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**INVESTIGATING SPACE PROTECTION DYNAMICS  
IN NBA AND EUROLEAGUE**

**Final Master's Thesis**

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# **ABSTRACT**

## **INVESTIGATING SPACE PROTECTION DYNAMICS IN NBA AND EUROLEAGUE**

**Keywords:** basketball, team sports, performance analysis, defence, tactics

**Research problem question:** Which defensive tactical elements and strategies are used by teams on elite levels of basketball?

**Research aim:** To determine differences in usage of selected Space Protection Dynamics (SPDs) between two top level basketball leagues – in USA (NBA-National Basketball Association) and Europe (Euroleague).

**Hypothesis 1:** There will be significant differences in usage of SPDs between NBA and Euroleague.

**Hypothesis 2:** There will be significant differences in usage of SPDs between regular season and playoff games in the same league.

### **Research methods:**

1. Literature review
2. Data collection through video analysis using NBA League Pass and Euroleague TV paid subscription
3. Statistical analysis using Microsoft Excel software and IBM SPSS software

SPDs investigated in this research were validated and classified previously by Santana et al. in 2015. Specifically, SPDs for 2vs2 of on ball screens (*defense of the ball player*) and 3vs3 of out of the ball screens (*defense of the receiver of the screen*) were analysed, with all subcategories.

Significant difference was found in the distribution between 2vs2 and 3vs3 in SPDs comparing NBA to Euroleague. Analysis of all subcategories for 2vs2 and 3vs3 between two leagues showed differences for both groups of SPDs. Differences in offensive strategies subsequently lead to different distribution of SPDs.

Comparing regular season with playoff games within the same league showed no significant differences in distribution between 2vs2 and 3vs3 in SPDs. Analysis of all subcategories for 2vs2 and 3v3 in the same league (regular season vs. playoffs), showed significant differences between both groups in NBA. However, while EL comparison showed

difference between 2vs2 subcategories, no difference was found in 3vs3. No significant differences found between regular season and playoff games could indicate that selected SPDs could be crucially important in all basketball matches. This study can be helpful to coaches with planning and preparation of defensive systems, as it investigated which defensive tactical manoeuvres are most prevalent to contain on ball and off ball screens in elite basketball.

# SANTRAUKA

## ERDVĖS APSAUGOS DINAMIKOS TYRIMAS NBA IR EUROLYGOS RUNGTYNĖSE

**Raktiniai žodžiai:** komandinės sporto šakos, veiklos analizė, gynyba, taktika.

**Tyrimo problema:** Išsiaiškinti kurie gynybiniai taktiniai krepšinio elementai ir strategijos yra naudojami aukščiausio lygio krepšinio komandų.

**Tyrimo tikslas:** Nustatyti pasirinktos erdvės apsaugos dinamikos (SPD) panaudojimo skirtumus tarp dviejų aukščiausio lygio krepšinio lygų – JAV (NBA-Nacionalinė krepšinio asociacija) ir Europos (Eurolyga).

**Hipotezė 1:** Tarp NBA ir Eurolygos komandų bus reikšmingi erdvės apsaugos dinamikos (SPD) skirtumai.

**Hipotezė 2:** Tarp reguliaraus sezono ir atkrintamųjų varžybų toje pačioje lygoje bus reikšmingi erdvės apsaugos dinamikos (SPD) skirtumai.

### **Metodai:**

1. Literatūros apžvalga
2. Duomenų rinkimas ir vaizdo medžiagos analizė naudojantis “NBA League Pass” ir “Euroleague TV” mokamos televizijos paslaugomis.
3. Statistinė analizė naudojantis “Exel” programa ir IBM SPSS programinė įranga

Šio tyrimo SPD buvo patvirtinta ir klasifikuota mokslininko Santana ir kt., 2015 metais. 2 prieš 2 kategorijoje buvo analizuojamos užtvaros statomos žaidėjui su kamuoliu (*kamuolio žaidėjo gynyba*) ir 3 prieš 3 kategorijoje buvo analizuojamos užtvaros žaidėjui be kamuolio (*užtvaros statančiojo gynyba*).

Reikšmingi skirtumai buvo rasti lyginant 2 prieš 2 ir 3 prieš 3 SPD naudojimą tarp Eurolygos ir NBA rungtynių. Analizuojant visas abiejų lygų 2 prieš 2 ir 3 prieš 3 kategorijas buvo rasti skirtumai abiejose SPD grupėse. Puolimo strategijos skirtumai tarp abiejų lygų nulėmė skirtingą SPD naudojimą.

Lyginant reguliaraus sezono ir atkrintamųjų varžybų toje pačioje lygoje SPD duomenis, nebuvo rasta jokių reikšmingų skirtumų tarp 2 prieš 2 ir 3 prieš 3 SPD. Analizuojant visas 2 prieš 2 ir 3 prieš 3 subkategorijas toje pačioje lygoje (lyginant reguliarųjį sezoną su

atkrintamosiomis) buvo atrasti reikšmingi skirtumai tarp abiejų grupių NBA lygoje. Visgi Eurolygos rungtynėse buvo atrasta skirtumų 2 prieš 2 subkategorijoje, tačiau jokių reikšmingų skirtumų nepavyko rasti 3 prieš 3 kategorijoje. Tai, jog nepavyko rasti jokių reikšmingų skirtumų tarp reguliaraus sezono ir atkrintamųjų varžybų gali reikšti, jog pasirinkti SPD gali būti itin svarbūs visose krepšinio rungtynėse. Šis tyrimas gali būti naudingas treneriams planuojat ir ruošiant gynybines sistemas, nes atliktas tyrimas padėjo nustatyti, kurie gynybiniai ir taktiniai manevrai yra labiausiai paplitę elitiniame krepšinyje, bandant sustabdyti užtvaras be kamuolio ir su kamuoliu.

# INTRODUCTION

**Relevance of the topic:** Basketball is characterized as an invasion team sport, where two teams dispute on a common field and the main objectives are to score goals, or points, and to prevent the opponent from scoring goals through individual, group, and team actions (Grehaigine et al.,1997; Hughes & Bartlett, 2002; Lames, 2006; Lebed, 2007). In a basketball match, defensive and offensive teams organize their plays to minimize scoring opportunities of the adversary and to maximize the chances of scoring points (Santana et al., 2015). Basketball coaches, sport analysts and scientists are constantly investigating performance indicators and action variables that could discriminate winning and losing outcome, both on offense and defense. According to Vaquera et al. (2016), performance analysis in basketball has passed from an analysis of quantifiable aspects to a more qualitative analysis, trying to find which factors influence during games and which ones are the key determinants on the game outcome (Christoforidis et al., 2000; Tsitskaris et al., 2002; Wang et al., 2009). Lamas et al. (2011) presented a set of basketball offensive classes corresponding to the possible offensive specifications to create space in the adversary defensive system, which leads to scoring opportunities, the space creation dynamics (SCD). Subsequently, SCDs were used as a reference to conceive and validate their correspondent defensive classes, the space protection dynamics (SPDs) (Santana et al.,2015).

**Research problem:** In the research done by Santana et.al (2015), main aim was to validate classes of defensive actions (SPDs) and to give insight on new approach in basketball analysis by investigating interactions between SCDs and their corresponding SPDs. Although SPDs seem an important characteristics of basketball defensive systems, no investigation characterized them in elite basketball. Scientific research in the field of basketball game is more offense oriented, with traditional and advanced statistical variables being investigated to evaluate most important factors for team's success. In recent years some authors investigated defensive strategies (Gomez et al.,2010; Alvarez et al. 2009; Franks et al., 2015), but there is still a lack of studies regarding defensive aspect of basketball.

**Aim and practical value of the study:** Aim of this study is to determine the differences in usage of SPDs between the two top level basketball leagues - in Europe (Euroleague) and USA (NBA). This research could help coaches in preparation of defensive strategies on all levels of basketball.

**Structure of thesis:** Literature review; research methodology and organization; results; considerations; suggested article

# **1.LITERATURE REVIEW**

## **1.1. Summary of performance analysis in basketball**

Basketball is characterized as a complex and dynamic sport since during the ball possessions across a game many different situations are presented to keep the offensive actions and to control the defensive stabilization (Polykratis et al., 2010). As an invasion team sport, there are two main goals in basketball-to score points, and to prevent opponent from scoring points. Although it may seem easy to accomplish these goals, during a basketball match there are many interconnected dynamics that can affect the outcome of the match. According to Lamas et al. (2011), the game of basketball involves several interactions of the offensive and defensive teams (i.e., dynamics). Because of its complexity and high number of modalities that can make a difference between winning and losing outcome, basketball was always systematically analyzed by coaches, sports analysts, and scientists.

According to Drust (2010) performance analysis is used in team sports to describe the technical, tactical, and strategic behaviors during training or competitions in order to measure and understand performance. Hughes & Franks; Oliver (2004) stated that statistics in sports have been an important tool for coaches to evaluate the team and player sports performance. Firstly, coaches and experts have analyzed games throughout main game-related statistical categories by filling up simple stat-sheets with data about points, rebounds, assists etc. Notational analysis provided coaches and staff with players and team performance evaluation that could be discriminative factor for the outcome of the match. According to Gonçalves et al. (2019), notational approach allows to understand the static complexity of performance, to produce a valid and reliable description of individual and team behaviors and to describe teams' performance by correlating a wide range of variables. However, Gonçalves et al. (2019) stated that although variables and methods describe the match results, they are limited in underpinning behaviors that lead to understand or even predict the outcome.

As game of basketball had progressed, performance analysis followed that trend in order to provide coaches with critical information that could lead to creating winning strategies. Also, it provides valuable source of information to managers and executives when creating a roster that can potentially be successful. As Mikolajec et al. (2013) stated, throughout the years of competitive basketball, numerous methods of game registration and analysis have been created, with the objective to precisely and objectively evaluate players and the whole team.

