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Preface - Forord

Denne oppgaven markerer slutten på nok et fullført utdanningsløp. Muligheten til å fylle på med ny, dypere kunnskap og kompetanse er noe jeg har satt pris på. Studieløpet, og arbeidet med denne oppgaven spesielt, har gjort at PhD-døra stadig har blitt mer fristende.

Langs veien er det flere personer som har hjulpet meg på ferden.

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Ole Martin

Sandnes, 2023

Abstract

Aim: The aim of this study was to investigate if the distance between central defenders shortly after a team's loss of ball possession differed when the team conceded a goal scoring opportunity compared to when the team did not concede a goal scoring opportunity.

Method: This study central defenders during soccer matches, specifically focusing on their positions immediately after loss of ball, 10 seconds later and within a 5-10 second interval and if there were a goal scoring opportunity. Data were collected using Global Navigation Satellite Systems units (Catapult Vector S7, Catapult Sports, Australia) and analysis data from Wyscout (Wyscout Platform, 2018). The dataset was categorized into three groups based on ascending distance: low distance group, medium distance group, and high distance group.

Results: There was a significant difference when comparing the distance between defenders when conceding a GSO and when preventing a GSO. 17% of the investigated events led to a goal scoring opportunity. The odds ratio showed that there were 12 times higher odds of conceding a goal scoring opportunity in the high distance group compared to low distance group.

Discussion: Central defenders should strive to have and maintain a short distance between them shortly after loss of ball possession to prevent a goal scoring opportunity.

Keywords: Football, tactical analysis, defending, counterattack

Sammendrag

Mål: Målet med denne studien var å undersøke om avstanden mellom sentrale forsvarsspillere kort tid etter at et lag har mistet ballbesittelse, var forskjellig når laget slapp til en målsjanse fra motstander sammenlignet med når laget ikke ga fra slapp til en målsjanse.

Metode: Denne studien undersøkte sentrale forsvarsspillere under fotballkamper, med fokus på deres posisjoner umiddelbart etter ballbesittelsestap, 10 sekunder senere og innenfor et 5-10 sekunders intervall og sett i sammenheng med mulige sjanser imot. Data ble samlet inn ved hjelp av globale satellittnavigasjonssystem-enheter (Catapult Vector S7, Catapult Sports, Australia) og analysedata fra Wyscout (*Wyscout Platform*, 2018). Datasettet ble kategorisert i tre grupper basert på økende avstand: lav avstand-gruppen, middels avstand-gruppen og høy avstand-gruppen.

Resultater: Det var en signifikant forskjell for når laget slapp til en sjanse og når man ikke slapp til en sjanse 17% av hendelsene som ble undersøkt førte til en målsjanse. Oddsratio viste at det var 12 ganger høyere sannsynlighet for å gi fra seg en målsjanse i høy avstand-gruppen sammenlignet med lav avstand-gruppen.

Diskusjon: Sentrale forsvarsspillere bør strebe etter å ha og opprettholde kort avstand mellom seg umiddelbart etter ballbesittelsestap for å forhindre målsjanser.

Nøkkelord: fotball, taktisk analyse, forsvarsspill, kontring

Contents

1. Introduction

Football is a popular sport with over 275 million players and 5 billion people interested in the sport (*The Football Landscape – The Vision 2020-2023*, n.d.), having more than 3.5 billion people watched the men's World Cup final in 2018 (*More than Half the World Watched Record-Breaking 2018 World Cup*, 2018). In team sports, the primary objective revolves around outscoring the opposing team. In the 2021/2022 season of the European club championship in football (Champions League), an average of 3.04 goals were scored per match (*Champions League Technical Report 2021/22*, 2022, p. 42), while in the Europe League, 2.64 goals were scored per match (*Europe League Techical Report 2021/22*, 2022, p. 41). These statistics underscore the dynamic nature of football and highlight the pivotal role of goal-scoring as a decisive factor in the game's outcomes.

In the realm of football research, numerous variables can be explored in relation to performance and match outcomes. These include team success (Andrzejewski et al., 2022) attacking methods (Schulze et al., 2022; Tenga et al., 2010b, 2010a), collective movements (Moura et al., 2012, 2013), and various physical variables (Bangsbo et al., 2006; Di Salvo et al., 2007; Rampinini et al., 2007). However, the defensive aspects in football have received relatively less attention, possibly due to the complexity in its measurement: the primary focus is to investigate the absence of the opponent's success. One can have a high degree of success and "only" concede one goal but nevertheless lose 1-0. While parameters such as number of goals, scoring opportunities, shots, and forward passes can be investigated in attack, defence can be seen as the absence of goals, scoring opportunities, shots, and forward passes[1].

In tactics and defence, researchers have tried to find patterns that describe collective behaviour in a team during a match (Mitchell, 1996; Moura et al., 2012; Yue et al., 2008). When it comes to investigating defensive play, higher-ranked teams allow fewer shots on their goal than medium and low-ranked teams per match (Andrzejewski et al., 2022, p. 4)[2]. Earlier papers (Mitchell, 1996, p. 32) claimed that in defence, players move to protect their own goal and regain possession of the ball. Some study (Moura et al., 2012, p. 91) found that teams reduce the space between players when they have possession of the ball and increase the space when they have ball possession. The findings indicate that the distances between players in the defensive team will decrease as a consequence of losing possession[3], thus

[1] More information in the appendix

[2] More information in the appendix

[3]

making the team more compact [4]. From the Norwegian premiership a study showed that defensive play by combining multiple variables[5] and showed that defensive effectiveness is lowest after losing possession, highlighting the efficacy of counterattacks (Tenga et al., 2010b, p. 239). A German study (Vogelbein et al., 2014, p. 1079) found that top-third teams use less time from losing possession until they win the ball back, when compared to teams in middle and lower third [6]. It has been revealed reduced synchronization among losing teams and higher similarity in actions among defensive players (Folgado et al., 2018, p. 104). Furthermore, research indicates central defenders have the largest individual playing area, indicating that the distance to teammates is longest for this group(Gonçalves et al., 2017, p. 6)[7].

Distances between defensive players and whether this has an impact on scoring chances for the opponent is an area that appears to be insufficient investigated in football[8]. The distance between defending team can be crucial to understanding tactical priorities, preventing goal scoring opportunities (GSO) and appear as a unit. Thus, the aim of this this study is to investigate if the distance between central defenders shortly after the team has lost ball possession differs when conceding and prevents a GSO in Norwegian premiership.

2. Method

2.1 Participants

Before we started to recruit participants, this study was approved by NSD (the Norwegian Centre for Research Data). Applicable candidates were invited to participate. Players, management and coaches were given oral and written information regarding the project and what participation entailed. Participants were informed that they at any point could withdraw from the study and that their data would be deleted. All players provided written consent.

The participants consisted of 5 athletes affiliated with the relevant team and actively participating in league matches during the seasons 2021 and/or 2022. The age range of the participants during data collection varied from 19 to 27 years. All participants held the role of

[4] More information in the appendix
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central defender (centre-back) for the same club, implying a shared mindset and understanding of positioning, tactics, and priorities on the football field.

2.2 Data collection and procedure

A cross-sectional design consisting of Global Navigations Satellite System (GNSS) files and analysis files was used to examine the research question. GNSS files from 30 premiership matches in Norwegian men's football from the seasons 2021 and 2022 were used. GNSS is a common method to measure kinematics in team sports (Malone et al., 2017, p. 18). GNSS data was recorded using Catapult Vector 7 (Catapult Vector S7, Catapult Sports, Australia, firmware 7.10+[9]). The league consisted of 16 teams playing against each other twice per season. This study is limited to the home field of one club and thus include 15 league matches per season.

Players used the GNSS devices during matches located at their upper back, attached using custom-made vests (Vector Core Vest, Catapult Sports, Melbourne, Australia). Players used the same unit throughout the season. The GNSS devices were activated when the players left the locker room and entered the playing field for kick off, approximately 10 minutes prior to kick off. This ensured that the devices were operational and had a sufficient reception from 5-7 satellites before the match begins (Malone et al., 2017, p. 21). After the end of the match, data was transferred to the Openfield Cloud Analytics platform (*Openfield Cloud Analytics Platform*, Catapult Sports, Australia, 2022, version 3.9.0) for further analysis. The study group obtained the data for analysis, which was subsequently exported to a spreadsheet[10]. To validate the accuracy of the GNSS data and confirm that the locations corresponded to the correct football stadium, a webpage (Norgeskart, n.d.) was employed.

