Electro, Sports instruments, Kempele, Finland*). The studied sample wore a high-frequency 10 Hz GPS, 200 Hz MEMS motion tracking sensor in a personal vest for the evaluation of the physical parameters: distances covered (m) with running speeds of:

- i. 0–7.99km.h⁻¹
- ii. 8–14.39km.h⁻¹
- iii. 14.4–19.79km.h⁻¹
- iv. 19.8–24.99km.h⁻¹
- v. >25km.h⁻¹

Statistical analysis

Descriptive statistics were calculated for each variable including means (M) and standard deviations (±SD). The normal distribution of the data was verified using the *Shapiro-Wilk* test ($p>.05$) and the homoscedasticity was confirmed by *Levene's test*. It is worth noticing, that, where the performance variables were not normally distributed or the homoscedasticity was violated, non-parametric test were conducted (*Kruskal-Wallis test*) to verify whether there were significant group differences. For the comparison of the independent variables ("positional role", "match location" and "match outcome") in relation to the "intensity zones" of the players covered distances, the multivariate analysis of variance was used (GLM). The effect size (η^2) was estimated [in accordance to *Cohen*: the Effect Size (ES) graded as small (ES):0.01; medium ES:0.06; large ES:0.13] while the pair-wise comparisons were performed by using the post-hoc *Bonferroni* test. The level of significance was set as $p < 0.05$. The analysis was performed with the use of IBM SPSS v26.0 statistics software (IBM, USA).

Results

The MANOVA showed significant differences in the covered distances in all match-play intensity zones in relation to the positional role of the studied players (Wilks' Lambda = 0,332, $F_{(16,220)} = 5.994$, $p=0,000$, $\eta^2=0,449$). The results presented that Central Midfielders and Wide Midfielders covered a greater amount of distances, in almost all intensity zones, in relation to Central Defenders and Forward players [$F_{(4,191)}=25,368$, $p<.000$]. Particularly, Central Defenders covered significantly greater amount of distances during their matches

(9462±563m) in comparison to other tactical positions. Moreover, the total distances covered by Full-Backs were 9153±565m, Wide Midfielders/Wingers 8915±512m, Forwards 8746±512m and Central Backs 7623±283m. More specifically, in the match-playing zone 2 (15-20km.h⁻¹), Central Midfielders and Full-Backs covered significantly greater amount of high intensity distances (884±270m & 877±234m respectively) in relation to the positional roles of Wide Midfielders/Wingers (809±226m), Forwards (774±211m) and Central Defenders (648±111m). The table 1 presents the match-play performance in all intensity zones of the studied amateur players in relation to their tactical position.

Table 1: Covered distances in all intensity zones in relation to the amateur players' tactical positions (mean±SD)

Variables	TOTAL (N=85)		CD (N=19)		FB (N=19)		CM (N=17)		F (N=17)		W (N=13)		F-TEST	Sig.	η ²
	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD	Mean	±SD			
Distance (m)	8754,9	878,5	7622,6	283,4	9153,2	564,5	9461,8**	563,1	8745,9	908,9	8915,4	512,3	F _(4,75) =21,874	p=.000	.538
Z1	7610,2	686,9	6732,6	257,4	7852,1	357,0	8267,6*	308,5	7630,0	795,9	7653,8	337,6	F _(4,75) =23,401	p=.000	.555
Z2	795,9	228,5	647,9	111,2	876,8	233,7	883,5	270,2	773,5	211,3	808,5	226,2	F _(4,75) =3,298	p=.015	.150
Z3	285,5	117,8	206,3	89,4	329,5	88,5	270,6	142,9	280,0	121,8	363,8	80,2	F _(4,75) =3,869	p=.007	.171
Z4	63,29	60,403	35,8	29,7	94,7	53,3	40,0	28,3	62,4	69,4	89,2	90,6	F _(4,75) =3,359	p=.014	.152

Notes: sig. p<.05*, p<.01**

Effect size (η²): <.30=small effect. .30-.50=medium effect. >.50=large effect

Abbreviations: Central Defender (CD), Full Backs (FB), Central Midfielders (CM), Forwards (F), Wide Midf.-Wingers (W)

Zone 1 (Z1)= Distance Speed Range (0-15km.h⁻¹), Zone 2 (Z2)= Distance Speed Range (15-20km.h⁻¹), Zone 3 (Z3)= Distance Speed Range (20-25km.h⁻¹), Zone 4 (Z4)= Distance Speed Range (>25km.h⁻¹)