Analysis of basketball strategies has one common aim—to find most important performance indicators that are important for individual and team success. According to Csataljay et al. (2009), performance indicators are often used to define the differences between winning and losing teams. To build up the best strategy, to make rational tactical decision and to enhance the team performance, coaches need to know which elements are the critical ones that most distinguish between winning and losing performances within matches (Csataljay et al., 2009). Previous basketball studies investigated game-related statistics and technical-tactical patterns to find out which performance indicators are most important for a team's success in basketball. Trninic et al. (2002) investigated 12 standard indicators of situation-related efficiency that discriminate winners and losers; Remmert (2003) investigated the exact constellations and actions within the offensive group-tactical plays (e.g., screen actions) and offensive finishing actions; Oliver (2004), selected 4 factors most affecting sport results in basketball (shooting efficiency, number of turnovers, offensive rebounds and free throws made) and additionally stated that effective offensive play leads to success in NBA. Mikolajec et al. (2013.) investigated game factors determining sports performance in NBA while García et al. (2013) investigated performance indicators that distinguish winners and losers in regular season and playoffs in elite basketball. Analysis of winning determining factors in youth categories was investigated by Lorenzo et al. (2010) for U16 male basketball; by Conte et al. (2018.) for elite college basketball, while Conte & Lukonaitiene (2018.) have investigated scoring strategies that lead to winning outcome in elite women's basketball.

In recent years, basketball experts have adopted new technologies to further investigate the game of basketball and its technical, tactical, physical, physiological, psychological, social, and other aspects. Observational video analysis was traditionally used to evaluate performance retrospectively, to investigate technical or tactical aspects of team's strategy, player preferences etc., in order to prepare own strategy or scout opponents. However, this approach could be biased and prone to human error, especially if there aren't clearly defined variables that are being investigated. Software such as "Synergy Sports Technology" and "Catapult Sports" made possible to analyze spatiotemporal dynamics, which Goldsberry (2012) found crucial along with statistical analysis. Previous statistical analyses of basketball performance have overlooked many of the high-resolution motifs—events not measurable by such aggregate statistics—that characterize basketball strategy (Cervone et al., 2016). Statistical analysis can help coaches and club staff with decision making but game of basketball cannot be only a game of numbers, as statistics alone do not explain dynamic complexity of the game. According to Lames & McGarry (2007), usual way of obtaining performance indicators

for game analysis does not consider the dynamic interactions of which they are comprised. During basketball match there are many unpredictable situations, improvisations and decisions that are dependent on various factors dictated by offense-defense dynamics. Performance analysis with all aforementioned methods can help coaches, players, and teams to achieve their highest potential by extracting most important factors that distinguish winners and losers.

## **1.2. Analysis of offensive strategies in basketball**

In recent decades, game of basketball gained the status of global sport and became one of the most popular and analyzed sports. From 1980's with rivalry between Los Angeles Lakers and Boston Celtics led respectfully by NBA superstars Magic Johnson and Larry Bird, through 1990's and dynasty of Chicago Bulls with Michael Jordan, basketball was always a game of superstars. These highly talented, skilled, and capable athletes helped basketball reach the status it has today. For a casual fan, offensive contribution and efficiency is the easiest way to evaluate player's importance for the team. Game statistics such as point per game, assists per game or three-point percentage are easy to understand to wider audience. Also, the ultimate goal of scoring more points to win the game makes fan appreciation for high-scorers understandable. Most of these superstars reached their status by being extremely effective on offensive end, especially in the NBA. In Europe, basketball is traditionally more team oriented with less individual approach. Difference in match duration, defensive rules, officiating, and strategies led to less scoring, both by teams and individuals. However, in last couple of years we can see more similarities between NBA and Euroleague (EL) in this regard. Almost every team in Europe has one or two offensively dominant players capable of scoring points in important matches.

In some ways, scientific and performance analysis of basketball game followed the trend of evaluating players and team performance through the offensive aspect of basketball game. Scientific literature and basketball studies are predominantly oriented on offense and offensive modalities in basketball. Franks et al. (2015) stated that although basketball is a dualistic sport, with all players competing on both offense and defense, almost all of the sport's conventional metrics are designed to summarize offensive play. Following this statement, we could conclude that aforementioned metrics of offensive phase could arguably be easier to investigate or seem as more important for success.

Basketball is constantly evolving, bringing new trends on basketball court but also in

field of basketball studies. Modern day game became faster, more athletic, and strategically more complex thanks to science-based training methods and advanced analysis approach. With more recent study results and findings, coaches have larger variety of traditional and advanced game-related statistics that can provide information when planning and creating team strategies. With aforementioned game-related statistics and performance indicators, most of the offensive technical-tactical modalities were investigated in recent years.

On ball screen/pick and roll (PnR) is one of the most used offensive modalities in modern basketball, and subsequently often studied. Polykratis et al. (2010); Gomez et al. (2015); Vaquera et al. (2016); Marmarinos et al. (2016) studied on ball screen effectiveness in elite men's basketball while Noivo et al. (2022) analyzed it in elite women's basketball; Remmert & Chau (2019) along with Stavropoulos N. & D. (2020) analyzed decision making of players involved in on ball screens; Calvo et al. (2017) analyzed mismatch situations in ball screens while Symenidou et al. (2021) investigated PnR exploitation speed in mismatch situations. Interestingly, off ball screens that are very utilized in modern basketball are much less investigated offensive team-tactical action. Stavropoulos et al. (2021) studied off ball screen effectiveness in elite basketball and concluded there is a limited number of studies. Off ball screens are a key part of every successful offense, leading to high percentage shots, good spacing and mismatch situations, and it should be further investigated.

As mentioned before, main goal in every basketball match is to score more points to win the game. Basketball studies that predict most efficient offensive maneuvers that lead to scoring and technical-tactical strategies that could lead to winning outcome were also investigated in recent years. Christmann et al. (2018) studied most effective play types in end of close basketball matches; Matulaitis & Bietkis (2021) investigated offensive possession ends in elite basketball; Zukolo et al. (2019) tried to determine structure of finishing actions and their effectiveness while Selmanovic et al. (2019) investigated finishing actions in NBA and Euroleague as well as basic characteristic of offensive modalities in NBA and Euroleague (Selmanovic et al., 2015). Very important part of every team's offensive strategy is transition phase (conversion from defense to offense). According to Krause et al. (2008), fastbreaks are most efficient way of transitioning from defense to offense. Analysis of fastbreaks in basketball was conducted by Evangelos et al. (2005.); effectiveness of fastbreak was investigated by Garefis et al. (2007) in two high level basketball championships; determinants of effectiveness of fastbreaks in elite and sub-elite teams by Conte et al. (2017) while Cardenas et al. (2015) investigated motor characteristics of fastbreaks in high level basketball. This element of offensive phase became distinguishing factor between winners and losers (Conte et al., 2017).

In a field of basketball research, offensive phase has been investigated from statistical, technical-tactical, team and individual aspect. Offensive performance indicators, ball screens, finishing actions, offensive modalities are thoroughly analyzed and vital in creating tactics. In personal opinion, there is still a lack of studies for off ball screens efficiency and spatiotemporal dynamics. Timely precise off ball screens done with proper spacing are a prerequisite for high team-play organization and successful offensive strategies.

### **1.3. Analysis of defensive strategies in basketball**

Since early days of organized basketball defensive strategy, team effort, and level of cooperation on defense was highlighted by coaches as a key element to win games and achieve long-term success. In 1950's and 1960's Boston Celtics team led by legendary coach Red Auerbach and center Bill Russell won 11 NBA Championships, becoming the most successful team in American sports history. With strong, organized defense they have created winning strategy that lasted over a decade and reached the level of greatness never seen before or after in basketball. In modern basketball, elite teams in high level leagues like NBA and Euroleague spend a lot of time working on defensive strategies to be able to contain opponents' offense and gain advantage during the match. However, within the study of performance indicators in basketball, most papers analyze aspects related to the offensive phase while few studies analyze defense (Alvarez et al., 2009). According to Franks et al. (2015), reason for that could be inefficacy of traditional defensive statistics, adding that steals, blocks, and defensive rebounds provide only a limited summary of defensive effectiveness.

Main and most used defensive strategies in basketball are defense against half-court set offense (man to man and zone defense), along with full court zone press and defense against transition that are less frequent. Gomez et al. (2006) analyzed defensive systems and how they affect ball possessions of offensive teams against different defensive strategies, and how they affect winning. Same author (2010) investigated differences in defensive strategies between home and away teams and concluded that both teams use mostly man to man defense with no significant differences found regarding location of the game. Alvarez et al. (2009) analyzed defensive performance indicators in Olympic Games 2008. and concluded that half court zone defense was most effective for winning teams. Most of studies that investigated defensive strategies had similar approaches, to determine which defensive systems are mostly used and how they affect winning. As stated by Franks et al. (2015) there has been little research characterizing individual player habits in dynamic, goal-based sports such as basketball.

Although in scientific literature there is a limited number of studies focusing on

defensive aspect of basketball, defensive rebounds are key factor for winning outcome according to number of authors. Trninic et al. (2002) concluded that defensive rebounds are key performance indicator for winning in elite basketball; Gomez et al. (2008) investigated difference in defensive rebound between winners and losers according to game location; Lorenzo et al. (2010) found defensive rebounds important in winning U16 games while Garcia et al. (2013) concluded that defensive rebound is discriminative factor both in regular season and playoffs. Good control of defensive rebounds means fewer scoring opportunities for opponents as it limits securing new possession with offensive rebound and can produce more fastbreaks. In research done by Ibanez et al. (2008), they concluded that steals and blocks were discriminative factor affecting long-season success between best and worst teams in sub-elite competition. High number of steals limits scoring opportunities and subsequently provide defensive team with more, as well as potential easy point from fastbreaks. According to Mikołajec et al. (2013); Csataljay et al (2009); Trninic et al (2002) offensive efficiency is one of the most important variables for a winning outcome in basketball. Blocking shots or heavily contesting them limits offensive efficiency, so it is clear that number of blocked shots affects defensive team performance positively, while negatively affecting offense.

Literature review of scientific work of defensive strategies in basketball showed significantly less sources than offensive-oriented investigations. There is no doubt that high level team performance and tactical preparedness of defensive phase affects chances to win games, and even be long-term successful. Most of studies are concentrated on selection of defensive strategies (i.e., man to man, zone) and if usage of one discriminates winners from losers. At the same time, there are limited findings that explain what led to selection of exact defensive strategy and what are occurring patterns and decisions by individuals or group of players. Due to the inefficacy of traditional defensive statistics, the state of the art in defensive analytics remains qualitative, based on expert intuition and analysis that can be prone to human biases and imprecision (Franks et al., 2015). Hopefully this work, and future studies will provide coaches with more detailed insight on this crucial part of basketball and help evaluate most important technical-tactical elements of defensive strategies.

#### **1.4. Introduction to SCDs and SPDs**

In every basketball competition, coaches along with players organize their offensive play to maximize their chances of scoring points. Offensive strategies usually involve planned or improvised technical and tactical maneuvers that are trying to disrupt defensive setup.