Analysis data from Wyscout (*Wyscout Platform*, 2018) was extracted using XML-files from each relevant game[11]. The event '*club name* - opposition counter-attack' was employed to confirm the investigated teams loss of possession and the occurrence of an opposing team's counterattack. The geographical distance between the included athletes 0 seconds, 10 seconds and in the interval 5-10 seconds after this event had occurred was registered and calculated[12].

[9] More information in the appendix
[10] More information in the appendix
[11] More information in the appendix
[12] More information in the appendix

By comparing the difference in distance from 0 to 10 seconds after the loss of ball possession, we were able to ascertain whether the distance between the selected athletes increased, decreased, or remained unchanged during the specified time interval. The investigation identified GSOs by examining the events 'Shots', 'Opportunity', and 'Goal' from the Wyscout file within 40 seconds following the event '*club name* - opposition counter-attack'. GSOs observed within this time frame were logged accordingly. This was done using Visual studio (Microsoft Corporation, 2022). The definitions of these events can be found in table 1.

Table 1 Wyscout definitions (Wyscout Glossary, n.d.)

Term	Wyscout definition
Counterattack	A transition of the possession from the opponent team, where the team is transitioning quickly from defensive to attacking phase, trying to catch the opponent out of their defensive shape.
Shots	An attempt towards the opposition's goal with the intention of scoring.
Opportunity	A clear chance of scoring a goal.
Goal	A goal scored as specified in law 10.1 of the IFAB Laws of the Game.

2.3 Validity and reliability

This study utilized two data production systems: Catapult units and Wyscout files. Previous research has demonstrated the validity of positioning units from Catapult when measuring movement, speed and distance in sport (Johnston et al., 2014, p. 1653; Varley et al., 2012, p. 123)[13]. GNSS units (Vector S7, Catapult Sports, Australia) have shown good inter-device reliability with minimal variability across sessions for distance, velocity, and average acceleration (Crang et al., 2022, p. 342). Data from Wyscout is mainly produces by trained video analysts and each match are typically completed by three operators (Pappalardo et al., 2019, p. 2; Zeng & Pan, 2021, p. 37). They have routines for ensuring validity and reliability[14].

[13] More information in the appendix
[14] More information in the appendix

2.4 Data processing

Each player's position at the relevant time was logged as Xp(*t*) and Yp(*t*), where *t* represents a time stamp. The GNSS devices recorded at a frequency of 10 Hz. Only data from central defenders were extracted from Openfield (*Openfield Cloud Analytics Platform*, 2022). Both Wyscout and Catapult provided data covering the entire duration of the match, from kick-off to the final signal, but there was a difference for timestamps in second half[15]. Wyscout (*Wyscout Platform*, 2018) assigns a separate event for each athlete involved, and we decided to delete what we considered duplicates[16].

Employing the Haversine formula (Robusto, 1957)[17] in Microsoft Excel (2018), we calculated the distance between the athletes locations per instant, resulting in 51 values. The average distance within the 5-10 second after the '*club name* - opposition counter-attack' was then determined. Subsequently, the data file with the average distance and whenever there were a GSO, were sorted in ascending order and divided into three equal-sized groups: low distance (LG), medium distance (MG), and long distance (LG).

2.5 Formation

The investigated team have varied their formation during the two seasons[18], and some players have varied which position they play. To handle this, we used the setup and positions logged by the club in their own Openfield-system. If a player was listed as a central defender for a specific game, he would be included in this study for that specific game[19]. In cases where the club had registered 3 central defenders, the distances between all 3 were calculated. The longest distance of the three, which indicate the distance between the two outermost players of the three, was used for further analysis.

[15] More information in the appendix
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2.6 Statistical analysis

Statistical analysis were performed in SPSS (*IBM SPSS Statistics*, 2021). The Kruskal-Wallis H test was utilized to examine difference between the groups[20]. Additionally, odds ratio (OR) was computed to assess variations in GSO between the groups, using binary logistic regression. In all cases, the statistical significance was set at 0.05. One of the groups contained a value of 0, and thus we used the Haldane-Anscombe correction, adding 1 to each group. The dependent variable was GSO and the independent was the distance groups.

3. Results

From the 30 investigated games, 5 games did not have any events of counterattack against the investigated team. One of the games did not contain valid GNSS-data from a playing athlete. From the remaining 24 games there was a total of 65 unique events for counterattack against the analysed team with 11 (17%) chances against. Each analysed game had between 1 and 7 counterattack-events.

3.1 Descriptive statistics

Descriptive statistics presented as means ± SD are provided in table 2. Mean distance between defenders were 17.9 metres in the 65 counterattacks, ranging from 2.5 m to 46.2 m (Table 2). There was a significant difference ($p = 0.003$) for distance between defenders when the counterattack led to a GSO (25.3 metres) and no GSO (16.4 metres). On average, the distance between the two widest central defenders increased by 0.79 metres (SD ± 6.56) from 0.0 seconds to 10.0 seconds after the ball was lost, ranging from -19.48 to 14.18 metres. The difference in distance between 0 and 10 seconds are included in table 2, presented as means ± SD, showing how the distance between the defenders changed from 0 to 10 seconds. There were more GSO in HG than in MG and LG (figure 1). In HG, 33% of the counterattacks led to a GSO, while it was 18% and 0% for MG and LG, respectively.

[20] More information in the appendix

Table 2 descriptive statistics for grouped distances

Group	N	Mean (m)	Std. Deviation	Difference (m)	Std. Deviation
LG	22	9.01	3.08	0.79	3.79
MG	22	16.44	2.17	1.42	6.99
HG	21	28.72	7.18	0.17	8.03
Total	65	17.90	9.31	0.79	6.56

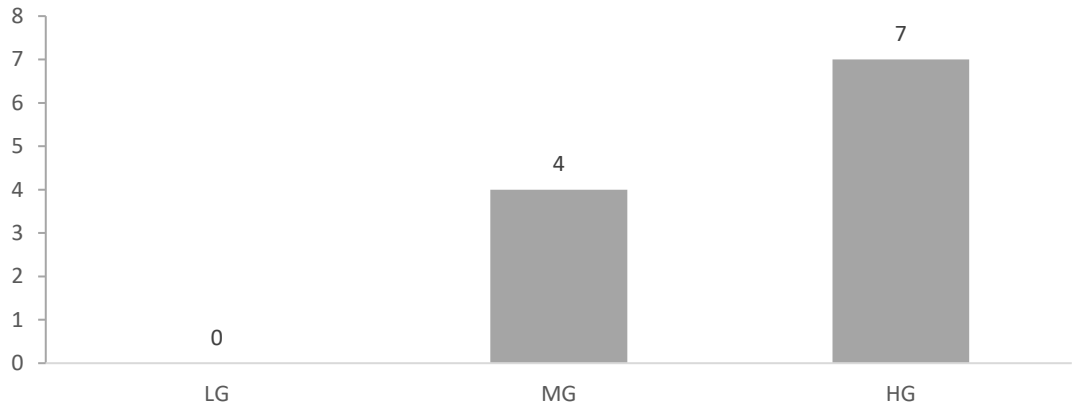

Figure 1 number of GSOs against grouped distance

3.2 Logistic regression analyses and odds ratio

The logistic analysis found a difference in the OR for conceding GSO between the LG, MG, and HG (table 3). There was a significant difference between the LG and HG ($p < 0.05$). It was found that the odds of conceding a GSO in the HG was 12.27 times higher than in the LG.

Table 3 Odds ratio between groups

Groups	Sig	Odds Ratio (exp(B))	95% CI for OR
MG versus LG	0.114	6.05	0.65 - 56.36
MG versus HG	0.293	2.03	0.39 - 5.02
HG versus LG	0.024*	12.27*	1.39 - 108.33*

* Significant at the 0.05 level

4. Discussion

Within our knowledge, this is the first study of its kind. The aim of this study was to investigate if there was a difference between the defenders when the team concede a GSO and when they are not. The main finding in this study is that after a team has lost ball possession, there exists a heightened distance between central defenders when the team concedes a GSO compared to instances where no GSO is conceded. In contrast: to prevent a GSO, the central defenders should pursue a low distance between them shortly after the loss of ball possession. Our data demonstrate an elevated OR for GSO in HG compared to LG, thereby reinforcing the significance of spatial proximity between central defenders immediately following the loss of ball possession.