Regarding the match location, during the amateur league the descriptive statistics presented that the amount of distance covered by the players were 8654±897m in home and 8900±844m in away matches. The MANOVA did not present significant differences in amateur players' match-play performance in all intensity zones regarding the match location (Wilks' Lambda = 0.954; F_(4,72) = .878; p=0.482; η²=0.046). Particularly, in the playing zone 2 (15-20km.h⁻¹) the players' performance was marginally, but not significant higher (p=0.83) in away matches (812±220m) in relation to the home matches of their team (785±236m). Similarly, in the intensity match-play zone 3 (20-25km.h⁻¹) the studied players' running performance was recorded higher but without significance (p=0.87) in away matches (294±97m) in relation to home matches of their teams (280±131m). Also, the multiple comparisons did not show any significant difference either in the players positional role and the match location or their covered distances in all intensity zones (Wilks' Lambda = 0.844; F_(16,220) = .789; p=0.697; η²=0.042). The table 2 illustrates the amateur players' match-play performance in all monitoring intensity zones in home and away matches of their teams.

Table 2: Match-play performance of the amateur players in relation to the match location (mean±SD)

Variables	HOME (N=50)		AWAY (N=35)		F-TEST	Sig.	η ²
	Mean	±SD	Mean	±SD			
Total Distance (m)	8653,6	896,6	8899,7	843,4	F _(1,75) =.704	p=.404	.009
Z1	7521,8	702,0	7736,6	653,9	F _(1,75) =1.153	p=.286	.015
Z2	784,4	235,8	812,3	219,9	F _(1,75) =.048	p=.826	.001
Z3	279,8	131,3	293,7	96,6	F _(1,75) =.027	p=.869	.000
Z4	67,6	68,9	57,1	46,0	F _(1,75) =1.231	p=.271	.016

Effect size (η²): <.30=small effect. .30-.50=medium effect. >.50=large effect

Abbreviations: Zone 1 (Z1)= Distance Speed Range (0-15km.h⁻¹), Zone 2 (Z2)= Distance Speed Range (15-20km.h⁻¹), Zone 3 (Z3)= Distance Speed Range (20-25km.h⁻¹), Zone 4 (Z4)= Distance Speed Range (>25km.h⁻¹)

Moreover, the total covered distance by the players in the winning matches were 8644±858m and 8868±876m in losing matches of their teams. The MANOVA showed no significant differences in the amateur players' match-play performance in all intensity zones regarding the match winning or losing outcome (Wilks' Lambda = 0.998; F_(1,69) = 2.197; p=0.143; η²=0.031). More specifically, in the intensity zone 2 (15-20km.h⁻¹), the players' running performance was marginally, but not significant higher (p=0.72) in losing matches (837±220m) in relation to the winning matches of their teams (742±206m). Similarly, in the intensity match-play zone 3 (20-25km.h⁻¹) competitive performance of the players was recorded higher but without significance (p=0.50) in losing matches (294±122m) in relation to the winning matches (282±111m). The table 3 presents the amateur players' covered distances in relation to the match-outcome of their teams.

Table 3: Covered distances of the amateur players in relation to the match outcome (mean±SD)

Variables	WIN (N=42)		LOSS (N=37)		F-TEST	Sig.	η^2
	Mean	±SD	Mean	±SD			
Total Distance (m)	8643,3	858,1	8867,8	875,3	$F_{(1,69)}=2.197$	p=.143	.031
Z1	7552,9	685,3	7677,8	714,3	$F_{(1,69)}=.898$	p=.347	.013
Z2	741,9	205,7	836,5	220,1	$F_{(1,69)}=3.335$	p=.072	.046
Z3	282,1	110,7	293,8	121,8	$F_{(1,69)}=.471$	p=.495	.007
Z4	66,4	62,1	59,7	59,6	$F_{(1,69)}=.060$	p=.808	.001

Effect size (η^2): <.30=small effect. .30-.50=medium effect. >.50=large effect

Abbreviations: Zone 1 (Z1)=Distance Speed Range (0-15km.h⁻¹), Zone 2 (Z2)=Distance Speed Range (15-20km.h⁻¹), Zone 3 (Z3)=Distance Speed Range (20-25km.h⁻¹), Zone 4 (Z4)=Distance Speed Range (>25km.h⁻¹)

