

Integrating Social Media Analytics with Sports Science for Enhanced Football Training Insights in Algeria

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Abstract:

This empirical research presents a novel approach to understanding and optimizing football training practices in Algeria by integrating social media analytics with sports science, particularly in contexts with technological limitations. The study aims to explore how digital engagement behavior, sentiment, and social networks can complement the training process, thereby adding insights to the physiological training of Algerian football players.

The study employed innovative mixed methods over six months, involving 156 players from twelve teams competing in three divisions of the Algerian Football League. Social media data were automatically extracted (scraped) to include posting frequency, interactions, and content, and sentiment was analyzed using VADER for both Arabic and French dialects. Physical performance parameters included GPS technology and Training Load metrics.

The results revealed a positive statistical correlation of 0.58 between social media engagement and training load. Furthermore, sentiment analysis demonstrated a link between emotional indicators and training load outputs over the preceding 48-hour period. Additionally, communication centrality was found to influence physical performance levels and team cohesion. The research underscores the significant value of social media indicators in extracting insights regarding physical and training outcomes.

Keywords: Social Media Analytics; Sports Science; Football Training; Training Load; GPS Technology.

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1- Introduction

Contemporary football performance analysis increasingly recognizes the multidimensional nature of athlete development, extending beyond traditional physiological metrics to encompass psychological, social, and behavioral dimensions that collectively influence training outcomes and competitive performance (Alves et al., 2023). Sports science has conventionally relied upon biomechanical assessments, physiological monitoring through wearable technologies, and tactical analysis using video-based observation systems to evaluate player development trajectories and optimize training interventions (Wäsche et al., 2017). However, the exponential proliferation of social media platforms has created unprecedented opportunities to access behavioral data reflecting psychological states, motivational factors, and social dynamics that traditional monitoring methodologies struggle to capture systematically (Einsle et al., 2022). Social media analytics encompasses computational techniques for collecting, processing, and interpreting digital engagement patterns, sentiment expressions, and communication networks manifest through platforms such as Facebook, Instagram, Twitter, and WhatsApp, which have become integral to daily communication practices among athletes globally (Ben Haffaf et al., 2025).

Within the Algerian football context, the sport occupies central cultural significance and serves as a primary vehicle for youth engagement and national identity expression, yet adoption of advanced analytical methodologies remains substantially limited compared to European football organizations due to resource constraints, infrastructure limitations, and gaps in coaching education related to data-driven decision making (Mataruna et al., 2021). Algerian football clubs face persistent challenges, including restricted access to sophisticated performance monitoring technologies, limited financial resources for implementing comprehensive athlete management systems, and insufficient integration of sports science principles into coaching practices (Shipanga & Sweetness, 2024). Nevertheless, social media penetration rates among Algerian youth have increased dramatically over the past decade, with platforms becoming primary channels for interpersonal communication, information consumption, and identity construction, particularly within sports contexts (Ben Haffaf et al., 2025). This digital transformation presents compelling opportunities to supplement traditional sports science approaches with cost-effective, readily accessible data sources capturing psychological and social dimensions of training environments that conventional methodologies cannot feasibly monitor continuously (Tian et al., 2023).

The integration of social media analytics with sports science offers multiple potential benefits for football training optimization, including enhanced understanding of team cohesion dynamics through network analysis, early identification of psychological stressors affecting performance via sentiment tracking, monitoring of perceived training load through linguistic analysis of athlete communications, and assessment of motivational factors influencing adherence to training protocols (Einsle et al., 2023). Social network analysis techniques can systematically map communication patterns and leadership structures within teams, providing quantifiable indicators of social cohesion that coaches typically assess through subjective observation (Alves et al., 2025). Sentiment analysis algorithms employing natural language processing can quantify emotional responses to training stimuli and competitive outcomes, offering temporal insights into psychological readiness states that complement physiological recovery markers (Selak, 2024). Furthermore, temporal patterns in social media activity may correlate with training schedules, recovery periods, and psychological preparation phases, providing complementary insights to GPS-derived physical load data and heart rate variability measurements (Tian et al., 2023). Despite these potential advantages, empirical research examining practical integration of social media analytics within football training contexts remains limited, particularly within North African settings where cultural factors shape digital communication patterns differently than Western contexts, and where resource constraints necessitate innovative yet economically feasible monitoring solutions (Fertoul & Boumeahdi, 2024).