4.1 Distance

The main finding of this study is the distance between central defenders differs when comparing GSO and no GSO. The study found that, on average, the distance is 9.9 metre longer when the defending team concedes a GSO than when there is not a GSO. The findings indicate that central defenders should strive to obtain and maintain a low distance between them shortly after the team has lost ball possession. As the distance is 9.9 metres lower while not conceding a GSO, it could be assumed that the athlete should be able to recognise if the gap between them is too wide.

This study provides a quantitative framework for football practitioners in the development and finetuning of team tactics. Previous studies in the Norwegian premiership (Tenga et al., 2010b, p. 240, 2010a, p. 250) has demonstrated that counterattacks represent the most efficient approach for scoring goals or gain scorebox-possession. Considering this, the current study aims to identify specific measures for the counterpart. However, the team under examination in this study exhibited more GSO than anticipated when compared with other studies (Tenga et al., 2010a, 2010b). This divergence may be attributed to the composition of the sample: Tenga et al. (2010a, 2010b) explored a broader range of teams encompassing both home and away matches. Thus, it is plausible that the investigated team represents an outlier within the league, characterised by a weak defensive tactics. As well, there is a definition that differs; this study used Wyscouts (*Wyscout Glossary*, n.d.) definition of a counterattack, while Tenga et al. (2010a, p. 246, 2010b, p. 238) used counterattacking and direct play interchangeably.

Moreover, this study reveals that the distance between the defenders did increase from the team lost the ball and the following 10 seconds. This finding contrasts with previous research (Moura et al., 2012). Moura et al. (2012, p. 91) observed that teams tend to reduce the spatial gaps and minimise the distances between their athletes when the team loose ball possession, while the World Cup Technical Report (*Technical Report - 2018 FIFA World Cup, Russia 2018*, 2018, pp. 17–79) showed that teams occupy a smaller territory when not in possession compared to when they have control of the ball. The dissimilarities could stem from the aforementioned studies incorporating all instances of a team's loss of possession, while this investigation solely examines the immediate seconds following the loss of ball possession. This disparity may also be explained by differing perspectives: other studies analysed entire teams as a collective entity, while this study focused on a subgroup of the defenders. This is a topic that could be further researched.

Table 2 shows that HG has the lowest difference in distance, increasing 0.17 metres on average. This phenomenon can be rationalised by two contrasting factors: defenders being content with their position, or, conversely, being unprepared for a potential loss of ball possession, thus resulting in a momentary state of inaction as the counterattack unfolds. The increase in distance for LG and MG is larger than HG, suggesting a greater feel of necessity for adjustment compared to HG. But, one should also take into consideration that HG has the highest frequencies for conceding GSO, indicating that there might be a need for other adjustment for this group. The LG contains values (distance) starting at 2.5 meters, which could seem unnatural low. This could be explained with the event occurring in relation with offensive set pieces where central defenders may actively participate in the attacking set up to score a goal from such situations, resulting in closer proximity between the players.

Full synchronisation among central defenders would result in consistent final distances between them across various events, particularly when they have sufficient time to react and adjust their positioning. The absence of complete synchronisation can be rationalised by considering the position of the ball and the opponents[21]. If so, it would contrast with Mitchell (1996, p. 32) who wrote that defending players primarily prioritise protecting their own goal and regain possession of the ball. However, since this study does not consider the distance from the defender to the ball nor their own goal, we are unable to confirm or reject if this occurs.

[21] More information in the appendix

This study provides evidence that an increase in distance between defenders is associated with a higher occurrence of GSOs. If a team plays with 3 central defenders, they would be able to cover a larger spatial area and still have a low distance between individual defenders. This larger spatial area could lead to the defenders having a larger degree of tactical freedom to act as they deem appropriate to prevent GSOs. The impact of varying numbers of defenders on the relationship between distance and GSO should be further investigated in future studies.

4.2 GSO

This study found that 17% of the counterattacks led to a GSO, while an earlier study (Tenga et al., 2010b, p. 240) found that 13.4% of counterattacks led to a goal. The results from both studies could appear to show a similar tendency. However, there is a difference in which dependent variable has been utilised: while this study includes goals, shots and chances, the aforementioned study exclusively used goals. As this study solely investigates one football team in their home ground in the Norwegian premiership, the visiting team(s) could, unknowingly, have shared a tactical approach to the game and avoid using counterattacks as a game tactic for scoring goals[22]. Similarly, the investigated team could have a tactical approach to the match with a plan to deny the opponent to exploit counterattacks.

4.3 Distance group and GSO

The OR analysis revealed a significant difference between LG and HG. A wider distance between athletes provides more space for opponents to explore, potentially causing defensive imbalance and compromising the defending team's tactical superiority. Conversely, a lower distance between defenders suggests control over crucial area. Consequently, the counterattacking team may need to prioritize alternative methods or tactical approaches to generate a GSO[23]. Notably, 63% of registered GSOs fall into HG, reinforcing the notion that a larger distance between defenders is unfavourable.

[22] More information in the appendix
[23] More information in the appendix

4.4 Limitations

The study's reliance on data from a single team over two seasons enhances its reliability but raises concerns about the generalizability and validity of the findings to other teams and leagues. Additionally, the limited inclusion of counterattacks in the study may impact the results, emphasizing the need for a more expansive sample to offer a more precise understanding of defensive play during counterattacks.

It is important to consider the potential artificiality of the distances observed in this study, which examine defensive play involving both two (mean = 16.2 m) and three (mean = 24.8 m) centre backs. This aspect warrants consideration when interpreting the findings.

While opting for Wyscout over manual analysis improved efficiency, reliability, and reproducibility, it is worth noting that manual analysis may yield variable outcomes, impacting both validity and reliability. Moreover, the exclusion of events occurring within the subsequent 10 seconds, as we considered duplicates, may result in a distinct data representation, as teams can experience scenarios where possession is lost and regained within this timeframe.

Future investigations could delve into the relationship between game scores and the distances between central defenders. If a team is pursuing goals or headed for loss, they could increase the risk, allow for greater distance between defenders. This was not investigated in the current study due to the low sample size.

4.5 Conclusion

In conclusion, the analysis of the distance between the defenders during counterattacks revealed significant differences based on the outcome of the counterattack. Counterattacks that led to a chance against the defending team exhibited a greater distance between defenders compared to counterattacks without a chance.

This study serves as a supplement and counterweight to existing research that has focused on attacks and scoring goals (Andrzejewski, 2022; Schulze et al., 2022; Tenga et al., 2010b, 2010a). It aims to shed light on defensive measures teams can employ to prevent chances from the opposition shortly after losing the ball. The findings offer tangible defensive guidelines, particularly in countering counterattacks. It is important to note that while these

measurements provide reference values, their generalizability to the entire league, sport, or specific team across multiple seasons remains uncertain.

4.5.1 Practical implications

This study provides evidence supporting the notion that central defenders should endeavour to maintain a diminished distance between them following the loss of ball possession by their team. Contrary to the notion of increasing the distance between defenders, it is recommended to maintain a reduced distance to impede opponents from capitalising on counterattacking opportunities and attaining GSOs. This assertion is supported by the observation that the OR between HG is 12 times higher than that in LG. Thus, it is recommended that central defenders prioritise minimising the distance between them to effectively oppose counterattacks.

Fundings

This study was partly funded by VRI Rogaland. The funding source were not involved in the study design, data acquisition, data analysis, statistical analysis, interpretation of data, discussion or production of this study.

Conflict

The main author has a minor involvement in the football club. There is no relation between his contract and the investigated team.

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Appendix

Appendix 1 - cap

Technicalities

This article has been produced with an intent to be published in Journal of Sports Sciences https://www.tandfonline.com/action/authorSubmission?show=instructions&journalCode=rjsp20

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This section is structured with corresponding numbers to the main text. The numbers in the beginning of the cap are there to show which footnote from the paper is corresponding.

