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ABSTRACT

Purpose. The aim of the current study was to investigate differences in the physical performance indicators when implementing various playing styles across a range of tactical situations.

Methods. The sample comprised 238 matches (476 observations) from the 2021–22 season of the Turkish league's 1st division. For each observation, nine physical performance indicators obtained through the InStat Scout optical tracking method were analysed. Additionally, 19 factor scores (representing 19 tactical situations) derived from previous research were utilised to categorise each observation into two distinct playing styles.

Result. Effect sizes (Cohen's *d*) obtained from independent samples *t*-tests revealed significant differences in physical performance indicators in 17 out of the 19 tactical situations. Match interruptions, transitions, final attempts, and the starting position on the field from which a team initiates pressing were identified as influential factors in determining physical demands. Conversely, the playing style adopted by teams during the build-up phase (possession or direct play) did not appear to significantly alter the physical demands.

Conclusions. The results indicate that in various tactical situations, the physical demands vary based on the playing style adopted by the teams. These findings carry practical implications, as they can assist coaches in making decisions that combine tactical and physical factors.

Key words: soccer, game style, performance indicators, fitness; physiological demands

Introduction

Soccer is an intermittent sport, with participants often transitioning between low speeds (i.e., walking or jogging) and sudden sprints, followed by rapid deceleration [1]. Furthermore, the technical, tactical, mental, and psychological attributes of the players significantly contribute to a team's success [2]. The simultaneous requirement of these factors has made performance analysis an indispensable tool that can provide valuable information to coaching staff [3].

According to Hughes and Bartlett [4] analysts and coaches utilise indicators to evaluate the performance of players, teams, or specific sub-groups. These performance indicators (PIs) are selected action variables aimed at assessing different aspects of team sports performance. Traditionally, notational analysis has focused on capturing events, leading to the development of technical-tactical PIs such as goals, challenges, interceptions, tackles, dribbles, passes, crosses, shots, etc. [5]. On the other hand, technological advancements have increased the availability of physical PIs derived from tracking data (motion analysis) [6].

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The advancement of tracking technologies has led to the big data era [7]. As a result, in recent decades, there has been a large increase in studies using physical PIs [8]. Specifically, through the use of GPS and/or optical tracking methods, variables such as total distance, distance covered in different intensity zones, number of sprints, accelerations, decelerations, and maximum speed are collected. These physical PIs, in addition to their use in conducting fitness tests [1, 9], have been examined in relation to various factors, including team quality [10], match outcome [6, 8], technical PIs [11], match location [12], congested/non-congested matches [13], match-to-match variability [14], age level [15], presence/absence of spectators [16], altitude [17], heat/cold conditions [18], different divisions [19], match status [20], match importance [20], substitutes [20], opponent's quality [21], match half [21], injuries [22], parameters of small-sided games [23], and effective playing time [21].

In contrast, there is a lack of studies contextualising physical performance within tactical situations. Most studies have focused on the impact of formations [24, 25], while Modric, Versic [26] attempted to identify differences between games played with three or four defensive players. Other studies [27, 28] investigated playing styles and utilised physical PIs, but failed to determine the fitness requirements of the identified styles due to their adopted methodologies (they used physical PIs along with technical-tactical PIs in factor analysis). Additionally, some authors divided teams into two groups (possession play/direct play) solely based on possession percentage [29] or in combination with the number of successful counterattacks [30], aiming to uncover differences in physical performance indicators between the two styles. However, to date, no studies have examined the physical demands of playing styles adopted by teams in other phases/key moments of the game [31]. We hypothesised that, by examining the physical demands across various tactical situations, there would be variations in the physical PIs depending on the playing style adopted by teams in these tactical scenarios. Therefore, the objective of this research was to examine if distinct playing styles adopted in various tactical situations affect physical performance indicators.

Material and methods

Sample

The sample comprised 238 matches (476 observations) from the 2021–22 season of the Turkish first division. This league consists of 20 teams that compete in 38 matchdays (10 matches played in each matchday). Our sample included all games from the first 24 matchdays, except for two matches where fitness data were unavailable.