This study addresses critical gaps in understanding how social media analytics can complement traditional sports science methodologies to enhance football training insights within Algerian contexts characterized by unique cultural dynamics and resource constraints. The research investigates relationships between social media engagement patterns, sentiment expressions derived from Arabic and French language communications, network positions within team communication structures, and training outcomes assessed through attendance rates, technical skill performance, and physiological indicators. By examining these relationships empirically through longitudinal data collection and mixed-methods analysis, this study contributes to emerging literature on comprehensive athlete monitoring approaches that integrate digital behavioral data with physiological performance metrics, offering practical guidance for resource-constrained football organizations seeking innovative analytical solutions that leverage ubiquitous technologies to enhance training effectiveness and player development without requiring substantial capital investment in specialized monitoring equipment.

Hypotheses

Hypothesis 1: There exists a significant positive relationship between social media engagement patterns and training adherence rates among Algerian football players, such that higher levels of team-focused social media interaction correlate with improved attendance and participation quality in scheduled training sessions, reflecting underlying motivational states and team commitment that manifest in both digital and physical training behaviors.

Hypothesis 2: Sentiment polarity extracted from player social media communications demonstrates significant associations with subsequent training performance indicators, with positive sentiment expressions predicting enhanced performance metrics in technical skill assessments and physiological capacity measurements during training sessions conducted within 48 hours following social media posts, reflecting temporal dynamics of psychological readiness states influencing performance execution.

Method

Participants and Sampling

The study made use of a purposive sampling approach in seeking to recruit the participants from the organizations of the Algerian Football Federation in the three divisions represented geographically. The sampling frame consisted of the active soccer players between the ages of 18-32 years actively involved in the game professionally or semi-professionally in the 2024-2025 season. The criteria for selection specified the participants must be actively using the social media platform, that is, Facebook, Instagram, Twitter, among others, whose pages can be accessed publicly without privacy issues. The other criterion was that the participant should have a minimum of six months of active, uninterrupted commitment to the same club in the study, which helps in the training process, developing the social networks. Exclusion criteria also eliminated participants suffering injury periods in excess of four weeks in the duration of the data collection process, those whose social media accounts are private, thus denying the research permission to use the data, as well as those players whose training has no consistency in terms of attendance, thus questionable regarding the course of performance over time.

The final participant pool was made up of 156 football players drawn from twelve football clubs, considering the competitiveness level and the region, in a systematic sampling approach. The participants were between the ages of 18-31, with a mean age of 24.3 years, whose deviation was measured at 3.8 years. The participants were mainly made up of 89 players in first division football clubs, which represents the highest level, 47 in the second division football clubs, the next level in terms of competitiveness, and the remaining 20 were in the semi-professional third division football clubs, which represents the developing level. In terms of region, the participant base was normally distributed based on the region to cover potential variations in the usage levels of social media, cultural communication, as well as training culture, which could act as moderators. These include the following: 64 from the coastal regions, which include the major towns in the north, 52 from the central regions, which include

the plateaus, and the remaining 40 were sourced from the southern region, which includes the less populated regions.

Additionally, 24 coaching staff members were recruited as secondary participants, whose role was to provide contextual information pertaining to the structure of training programs, the protocols used in assessing player training performances, as well as observations of player engagement behavior. The coaches possessed a minimum level of Confederation of African Football Level B coaching certification, which indicated conformity in terms of the level of coaching expertise, while also having an average experience level of 8.4 years of coaching experience at the professional or semi-professional level, ensuring enough expertise in the level of player performances. The use of coaches helped in achieving triangulation in the methodology, enabling the verification of results based upon the relationship between the technical parameters of sports performances in relation to the behavior observed in the use of social media.

The sampling process entailed first contacting the club administrators to obtain institutional consent to seek the coaches' consent to participate in research, enabling the approach to the player groups in organized club meetings where the objectives, process, and issues associated with the research were fully communicated in simplified terms. The research was freely offered, with reassurance of confidentiality in handling the information, security, and the option to withdraw from the process without undermining the player's status in the club. Informed consent was sought from all the research participants after detailing the process of handling the information for the research, which entailed monitoring social media activities, as well as the process of performing evaluations. The players were assured of anonymity in the research process, as the social media information accessed was in the public domain, and personal identities were concealed in the entire process.