"Offence wins tickets, defence wins championship" is a quote from the american sportsman Bear Bryant, indicating that defensive work is important if a team was to pursue a league title. This quote was central in the growth of the research question: building a baseline for development of a quantitative defensive framework.

1) The present study intended to investigate the absence of the events goals, chance, and shots on target in a specific situation. The evidence of absence will in this study be the value of an event not occurring in the specific time interval. As this study also could include that goal scoring opportunities (GSO) does occur, the absence should be possible to evident. If both events were to occur in games, we shall be able to find ground for comparison using GSO as a dependent variable. While a quantitative overview of defensive actions can be developed and utilised for measuring defensive action and performance, it is important to note that such an analysis may not always align with excellent performance: conceding a single goal can be enough to lose a football match.

2) Furthermore, the study shows that the number of goals scored has a strong positive correlation with the final league position, while the number of goals conceded has a strong negative correlation with the final league position (Andrzejewski et al., 2022, p. 3). This indicates that defence is important for the result of a football match and final table position,

and therefore should be interesting and important for football practitioners. According to the findings (Andrzejewski, 2022, p. 4), conceding few goals should be important if a team wants to have a high table position. Evidence supporting this assertion can be found in the conclusive data derived from the final standings of the Norwegian premiership over the past three seasons. Specifically, an examination of the respective tables reveals a consistent trend: the team crowned as the champion in 2020, 2021, and 2022 exhibited a superior defensive record by conceding fewer goals than any other competing team, as in line with the quote of Bear Bryant. Moreover, they demonstrated their offensive prowess by securing the highest, third highest, and second-highest goal tallies during these seasons, respectively (Norges Fotballforbund, 2020, 2021, 2022). These findings underpin the importance of both scoring goals as well as preventing the opponent from gaining a GSO for finishing with a high table position at the end of a season.

3) The technical report from the 2018 World Cup (Boban, 2018 p. 37) states that the French champions covered an average of 748 m2 when having the ball and 542 m2 when not in possession. When it comes to width, the Frenchmen covered 40 metres when having the ball and 32 metres when the opponent has the ball, indicating that they reduce the space they cover wide with 8 metres. A similar trend can be seen from the rest of the teams in FIFA world cup 2018: they cover a smaller area when out of possession when in possession of the ball (Boban, 2018, p. 17-79). This could be explained by a wish to control areas and deny opponents the opportunity to gain control within their own defending structure. Further, the report informs that the winners, on average, entered the opponents penalty area 29 times (per game), while a study from the Norwegian premiership had an average of 1.6 score-box possessions per match (Tenga et al., 2010a, p.249). As these two numbers are different, it could tell us that the international championship differs from the Norwegian premiership when looking at GSOs or similar variables.

4) Tenga et al. (2010a, p.249) combined the variables of defensive pressure, defensive back up, and defensive cover, which together make up a total defensive score. The study refers to a low score as the defending team being imbalanced and used the terms counterattack and direct play as synonyms (Tenga et al., 2010a, p.249). The alternating terms creates a gap from Wyscout (*Wyscout Glossary*, n.d.), as Wyscout has a definition for counterattack but nothing defined as direct play in their glossary.

5) Teams from the top third take on average one and two seconds less than those from the middle and lower third before regaining possession of the ball (Vogelbein et al., 2014, p.

1079). The same study showed that match status can affect reaction time. Losing teams have shorter reaction times than teams that are heading for a draw or victory: losing teams take on average 9 or 11 seconds to win the ball back depending on the opponent's league position, while the two other groups (draw and win) take 11-14 seconds. Within these seconds, the defenders should be able to adjust, react and readjust their positioning in relation to each other, opponents, ball, and their own goal. This tells us that top teams are both quick in regaining possession of the ball, as well as that the result within a game has an impact. These time intervals will serve as a reference to this study in terms of which time interval we should use in our research.

6) Further, Folgado et al. (2018, p. 106) showed that defensive players have a tendency to act similar and synchronised; interpreting situations in a common way. It could be expected that they should have a common understanding of how to act in altering situations.

(7) In summary, the findings suggest that defending teams are most vulnerable to conceding a goal shortly after losing possession while still being unbalanced. There is little research on player distances in football in general, especially within defensive phases. Therefore, it is of interest to investigate whether the distance between defensive players can affect the opponent's scoring chances.

8) The data collection process yielded an extensive dataset, comprising a minimum of 54,000 data points per player who participated in a complete game, resulting in more than 3 million values. This abundance of data provided a rich and comprehensive resource to effectively address the research question and enabled a detailed examination of the relevant variables in the study.

9) At the time we accessed the Catapult S7 units, they had firmware 7.10. The firmware has been updated throughout the investigated seasons, which may impact the devices.

10) We opted to utilise pre-existing analysis data provided by a commercial entity instead of conducting our own data collection. While this approach saves time and allows us to identify the time stamps, we deemed relevant for the chosen events, it restricts our ability to assess the reliability and validity of the data, thereby potentially compromising the internal reliability and validity of our study. However, it enhances the potential for external reproducibility, as the data source is widely available and can be accessed by others. The validity and reliability are further described in chapter 2.3.

11) We chose to investigate the average distance 5-10 seconds after the ball was lost of two reasons: a) it gives a more accurate picture of how the defenders work together to prevent a chance against than just looking at one individual value, and b) the defenders will have had time to adjust their position from the initial timestamp of ball loss. Further, we decided to set a time limit for when the GSO would have to occur. If the attacking team would have a GSO within this time interval, it would indicate that the defenders were insufficient in their defending and had handled the defensive transition poorly. In agreement with the representatives from the investigated club, we agreed to set a time limit after the ball loss at 40 seconds. In this study we decided to use a calculated distance between the defenders in a time interval of 5 seconds, 5 seconds after the team had lost ball possession. This did give us a accurate picture of the distance between the athletes, and therefore was not too affected by a single (extreme) value. The available data could also be utilized to determine how a team differs in shape and distances through different phases and events in a game. The value we have chosen to use is therefore affected by the movement of multiple athletes during those seconds rather than having a cross section from the individual situation.

12) In the context of measurement reliability and validity, typical error of measurement (%TEM) is commonly utilised as a standard measurement to assess the extent of score variation and dispersion around a true score. When measuring total distance, 10 Hz units from Catapult have been proven to be reliable and valid ($p > 0.05$, %TEM = 1.3%), and are therefore assumed to be reliable (Johnston et al., 2014). A p-value greater than 0.05 indicates that the unit is not statistically different from the actual distance, while a %TEM of 1.3% indicates that two identical units differ 1.3 % from each other. Global navigation satellite system (GNSS) technology has been examined, deemed and assessed as satisfactory in previous research (Beato et al., 2018; Delaney et al., 2019). However, it has not been deemed as satisfactory for accelerations and decelerations (Crang et al., 2022, p. 344). However, it is important to note, to the author's knowledge, there is currently no peer-reviewed data available on the reliability and validity of Catapult Vector GNSS system specifically concerning accuracy in localization and coordinates.

13) Wyscout have established internal routines to strengthen reliability and validity. According to Pappalardo et al. (2019, p. 2), Wyscout incorporates an algorithm designed to mitigate errors introduced by operators by cross-checking if two operators have assigned identical content to an event. This algorithm serves to minimise discrepancies and enhance the overall accuracy of the data collection process. By comparing the tags assigned by multiple

operators, Wyscout aims to reduce potential errors and improve the reliability of the data utilised in this study. Further, Wyscout employs algorithms to ensure the temporal consistency of events, preventing the occurrence of impossible events happening simultaneously or consecutively. As described by Pappalardo et al. (2019, p. 2), Wyscout follows a 3 step process for data production. Firstly, they establish the team's formation, which players are starting in the different positions and whom starts as substitute players. Secondly, continuously throughout the game, operators create new events by tagging a player for each touch on the ball. These events are then enriched with additional information such as the category of the event (e.g., pass, shot, tackle) and the corresponding coordinates of the player and the ball. This iterative process allows for a more detailed and comprehensive representation of the events occurring in the game. The third step is the quality control, consisting of the aforementioned algorithm, before the manual control done by a supervisor. The home ground of the researched team did not have custom-installed cameras from Wyscout as other studies (Arjol-Serrano et al., 2021, p. 2), and the analysis used for this study have therefore used commercial videos from the television. But nevertheless, the analysis is carried out by humans, who can, despite training and experience, make mistakes; human error has been documented elsewhere (Salmon et al., 2009). Furthermore, despite receiving training, the operators involved in the data tagging process may have individual interpretations and understandings of the situations they are analysing. This subjective element can introduce variability and potential discrepancies in the way events are perceived and recorded. It is important to acknowledge the possibility of differing interpretations among operators and consider the potential impact on the reliability and consistency of the collected data.