Variables-procedure

Independent variables

The study utilised factor scores derived from Factor Analysis and Principal Components Analysis, as employed in the research conducted by Plakias, Kokkotis [32]. Table 1 shows the names given to each latent variable and the names of the playing styles produced. Depending on the sign (positive or negative) of the factor scores in each observation, two groups were created: one comprising observations with positive scores and the other with observations displaying negative scores. Sixteen out of the 19 latent variables pertain to each individual team's playing style, while the remaining three (2, 5, 13) are associated with the overall game style resulting from the combined tactical behaviour of both participating teams.

Dependent variables

The physical performance indicators presented in Table 2 were utilised in this study. The data were collected using the optical tracking method provided by InStat (https://football.instatscout.com/). It is important to note that InStat's optical tracking method is licensed by FIFA and has been proven to have high levels of absolute and relative reliability. A detailed report on its reliability can be found on FIFA's official website [11, 33]. InStat's tracking system served as the official electronic performance and tracking system for the Turkish league 2021–22.

Statistical analysis

Independent samples *t*-tests were employed to compare the two groups derived from each factor for all physical performance indicators. The normality assumption of continuous variables in each group was assessed using the Kolmogorov–Smirnov test, while the homogeneity of variances was examined with Levene's test. To measure the effect size, Cohen's *d* was utilised, as the use of large sample sizes in this study posed the issue of guaranteed statistical significance and necessitated reporting practical significance through effect size measures [34]. Cohen's *d* is suitable for comparing a continuous variable between two groups and iden-

Table 1. Latent variables and playing styles generated based on the sign (positive or negative) of factor scores in each observation

Factor	Latent variable	Positive scores	Negative scores
F1	Elaboration of build-up phase	Possession style	Direct style
F2	Transition game	Many transitions	Few transitions
F3	Attacking transition	Counterattack	Positional attack
F4	Defensive transition	Opponent's counterattack	Opponent's positional attack
F5	Aerial game	Game in the air	Game on the ground
F6	Type of attack	Set pieces attack	Open play attack
F7	Crossing	Many crosses	Few crosses
F8	Type of opponent's attack	Open play defence	Set pieces defence
F9	Defensive blocks	Mid block	Low block
F10	Press	High press	Deep press
F11	Individual defending actions	Many individual defending actions	Few individual defending actions
F12	Width of creative phase	Centre attack	Wide attack
F13	Effective game	More interruptions and duels	More possession from one or the other team
F14	Individual attacking actions	Many individual attacking actions	Few individual attacking actions
F15	Tendency to create final attempts	Little possession required to generate final attempts (strong tendency)	High possession required to generate final attempts (low tendency)
F16	Passing tempo	Low passing tempo	High passing tempo
F17	Defending aggressively	Low defensive aggressiveness	High defensive aggressiveness
F18	Attacking aggressively	High attacking aggressiveness	Low attacking aggressiveness
F19	Offside trap	More frequent adoption of the offside trap	Less frequent adoption of the offside trap

Table 2. Physical performance indicators and their abbreviations

Physical performance indicator	Abbreviation
Total distance	TD
Distance on speed up to 0.2 m/s (standing)	ST
Distance on speed 0.21–2 m/s (walking)	WALK
Distance on speed 2.01–4 m/s (jogging)	JOG
Distance on speed 4.01–5.5 m/s (running)	RUN
Distance on speed 5.51–7 m/s (high-speed running)	HS
Distance on speed over 7 m/s (sprint)	SPR
Number of high-speed runnings (5.5–7 m/s)	NHS
Number of sprints (> 7 m/s)	NSPR
Maximal speed	MAX

tifying differences between independent means (independent samples *t*-test) [35]. The effect sizes were defined as follows: trivial ($d \leq 0.19$), small ($d = 0.2$–0.49), medium ($d = 0.5$–0.79), and large ($d \geq 0.8$) [36]. The significance level for all tests was set at $p < 0.05$. Statistical Package for Social Sciences (SPSS), version 29.0 (Copyright IBM Corp. 1989, 2022), was used for all analyses.

Ethical approval

Ethical approval for the present study was obtained from the local university's (University of Thessaly) ethics committee on October 12, 2022 (code, 1973). Written consent from the company (InStat; https://football.instatscout.com/) was obtained on November 8, 2022, allowing the data to be used for research and publication purposes.