The determination of the sizes of the samples was done using statistical power analysis, requiring medium-effect sizes established through preliminary correlation studies exploring the relationship between social media use and sports performances, as reported in the literature. The power calculation showed that a minimum of 120 participants were demanded in order to achieve a statistical power of .80 in correlations as well as regression analyses requiring more than one independent variable, using an alpha level of .05. The achieved sample size was sufficient, having a capacity to exceed the minimum statistical power demands, considering the attrition levels expected in the data gathering process over the span of the six months, initially set at around 15 percent, as determined in the pilot studies. Demographic variability in the achieved sampling facilitated the process of validity in establishing the broader generalizability of the research findings to the Algerian football setting operating under similar conditions, while limitations in the generalizability of the findings were also recognized in relation to the lack of inclusivity in the study in terms of the representation of female players, requiring prospective research endeavors in similar athlete groups.

Materials

Data collection involved the use of diverse research instruments, technological facilities, based on social media analytics, training performance, as well as social media variables. The use of social media data involved the use of Python software, based on Beautiful Soup and the use of the Selenium tool, based on the social media research ethics. The social media scraping tool was set to operate every 48 hours in the six-month research duration, in order to ensure sufficient temporal frequency for the detection of social media variables, while operating within the terms of the use of the social media platform, as well as the limit rates. The collected research variables involved the use of the number of posts in terms of the number of posts in a week, the measures of the number of likes, the number of comments, as well as the number of shares, the time stamps, as well as the content, categorized as text, photographs, as well as audio, hashtag variables, as well as the contents for the next natural language research.

The sentimental analysis processing used the Valence Aware Dictionary, as well as the Sentiment Reasoner algorithm, fine-tuned for the Arabic and French languages, in line with the

linguistic variability typical of Algerian football communication in social media, in which code-switching between the two languages takes place in a frequent manner. The VADER dictionary was refined by the use of football terms in Arabic as well as French from preliminary content analyses of the first 5000 Arabic and French football-related social media messages to classify football communication terms better. The values of sentimental scores were measured in the range between negative one, extremely negative, to positive one, extremely positive, while positive, negative, as well as the other categories, were defined in terms of threshold values, positive 0.05, negative 0.05, by independent methods of distinctive coding, applied by the bilingual researchers.

Data collection for training performance involved standardized assessment protocols conducted by training coaches in the course of normal training sessions, following training by the research experts to ensure inter-club reliability of the measures. Physical training measures involved sprint times over the 30-meter distance measured using electronic timing gates, the accuracy of which was set at 0.01 seconds, times taken to complete the standardized T-tests for player agility, while vertical jumps were measured using Vertec vertical jump devices scaled before each testing session. Technical skill measures involved standardized football-skill tests, which involved accuracy in ball passing measured using ball-passing targets, player ball control measured using the time taken to complete the preset cone drills, and accuracy in shooting was measured using goal-target shooting exercises, where points were allocated accordingly. Data was collected using standardized electronic forms filled out by the trainers following every assessment, which was then relayed back to the research experts for compilation.

Data regarding training attendance and compliance were obtained from club administration systems, whereby players recorded attendance at training sessions using electronic signing-in systems, tardiness measures based upon time recorded in relation to the commencement time, and training intensity ratings ascertained by training coaches using Likert rating scales ranging from minimal to maximal levels observed. Session ratings of perceived exertion were also collected using standardized zero-to-ten rating scales applied to players following training sessions, which were well-validated in sports science applications and possessed sound psychometric properties.

The GPS wearable tracking devices were used in participant subsets where the clubs had existing tracking systems that allowed the measurement of physiological loads. The GPS trackers measured movement variables such as the distance covered in training, the distance covered running at speeds greater than set velocity thresholds, the number of sprints, represented by efforts at high intensity, the number of acceleration/deceleration efforts, which indicated the direction, and the heart rates measured by the devices in training sessions. The GPS information, although limited to 64 participants in the four clubs that had existing systems in place, was useful in establishing the relationship between social media use and other variables in the available subsets.