Whether it is the case of team-play, individual or a group of players, goal is always to find most efficient and repeatable ways of scoring.

In 2011, Lamas et al. presented a set of basketball offensive classes corresponding to the possible offensive specifications to create space in the adversary defensive system, which leads to scoring opportunities, the Space Creation Dynamic (SCD) (Santana et al., 2015). According to Lamas et al. (2011) the most important states for the offence are the ones that produce a rupture of the defense, creating empty spaces for scoring opportunities and they defined these classes as SCDs. Most of the actions in offensive phase have some form of SCDs, so this research was important to understand how elite teams attack opponents, which technical-tactical solutions they prefer and what is the level of decision-making by elite players. Authors considered three essential attributes of the defensive rupture actions (SCDs):

- a) the number of players involved*
- b) the technical skills used*
- c) the decision context observed.*

The number of players involved defines the complexity of the opposition (i.e., 1x1, 2x2 and 3x3 situations) and determines the technical skills that may be used to create space in a game (i.e., ball fakes and jump shots, dribbling penetrations, back-door cuts, on ball screens, indirect screens, etc.). These technical skills may be performed in a decisional context in which the teammates not involved in the ball action may or may not have an a priori decision of opening space for the action of the player handling the ball (Lamas et al., 2011). Game of basketball is an art of playing with the ball but playing without the ball is equally important in creating scoring opportunities. Positioning of defensive players as well as offensive (spacing) dictates decision making of players with possession of the ball and without it, so selected attributes perfectly describe complexity of basketball.

For a casual fan, it might seem that basketball is sometimes unpredictable and mostly improvised in offensive phase. Players react accordingly in small areas, having few seconds or less to make appropriate decisions for their team. In practice, all these plays are part of the offensive strategy designed by coaches and later executed by players. Because the game of basketball is unpredictable, teams must have more technical-tactical solutions to use against opponents. With that in mind, Lamas et al. (2011) selected most important SCDs in their opinion and described it as follows:

- 1) *Space Creation with Ball Dribbled (BD)*: individual actions when the space to take the shot is created by the player who is dribbling, (i.e., displacement away from the defender plus jump-shot situations),

- 2) *Space Creation with Ball not Dribbled (BND)*: similar to BD but without a dribble, using only body displacements techniques (i.e., ball fakes),
- 3) *Perimeter Isolation (PerI)*: player with the ball is isolated in the perimeter, usually in central area (very common at the end of ball possessions with the isolation of the best scorer),
- 4) *Post Isolation (PostI)*: similar conception of PerI but occurring in the post area, close to the key. Both PerI and PostI are particular cases of BD or BND because the space is created in a 1x1 situation
- 5) *Space Creation Without Ball (WB)*: consists in a two players action and when one of them creates space, receives a pass from the teammate (i.e. back-door situations),
- 6) *On Ball Screen (OnBS)*: one of two players position himself in the trajectory of the defender of his teammate with the ball, interrupting the defender's line of displacement (i.e., screen), thus creating space (i.e., called pick and roll situations),
- 7) *Out of Ball Screen (OutBS)*: similar to OnBS but both players involved in the screen do not have the ball. After the defender trajectory has been interrupted by the screen, a third offensive teammate passes the ball to the teammate with no defender (Lamas et al., 2011).

Author concluded that above mentioned SCDs are key components of every offensive action, and by referencing literature or simple eye test we can agree that could be correct. On ball screens (OnBS) were most used SCD in with 34,8% frequency. As Remmert & Chau stated (2019) the pick and roll is the most frequently used option in taking advantage of 2-on-2 ball screen actions in basketball (Gómez et al., 2015; Marmarinos et al., 2016; Polykratis et al., 2010).

While offensive teams create strategies to efficiently attack and try to score points, defensive team use technical and tactical maneuvers to prevent them from scoring. After Lamas et al. (2011) defined offensive classes that disrupt defense, next logical step was to define defensive classes that are used to contain SCDs and disrupt opponent offense. In research conducted in 2015 by Santana et al., they used SCD classes as a reference to conceive and validate their corresponding defensive classes, Space Protection Dynamics (SPD). According to Santana et al (2015), SPDs are defensive actions for containing offense in basketball. With this research they tried to provide insight on new approach in basketball analysis by investigating interactions between SCDs and their corresponding SPDs.

Authors firstly used attributes by Lamas et al. (2011) to classify defensive action of SPD but later modified criteria by:

a) *the SCD performed by offense*, which defines the number of players involved in an offensive action and the respective number of players involved in the defensive action.

b) *the relative body orientation* (e.g., oriented defense in 1x1 situation in the perimeter)

c) *or displacement performed by the defender in relation to the attacker* (e.g., defensive action “show” against the offensive action “pick,”) (Santana et al., 2015).

Main aim of defensive strategies is to contain offense and take advantage of offensive players weaknesses. Authors observed games and noted most reoccurring defensive actions that were later classified as SPD classes for 1x1,2x2 and 3x3 situations (Table 1.).

**Table 1.** -Classes of defensive actions-Space Protection Dynamics (Santana et al.,2015)

<b>Space Protection Dynamics(SPD)</b>	<b>Criteria</b>
1.) 1x1 situations in the Perimeter	oriented (baseline, middle)/non oriented(neutral)
2.) 2x2 situations in the Post	defence of the passer/post player (before and after entry pass)
3.) against space creation without the ball situations	defence of passer/receiver of the ball
4.) 2x2 situations of on ball screen	defence of the ball player(ballhandler)/screener
5.) 3x3 situations of out of the ball screen	defence of the passer/screener/screen receiver.

Although all the above mentioned SPDs are key components of basketball defensive systems, and important characteristics of basketball defensive strategies, no investigation characterized them in elite basketball. Santana et al. (2015) verified and classified SPDs and investigated frequency and outcome of SCD-SPD couples. There is a need for investigation of SPDs to answer which technical and tactical elements are used in defensive systems in highest levels of basketball. SPDs analysed in this work are 2vs2 on ball screen (defence of the ball player) and 3vs3(defence of the screen receiver). Reviewing literature gave conclusion that on ball screen (pick), so much investigated in literature in offensive phase, needs to be analysed for defence against it. Off ball screens are vital part of every offense, but also under investigated

both for offense and defence against it.

In scientific literature, comparative studies between NBA and Euroleague were conducted to determine differences in offensive preferences of the teams and players in two leagues (Milanovic et al.,2014; Selmanovic et al. 2015,2019). These studies confirmed that NBA and Euroleague teams tend to use different strategies in offensive phase, so it would be interesting to see if same applies for SPDs used during defensive phase. As mentioned before, SPDs are used on defense to contain corresponding SCDs on offense, so distribution of SPDs should be different as well. Moreover, we wanted to investigate if there are any differences in distribution of SPDs between regular season and playoff games in the same league. Playoffs are most important part of the season, so elite coaches and teams tend to adjust their tactics as they face higher level opponents in games that can be eliminating. Investigating season phases in Spanish 1<sup>st</sup> division, Garcia et al. (2013) stated that winning and losing teams played different in regular season and playoff games. Furthermore, Strumbelj et al. (2013); Jungic et al. (2015) stated that NBA teams do not play their strongest basketball during the regular season, Therefore, an analysis of the difference of the adopted SPDs in the regular and playoff phase is necessary.

This work will try to provide information that are missing, due to limited number of scientific studies that analyses defensive strategies in basketball from a technical and decision-making standpoint, while focusing on most frequent defensive tactical patterns of individuals or group of players. Results from this study could provide coaches with valuable information how to create successful defensive systems by implementing defensive tactics used by best teams in the world.

## **2. RESEARCH METHODOLOGY AND ORGANIZATION**

### **2.1. Research object**

Playing basketball in elite leagues demands high level of technical-tactical abilities and team-play on offense and defense. Most successful teams in world's best competitions such as NBA and Euroleague have strong balance of offensive and defensive efficiency. Scoring points is crucial in winning games but we could argue that defensive phase is equally or even more important for success. In some games players underperform in offense, shooting low percentages and missing easy shots, but if defensive strategies are executed correctly, it increases team's chances for successful outcome. Although it may seem that offensive systems are dominantly planned and developed, every successful coach and team produces great effort

to create defensive systems and later execute them on basketball court. Space Protection Dynamics (SPD) are key components of defensive systems, and therefore should be investigated in elite basketball.

Main aim of this research is to determine differences in usage of SPDs between two best basketball leagues in the world-NBA and Euroleague, and if there are any when comparing regular season vs. playoffs in the same league.

## 2.2 Research strategy and logic

Space Protection Dynamics validation and classification was done by Santana et al. in 2015. Since then, there were no studies that investigated usage of SPDs in defensive systems of elite teams that compete in top level leagues. Because of high number of SPDs used during one defensive sequence, it is hard to determine if usage of certain SPDs can discriminate winners and losers or classify them by the outcome (i.e., successful vs. unsuccessful). However, we considered important to investigate which technical-tactical defensive strategies are used by best teams in the world, and which defensive actions are most frequently used to disrupt opponents' offense.

Since there is no similar investigation regarding usage of SPDs, research strategy was conducted in next steps:

1. Reviewing scientific literature that studied offensive and defensive systems in basketball.
2. Studying literature on validation and classification of SCDs; validation and classification of corresponding SPDs.
3. SPDs investigated in this research were selected from study by Santana et al. (2015.) "*Space protection dynamics in basketball: Validation and application to the evaluation of offense-defense patterns*"
4. SPDs that were selected between all defensive classes are: ***SPD for 2x2 situation of on ball screen-defense of the ball player; SPD for 3x3 situation out of the ball screen-defense of the receiver of the screen*** -all subcategories were taken in account (Table 2. and 3.)
5. Data collection was obtained by video analysis through publicly available sources and later statistically analyzed. Frequency of occurrence (percentages and counts), SPDs per ball possession and determining differences with chi-

square analysis was done using Microsoft Excel software while intra-rater reliability was assessed using IBM SPSS statistics analysis software.

Selection of 2vs2 SPDs was decided after literature review showed limited information about how teams defend against most used offensive modality in modern basketball, on ball screens. Pick and roll is perhaps the most-used tactical pattern during a game in modern basketball (Vaquera et al., 2013). For same reason, 3vs3 SPDs were selected for analysis, because most common offensive tactics used on the weak side are the off-ball screens (Bazanov et al., 2006).