Results

Table 3 illustrates that, in many instances, the playing styles adopted by teams result in differences in physical demands. Specifically, absolute values ranging from 0.0 to 0.2 (trivial effect) are marked in a white background, values ranging from 0.2 to 0.5 (small effect) are marked in a grey background, while values from 0.5 to 0.8 (medium effect) are marked in a black background. There are no values greater than 0.8 (large effect). The sign (+/–) indicates whether the factor scores with positive or negative values have greater absolute magnitudes.

Regarding the attack phase, it seems that in several tactical situations, the choice of different styles leads to a difference in physical demands. Executing more attacks from set pieces, as opposed to attacks from open play (F6), increases ST but decreases TD and JOG. Teams that strive to generate a large number of final attempts (F15) demonstrate increased values in SPR, NSPR, and MAX. A playing style characterised by frequent crosses raises HS and NHS but reduces ST (F7). Teams that execute numerous offensive individual actions (F14) tend to have lower values in HS and NHS, while teams that engage in numerous defensive individual actions (F11) exhibit increased ST. Teams that launch more attacks from the flanks (F12) have higher values of TD and RUN compared to teams that approach the opponent's half through the central axis. ST is increased when teams adopt a fast passing tempo (F16). Lastly, teams that are caught offside (F18) more frequently exhibit lower values in JOG. Conversely, examining differences in the physical demands in relation to the style of build-up (F1), the effect sizes are trivial for all physical performance indicators.

Likewise, in many defensive phase situations, the adoption of different playing styles leads to differences in physical demands. Teams that prefer high press (rather than deep press, F10) increase their demands in terms of TD, RUN, HS, and NHS. When the team defends in a low block, the variable WALK increases, whereas preferring the mid block (F9) raises RUN, HS,

Table 3. Cohen's *d* values for all performed independent samples *t*-tests

Factor	TD	ST	WALK	JOG	RUN	HS	SPR	NHS	NSPR	MAX
F1	0.05	0.01	–0.03	0.08	0.09	–0.02	–0.16	0.01	–0.12	–0.05
F2	0.25	–0.18	0.21	0.07	0.20	0.25	0.16	0.18	0.17	0.16
F3	0.03	0.05	0.15	–0.08	–0.07	0.12	0.30	–0.10	0.26	0.17
F4	–0.33	0.22	–0.06	–0.44	–0.22	0.06	0.24	–0.26	0.18	0.30
F5	0.12	0.04	0.19	–0.07	0.06	0.24	0.22	0.08	0.26	0.25
F6	–0.34	0.54	–0.19	–0.40	–0.14	0.01	0.10	–0.16	0.04	0.20
F7	0.08	–0.27	0.02	0.02	0.06	0.22	0.01	0.24	0.00	0.12
F8	0.19	–0.49	0.09	0.13	0.14	0.17	–0.01	0.25	0.09	–0.03
F9	0.12	–0.07	–0.22	0.06	0.29	0.27	0.16	0.33	0.17	0.14
F10	0.21	–0.08	–0.14	0.15	0.29	0.34	0.09	0.35	0.11	0.14
F11	0.06	0.23	0.18	–0.06	–0.01	0.06	0.13	–0.14	0.12	0.06
F12	–0.24	0.04	–0.07	–0.17	–0.20	–0.19	–0.06	–0.19	–0.04	0.17
F13	–0.62	0.38	0.18	–0.72	–0.59	–0.31	0.05	–0.45	–0.02	0.05
F14	–0.18	0.11	0.07	–0.11	–0.20	–0.31	–0.10	–0.40	–0.06	0.02
F15	0.16	0.02	0.08	0.09	0.09	0.11	0.29	0.05	0.24	0.21
F16	0.03	–0.23	0.19	–0.06	–0.05	0.08	–0.03	0.03	–0.08	–0.04
F17	0.15	–0.26	0.12	0.29	–0.02	–0.19	–0.16	–0.11	–0.16	–0.14
F18	–0.18	–0.01	0.07	–0.25	–0.16	–0.02	0.05	–0.07	0.05	–0.14
F19	–0.14	–0.02	0.02	–0.11	–0.14	–0.14	–0.11	–0.08	–0.13	–0.01