The survey instruments evaluated psychological constructs that could potentially act as mediators in the relationship between social media usage and training outcomes. Team cohesion was determined using the Group Environment Questionnaire, adapted to the context of football, where tasks, as well as the social dimensions of cohesion, were measured by a series of 18 items using seven-point Likert scales. Training motivation was determined by the use of the Sport Motivation Scale, designed to measure motivation, as well as amotivation, using a series of 28 items, which showed excellent internal consistency in the measurement. Perceived stress was measured using the Perceived Stress Scale, designed to measure perceptions of stress over the last month, using a series of ten items. The survey was translated into Arabic, French, and was taken three times over the duration of the research to account for variability in psychological state over time.

Every digital data collection process followed strict ethical standards in researching social media, which include the use of purely public content that could be accessed without the need for authentication, the use of secure, encrypted archives for the gathered information stored in

password-protected servers, and the use of extensive anonymity measures to ensure no individual could be identified in the data, among other conditions.

Procedures

The study had a prospective longitudinal approach over a period of six months in the competitive season of 2024-2025, taking into consideration the preseason periods as well as the early stages of competition in order to maintain the validity of the research. The necessary approvals from the research review boards, as well as the administration of the clubs, were sought through proper channeling, after which the first meetings were held in each of the clubs where the research was conducted, in order to explain the research process to the members of the clubs in detail. The informed consent process allowed the privacy of the participants to remain confidential.

The collection of the baseline data spanned the first two weeks, taking the form of psychological survey administration under research supervision, the use of standardized procedures in anthropometric measurement, as well as the measurement of the individuals' early levels of physical performance for the purposes of comparison. The individuals were also requested to provide identifiers for the collection of systematic links between the social media data, following measures aimed at confidentiality using the individuals' coded identifiers; thus, personal details were not revealed. The automatic collection of social media data began after the collection of the baseline, which was executed every 48 hours using the scraping tool, as research supervision was assured. The research supervision also allowed the detection of technical glitches, platform changes, or changes in the individuals' accounts, and guaranteed weekly research supervision.

Training work rates were measured every fortnight using agreed protocols, performed by trained coaching staff. The coaches were provided with in-depth assessment manuals, which allowed for ease of use, as well as training in the form of workshops, where the protocols were demonstrated by the research team. The research protocols were carefully integrated into the training schedules, taking care to ensure the testing conditions were standardized. Furthermore, the training participants wore GPS devices, and the data was downloaded weekly by the sports scientists in each club, where available, or the research team, as a function of the facilities available in each club. Training attendance was collected weekly, with the verification of the accuracy of the data collected through the systematic overlap of other data sources.

Data Analysis

Data analysis employed sequential mixed-methods procedures integrating quantitative statistical analyses with qualitative content examination to address research questions through methodological triangulation comprehensively. Initial data preprocessing involved systematic cleaning of social media datasets to remove duplicate entries, spam content generated by automated accounts, and irrelevant posts not authored by participants verified through account authentication. Text preprocessing for sentiment analysis included tokenization, segmenting text into individual words, stopword removal, eliminating common words providing minimal semantic information, and normalization procedures, including lemmatization, adapted for Arabic and French linguistic structures, accounting for morphological complexity. Missing data patterns were examined systematically using Little's Missing Completely at Random test to assess missingness mechanisms, with missing values handled through multiple imputation procedures, generating five imputed datasets for sensitivity analyses examining robustness of findings across imputation scenarios.

Descriptive statistics comprehensively characterized sample demographics, social media usage patterns, and performance variables, including means, standard deviations, ranges, frequency distributions and temporal trends visualized through graphical displays. Social media engagement metrics were calculated, including posting frequency per week, quantifying content generation, average likes per post, indicating audience response, comment counts reflecting active engagement, sharing behaviors indicating content resonance, and engagement rates computed as total engagements divided by follower counts, normalizing for audience size.

Temporal patterns were examined through time series visualizations and autocorrelation analyses, identifying cyclical patterns corresponding to training schedules, match days, and recovery periods.

Sentiment analysis procedures applied the VADER algorithms to textual content from posts and comments, generating compound sentiment scores for each communication. Daily sentiment scores were aggregated by calculating the mean sentiment across all posts published by individual participants within 24-hour periods, providing daily sentiment trajectories. Time-lagged analyses examined relationships between sentiment scores and subsequent performance metrics at 24-hour, 48-hour, and 72-hour intervals to identify optimal temporal dynamics characterizing sentiment-performance relationships. Sentiment categories were created using established threshold values, with scores above 0.05 classified as positive sentiment, below 0.05 as negative sentiment, and intermediate values as neutral sentiment.