During the observation and notational analysis, for simplicity and as reference to original author, SPD classes and numbering were taken from original research conducted by Santana et al. (2015). According to authors there are different ways of defending selected 2x2 and 3x3 SPDs. In Table 2. and Table 3. we can see description of investigated SPDs with all belonging subcategories.

**Table 2.** – defense against ballhandler in on ball screens

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<b>SPD for 2x2 situations of on ball screen</b>
<b>4.1 Defense of the ball player</b>
<b>4.1.1 Second (Fight-thru):</b> Defender passes over the screen with his defensive posture preserved and conserves himself between the attacker and the basket
<b>4.1.2 Second (Follower):</b> Defender passes over the screen but loses his defensive posture and is either delayed or side-by-side with the attacker in relation to the basket
<b>4.1.3 Third (Middle):</b> Defender of the ball player passes between the screener and the defender of the screener in order to follow the attacker that received the screen.
<b>4.1.4 Fourth (Behind) :</b> Defender of the ball player passes behind the defender of the screener in order to follow the attacker that received the screen
<b>4.1.5 2x1 (Trap):</b> The defender of the ball player and the defender of the screener momentarily guard (i.e. double guard with pressure) the ball player.
<b>4.1.6 Switch:</b> The defender of the ball player and the defender of the screener switch players being guarded.
<b>4.1.7 Deny:</b> The defender of the ball player rotates his body obstructing the attacker's displacement toward the screen set by the screener.

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\*Table taken from the original article by Santana et al., 2015 (*Space protection dynamics in basketball: Validation and application to the evaluation of offense-defense pattern*)

**Table 3.-**defense against receiver of the screen in out of the ball screens

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<b>SPD for 3x3 situations of out of the ball screen</b>
<b>5.3 Defense of the receiver of the screen</b>
<b>5.3.1 Second (Fight-thru):</b> Defender passes over the screen with his defensive posture preserved and staying between the attacker and the basket.
<b>5.3.2 Second (Follower):</b> Defender passes over the screen but loses his defensive posture and is either behind or side-by-side with the attacker in relation to the basket.
<b>5.3.3 Third (Middle):</b> Defender passes between the screener and the defender of the screener in order to follow the attacker that received the screen.
<b>5.3.4 Fourth (Behind):</b> Defender passes behind the defender of the screener in order to follow the attacker that received the screen.
<b>5.3.5 Switch:</b> The defender of the ball player and the defender of the screener switch players being guarded.
<b>5.3.6 Deny:</b> The defender of the ball player rotates his body obstructing the attacker's displacement in direction to the screen set by the screener.

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\*Table taken from the original article by Santana et al., 2015 (*Space protection dynamics in basketball: Validation and application to the evaluation of offense-defense pattern*)

According to Jorgensen et al. (2021), the types of offense differ between European and NBA basketball. Offensive SCDs subsequently lead to usage of corresponding SPDs, so this work tried to confirm the first hypothesis and determine if there are any differences on how NBA players defend on and off ball screen opposite to European players. Basketball fans have a popular opinion that NBA teams do not play strong defense during regular season, with increased intensity when playoffs arrive. NBA playoffs basketball is more similar to European style of basketball which suggests that NBA teams do not play their strongest basketball during the regular season (Štrumbelj et al., 2013, Jungić et al., 2015). For this reason, it was interesting to see if second hypothesis is true: there are differences between the regular season defense and the playoff defense regarding usage of SPDs.

## **2.3 The nature of research**

This research is an observational study with data collected using notational analysis. According to Gonçalves et al. (2019), notational approach allows to understand the static complexity of performance, to produce a valid and reliable description of individual and team behaviors and to describe teams' performance by correlating a wide range of variables.

## 2.4 Contingent of research subjects

For purposes of this research all observed games were analyzed through publicly available sources, so there was no need for consent from athletes.

Research sample was collected by video analysis of 32 games from season 2020/2021 (see Table 4.). For each professional league, America’s NBA and European Euroleague, 16 games were investigated (8 regular season; 8 playoff games). To ensure larger variety of teams included, no team was analyzed more than 3 times, while investigating close matches (up to 10 points difference) ensured maximum effort by both teams.

NBA format has 82 regular season games, and four stages of playoff elimination rounds (first round, conference semi-finals, conference finals, finals). Playoff format is “best of 7”, so first team that secures 4 wins is the series winner and advances in competition. Euroleague teams play 34 regular season games, while in playoff after first elimination round with “best of 5” format (first team with 3 wins advances), teams secure spot in “Final Four” tournament where they play semi-finals, third place and finals game. All phases in each league were taken in account, to represent possible adjustments teams make in their defensive systems during long competitive seasons. After completing analysis of selected games, total of:

- 4136 defense sequences against set offense ball possessions were analyzed- NBA 2200; Euroleague 1936
- 6211 SPDs were investigated- NBA 2841; Euroleague 3370.

**Table 4.-** List of analyzed games (8 games of regular season; 8 games of playoffs)

<u>NBA LEAGUE</u>	<u>Euroleague</u>
<b><u>NBA-REGULAR SEASON</u></b>	<b><u>EUROLEAGUE -REGULAR SEASON</u></b>
GAME 1: Milwaukee Bucks @ Boston Celtics 121:122 (23.12.2020.)	GAME 1: Khimki Moscow Region vs. Panathinakos OPAP Athens 76:78 (02.10.2020.)
GAME 2: New York Knicks @ Atlanta Hawks 113:108 (05.01.2021.)	GAME 2: ALBA Berlin vs. TD System Baskonia-Vitoria Gasteiz 95:91 (05.01.2021.)
GAME 3: Chicago Bulls @ LA Lakers 115:117 (09.01.2021.)	GAME 3: Maccabi Playtika Tel Aviv vs. Fenerbahce Beko Istanbul 65:75 (29.10.2020.)
GAME 4: Philadelphia 76ers @ Phoenix Suns 111:120 (13.02.2021.)	GAME 4: Real Madrid vs. LDLC ASVEL Villeurbanne 91:84 (04.12.2020.)
GAME 5: Brooklyn Nets @ LA Clippers 112:108 (22.02.2021.)	GAME 5: Zenit St.Petersburg vs. FC Bayern Munich 79:75 (16.12.2020.)
GAME 6: Portland TrailBlazers @ Denver Nuggets 106:11 (24.02.2021.)	GAME 6: Valencia Basket vs. Zalgiris Kaunas 78:79 (27.01.2021.)
GAME 7: Utah Jazz @ Toronto Raptors 115:112 (20.03.2021.)	GAME 7: Olympiacos Piraeus vs. CSKA Moscow 74:75 (25.02.2021.)
GAME 8: San Antonio Spurs @ New Orleans Pelicans 110:108 (25.04.2021.)	GAME 8: Panathinaikos OPAP Athens vs. Crvena Zvezda mts Belgrade 82:86 (19.03.2021.)
<b><u>NBA-PLAYOFFS</u></b>	<b><u>EUROLEAGUE-PLAYOFFS</u></b>
GAME 9: Dallas Mavericks @ LA Clippers 127:121 (26.05.2021.)	GAME 9: AX Armani Exchange Milan vs. FC Bayern Munich 79:78 (20.04.2021.)
GAME 10: Utah Jazz @ Memphis Grizzlies 120:113 (01.06.2021.)	GAME 10: FC Barcelona vs. Zenit St.Petersburg 74:76 (21.04.2021.)
GAME 11: Milwaukee Bucks @ Brooklyn Nets 107:115 (06.06.2021.)	GAME 11: Real Madrid vs. Anadolu Efes Istanbul 80:76 (27.04.2021.)
GAME 12: Atlanta Hawks @ Philadelphia 76ers 128:124 (06.06.2021.)	GAME 12: FC Bayern Munich vs. AX Armani Exchange Milan 85:82 (30.04.2021.)
GAME 13: LA Clippers @ Utah Jazz 109:112 (09.06.2021.)	GAME 13: Zenit St.Petersburg vs FC Barcelona 70:78 (28.04.2021.)
GAME 14: Phoenix Suns @ Denver Nuggets 125:118 (14.06.2021.)	GAME 14: CSKA Moscow vs. Anadolu Efes Istanbul 86:89 (28.05.2021.)
GAME 15: Brooklyn Nets @ Boston Celtics 119:125 (29.05.2021.)	GAME 15: AX Armani Exchange Milan vs. CSKA Moscow 83:73 (30.05.2021.)
GAME 16: Milwaukee Bucks @ Phoenix Suns 123:119 (18.07.2021.)	GAME 16: FC Barcelona vs. Anadolu Efes Istanbul 81:86 (30.05.2021.)

## **2.5. Research Methods**

For this research games were video analyzed with paid subscription to “NBA League Pass” and “EuroleagueTV”. These websites give unlimited access to all NBA and Euroleague games, and that provides lot of possibilities for wide array of basketball studies. Microsoft Excel software was used for notational analysis of occurring SPDs, and afterwards for statistical analysis. IBM SPSS statistical analysis software was used to calculate intra-rater reliability.

## **2.6. Research Organization**

Research for this work was approved by Lithuanian Sports University Ethics Committee. Application for approval to conduct social study was submitted 2021-10-12 to LSU Ethics Committee and was implemented 2021-11-03 with permit No. 24428 (see Annex C).

## **2.7. Methods of statistical analysis**

Statistical analysis methods conducted in this work are used to present descriptive statistics for frequency of occurrence of selected SPDs (counts and percentages) and SPDs per game/ball possession (averages). To determine the differences in the distribution of SPDs between two leagues and to compare regular season vs. playoffs, chi-square analysis was conducted with significant difference threshold set at  $p < 0.05$ . All data were analyzed using the software Microsoft Excel and SPSS (version 27).

To ensure the validity of investigated data, 4 random games (2 NBA; 2 EL games) were re-analyzed for intra-rater reliability test using Cohen’s-Kappa test, with criteria set according to Landis & Koch (1977) interpretation, where 0.81 to 1.0 coefficient indicates almost perfect or perfect agreement.

## **3. RESEARCH FINDINGS**

This section presents obtained results from the work done on investigating defensive actions that are used to contain offensive strategies, SPDs.

### 3.1 Descriptive statistics

After video-analysis of all 32 games selected for this study, statistical analysis was conducted to obtain desired data. Descriptive statistics were used to identify frequency of occurrence (counts and percentages), compare NBA vs. Euroleague; regular season vs. playoffs with chi-square test, and to count average usage of SPDs per ball possession and per game.