Discussion

Match-play performance in relation to the players' tactical position

From the results, it was shown that the mean covered distances by the players during the match were 8756±879m. The above is in accordance with the literature, which states that the mean covered distances by young or amateur players in an official match ranged from 8500m to 9500m (Castellano, Blanco-Villasenor & Alvarez, 2011). However, the most important result is that the majority of their match-play performance (7610±687m) represents running speed from 0 to 15km.h⁻¹. This low intensity playing performance is in conjunction with the bibliography that reports that the matches in amateur leagues are not a high demanding workout (Viera et al., 2019). Similarly, the performance of the studied amateur players during the official matches was recorded as low as 796±229m for the zone 15-20km.h⁻¹, 286±118m for the zone 20-25km.h⁻¹ and just 63.3±60.4m in the very high intensity zone >25km.h⁻¹. However, one of the most prominent finding from this performance analysis study was the great differences in match-play covered distances in all intensity zones among the various playing positions of the amateur players. According to similar studies, which compared the five most-common tactical positions, it is clear that Central Midfielders (9462±563m) and Full-Backs (9153±565m) cover a greater amount of distances than any other positions. In accordance with the bibliography, this study confirms that Wide Midfielders/Wingers (8915±512m), Forwards (8746±909m) and Central Defenders (7623±284m) consistently show lower intensity position-specific physical performance during the matches (Di Salvo et al., 2007; Bradley & Noakes, 2013).

Match-play performance of the players in relation to the match location

According to the finding of this study, the players' mean match-play performance ranged from 8654min in home matches to 8900m in away matches. Referring to the relevant literature, this amount of covered distances per match of the studied amateur players, is close but lower than professional players' (more than 10000m) or to high-level players' who cover more than 11500m (Smalley, Bishop & Maloney, 2022). Thus, the above finding is in accordance with the bibliography that states that the covered distances in young, semi-professional or amateur players during the official matches are recorded from 8000m to 9500m (Modric et al., 2019). In addition, the marginally better match-play performance of the amateur players in away instead of home matches is in accordance with the literature, which confirms that the match location strongly affects the activity profile of the players regardless of their level (Izzo & Carrozzo, 2015). More specifically, the recorded distances covered by the amateur players in their teams' matches were quite higher in away matches in both 15-20km.h⁻¹ intensity zone (812m) and 20-25km.h⁻¹ playing zone (294m). In reference to the *Greek* leagues, the findings of this study, which is the first one ever conducted in amateur teams, must be compared with the studies derived from *Greek Superleague* and *Superleague 2* teams. For this reason, the match-play performance of the amateur players, as expected, is lower than the standards of professional players' performance in both home and away official matches in *Greek* professional leagues (Smpokos, Mourikis & Linardakis, 2018). Moreover, the professional players participating in *Greek* teams accumulate a greater amount of match covered distances in both high playing zone intensities from 20 to 25km.h⁻¹ and very high playing intensity >25km.h⁻¹ than the amateur players of this study.

Match-play performance of the players in relation to the match outcome

Regarding the contextual factors, this study proved that the covered distances by the amateur players during their official matches were greater in losing conditions (8868m) rather than in winning situations (8644m). The above findings are in conjunction with the soccer bibliography, which confirms that elevated work rate is reported during losses, enhancing the competitive level of the players in order to change the match outcome (Hennessy & Jeffreys, 2018). In contrary, there is a number of studies that showed that the winning situation increases the competitive performance of the players during official match, mainly via the increase of the playing-time distances (Memmert, 2010; Izzo & Varde'I, 2017). Furthermore, the marginally better match-play

performance of the amateur players in losing instead of winning conditions is in accordance with the literature, which confirms that the match outcome affects various running intensities of the players, especially the experienced and professional players (Nobari, et al., 2021). More specifically, this study recorded that the distances covered by the amateur players in their teams' matches were quite higher in losing matches in both medium (15-20km.h⁻¹) intensity zone (837m) and high playing zone (294m). The above findings should be compared with the existed data of the professional players from *Greek Superleague* and *Superleague 2* teams since there is no match-play performance data in *Greek* amateur leagues. Thus, the amount of covered distances by the amateur players during their matches are, as expected, lower than the competitive performance of the players during the official matches in *Greek* professional leagues (Mitrotasios et al., 2022). Regardless the match outcome, the professional players accumulate a greater amount of match covered distances in high playing zone representing intensities from 20 to 25km.h⁻¹ in comparison to the amateur players who play with low and medium running intensities in their teams (Ispyrlidis et al., 2022).

Conclusion

The importance of this study lies in the fact that it presents match-play data with GPS system in amateur players and it complements the relevant bibliography, which mainly evaluates professional or young soccer players. At the same time, the current research constituted the first one that presents data derived from the players who participated in amateur leagues in Greece offering useful and applicable information to a large number of coaches and players simulating the match-play performance at their trainings. Finally, the present study proved that contextual variables, such as in-season match location or match outcome, could equally differentiate the match play performance across all positions of the studied amateur players. Therefore, soccer scientists should examine the impact of contextual variables on both amateur players' performance and their tactical positional basis in order to create individualized training plans leading to the development pathway of the players.

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