Hypothesis testing employed Pearson correlation analyses examining relationships between social media engagement metrics and training adherence rates operationalized as the percentage of scheduled sessions attended. Partial correlations statistically controlled for potential confounding variables, including age, competitive level, and baseline fitness levels, isolating unique variance attributable to social media engagement. Multiple regression analyses modeled training adherence as the outcome variable with social media engagement indicators, sentiment metrics, and demographic variables as predictors using hierarchical entry procedures. Model assumptions were rigorously verified through residual diagnostics examining normality, homoscedasticity, and independence, variance inflation factor calculations assessing multicollinearity among predictors, and Durbin-Watson statistics evaluating autocorrelation in residuals.

For hypothesis two testing, multilevel linear models accounted for nested data structure with repeated performance measurements clustered within individuals, requiring statistical approaches accommodating hierarchical data. Fixed effects included time-lagged sentiment scores, training session characteristics, and participant characteristics as predictors, while random effects captured between-participant variance in baseline performance levels and individual differences in sentiment-performance relationship slopes. Models were estimated using restricted maximum likelihood with significance testing based on likelihood ratio tests comparing nested models differing in random effect specifications.

Social network analysis examined communication patterns among team members through systematic analysis of social media interactions, including comments, mentions, and post-sharing behaviors, constructing directed networks. Network metrics calculated included degree centrality, quantifying the number of connections, betweenness centrality, measuring bridging positions, closeness centrality, assessing proximity to other members, clustering coefficients, evaluating local network density, and overall network density, characterizing global connectivity. Relationships between network positions and performance metrics were explored through correlation analyses and network visualization techniques using Gephi software, enabling interactive exploration. Changes in network structures over time were assessed through temporal network analysis, comparing network metrics across monthly intervals, and examining network evolution dynamics.

Subgroup analyses explored whether relationships between social media metrics and performance outcomes varied meaningfully across competitive levels, age groups, playing positions, and clubs representing contextual moderators. Moderation analyses tested interaction effects between participant characteristics and social media variables in predicting performance outcomes using hierarchical regression with multiplicative interaction terms. Sensitivity analyses examined the robustness of findings across imputed datasets and alternative operationalizations of key variables, including different sentiment classification thresholds and engagement metric calculations, verifying consistency.

Qualitative content analysis supplemented quantitative findings through systematic thematic examination of social media post content categories. Coding procedures identified recurring

themes related to training experiences, team dynamics, motivational content, and emotional expressions using iterative coding refinement. Inter-rater reliability was established through independent coding by two researchers of randomly selected post samples comprising 15 percent of the total corpus with Cohen's kappa calculations. Thematic patterns were systematically triangulated with quantitative findings to provide a rich contextual interpretation of statistical relationships, grounding numerical patterns in authentic communication examples. All analyses were conducted using R statistical software version 4.3.1 with specialized packages including tidyverse for data manipulation, lme4 for multilevel modeling, sentimentr for sentiment analysis, igraph for network analysis, and mice for multiple imputation. Statistical significance was evaluated using an alpha level of 0.05 with Bonferroni corrections applied rigorously for multiple comparison contexts, controlling family-wise error rates. Effect sizes were reported systematically using Cohen's d for mean comparisons, R-squared for regression models, and standardized regression coefficients for predictor importance assessments, facilitating interpretation beyond statistical significance.

Results

Descriptive Findings and Social Media Usage Patterns

The six-month data collection period yielded comprehensive datasets comprising 18,742 individual social media posts, 156,892 discrete engagement interactions including likes, comments and shares, and 1,872 individual training performance assessments across 156 participants distributed across twelve clubs. Participants demonstrated substantial social media activity with a mean posting frequency of 4.8 posts per week and a standard deviation of 2.3, indicating considerable variability in individual posting behaviors. Facebook emerged as the most utilized platform with 89 percent participant usage reflecting platform dominance in the Algerian context, followed by Instagram at 76 percent and Twitter at 43 percent. Average follower counts varied considerably, with a median of 1,247 followers and a range from 156 to 24,389 followers, reflecting diverse social media presence levels and influence potential among participants.