As seen in Table 5, total of 37 teams were represented in this research (NBA 18; EL 19) while total sample of investigated set-offense ball possessions, and defense against was 4136 (NBA 2200; EL 1936). During the investigation, ball possessions and corresponding defensive sequences that did not contain any of the SPDs were also identified. In NBA league 16.82% of defensive sequences did not contain selected SPDs while in Euroleague only 13.22% were without defensive actions against opponents on ball(2vs2) and off ball(3vs3) screens. NBA teams had to use SPDs to contain on and off ball screens in 83.28% of half court offenses, while in Euroleague this occurred in 86.78% of all set offenses (Table 6.)

During these defensive actions, 6211 SPDs were used to contain opponent's offensive strategies. If we look Table 5 and 6, we conclude that NBA teams have to defend more against pick game than weak side screens (67.02%; 32.98%) while in Euroleague game is more balanced as 2vs2 SPDs are used 54.99% opposing to 45.01% of 3vs3. Although NBA matches are longer 8 minutes in duration, there was a higher frequency of SPDs in Euroleague (NBA 2841; EL 3370). If we look at Table 5, in Euroleague matches average of used SPDs per game was higher than the NBA (NBA 177.5; EL 210.6) which led to higher numbers of SPDs per ball possession. When taking all ball possessions in account, we conclude that NBA teams on average use 1.29 SPDs per possession opposing to Euroleague's 1.74. If we consider only ball possessions that contain SPDs these numbers go up (NBA 1.55; EL 2.01). According to Selmanovic et al. (2015), American style of basketball can be characterized as a game with a higher tendency of fast-breaks, and higher frequency of finishes 1vs1 facing the basket. These tendencies could be the result of lower number of selected SPDs in NBA, because lower frequency of set offenses lead to less SCDs and ultimately SPDs.

**Table 5.-** Basic descriptive statistics-counts for all 32 games

	<b>NBA</b>	<b>EUROLEAGUE</b>
Number of analyzed games	16	16
Number of teams represented	18	19
Total BP	2200	1936
BP w/ SPD	1830	1680
BP w/o SPD	370	256
Number of SPDs	2841	3370
2vs2 SPD	1904	1853
3vs3 SPD	937	1517
SPDs per game	177.5	210.6
SPDs per possession (all BP)	1.29	1.74
SPDs per possession (BP w/ SPD)	1.55	2.01

*SPD-space protection dynamics; BP-ball possession; w/-with; w/o-without*

**Table 6.-** Basic descriptive statistics -percentages for all 32 games

	<b>NBA</b>	<b>EUROLEAGUE</b>
Total BP	100	100
BP w/ SPD	83.18	86.78
BP w/o SPD	16.82	13.22
Total of SPDs	100	100
2vs2 SPD	67.02	54.99
3vs3 SPD	32.98	45.01
SPDs per game	100	100
SPDs per game (2vs2)	67.02	54.99
SPDs per game (3vs3)	38.98	45.01

*All values presented as percentage of (%)*

### 3.2 Frequency of occurrence of investigated SPDs in NBA and EL

**NBA vs. Euroleague:** In order to understand the preferences of teams and players in NBA and Euroleague, and to determine differences in defensive strategies between regular season and playoff games, all 2vs2 and 3vs3 subcategories were investigated. In Tables 7 and 8 we can see counts for all subcategories on how teams defend player with the ball in on ball screens (pick and roll, pick and pop) and screen receiver in off ball screens. SPD classification

(numbering) was taken from the original author (Santana et al., 2015) and was used during the notational process.

**Table 7.** – 2vs2 SPDs for on ball screen-defense of ball handler; counts for 32 games

<b>SPD Classification 2x2</b>	<b>NBA</b>	<b>EUROLEAGUE</b>
4.1.1	97	138
4.1.2	663	448
4.1.3	244	228
4.1.4.	25	39
4.1.5	185	320
4.1.6	593	620
4.1.7	97	60
TOTAL	1904	1853

*4.1.1- Fight-thru; 4.1.2-Follow, 4.1.3- Middle; 4.1.4-Behind; 4.1.5-Trap; 4.1.6-Switch; 4.1.7-Deny*

**Table 8.**-3vs3 SPDs for out of the ball screen-defense of screen receiver; counts for 32 games

<b>SPD Classification 3x3</b>	<b>NBA</b>	<b>EUROLEAGUE</b>
5.3.1	54	92
5.3.2	380	703
5.3.3	255	393
5.3.4	81	173
5.3.5	118	87
5.3.6	49	69
TOTAL	937	1517

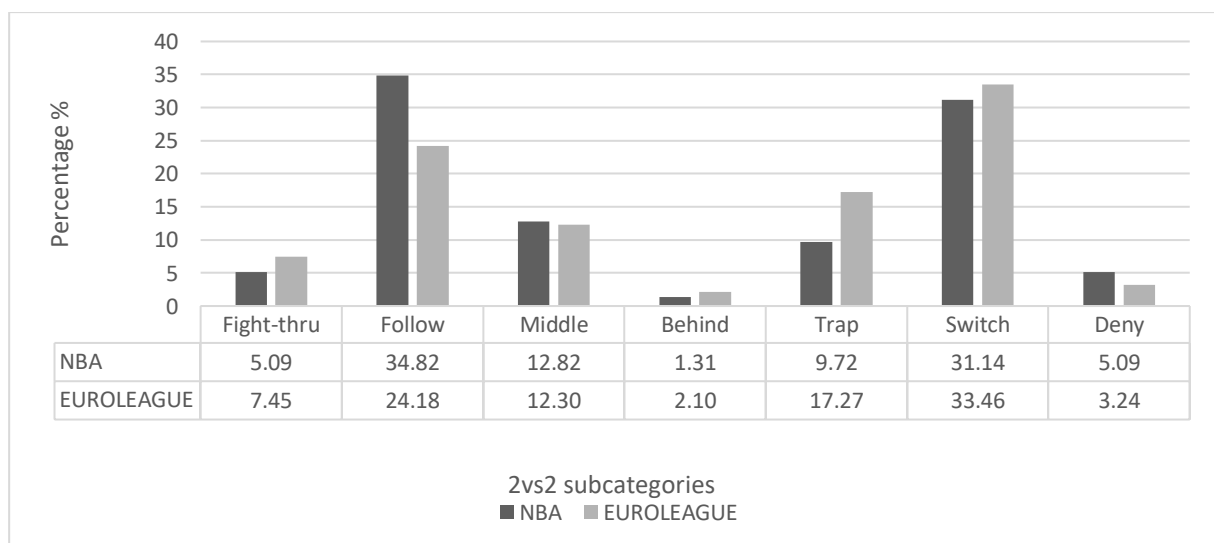
*5.3.1- Fight-thru;5.3.2-Follow, 5.3.3- Middle; 5.3.4-Behind; 5.3.5-Switch; 5.3.6-Deny*

**2vs2 SPDs:** In Figure 1 we can see comparison between NBA and Euroleague and which defensive strategies are used to defend ball handler in pick situations. NBA teams mostly use follow (34.82%), switch (31.14%) and middle (12.82%) to defend player with the ball, while European teams use switch (33.46%) more than follow (24.18%) and trap (17.27%). Least used actions against picks were behind (NBA 1.31%; EL 2.10%), deny (NBA 5.09%; EL 3.24%) and fight thru (NBA 5.09%; EL 7.45%). We can conclude that follow, switch and middle are most frequently used SPDs to defend ball player in pick situations in elite basketball. Behind, deny and fight-thru are used only in some specific situation (i.e., behind can be used to defend poor shooter).

Athletes in modern basketball are very fast and agile, and best players such as Luka Doncic in NBA or Mike James in Euroleague play a lot of pick and roll to create mismatch situations and create scoring opportunities. According to Matulaitis & Bietkis (2021) PnR with ball handler finish is one the most efficient modalities in basketball when used in last 9 seconds of offensive possession. To contain this SCD, teams use follow SPD as defender of ball player passes over the screen with disrupted defensive posture in attempt to regain defensive control. Usually, defender of the screener is keeping distance in front of ball player, obstructing path toward the basket (drop cover), until ballhandler defender regains control.

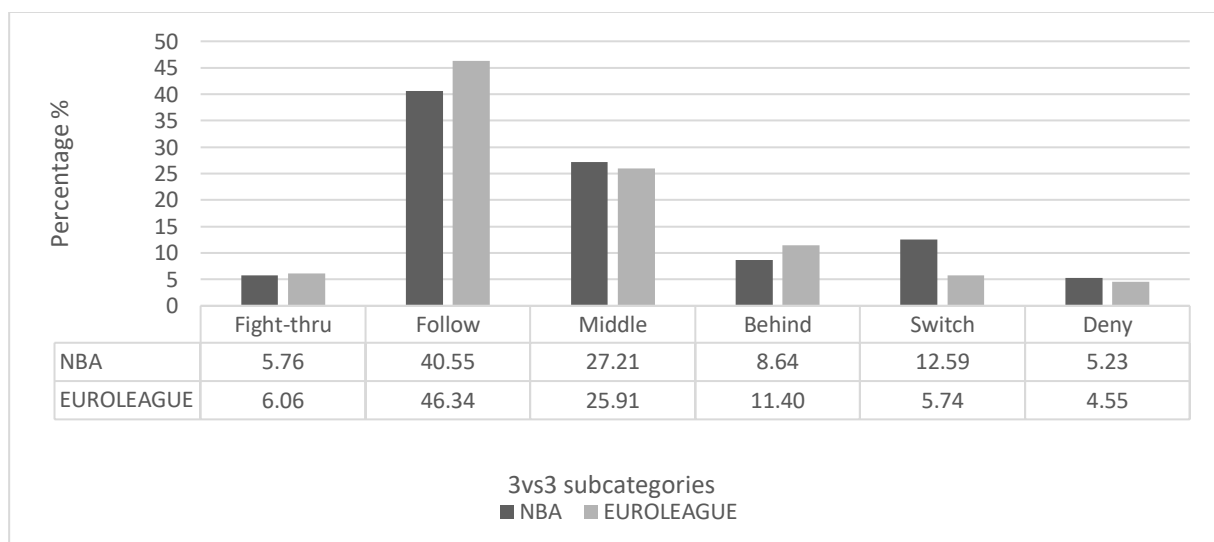
If teams have high level of tactical cooperation on defense, strong guards that can defend in low post, and agile defenders at “big man” positions, they tend to use switch more often. Results on frequency of the switch in NBA and especially Euroleague coincide with Remmert (2003) conclusion that basketball players should focus on switching when defending on ball screens. According to Jorgensen & Selmanovic (2021), 1vs1 face to the basket was significantly more common in the NBA than EL. Excellence of NBA players in playing one-on-one could be the reason that NBA teams use more follow than switch opposing to EL team. Players in Europe arguably do not possess skillset to exploit mismatch situations effectively as in NBA, so coaches tend to switch more.