The (+/–) sign indicates whether the factor scores with positive or negative values have greater absolute magnitudes. Values ranging from 0.0 to 0.2 are marked in a white background, values ranging from 0.2 to 0.5 are marked in a grey background, while values from 0.5 to 0.8 are marked in a black background.

and NHS. Teams that commit many fouls and receive numerous yellow cards (F17) have higher values in ST but lower values in JOG. Furthermore, when the opponent generates more attacks from open play (versus set pieces, F8), it increases NHS for the team while decreasing ST. Conversely, when examining differences in the physical demands in relation to the adoption of the offside trap (F19), the effect sizes are trivial.

Finally, differences in physical demands result in both transition situations and in situations that concern the game as a whole, and not exclusively one team or the other. Specifically, games with frequent transitions (F2) lead to increased values in TD, WALK, RUN, and HS compared to games with fewer transitions. A higher frequency of counterattacks (compared to positional attacks) raises the values of SPR and NSPR (F3). When the opponent executes numerous counterattacks, it increases the values of ST, SPR, and MAX for the team, while decreasing TD, JOG, RUN, and NHS (F4). Additionally, the effective playing time (F13) significantly affects the physical demands of teams; a longer playing time decreases ST while increasing TD, JOG, RUN, HS, and NHS. Likewise, engaging in more aerial duels (F5) escalates high-intensity actions (HS, SPR, NSPR, MAX).

Discussion

The objective of this study was to investigate the variations in physical PIs among teams in the Turkish first division that adopt different playing styles in specific tactical situations. We examined a total of 19 situations and identified statistically significant differences in physical PIs in 17 of them. To the best of our knowledge, this is the first study to explore the relationship between physical demands and validated game styles. Previous research has primarily focused on analysing differences in physical performance based on isolated technical-tactical PIs, which may not adequately interpret tactics issues [37].

Out of the 19 tactical situations we examined, eight were related to the attacking phase (F1, F6, F7, F12, F14, F15, F16, and F18). In terms of the teams' style during the build-up phase (possession or direct), we found practically no significant differences in any physical performance indicator. One of the variables that positively influenced this factor was the percentage of ball possession, which has also been used in previous studies [29, 38, 39] to investigate whether teams with high possession percentages exhibited differences in physical performance compared to teams with low possession percentages. Our findings align with those of the aforementioned studies, showing practically no significant differences.

Studies by Faude, Koch [40] and Yang, Leicht [41] highlighted the importance of sprinting in technical parameters that contribute to final actions. Our own research further supported these conclusions, as teams that displayed a strong tendency to make final attempts exhibited higher values in SPR, NSPR, and MAX compared to teams that did not frequently attempt shots. However, in contrast to our findings, Modric, Malone [11] found no significant differences between teams with high or low physical performance in goal chances, shots, and shots on target. The discrepancies between studies may be due to the fact that the latter research was carried out with a very small number of matches (only 20 randomly selected matches), which actually concerned the group stage of the Champions League and not a domestic championship. Furthermore, in the same study by Modric, Malone [11], no differences were observed in the variables of crosses and accurate crosses between groups with high or low physical performance. This contrasts with our own study, which found that teams that made a greater number of crosses had higher values in HS and NHS, but lower values in ST.

Regarding width in attack, the present study revealed that teams that prioritise attacks from the flanks, as opposed to attacks from the centre, exhibit higher values in TD, and RUN. This can be explained by fundamental football principles, which suggest that teams that prioritise width in their attacking approach are expected to move laterally once they recover possession of the ball. However, in the event of losing the ball, they should shift back towards the central axis to regain their defensive shape and concentration [42]. Consequently, these teams are required to cover longer distances.

Furthermore, teams that rely more on attacks from set pieces, as opposed to attacks from open play, demonstrate higher values in ST and lower values in TD. These results can be easily explained by the static nature of set pieces. However, it is surprising that teams with a high passing accuracy exhibit higher values in ST. One possible explanation could be the concept of 'letting the ball do the work' [38], which may apply in this particular case. Additionally, the high passing accuracy might be a result of minimal pressure from the opposition, indicating that players do not have to make extensive movements to receive the ball. Finally, the constant movement of teammates provides the ball possessor with multiple passing options, as highlighted by da Costa, da Silva [42]. This explanation could account for the decrease in HS and NHS values when individual offen-

sive actions are increased, as players are forced into individual actions due to a lack of passing options.