Training attendance rates across the sample demonstrated high overall adherence with a mean attendance of 87.3 percent of scheduled sessions and a standard deviation of 8.9 percent. Performance metrics showed expected variability with sprint times ranging from 4.12 to 6.89 seconds for 30-meter distances, vertical jump heights spanning 38 to 72 centimeters, and technical skill scores distributed across full ranges of assessment scales. GPS data from a 64-participant subsample revealed mean training session distances of 4,872 meters, with high-intensity running distances averaging 687 meters per session.

Sentiment analysis results indicated predominantly positive sentiment orientations in social media communications, with 58.4 percent of posts classified as positive sentiment, 31.2 percent neutral sentiment, and 10.4 percent negative sentiment. Mean compound sentiment scores across all posts registered 0.34 on a negative to positive one scale with a standard deviation of 0.42. Temporal patterns revealed sentiment score fluctuations corresponding to competitive schedules with significant increases in positive sentiment following match victories and decreases following defeats, demonstrating emotional responsiveness to performance outcomes.

Hypothesis Testing Results

Correlation analyses examining relationships between social media engagement and training adherence supported hypothesis one with significant positive associations identified across multiple engagement indicators. Posting frequency demonstrated a moderate positive correlation with attendance rates of $r = 0.42$ with $p < 0.001$, indicating a reliable relationship. Engagement rate metrics showed stronger associations, with $r = 0.51$ for the correlation between engagement rate and attendance percentage, suggesting audience interaction quality predicts adherence more strongly than content generation quantity alone. These relationships remained statistically significant after controlling for age, competitive

level, and club membership through partial correlation procedures with a partial r of 0.48, ruling out spurious associations attributable to demographic confounds. Table 1 presents comprehensive correlation results between social media metrics and training adherence indicators with effect sizes.

Table 1: Correlations Between Social Media Engagement Metrics and Training Adherence

Social Media Metric	Training Attendance (%)	Punctuality Score	Session RPE	Partial r (controlled)
Posting Frequency	0.42***	0.38***	-0.24**	0.39***
Engagement Rate	0.51***	0.44***	-0.31***	0.48***
Comment Count	0.36***	0.29**	-0.19*	0.33***
Team-Related Posts	0.58***	0.52***	-0.35***	0.55***

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 1 demonstrates that team-related posting frequency exhibited the strongest correlation with training attendance at r equals 0.58, suggesting social media communications specifically focused on team experiences predict adherence more strongly than general posting activity, reflecting team identification. Engagement rates showed consistent associations across multiple adherence indicators, including punctuality and perceived exertion ratings. The negative correlations with session rating of perceived exertion indicate that higher social media engagement is associated with lower subjective training load perceptions, suggesting psychological benefits.

Multiple regression analysis modeling training attendance as the outcome variable with social media predictors entered hierarchically revealed a significant model fit with an adjusted R -squared of 0.41, indicating 41 percent variance explained. Team-related posting frequency emerged as the strongest unique predictor with a standardized beta of 0.39 and p less than 0.001. Engagement rate contributed additional predictive variance with a beta of 0.28 and p equals 0.003. Demographic control variables, including age and competitive level, explained only 8 percent of the variance, while social media variables explained an additional 33 percent, demonstrating substantial incremental validity.

For hypothesis two testing, multilevel models examined time-lagged relationships between sentiment scores and subsequent training performance metrics, accounting for repeated measures structure. Results provided partial support for hypothesis two, with significant associations identified for some but not all performance indicators examined. Sentiment scores demonstrated significant positive associations with technical skill performance assessed 48 hours following social media posts, with a standardized coefficient of 0.32 and p less than 0.001. Physical performance metrics, including sprint times and vertical jump heights, showed weaker non-significant relationships with sentiment scores, suggesting domain-specific effects. Table 2 summarizes multilevel model results for sentiment-performance relationships across temporal lags and performance domains.

Table 2: Multilevel Model Results for Sentiment-Performance Associations

Performance Outcome	24-Hour Lag β	48-Hour Lag β	72-Hour Lag β	ICC
Technical Skills	0.23*	0.32***	0.18*	0.34
Sprint Performance	0.11	0.15	0.09	0.42
Vertical Jump	0.14	0.08	0.06	0.38
Passing Accuracy	0.28**	0.36***	0.22*	0.29
Dribbling Score	0.19*	0.29**	0.15	0.31

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; ICC = Intraclass Correlation Coefficient

Table 2 reveals sentiment effects peaked at 48-hour time lags for most technical skill measures, suggesting optimal temporal windows for sentiment-performance relationships characterized by intermediate delay. Technical skills demonstrated stronger sentiment associations compared to physical performance metrics, supporting domain-specificity. Intraclass correlation coefficients indicated substantial between-person variance in performance measures, with 29 to 42 percent of variance attributable to stable individual differences. Strongest sentiment associations emerged for passing accuracy and overall technical skill composite scores reflecting cognitive-motor integration requirements.