Defensive action trap, where 2 players double guard ball player with pressure was significantly more used in EL than NBA (17.27% to 9.72%). As stated by Paulauskas et al. (2018), NBA players are on average taller, more athletic, and heavier than their Euroleague counterparts. Because of these differences in physical attributes, we could argue that trap could be harder to execute efficiently in NBA than in Euroleague.



**Figure 1.-** distribution of 2vs2 SPDs for on ball screen- NBA (16) vs. EL (16); 32 games

**3vs3 SPDs:** Although off ball screens were significantly more used in EL than NBA games (45.01% to 32.98% of occurred SPDs), American and European top teams defend this offensive modality pretty similar. As seen in Figure 2, most frequent defensive action to contain screen receiver offense were follow (NBA 40.55%; EL 46.34%) and middle (NBA 27.21%; EL 25.91%). Teams probably prefer these 2 SPDs, as they allow defenders to regain defensive control even if they have lost defensive posture or stayed behind, because screener defender can help until recovery. NBA teams have higher tendency of switching in weak side screens (12.59%) then Euroleague's (5.74%). Best shooters and athletes in the world are playing in NBA league and switch is effective way of defending shots and penetrations after off ball screens. For this same reason, EL teams can take a bit more risk and go under in these situation (NBA 8.64%, EL 11.40%). Least used defensive action were deny (NBA 5.23%; EL 4.55%) and fight-thru (NBA 5.76%; EL 6.06%).



**Figure 2.-** distribution of 3vs3 SPDs for out of the ball screen-NBA(16) vs. EL(16);32 games

**Chi-square analysis:** Comparison between NBA and Euroleague for main defensive classes of selected SPDs and all of belonging subcategories identified significant differences in distribution of SPDs between two leagues. As seen in Table 9, Chi-square test determined that that are significant differences in distribution of SPDs used to contain on ball and off ball screens during basketball games in NBA and EL ( $p < 0.001$ ). Furthermore, comparison of SPD subcategories also showed that distribution of SPDs to defend ball player in pick situations and screen receiver in weak side screens is significantly different ( $p < 0.001$ ). Previous literature has indicated that there is a difference in the offensive preferences of EL and NBA teams (Jorgensen

et al.,2021). Differences in offensive strategies subsequently lead to different distribution, as SPDs are always counteracting opponent SCDs.

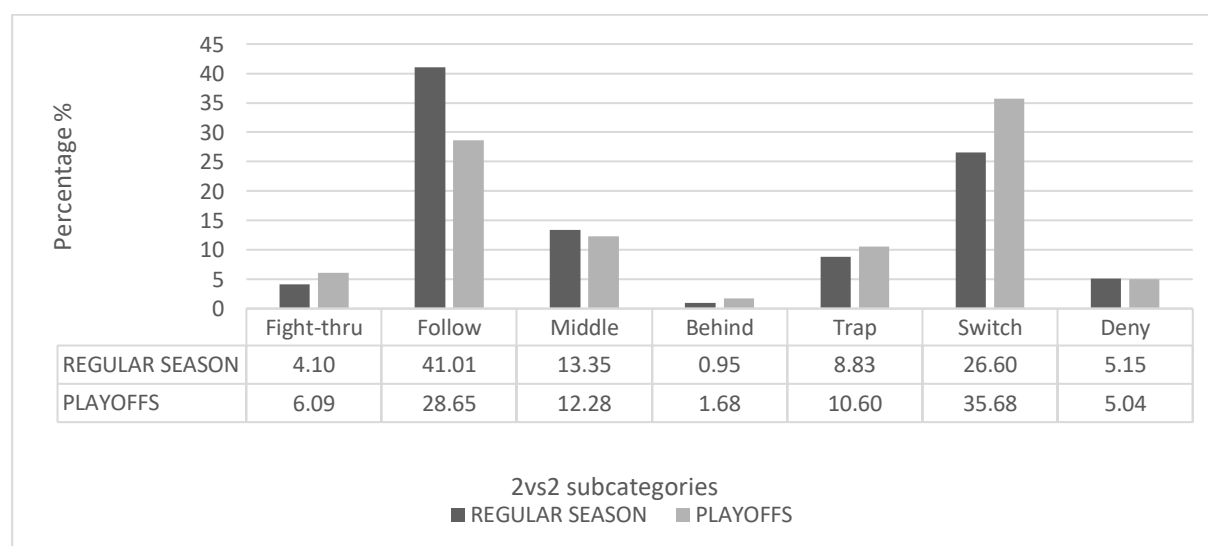
**Table 9.-** Chi-Square analysis comparison- NBA vs Euroleague; 32 games

NBA vs. Euroleague comparison	P Value
2vs2 and 3vs3 SPD	p<0.001
2vs2 subcategories (4.1.1-4.1.7)	p<0.001
3vs3 subcategories (5.3.1-5.3.6)	p<0.001

*Significance level p<0.05*

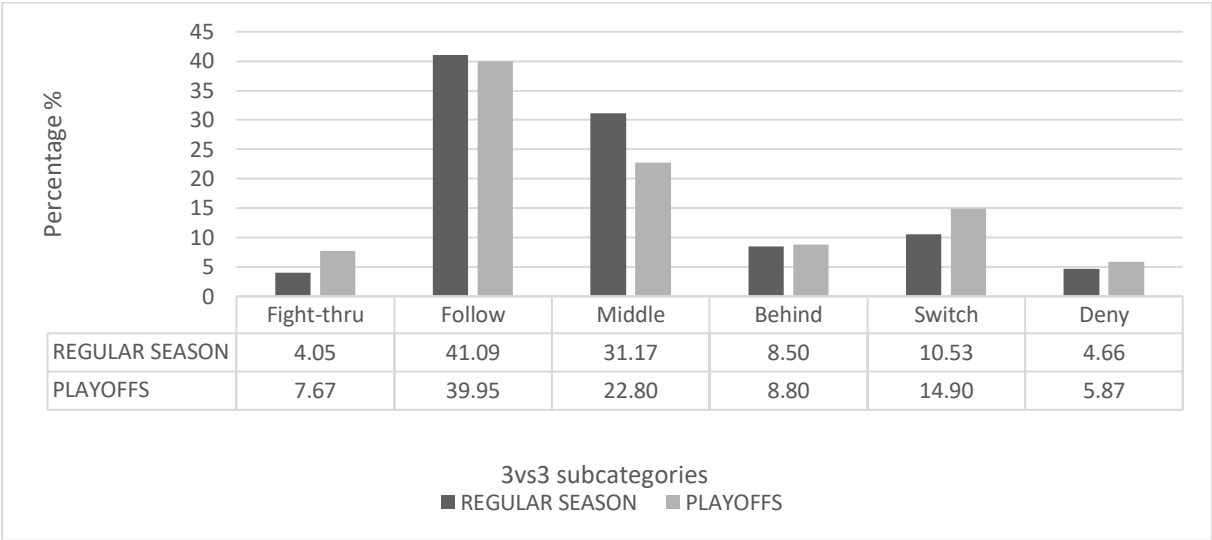
### 3.3. Frequency of occurrence of investigated SPDs in regular season and playoffs

**NBA regular season vs. playoffs:** Results of comparison between regular season and playoffs in the same league show that NBA teams make adjustments in defensive strategies with arrival of playoffs. Figure 3 shows that NBA teams defend ball player during pick actions by switching more than in regular season (35.68% and 26.60%), while follow SPD usage drops down from 41.01% to 28.65%. Playoff defensive strategies in NBA are same as in Euroleague, with switch and follow being most frequent defensive tactical maneuvers. That confirms findings that NBA basketball is more alike European when playoff begins (Strumbelj et al., 2013, Jungic et al., 2015)



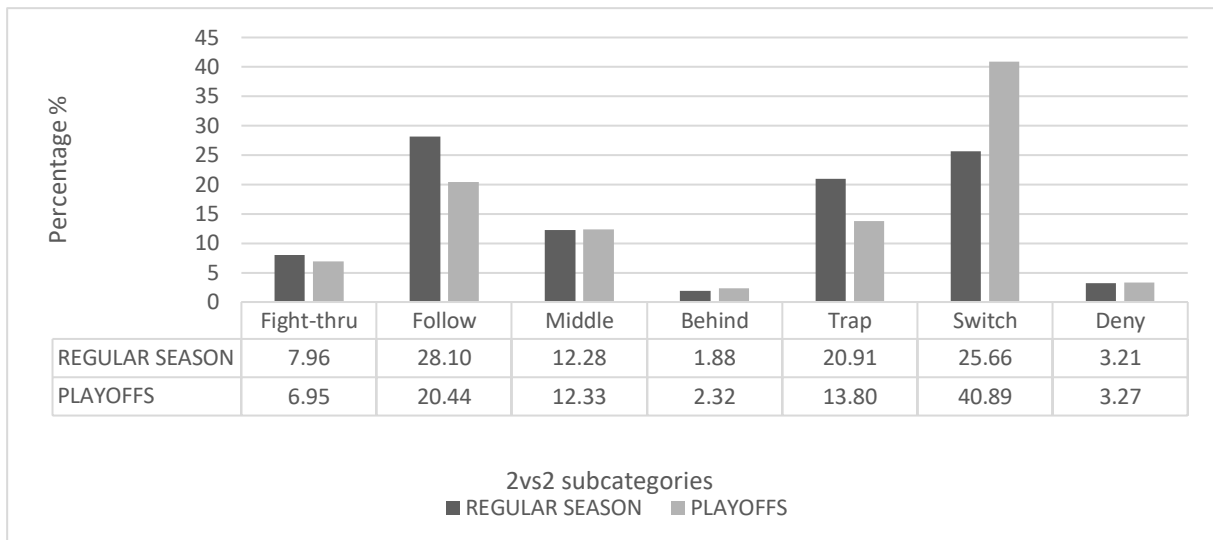
**Figure 3.-** distribution of 2vs2 SPDs for on ball screen- NBA RS (8) vs. PO (8); 16 games

Defensive tactics in playoffs used to contain off ball screens also differ from regular season (Figure 4.). Although follow SPD stays most common way of defending screen receiver, middle SPD frequency drops down from 31.17% to 22.80% while switching increases from 10.53% to 14.90%. There is a slight increase in fight-thru defensive action (4.05% to 7.67%), as defensive intensity and effort increases in playoffs.