14) The GNSS-units from Catapult continue through the half-time break to log movements, while the analysis file from Wyscout ignores the break. This meant that the timestamps between the files were not synchronised from the start of halftime. We used the event 'first half end' to mark the end of the first half, and the event 'second half start' to mark the beginning of the second half. Between these two events there is a break with a varying duration, independent and unique from match to match. To manage this, the total duration in the different files was analysed, and the difference was added as halftime duration in the Wyscout file for each game. Visual Studio Code (Microsoft Corporation, 2022) was used to conduct this analysis and adjustment. We added the calculated difference to the start time of the second half, and thus adjusted the inequality. The employed code is pasted below and was

used to both adjust the time stamps from second half as well as analyse the relevant events of counterattack and GSO.

```
function Get-ShotAgainstAfterLoss([double]$ballLossTime, $shotsAgainst, $timeFrame) {
    foreach($shotAgainst in $shotsAgainst) {
        if ($shotAgainst -eq $false -or $shotAgainst -eq $true) {
            continue
        }

        [xml]$content = [System.Xml.Linq.XElement]::Parse("<instance>" + $shotAgainst + "</instance>")
        #Write-Host $content.OuterXml
        $shotAgainstStart = Select-Xml -Xml $content -XPath "/instance/start"
        $shotAgainstPlayer = Select-Xml -Xml $content -XPath "/instance/code"
        $shotAgainstTime = [double]::Parse($shotAgainstStart.Node.InnerText)
        if ([Math]::Abs($shotAgainstTime-$ballLossTime) -le $timeFrame) {
            return $true,$shotAgainstPlayer.Node.InnerText
        }
    }
    return $false,$null
}

function Get-BallLossTimes([string]$xmlFilePath, [int]$playerEndTime) {
    $xml = Get-Content -LiteralPath $xmlFilePath -Raw -Encoding Unicode
    [xml]$content = [System.Xml.Linq.XElement]::Parse($xml)

    # Spillertid starter ved avspark (0). Hvis starttid i kampfil er > 0 kompenserer vi for dette i uthentingen
av tidpunkter
    $firstHalfOffset = [int]::Parse($(Select-Xml -Xml $content -XPath
"/file/ALL_INSTANCES/instance[label/text='First half start']/start").Node.InnerText)
    $secondHalfStart = [int]::Parse($(Select-Xml -Xml $content -XPath
"/file/ALL_INSTANCES/instance[label/text='Second half start']/start").Node.InnerText)
    $secondHalfOffset = [System.Math]::Abs($playerEndTime - [int]::Parse($(Select-Xml -Xml $content -
XPath "/file/ALL_INSTANCES/instance[label/text='Second half end']/start").Node.InnerText))

    $ballLosses = Select-Xml -Xml $content -XPath "/file/ALL_INSTANCES//instance[code='Viking -
Opposition counter-attack']/start"
```

```
    $shotsAgainst = Select-Xml -Xml $content -XPath "/file/ALL_INSTANCES//instance[label/text='Shots' or label/text='Opportunity' or label/text='Goal']"

    $resultFile = $xmlFilePath.Replace(".xml", ".txt")

    if (Test-Path $resultFile) {
        Remove-Item $resultFile -Force | Out-Null
    }
    New-Item -Path $resultFile -ItemType File | Out-Null

    $timeDelay = 10
    $timeFrameShotAgainst = 30

    if ($null -eq $ballLosses -or $ballLosses.Length -eq 0) {
        Write-Host "No ball losses for '$xmlFilePath'" -ForegroundColor Red
    }
    else {
        foreach($ballLoss in $ballLosses) {
            $ballLossStartTime = [double]::Parse($ballLoss.Node.InnerText) + $timeDelay

            $shotsAgainst, $playerName = Get-ShotAgainstAfterLoss -ballLossTime $ballLossStartTime -shotsAgainst $shotsAgainst -timeFrame $timeFrameShotAgainst
            if ($shotsAgainst) {
                $resultedInShotAgainst = 1
            }
            else {
                $resultedInShotAgainst = 0
            }

            if ($ballLossStartTime -lt $secondHalfStart) {
                $timestamp = $ballLossStartTime + $firstHalfOffset
            }
            else {
                $timestamp = $ballLossStartTime + $secondHalfOffset
            }
            Add-Content -Path $resultFile -Value "$($timestamp.ToString("0.#"))|$($resultedInShotAgainst)|$($playerName)"
        }
```

```
    }
}

function Get-BallLossTimesForMatch([string]$matchDirectory) {
    Write-Host $matchDirectory
    $matchFile = $(Get-ChildItem $matchDirectory -Filter "*.xml").FullName
    $playerFile = $(Get-ChildItem $matchDirectory -Filter "*.csv" | Select-Object -First 1).FullName
    $playerEndTime = [double]$(Get-Content -LiteralPath $playerFile -Tail 1).Split(";")[1].Replace(",", ".")
    Get-BallLossTimes -xmlFilePath $matchFile -playerEndTime $playerEndTime
}

Get-ChildItem -Path . -Directory | ForEach-Object { Get-BallLossTimesForMatch -matchDirectory
$_.FullName }
#Get-BallLossTimesForMatch -matchDirectory "C:\Users\olemo\OneDrive\Dokumenter\Master -
data\bearbeidet wyscout\21 Brann"
```

15) Wyscout (*Wyscout Platform*, 2018) creates a new event for each athlete involved in an event, such as a counterattack. To handle this, we decided to delete recurring tags; if a team had been logged with a (new) counterattack within the next 10 seconds after the initial/previous one, we decided that the incident was a duplicate, and was therefore excluded from the study.

16) The Haverine formula, Hav(θ), calculates the distance between the two points on a sphere; φ (phi) is latitude and λ (lambda) is longitude. This value is then multiplied with 6371, as this is the average of the earth's radius between equator and the poles, and then multiplied with 1000 to have a value in metres.

$$hav(\theta) = hav(\varphi_2 - \varphi_1) + cos\ cos\ (\varphi_1)\ \ cos\ cos\ (\varphi_2)\ hav(\lambda_2 - \lambda_1) \cdot 6371 \cdot 1000$$

17) This means that formation has been logged and has been determined based on the clubs own GNSS-log from the individual match.

18) The investigated team has varied within a season how many central defenders (2 and 3) they have had in their starting 11. This could affect the athletes' synergy and collaboration in different situations. As well, players can be substituted. To handle this, we would have to resynchronize timestamps between GNSS-files between athletes as well as from the analysis-file.

19) The Kruskal-Wallis test on ranks is used to compare two or more independent samples which does not require normality of distribution. The test determines if it is a statistically significant difference between those groups (ordinal, dependent variable) on an independent variable.

There are various aspects within our study that offer potential for further investigation, enhancing the academic understanding of defensive variables based on our dataset. Exploring these factors can provide additional insights, refine our findings, and give a direction for future studies. By delving deeper into these findings and conducting further research, we can gain a more comprehensive understanding of defensive variables in soccer. This expanded investigation has the potential to bring nuance to our existing results, open up new research directions, and contribute to the scholarly discourse surrounding defensive strategies and their impact on goal-scoring opportunities.