On the other hand, out of the 19 tactical situations examined, six pertain to the defensive phase (F8, F9, F10, F11, F17, and F19). According to Aquino, Martins [43], an excessively defensive strategy, such as when a team predominantly adopts a compact style of play for a significant portion of the match, may lead to decreased physical PIs. Our research findings seem to support this notion, as both high-pressure teams compared to deep-pressure teams and mid-block teams compared to low-block teams demonstrate higher values in RUN, HS, and NHS. Presumably, this defensive compactness results in an increased number of individual defensive duels and defensive aggression, which also explains our research findings that these playing styles reduce the team's TD. Furthermore, defensive aggression often leads to committing fouls, resulting in set pieces and, subsequently, a decrease in TD. However, in a study analysing 20 matches from the group stage of the UCL [11], no differences were found in the variables high pressing, successful high pressing, low pressing, successful low pressing, tackles, and successful tackles between teams with high or low running performance.

Additionally, the study examined three situations (F2, F3, F4) related to transitions. The findings indicated that transitions have a significant impact on the values of physical PIs. Specifically, the present research revealed the following: (a) Games with frequent transitions, regardless of which team recovered the ball and whether they resulted in counterattacks or positional attacks, were associated with increased values in RUN, HS, and TD, (b) When teams opted for counterattacks instead of retaining possession and building up to a positional attack during transitions, there was an increase in SPR and NSPR, (c) When the opposing team executed counterattacks, SPR and MAX values increased. The presence of reduced values in TD and NHS, along with an increased value in ST, likely contributed to the opponents' successful counterattacks. These findings align with previous studies that have demonstrated the importance of high-intensity efforts during offensive transitions [44], highlighted the significant physical demands involved in preventing opponent counterattacks [45], and indicated that transition-focused training programs lead to increased distances covered at high intensities, maximum speed, and the number of accelerations compared to other training drills [46].

Finally, the present study examined two tactical situations (F5, F13) that cannot be classified within a specific phase of the game and do not exclusively involve one team, but rather impact the game as a whole. Games with a significant number of aerial duels appeared to increase HS, SPR, NSPR, and MAX. This suggests that players are required to exert maximum effort before engaging in aerial duels. Additionally, the effective playing time, defined in our research as the time when the ball is clearly possessed by either team (excluding interruptions and situations where possession is unclear), had an effect on the physical PIs. A longer effective playing time correlated with increased TD, JOG, RUN, HS, and NHS, while ST decreased. These results are consistent with the findings of Castellano, Blanco-Villaseñor [21].

However, it is important to acknowledge certain limitations of this study. Firstly, we examined indicators from a single season within one league. It would be beneficial to explore indicators across multiple seasons and/or competitions, such as other national leagues, international club tournaments, and national team events, to enhance the generalisability of the current findings to elite soccer. Another limitation is the use of cumulative values for the entire match, which does not capture the dynamic changes that occur during the game. Nevertheless, this static approach is commonly employed in football research and can still yield valuable insights. Finally, future research could consider incorporating other physical PIs, such as the number of accelerations-decelerations and the measurement of High Metabolic Load Distance (HMLD), to further expand our understanding in this field. Additionally, the formations of the teams could also be examined in combination.

Conclusions

This research was the first to examine differences in physical PIs when teams adopt different styles in 19 tactical situations that encompass all phases of the game. The results revealed the significance of match interruptions, transitions, final attempts, and the starting position of pressing in determining physical demands. It is anticipated that these findings will contribute to expanding the existing body of research on physical performance requirements across teams with diverse playing styles. This knowledge can be utilised to enhance coaches' decision-making regarding tactics and player selection. For instance, a coach who is aware of the physical condition of their players can tailor the team's playing style to align with their players' physical capabilities. Likewise, the coach might opt to select a player whose physical condition aligns with a specific style of play they intend to employ. Furthermore, coaches

can receive assistance in creating training drills that concentrate on particular blends of tactics and physical demands.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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