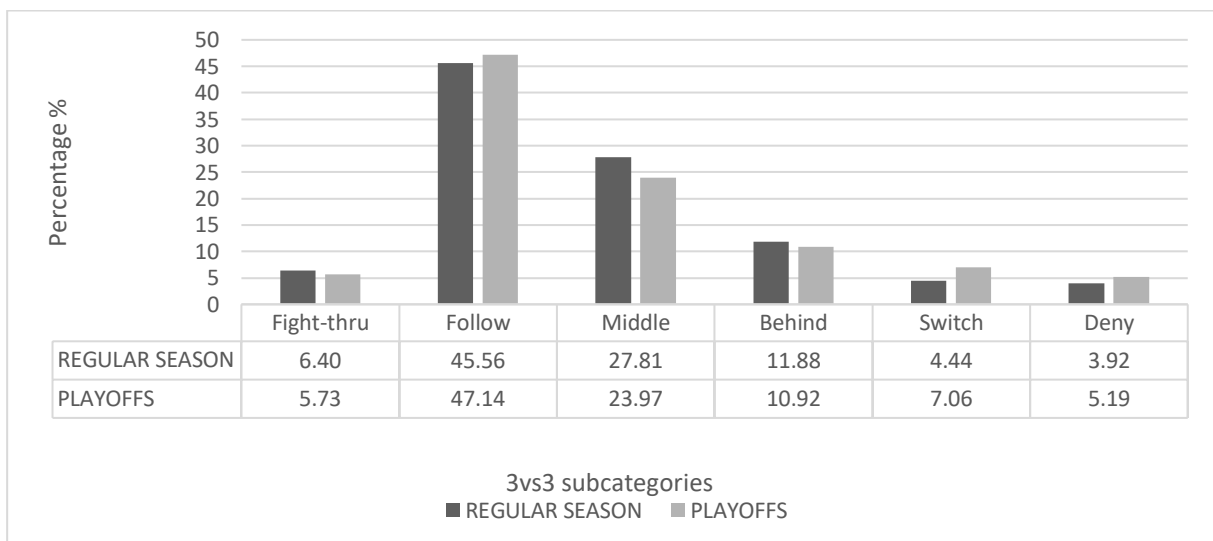
**Figure 4.-** distribution of 3vs3 SPDs for out of the ball screen-NBA RS (8)vs. PO (8); 16 games

**Euroleague regular season vs. playoffs:** In Figure 5 we can see how Euroleague teams adjust their defensive strategies against pick in playoff games. Defending ball player by following him becomes less frequent (28.10% to 20.44%), same as traps (20.91% to 13.80%). Biggest adjustment is made in usage of switch, which is significantly more common in EL playoff games in comparison with regular season (20.66% to 40.89%). Other subcategories frequency mostly stays similar between phases of competition.



**Figure 5.-** distribution of 2vs2 SPDs for on ball screen- EL RS (8) vs. PO (8); 16 game

According to results from Figure 6, Euroleague teams seem to make less adjustments of defensive strategies in playoff than NBA teams. Most frequent actions to contain off ball screens and defend screen receiver are follow (45.56% to 47.14%) and middle (27.81% to 23.97%). With slight decrease in frequency of middle SPD, we can see increase in usage of switch (4.44% to 7.06%) and deny (3.92% to 5.19%).



**Figure 6.-** distribution of 3vs3 SPDs for out of the ball screen-EL RS (8) vs. PO (8); 16 games

**Chi-square analysis:** In comparison of regular season and playoffs, no significant differences in the distribution of main categories of SPDs were identified (Table 10.), both in NBA and Euroleague ( $p>0.05$ ).

NBA comparison of all subcategories when defending ball player in pick action or screen receiver in weak side screens showed significant difference in distribution of both SPDs (2vs2  $p<0.001$ ; 3vs3  $p<0.05$ ). Although Euroleague comparison determined significant differences in distribution between 2vs2 subcategories ( $p<0.001$ ), no differences were identified for 3vs3 ( $p>0.05$ ).

No differences found between main categories of SPDs in comparison of regular season and playoffs could indicate that SPDs are crucially important in all matches, and that elite teams use similar defensive tactical patterns. Teams in NBA and Euroleague made more adjustments when defending pick actions than off ball screens. Pick and roll is possibly the only offensive element that is present as an indicator of performance in all types of matches (Mavridis et al.,2009).

**Table 10.-** Chi-square analysis comparison-regular season vs. playoff

Regular season vs. playoff comparison	NBA	Euroleague
	P Value	P Value
2vs2 and 3vs3 SPD	$p>0.05$	$p>0.05$
2vs2 subcategories (4.1.1-4.1.7)	$p<0.001^*$	$p<0.001^*$
3vs3 subcategories (5.3.1-5.3.6)	$p<0.05^*$	$p>0.05$

*Significance level  $p<0.05$ ; \*-significant difference*

## 4. CONSIDERATIONS

Main aim of this study was to investigate which technical and tactical defensive strategies are used by teams in elite levels of basketball. More exactly, usage of defensive Space Protection Dynamics (SPD) that counteract against offensive Space Creation Dynamics (SCD) was investigated in top basketball championships. SPDs are key components of every defensive strategy in basketball, and according to Santana et al. (2015) all defensive system are comprised of these defensive actions. NBA and Euroleague are widely considered as best leagues in the world, and differences between offensive preferences of teams from these two leagues are thoroughly studied (Jorgensen et al. 2021, Selmanovic et al. 2015, Milanovic et al. 2014). These studies were important in investigation of SPDs, because usage of SCD leads to usage of corresponding SPDs. There are limited scientific sources investigating defensive systems in basketball, as well about defensive preferences of NBA and Euroleague teams. This comparative study tried to determine if there are any differences in defensive strategies between two leagues through comparison of distribution of SPDs.

To decide which SPDs to select, literature review about most used offensive modalities was conducted. After reviewing scientific works, selected SPDs were *defense of the ball player in on ball screens(2vs2)* and *defense of the screen receiver in off ball screens(3vs3)*. According to Remmert & Chau (2019), up to 40% of all finishing actions in modern basketball directly result from ball screens (Gómez et al., 2015), while off ball screens were identified by Zukolo et al. (2019) as one of the most effective finishing actions in 2013 European Championship. After selection, desired data was collected through video-analysis of NBA and Euroleague games from season 2020/2021, and later statistically analyzed.

**Hypothesis 1-NBA vs. Euroleague:** Results from this study confirmed the first hypothesis that there will be significant differences in distribution of SPDs between NBA and Euroleague teams. Chi-square analysis determined significant differences in distribution of two main categories of SPDs (2vs2  $p<0.001$ ; 3vs3  $p<0.001$ ). Furthermore, comparison of both subcategories of selected SPDs against on ball (pick) and off ball screens found significant differences in distribution between two leagues (2vs2  $p<0.001$ ; 3vs3  $p<0.001$ ).

Results from this investigation confirm studies by authors that studied differences in offensive systems between NBA and Euroleague (Jorgensen et al. 2021, Selmanovic et al. 2015, Milanovic et al. 2014). Usage of different SCDs to disrupt defense subsequently leads to

usage of corresponding SPDs to contain offense.

**Hypothesis 2-regular season vs. playoffs:** Second hypothesis could be partially confirmed. Comparison of regular season and playoff games in the NBA showed no significant differences found in distribution between the two main categories of SPDs ( $p>0.05$ ). However, when subcategories of selected SPDs were compared, significant difference was found both for 2vs2 ( $p<0.001$ ) and 3vs3 ( $p<0.05$ ). Euroleague comparison of regular season and playoff games determined that there was no significant difference in distribution of main categories of SPDs ( $p>0.05$ ) nor 3vs3 subcategories ( $p>0.05$ ). Only significant difference was found in distribution between 2vs2 subcategories ( $p<0.001$ ).

Teams in NBA adjusted their offensive strategies for playoffs, that led to different distribution of SPDs as defensive intensity and importance of containing offense became crucial. Significant differences found in both subcategories in NBA comparison could coincide with statement that NBA teams do not play their strongest basketball during the regular season (Štrumbelj et al., 2013; Jungić et al., 2015).

Differences identified in EL for 2vs2 subcategories indicate the importance of pick game in modern basketball, as coaches considered it is crucially important to defend on ball screens and containing ballhandlers in PnR. According to Zukolo et al. (2019), elite men basketball teams more often use PnR ball handler as an end of the ball possession, and that could be the reason for determined differences. No differences found in 3vs3 subcategories could indicate that Euroleague teams play with highest effort during the whole season, so defensive strategies for containing off ball screens were similar in regular season and playoffs, unlike NBA. That coincides with findings by Mandić et al.(2019), that stated once winning becomes more important, teams put more emphasis on tactical play and defence. This is something that European teams do more consistently, as there are no substantial differences between regular season and playoff games (Mandić et al., 2019).

Collected data on frequency of occurrence (32 games) proved that although there are differences between the NBA and Euroleague in offensive systems, defensive strategies are pretty similar. During PnR and PnP situation(2vs2) in NBA games, most occurrent SPDs against the ballhandler are follow (34.82%), switch (31.14%), middle (12.82%) and trap (9.72%) while less frequent are deny & fight-thru (5.09%) and behind (1.31%). Gomez et al. (2015) obtained similar results, as it was revealed that after the most PnR situations the defender of the ball handler follows him and does not change.

Euroleague teams defend ball player in pick situations quite similar, as switch and follow are most frequent SPDs (33.46% and 24.18%), followed by trap and middle (17.27% and 12.30%)

while less frequent are fight-thru (7.45%), deny (3.24%) and behind (2.10%). We can conclude that most frequent SPDs against the ball player in PnR/PnP situations used by elite teams are follow and switch. Middle and trap are also vital component of defensive strategies, while fight-thru, behind and deny are used mostly when they present most efficient tactical solution. Results on frequency of the switch in NBA and especially Euroleague coincide with Remmert (2003) conclusion that basketball players should focus on switching when defending on ball screens. It is hard to compare these results with other authors finding, as for our knowledge there are no similar studies that investigated distribution of SPDs in elite basketball.