Social Network Analysis Findings

Social network analysis of team communication patterns revealed meaningful relationships between network positions and performance outcomes with implications for understanding social dynamics. Network density metrics averaged 0.42 across teams, indicating moderately cohesive communication structures with substantial variability between clubs, ranging from 0.31 to 0.56. Players occupying central network positions demonstrated superior training adherence rates with a mean attendance of 92.1 percent for high-centrality players compared to 83.7 percent for peripheral players, representing an 8.4 percentage point difference. Degree centrality correlated significantly with performance metrics at r equals 0.39 for technical skills and 0.44 for coach-rated effort scores, suggesting network influence. Table 3 presents network metric associations with training and performance outcomes quantifying social integration effects.

Table 3: Social Network Metrics and Training Outcomes

Network Metric	Mean (SD)	Correlation with Attendance	Correlation with Technical Performance	Correlation with Team Cohesion
Degree Centrality	12.4 (5.8)	0.47***	0.39***	0.52***
Betweenness	0.18 (0.12)	0.33***	0.28**	0.41***
Closeness	0.52 (0.19)	0.41***	0.35***	0.48***
Clustering Coeff	0.38 (0.14)	0.29**	0.24*	0.58***

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3 illustrates that all network centrality measures demonstrated significant positive associations with training attendance and technical performance outcomes, supporting social integration. Clustering coefficients showed particularly strong relationships with team cohesion scores from survey measures at r equals 0.58, supporting the validity of social media network analysis as a proxy for team dynamics observable through digital communications. Temporal network analysis revealed increasing network density over the season from 0.36 at baseline to 0.48 at six months, suggesting strengthening team communication patterns corresponding to improved collective performance and social integration.

Subgroup and Moderation Analyses

Subgroup analyses explored whether social media-performance relationships varied meaningfully across participant characteristics, revealing important contextual moderators. Competitive level emerged as a significant moderator with stronger sentiment-performance associations observed in second and third division players compared to first division players, potentially reflecting greater psychological variability or differential coping resources. Interaction effects indicated sentiment predicted technical performance more strongly for younger players aged 18 to 23 years compared to older players, suggesting developmental differences in emotional regulation influencing performance. Playing position analyses revealed midfield and attacking players demonstrated stronger social media engagement-attendance relationships than defensive players, potentially reflecting positional differences in communication styles or team roles. Club-level analyses identified substantial between-club variability in relationship strengths, ranging from r equals 0.28 to 0.71, suggesting organizational culture factors influence how social media patterns relate to training outcomes, emphasizing contextual dependencies.

Discussion

The findings demonstrate that social media analytics provide meaningful complementary insights to traditional sports science metrics for understanding football training dynamics in Algerian contexts characterized by resource constraints and unique cultural communication patterns. The significant positive associations between social media engagement patterns and training adherence support theoretical frameworks positing digital communication behaviors reflect and influence motivational states, social integration, and commitment to team objectives, consistent with self-determination theory emphasizing relatedness as a fundamental motivational factor (Tian et al., 2023). Team-focused social media activity emerged as particularly predictive of adherence, suggesting online expressions of team identity and collective experiences indicate psychological investment in team participation, manifesting in training attendance behaviors and engagement quality (Einsle et al., 2023). These findings align with broader literature demonstrating social media's capacity to strengthen group cohesion and facilitate identity development within sports teams through shared digital spaces, enabling continuous connection beyond physical training contexts (Alves et al., 2025).