Table 1 presents valuable information regarding the average distance when using 2 or 3 defenders, along with the average timestamp for the event of a counterattack. The data reveals that the mean distance increases by 8.8 metres when an additional defender is added to the defensive setup. The standard deviation (SD) is similar between the two groups, suggesting a consistent pattern. Furthermore, the timestamp analysis indicates that, on average, a counterattack leading to a goal-scoring opportunity (GSO) occurs earlier in the game when there are 3 defenders compared to 2 defenders. In Table 2, we observe the mean time for counterattacks resulting in a GSO versus counterattacks without a GSO. The data shows that, on average, counterattacks leading to a GSO occur earlier in the game compared to counterattacks that do not result in a GSO. Table 3 demonstrates significant correlations among various factors, including distance and time, distance and number of defenders, and GSO and distance. These correlations provide insights into the interrelationships between these variables, highlighting influences of distance, time, and defensive strategies on the occurrence of GSOs.

Table 4 provides insights into the distribution of distance groups when examining the difference in distance from the first recorded value to the last within a 10-second interval. The data reveals an even distribution across the distance groups. Further, when looking into the difference in distance and whenever a GSO occurs (table 5), there were similar frequencies; when a GSO occurred, 5 of the events had a difference above 0 while 6 events had a difference below 0. In contrast, when there was no GSO, there were 28 events with a difference above 0 and 26 below 0.

These findings prompt further inquiry into the complex dynamics of the sport, counterattacks and GSO. While the difference in distance does not seem to explain the likelihood of a GSO, there may be other variables at play that contribute to the success or failure of a counterattack in producing a scoring opportunity. By exploring these additional factors and conducting more in-depth analyses, we can gain a deeper understanding of the intricacies involved in offensive and defensive strategies during counterattacks in soccer.

Table 1 average distance and timestamp, grouped by number of defenders

Number of defenders		Distance (m)	Time (s)
2	Mean	16,2	3482,8
	N	52	52
	Std. Deviation	8,7	1983,4
3	Mean	24,8	3023,1
	N	13	13
	Std. Deviation	8,9	2021,5
Total	Mean	17,9	3390,8
	N	65	65
	Std. Deviation	9,3	1983,7

Table 2 timestamp for chance

GSO	Mean	N	Std. Deviation
Yes	2661,8	11	1693,5
No	3539,3	54	2019,4
Total	3390,8	65	1983,7

Table 3 Correlation

		time (s)	Distance	Number of defenders
Time (s)	Pearson Correlation	1	-,330**	-,081
	Sig. (2-tailed)		,009	,537
	N	61	61	61
Distance	Pearson Correlation	-,330**	1	,430**
	Sig. (2-tailed)	,009		<,001
	N	61	61	61
Number of defenders	Pearson Correlation	-,081	,430**	1
	Sig. (2-tailed)	,537	<,001	
	N	61	61	61

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4 difference in distance 0-10 sec across groups

Grouped distance	LG	MG	HG
Over 0	11	11	11
Below 0	11	11	10

Table 5 GSO and difference in distance from 0-10 seconds

Grouped distance	GSO	No GSO
Over 0	5	28
Below 0	6	26

Table 6 difference in distance when looking into number of defenders

Grouped distance	2 defenders	3 defenders
Over 0	28	5
Below 0	24	8

As table 1 shows, there is a basis for expecting each defender to cover an area with a radius of 8 metres (16.2/2 = 8.1m, 24.8/3 = 8.2m), similar to numbers from the Frenchmen's in World Cup 2018 covering 8m each in width (32/4 = 8m) (Boban, 2018, p. 37). This could therefore appear to be a common guideline when out of possession: averaging a distance between teammates of 8 metres when out of possession. When comparing the investigated team with the world champions, the defending distances and the area each defender covers appear to be similar. This finding could therefore suggest that the transferability from Norwegian premiership to international championship is present. The report does not provide information regarding counterattacks and could therefore be used as a basis for further studies in a different league.

When looking into the difference in distance whenever it is above or below 0 in relation with GSOs, there appears to be no difference. The data suggests that the difference in distance does not appear to be a determining factor in predicting whether a counterattack will result in a GSO. This finding indicates that other variables or factors may play a more significant role in influencing the outcome of a counterattack, and further investigation is needed to identify these factors.

20) In certain situations during a football match, the movement of the ball or an opponent may prompt a defender to deviate from their intended position to react and prevent a GSO. This could occur when a defender decides to engage in a countermove, such as pursuing an opponent or attempting to regain possession of a free ball. In such cases, the defender's actions may lead to an expansion in the distance between themselves and their teammates, as they temporarily abandon their designated positions to address the immediate threat. While this may appear as a weakening of synchronisation in terms of numbers and distance, it serves the purpose of preventing a potential GSO. This type of defensive strategy often requires a common understanding or agreement among the defenders regarding when it is permissible to deviate from their positions to address specific threats. It may involve coordinated

communication or non-verbal cues among the defensive players to ensure effective coverage and minimise the chances of an opponent capitalising on the defensive gaps. From an analytical perspective, this expansion in distance between defenders due to individual countermoves can create challenges when studying defensive coordination. It may give the impression of weak or absent synchronisation in terms of numbers and distance, but it is important to consider the tactical intentions and adaptive decision-making of the defenders in such situations.

Contrary to the belief that counterattacks leading to a GSO would be more prevalent later in a game due to fatigue and tiredness among athletes, Table 2 (cap) provides evidence that challenges this assumption. The findings from this study demonstrate that, on average, the occurrence of GSOs takes place earlier in the game compared to counterattacks that do not result in a GSO. This suggests that factors other than fatigue and tiredness may play a more significant role in determining the likelihood of a counterattack leading to a GSO. It implies that specific tactical or strategic elements, individual player skills, team dynamics, or situational circumstances may have a greater influence on the success of counterattacks and the subsequent creation of goal-scoring opportunities. The findings from Table 2 underscore the importance of considering various factors beyond just physical fatigue when analysing the timing and effectiveness of counterattacks in soccer. Exploring these factors can provide valuable insights into the complex interplay between physical and tactical aspects of the game and help refine our understanding of the dynamics involved in goal-scoring opportunities during different phases of a match.

Table 3 (cap) provides valuable insights into the relationship between the distance between central defenders and the timing of the game. The findings suggest that the distance between athletes is influenced by the progression of time within the match. Specifically, it indicates that as the game progresses, the distance between central defenders tends to decrease. This observation raises intriguing possibilities regarding the defenders' collective understanding of their role in preventing goal-scoring opportunities. As the match unfolds and fatigue sets in, the central defenders may become more cognizant of the criticality of maintaining a compact defensive unit. They may recognize that their individual and collective performance can be affected by fatigue and that a closer proximity to their teammates can enhance their ability to thwart the opposition's attacks effectively. On the other hand, at the beginning of the game, there may be a tactical emphasis on utilising space in an offensive manner for the central defenders. This approach could involve a wider distribution of positions to initiate attacking

moves or provide passing options to teammates. Consequently, the distance between central defenders might be initially wider as they contribute to the team's offensive play. The findings from Table 3 suggest that the central defenders' positional dynamics are influenced by both tactical considerations and the evolving demands of the game. It highlights the interplay between strategic priorities and the awareness of collective defensive responsibilities, taking into account factors such as fatigue and the importance of maintaining a compact defensive structure throughout the course of the match. Further exploration of these dynamics can deepen our understanding of how central defenders adapt their positioning strategies based on various contextual factors in a game.

21) Furthermore, it is worth noting that this study exclusively investigated a single football team in their home ground within the Norwegian premiership. The tactical approaches adopted by the visiting team(s) could have influenced the outcomes observed. It is possible that these teams shared a similar tactical approach, deliberately avoiding the use of counterattacks as a primary strategy for scoring goals. In contrast, the investigated team may have employed a specific tactical approach aimed at minimising the opponent's ability to exploit counterattacks effectively. These contextual factors highlight the importance of considering the specific circumstances and conditions under which the study was conducted. The findings should be interpreted within the context of a specific team, their home ground, and the broader tactical dynamics of the Norwegian premiership. Further research encompassing multiple teams and diverse competitive settings could provide additional insights into the tactical variations employed by different teams and shed light on the influence of game context on counterattack effectiveness.