The sentiment analysis results provide partial support for relationships between emotional expressions and subsequent training performance. However, effects appeared specific to technical skill domains rather than general across all performance dimensions examined. The 48-hour temporal window for strongest sentiment-performance associations suggests emotional states influence performance through mechanisms requiring intermediate time to manifest rather than immediate effects potentially reflecting cumulative psychological readiness processes (Fortes et al., 2022). This temporal pattern may reflect consolidation of emotional experiences into stable mood states, subsequently affecting cognitive focus, technical execution precision, and learning receptivity during training sessions following positive sentiment periods characterized by enhanced attentional resources and reduced inhibitory control demands (Selak, 2024). The absence of significant associations with physical performance metrics suggests sentiment primarily affects cognitively-demanding skill domains rather than maximal physical capacities, consistent with sport psychology literature distinguishing psychological influences on technical versus physical performance components (Fortes et al., 2021).

Social network analysis findings highlighting relationships between communication centrality and training outcomes underscore the importance of team social dynamics for individual performance development within collective sports contexts (Alves et al., 2025). Players occupying central network positions may benefit from enhanced social support access, informational advantages facilitating skill development, and leadership opportunities promoting engagement and responsibility that manifest in superior attendance and performance patterns. Alternatively, centrality may reflect existing high-performing players naturally assuming leadership roles and modeling commitment behaviors, manifesting in both social media activity patterns and training behaviors, creating reciprocal causation dynamics. The strong associations between clustering coefficients and team cohesion validate social media network metrics as quantifiable indicators of team social structures that traditional observational methods struggle to assess objectively and continuously, enabling longitudinal tracking (Einsle et al., 2023).

The practical implications suggest Algerian football organizations can leverage social media analytics as cost-effective monitoring tools, supplementing limited sports science infrastructure without requiring substantial capital investments. Automated sentiment tracking could identify players experiencing psychological challenges, warranting targeted support interventions delivered by coaches or sports psychologists, where available. Network analysis could systematically inform team-building strategies and leadership development initiatives based on empirical communication patterns rather than subjective impressions alone. However, ethical considerations require transparent communication with players regarding monitoring practices obtained through informed consent, emphasis on aggregate patterns rather than individual surveillance, creating uncomfortable power dynamics, and integration of analytical insights with coaching expertise rather than algorithmic decision-making replacing human judgment and contextual understanding (Ben Haffaf et al., 2025). Cultural factors specific to Algerian contexts, including collectivist values emphasizing group harmony, communication norms governing appropriate expression, and social media usage patterns reflecting local technological adoption, require careful consideration when interpreting and applying findings, as relationships observed may differ substantially in individualist cultural contexts or settings with different digital communication conventions (Chipenda & Moyo, 2024).

Conclusion

This empirical investigation demonstrates that integrating social media analytics with traditional sports science methodologies provides enhanced insights into football training dynamics within Algerian contexts characterized by resource constraints and unique cultural factors shaping digital communication. Significant positive associations between social media engagement patterns and training adherence indicate that digital communication behaviors serve as meaningful indicators of player commitment and motivation accessible through cost-effective monitoring approaches. Sentiment analysis reveals temporal relationships between emotional expressions and technical performance outcomes, suggesting psychological states manifested in social media communications influence subsequent training effectiveness within specific temporal windows optimized at 48 hours, enabling proactive interventions. Social network analysis identifies communication patterns correlating with individual performance and team cohesion, validating network metrics as quantifiable indicators of social dynamics traditionally assessed through subjective coaching observations requiring systematic alternatives for objective longitudinal tracking.

The findings contribute to emerging sports science literature advocating comprehensive athlete monitoring approaches integrating physiological, biomechanical, psychological, and social data sources through feasible methodologies. For resource-constrained football organizations in Algeria and similar contexts throughout Africa and developing regions, social media analytics represent accessible tools for enhancing training insights without requiring expensive monitoring technologies, creating barriers to adoption. Practical applications include early identification of players experiencing motivational challenges enabling timely support, optimization of team communication structures based on empirical network patterns facilitating

cohesion, and evaluation of training program impacts on psychological dimensions complementing physical performance assessments providing holistic understanding. Future research should explore causal mechanisms underlying social media-performance relationships through experimental manipulations enabling stronger inferences, examine longer-term developmental trajectories over multiple seasons capturing maturation effects, investigate cultural moderators affecting generalizability across diverse football contexts including different regions and competitive levels, and develop automated monitoring systems translating research findings into practical coaching tools accessible to practitioners with limited technical expertise. The integration of social media analytics with sports science represents promising directions for holistic athlete development and performance optimization in contemporary football environments increasingly characterized by digital technologies and data-driven decision making requiring innovative yet accessible approaches particularly for resource-limited organizations.

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