21) The logistic regression analysis conducted in this study revealed a significant difference between LG and HG in terms of their defensive effectiveness, presented as Odds Ratio. The wider distance observed between athletes in LG indicates that there is more space available for opponents to exploit. This increased space can lead to defensive imbalances and potentially compromise the tactical superiority of the defending team. On the contrary, a lower distance between defenders suggests a greater control over crucial areas on the field. This close proximity between defenders indicates a stronger defensive structure and coordination, which can make it more difficult for the opposing team to penetrate and create GSOs. As a result, the counterattacking team may need to prioritise alternative methods or tactical approaches to generate GSOs when facing a well-organised defence with a lower distance between defenders. It is worth noting that the data analysis revealed that 63% of the

registered GSOs occurred within HG. This finding further reinforces the notion that a larger distance between defenders is unfavourable for the defending team. It suggests that maintaining a compact defensive shape and minimising the distance between defenders can be a crucial factor in preventing the opponent from creating high-quality scoring chances. However, it is important to consider the context in which the low distance values were observed in the LG. The inclusion of values starting at 2.5 metres may initially seem unusually low. This lower distance could be explained by specific game situations, particularly offensive set pieces, where central defenders may actively participate in the attacking set-up in an attempt to score goals. This participation in offensive plays can result in closer proximity between the players and may explain the occurrence of lower distance values within the LG. These findings highlight the complex interplay between defensive distances, tactical strategies, and offensive set-piece scenarios. Further research is needed to explore the specific situational factors that influence defensive distances and their impact on defensive effectiveness. Understanding these nuances can provide valuable insights for coaches and teams in devising effective defensive strategies and optimising their tactical approach in different game situations.

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Appendix 2 – consent norwegian

Vil du delta i forskningsprosjektet

«forsvarsspill til besvær»?

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er undersøke sammenhengen mellom avstander i forsvarende fotballag og scoringsmulighet imot. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

- **Formål**

Formålet med oppgaven er å undersøke hvordan man kan måle forsvarsspill. Utgangspunktet er å bruke GPS-data fra obligatoriske seriekamper for å avgjøre nøyaktig avstand mellom utøvere, og så undersøke hvordan det påvirker scoring og scoringsmulighet fra motstander. I utgangspunktet vil studien ta for seg avstander mellom midtstoppere mens ballen befinner seg utenfor egen tredjedel. Prosjektet er en del av en mastergrad-avhandling.

- **Hvem er ansvarlig for forskningsprosjektet?**

Universitetet i Stavanger og Norges Idrettshøgskole er ansvarlig for prosjektet.

- **Hvorfor får du spørsmål om å delta?**

Du får spørsmål om å delta som følge av at du spiller fotball i Viking fotball for A-laget.

- **Hva innebærer det for deg å delta?**

Hvis du velger å delta vil GPS-data fra offisielle Viking a-kamper bli delt med studiegruppen. Du vil ikke behøve å svare på spørsmål eller stille opp til noen undersøkelser. Data om spillerposisjon(er) på banen vil om nødvendig bli hentet fra Viking sin hjemmeside.

- **Det er frivillig å delta**

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykke tilbake uten å oppgi noen grunn. Alle opplysninger om deg vil da bli anonymisert. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.
Din deltakelse vil ikke påvirke din arbeidssituasjon i Viking fotball.

- **Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger**

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

Prosjektgruppen ved Ole Martin Øgaard (UiS) og Live Luteberget (NIH) vil ha tilgang til dataen. Navnet ditt vil bli erstattet med en kode som lagres på eget dokument. Navnet ditt vil ikke være oppgitt sammen med data.

I en publikasjon vil det ikke være mulig å koble dataen sammen med deltaker. I en eventuell publikasjon vil avstander mellom ikke-navngitte utøvere bli oppgitt.

- **Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?**

Prosjektet skal etter planen avsluttes 1.6.2023. Etter prosjektslutt vil data og personopplysninger slettes.

- **Dine rettigheter**

Så lenge du kan identifiseres i datamaterialet, har du rett til:
innsyn i hvilke personopplysninger som er registrert om deg,

- å få rettet personopplysninger om deg,
- få slettet personopplysninger om deg,
- få utlevert en kopi av dine personopplysninger (dataportabilitet)
- å sende klage til personvernombudet eller Datatilsynet om behandlingen av dine personopplysninger.

- **Hva gir oss rett til å behandle personopplysninger om deg?**

Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Universitetet i Stavanger/Norges Idrettshøgskole har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

- **Hvor kan du finne ut mer?**

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med:

- Universitetet i Stavanger ved Live Luteberget (Email: livesl@nih.no, telefon: +47 23 26 23 25).
- Vårt personvernombud kan nåes på epost: personvernombud@uis.no
- NSD – Norsk senter for forskningsdata AS, på epost (personverntjenester@nsd.no) eller telefon: 55 58 21 17.

Med vennlig hilsen

Live Steinnes Luteberget
(Forsker/veileder)

Ole Martin Øgaard

- **Samtykkeerklæring**

Jeg har mottatt og forstått informasjon om prosjektet *[sett inn tittel]*, og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta i observasjonsstudien
- ☐ at fysisk trener kan gi opplysninger om meg til prosjektet

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, cirka juni 2023.

(Prosjektdeltakers navn med blokkbokstaver)

---/---/---
(Sted /dato /prosjektdeltakers signatur)

Appendix 4 – Consent English

Would you like to participate in the research project "Inconvenient defence"?

This is a question for you regarding participation in a research project that aims to investigate the relationship between distances in defensive football teams and scoring opportunities against. In this document, we provide you with information about the goals of the project and what participation would entail for you.

Purpose

The purpose of this study is to examine how defense can be measured. The starting point is to use GPS data from official league matches to determine the precise distance between players and then investigate how it affects scoring and scoring opportunities against the opponent. Initially, the study will focus on distances between central defenders while the ball is outside their own third of the field. The project is part of a master's thesis.

Who is responsible for the research project?

The University of Stavanger and the Norwegian School of Sport Sciences are responsible for the project.

Why are you being asked to participate?

You are being asked to participate because you play football for Viking Football on the A-team.

What does it mean for you to participate?

If you choose to participate, GPS data from official Viking A-team matches will be shared with the study group. You will not need to answer any questions or participate in any surveys. If necessary, player position data on the field will be obtained from Viking's website.

Participation is voluntary

Participation in the project is voluntary. If you choose to participate, you can withdraw your consent at any time without providing a reason. All information about you will then be anonymized. There will be no negative consequences for you if you do not want to participate or later choose to withdraw. Your participation will not affect your employment situation at Viking Football.

Your privacy - how we store and use your information

We will only use the information about you for the purposes we have described in this document. We treat the information confidentially and in accordance with privacy regulations.

The project group consisting of Ole Martin Øgaard (UiS) and Live Luteberget (NIH) will have access to the data. Your name will be replaced with a code stored in a separate document. Your name will not be associated with the data.

In a publication, it will not be possible to link the data to the participants. Distances between unnamed participants will be provided in any potential publication.

What happens to your information when we conclude the research project?

The project is scheduled to conclude on June 1, 2023. After the project ends, the data and personal information will be deleted.

Your rights

As long as you can be identified in the data material, you have the right to:

Access the personal information registered about you

- Have incorrect personal information about you corrected
- Have personal information about you deleted
- Receive a copy of your personal information (data portability)

- Submit a complaint to the Data Protection Officer or the Norwegian Data Protection Authority (Datatilsynet) regarding the processing of your personal information.

What gives us the right to process personal information about you?

We process information about you based on your consent.

On behalf of the University of Stavanger/Norwegian School of Sport Sciences, the Norwegian Centre for Research Data (NSD) has assessed that the processing of personal information in this project complies with privacy regulations.

Where can you find more information?

If you have any questions about the study or wish to exercise your rights, please contact:

- University of Stavanger, Live Luteberget (Email: livesl@nih.no, phone: +47 23 26 23 25)
- Our Data Protection Officer can be reached by email: personvernombud@uis.no
- Norwegian Centre for Research Data (NSD), by email (personverntjenester@nsd.no) or phone 55 58 21 17

Kind regards,

Live Steinnes Luteberget Ole Martin Øgaard

(Forsker/veileder)

Consent Declaration

I have received and understood the information about the research project "Defensive Strategies for Disadvantage" and have had the opportunity to ask questions. I consent to:

- ☐ Participate in the observational study.
- ☐ Allow the physical trainer to provide information about me to the project.

I consent to the processing of my information until the project is concluded, around June 2023.

_____

(Project Participant's Name in block letters)

----------/----------/----------

Place /Date /Project Participant's Signature

Appendix 4 – Application to NSD

Meldeskjema /
Forsvarsspill til besvær /
Eksport

Meldeskjema

Referansenummer
882091

Hvilke personopplysninger skal du behandle?

Navn (også ved signatur/samtykke)
Gps eller andre lokaliseringsdata (elektroniske spor)

Prosjektinformasjon

Prosjekttittel
Forsvarsspill til besvær
Prosjektbeskrivelse
Benytte GPS-data for å undersøke sammenheng mellom avstand mellom spillere og scoringsmulighet i mot.
Begrunn hvorfor det er nødvendig å behandle personopplysningene
GPS-data utgjør datagrunnlaget for studien
Prosjektbeskrivelse
Prosjektbeskrivelse 3.0.docx
Ekstern finansiering
Ikke utfyllt
Type prosjekt
Studentprosjekt, masterstudium
Kontaktinformasjon, student
Ole Martin Øgaard, olemogaard@uis.no, tlf: 99322863

Behandlingsansvar

Behandlingsansvarlig institusjon
Universitetet i Stavanger / Fakultet for utdanningsvitenskap og humaniora / Institutt for grunnskolelærerutdanning, idrett ogspesialpedagogikk
Prosjektansvarlig (vitenskapelig ansatt/veileder eller stipendiat)
Live Steinnes Luteberget, livesl@nih.no, tlf: 23262325
Skal behandlingsansvaret deles med andre institusjoner (felles behandlingsansvarlige)?
Nei

Utvalg 1

Beskriv utvalget
Fotballspillere som spiller på elitenivå i Norge
Beskriv hvordan rekruttering eller trekking av utvalget skjer
Utvalget rekrutteres gjennom eget nettverk
Alder

16 - 41
Personopplysninger for utvalg 1
Navn (også ved signatur/samtykke)

Gps eller andre lokaliseringsdata (elektroniske spor)

Hvordan samler du inn data fra utvalg 1?

Ikke-deltakende observasjon

Grunnlag for å behandle alminnelige kategorier av personopplysninger

Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)

Hvem samtykker for ungdom 16 og 17 år?

Ungdom

Informasjon for utvalg 1

Informerer du utvalget om behandlingen av personopplysningene?

Ja

Hvordan?

Skriftlig informasjon (papir eller elektronisk)

Informasjonsskriv

infoskriv.doc

Tredjepersoner

Skal du behandle personopplysninger om tredjepersoner?

Nei

Dokumentasjon

Hvordan dokumenteres samtykkene?

Manuelt (papir)

Hvordan kan samtykket trekkes tilbake?

Skriftlig/muntlig kommunikasjon med forsker

Hvordan kan de registrerte få innsyn, rettet eller slettet personopplysninger om seg selv?

På forespørsel kan de få innsyn i opplysninger og data som er tilknyttet seg selv.

Totalt antall registrerte i prosjektet

1-99

Tillatelser

Skal du innhente følgende godkjenninger eller tillatelser for prosjektet?

Ikke utfyllt

Behandling

Hvor behandles personopplysningene?

Private enheter

Mobile enheter tilhørende behandlingsansvarlig institusjon

Retningslinjer/tillatelse til å behandle opplysninger på private enheter

Retningslinjer for behandling av opplysninger på private enheter.docx

Hvem behandler/har tilgang til personopplysningene?

Prosjektansvarlig

Student (studentprosjekt)

Andre med tilgang til opplysningene

Andre som har tilgang til personopplysningene

Klubben som spillerne spiller på har tilgang til dataene. Dette er i utgangspunket utenfor prosjektet, fordi det er prosjektet som fårtilgang fra klubben.

Tilgjengeliggjøres personopplysningene utenfor EU/EØS til en tredjestat eller internasjonal organisasjon?

Nei

Sikkerhet

Oppbevares personopplysningene atskilt fra øvrige data (koblingsnøkkel)?
Ja
Hvilke tekniske og fysiske tiltak sikrer personopplysningene?
Adgangsbegrensning
Andre sikkerhetstiltak
Hvilke
Kryptert fil med passord-beskyttelse

Varighet

Prosjektperiode
08.08.2022
-
01.06.2023
Hva skjer med dataene ved prosjektslutt?
Data anonymiseres (sletter/omskriver personopplysningene)
Hvilke anonymiseringstiltak vil bli foretatt?
Koblingsnøkkelen slettes
Vil de registrerte kunne identifiseres (direkte eller indirekte) i oppgave/avhandling/øvrige publikasjoner fra prosjektet?
Nei

Tilleggsopplysninger

GPS-data samles kun inn på kamper - det vil si at det ikke er mulig ut i fra dataene å finne ut personlige opplysninger om deltakerne(hvor de bor osv).Vi henter kun ut rå-dataene fra GPS. Det vil si at vi ikke deler dataene med en tredjepart (GPS-selskapet). Det er klubben som eierdataene, og som velger om de vil dele dataene med en tredjepart (GPS-selskapet).

Appendix 5 – Reply from Sikt

Sikt

Meldeskjema / Forsvarsspill til besvær / Vurdering

Vurdering av behandling av personopplysninger

Referansenummer	Vurderingstype	Dato
882091	Standard	06.12.2022

Prosjekttittel
Forsvarsspill til besvær

Behandlingsansvarlig institusjon
Universitetet i Stavanger / Fakultet for utdanningsvitenskap og humaniora / Institutt for grunnskolelærerutdanning, idrett og spesialpedagogikk

Prosjektansvarlig
Live Steinnes Luteberget

Student
Ole Martin Øgaard

Prosjektperiode
08.08.2022 - 01.06.2023

Kategorier personopplysninger
Alminnelige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 01.06.2023.

Meldeskjema

Kommentar
OM VURDERINGEN
Personverntjenester har en avtale med institusjonen du forsker eller studerer ved. Denne avtalen innebærer at vi skal gi deg råd slik at behandlingen av personopplysninger i prosjektet ditt er lovlig etter personvernregelverket.

Personverntjenester har nå vurdert den planlagte behandlingen av personopplysninger. Vår vurdering er at behandlingen er lovlig, hvis den gjennomføres slik den er beskrevet i meldeskjemaet med dialog og vedlegg.

VIKTIG INFORMASJON TIL DEG
Du må lagre, sende og sikre dataene i tråd med retningslinjene til din institusjon. Dette betyr at du må bruke leverandører for spørreskjema, skylagring, videosamtale o.l. som institusjonen din har avtale med. Vi gir generelle råd rundt dette, men det er institusjonens egne retningslinjer for informasjonssikkerhet som gjelder.

DEL PROSJEKTET MED PROSJEKTANSVARLIG
Det er obligatorisk for studenter å dele meldeskjemaet med prosjektansvarlig (veileder). Det gjøres ved å trykke på "Del prosjekt" i meldeskjemaet. Om prosjektansvarlig ikke svarer på invitasjonen innen en uke må han/hun inviteres på nytt.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige kategorier av personopplysninger frem til 01.06.2023.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

PERSONVERNPRINSIPPER
Personverntjenester vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Personverntjenester vurderer at informasjonen om behandlingen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18) og dataportabilitet (art. 20).

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
Personverntjenester legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

Ved bruk av databehandler (spørreskjemaleverandør, skylagring, videosamtale o.l.) må behandlingen oppfylle kravene til bruk av databehandler, jf. art 28 og 29. Bruk leverandører som din institusjon har avtale med.

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

MELD VESENTLIGE ENDRINGER
Dersom det skjer vesentlige endringer i behandlingen av personopplysninger, kan det være nødvendig å melde dette til oss ved å oppdatere meldeskjemaet. Før du melder inn en endring, oppfordrer vi deg til å lese om hvilke type endringer det er nødvendig å melde: https://www.nsd.no/personverntjenester/fylle-ut-meldeskjema-for-personopplysninger/melde-endringer-i-meldeskjema Du må vente på svar fra oss før endringen gjennomføres.

OPPFØLGING AV PROSJEKTET
Personverntjenester vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Kontaktperson hos oss: Janniche Linde

Lykke til med prosjektet!