Analysis of defense against the off ball screens (3vs3) also showed similarities in frequency of occurrence. To contain screen receiver shot or penetration after off ball screens, NBA teams use mostly follow and middle SPDs (40.55% and 27.21%), along with switch (12.59%). Less frequent are behind (8.64%), fight-thru (5.76%) and deny (5.23%). Euroleague teams have the tendency to guard screen receiver by following (46.34%) or slicing through the middle between screener and defender of the screener (25.91%). While NBA's third most used SPD is switch, Euroleague coaches prefer to go behind (under) during off ball screens (11.40%). Fight-thru (6.06%), switch (5.74%) and deny (4.55%) are least likely to occur against off ball screens in EL.

Most of the research deficiencies are lack of scientific literature that investigates defensive systems in basketball, as well as SPDs that are key part of the defensive strategies. Before this study, no research has characterized SPDs in elite basketball. Studies about defense in basketball are mostly focused on defensive systems used (i.e., man-to-man, zone defense) and there is a need to investigate which tactical pattern are most reoccurring in modern basketball defense.

## CONCLUSIONS

- 1) SPDs are used on defense to obstruct opponents offensive SCDs, so obtained data could provide insight on how elite teams defend accordingly to opponents' style of play. Most frequent SPDs for defending ballhandler in pick situation (2vs2) are follow and switch while screen receivers in off ball screens (3vs3) are defended with follow and middle SPDs.
- 2) Significant differences found in distribution between SPDs used in NBA and Euroleague confirm that there are different preferences in offensive strategies between two leagues, as use of SCDs leads to use of corresponding SPDs.
- 3) No significant differences found between the regular season and playoff games could indicate that selected SPDs could be crucially important in all basketball matches. High level of execution of defensive tactics is important in every basketball game to increase the chances of winning outcome.
- 4) This study can help coaches with preparation and planning of defensive systems, especially defensive tactical maneuvers against on ball and off ball screens which are very frequent offensive modalities. Additionally, it can help coaches when teaching young players how to properly defend screens in basketball.

## RECOMMENDATIONS

- 1) Scientific sources are lacking studies about the defensive systems in basketball, especially on individual and team tactics of players in defensive phase. As a recommendation for basketball scientists, SPDs provide a perfect opportunity to investigate how best players and teams contain offensive actions. When SPD classes were validated, most reoccurring defensive maneuvers were taken in account, so analysis of SPDs could cover all important defensive tactical elements in basketball. Bigger sample of investigated SPDs could provide coaches, players, and decision makers with valuable information about defensive strategies.
- 2) To further investigate the defending of on ball and off ball screens, similar research could investigate different approach, and analyze the SPDs to defend screeners in pick and roll and weak side actions. Along with results from this research, that would provide full insight to the coaches and players what are best and most prevalent defensive maneuvers to contain on ball and off ball screens.
- 3) There is a possibility to evaluate the impact of SPDs on winning outcome by investigating distribution of SPDs between winning and losing teams. Most successful teams have better cooperation on offense and defense in terms of technical-tactical abilities than less successful teams. Scientific literature investigated discriminating factors between the winning and losing outcomes but mostly from the offensive standpoint or game related statistics. There are limited sources on how defensive elements affect success in basketball match, so these information could give coaches more tools when creating winning strategies.
- 4) It would be time saving if SPDs were included in analysis software such as “Synergy Sports Technologies”. Notational analysis is time consuming and could be prone to human error. Including SPDs in modern performance analysis software would produce bigger sample size and more opportunities for investigation. Furthermore, spatiotemporal dynamics of defensive systems could be analyzed to fully understand this crucial phase of each basketball match.

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## LIST OF ABBREVIATIONS

<i>Abbreviation</i>	Explanation
<i>BP</i>	Ball possession
<i>EL</i>	Euroleague
<i>NBA</i>	National Basketball Association
<i>PnP</i>	Pick and pop
<i>PnR</i>	Pick and roll
<i>SCD</i>	Space Creation Dynamics
<i>SPD</i>	Space Protection Dynamics

# **ANNEXES**

**ANNEX A**

Suggested article prepared for *Journal of Physical Education and Sport*

# Investigating Space Protection Dynamics in NBA and Euroleague

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## Abstract

Aim of this study is to determine the differences in usage of Space Protection Dynamics (SPD) between the two top level basketball leagues - in Europe (Euroleague) and USA (NBA). Additionally, differences between usage of SPDs in regular season and playoff games in the same league were investigated. Although SPDs are a key component of defensive systems, no investigation characterized them in elite basketball. Presented research investigated which tactical elements and strategies are used by teams on elite levels of basketball. Focus of the study was to identify which SPDs are used to defend the ball player in on ball screens(2vs2) and screen receiver during the off ball screens(3vs3). Using a video analysis method, selected SPDs were observed in 32 close matches (no more than 10 points difference) in two top tier leagues: NBA and Euroleague. For each professional league, 16 matches were analysed (8 matches of regular season; 8 matches of playoffs), analysing defence against set offense possessions. 37 teams were represented in this study (NBA 18; EL 19), and no team was analysed more than 3 times. After completing notational analysis of selected games, total of 4136 defense sequences against set offense possession that contained 6211 SPDs were investigated. SPDs classification included 7 different subcategories of SPDs against on ball screens, and 6 against off ball screens. Most frequent SPDs against 2vs2 situations are follow and switch, while for 3vs3 teams mostly use follow and middle. Furthermore, Chi-square analysis confirmed there are: a) significant differences in distribution between two leagues for both main categories of SPDs (2vs2; 3vs3) and all belonging subcategories; b) no significant differences in NBA or EL found between regular season and playoff games when comparing main categories of SPDs; c) significant differences found between both groups of subcategories in NBA (regular season vs. playoff); d) significant differences found comparing 2vs2 subcategories in EL, with none found for 3vs3 (regular season vs. playoff). This study can help coaches with preparation and planning of defensive systems, especially defensive tactical maneuvers against on ball and off ball screens which are very frequent offensive modalities. Additionally, it can help coaches when teaching young players how to properly play defense against screens in basketball.

**Key Words:** basketball; NBA; Euroleague; defense; performance analysis

## Introduction

In a basketball match, defensive and offensive teams organize their plays to minimize scoring opportunities of the adversary and to maximize the chances of scoring points (Santana et al., 2015). Both teams have 2 main goals, to score points and prevent opponents from scoring. Since early years basketball coaches, sport analysts and scientists are constantly investigating performance indicators and action variables that could discriminate winning and losing outcome, both on offense and defense. Lamas et al. (2011) presented a set of basketball offensive classes corresponding to the possible offensive specifications to create space in the adversary defensive system, which leads to scoring opportunities, the space creation dynamics (SCD). Subsequently, SCDs were used as a reference to conceive and validate their correspondent defensive classes, the space protection dynamics (SPDs) (Santana et al., 2015). In recent years some authors investigated defensive strategies (Gomez et al., 2006.; 2010; Franks et al., 2015), but there is still a lack of studies regarding defensive aspect of basketball.

NBA and Euroleague are widely considered as best leagues in the world, and differences between offensive preferences of teams from these two leagues are thoroughly studied (Jorgensen et al. 2021, Selmanovic et al. 2015, Milanovic et al. 2014). These studies were important in investigation of SPDs, because usage of SCDs leads to usage of corresponding SPDs. There are limited scientific sources investigating defensive systems in basketball, as well about defensive preferences of NBA and Euroleague teams. In the research done by Santana et.al (2015), main aim was to validate classes of defensive actions (SPDs) and to give insight on new approach in basketball analysis by investigating interactions between SCDs and their corresponding SPDs. Aim of this study is to determine the differences in usage of SPDs between the two top level basketball leagues - in Europe (Euroleague) and USA (NBA). This comparative study tried to determine if there are any differences in defensive strategies between two leagues through comparison of distribution of SPDs, and which SPDs are most frequently used against on ball and off ball screens in regular season and playoff games.

## Material & methods

Research for this work was approved by Lithuanian Sports University Ethics Committee (permit No. 24428). For purposes of this research all observed games were analyzed through publicly available sources, so there was no need for consent from athletes.

### Research sample

Research sample was collected by video analysis of 32 games from seasons 2020./2021. For each professional league, America's NBA and European Euroleague, 16 games were investigated (8 regular season; 8 playoff games). To ensure larger variety of teams included (NBA 18; EL 19), no team was analyzed more than 3 times, while investigating close matches (up to 10 points difference) ensured maximum effort by both teams. NBA format has 82 regular season games, and four stages of playoff elimination rounds (first round, conference semi-finals, conference finals, finals). Playoff format is "best of 7", so first team that secures 4 wins is the series winner and advances in competition. Euroleague teams play 34 regular season games, while in playoff after first elimination round with "best of 5" format (first team with 3 wins advances), teams secure spot in "Final Four" tournament where they play semi-finals, third place and finals game. All phases in each league were taken in account, to represent possible adjustments teams make in their defensive systems during long competitive seasons.

After completing analysis of selected games, total of 4136 defense sequences against set offense ball possessions that contained 6211 SPDs were investigated. During the observation and notational analysis, for simplicity and as reference to original author, SPD classes and numbering were taken from original research conducted by Santana et al. (2015). Figure 1. and Figure 2. present sample variables investigated in this research, more exactly SPDs selected for analysis:

- 4. SPD for 2x2 situations of on ball screen
- 4.1 Defense of the ball player
  - 4.1.1 Second (Fight-thru): Defender passes over the screen with his defensive posture preserved and conserves himself between the attacker and the basket.
  - 4.1.2 Second (Follower): Defender passes over the screen but loses his defensive posture and is either delayed or side-by-side with the attacker in relation to the basket.
  - 4.1.3 Third: Defender of the ball player passes between the screener and the defender of the screener in order to follow the attacker that received the screen.
  - 4.1.4 Fourth (Behind): Defender of the ball player passes behind the defender of the screener in order to follow the attacker that received the screen.
  - 4.1.5 2x1 (Trap): The defender of the ball player and the defender of the screener momentarily guard (i.e. double guard with pressure) the ball player.
  - 4.1.6 Switch: The defender of the ball player and the defender of the screener switch players being guarded.
  - 4.1.7 Deny: The defender of the ball player rotates his body obstructing the attacker's displacement toward the screen set by the screener.

**Figure 1.-** – defense against ballhandler in on ball screens, *\*table from original article by Santana et al., 2015(Space protection dynamics in basketball: Validation and application to the evaluation of offense-defense pattern)*

- 5.3 Defense of the receiver of the screen
  - 5.3.1 Second (Fight-thru): Defender passes over the screen with his defensive posture preserved and staying between the attacker and the basket.
  - 5.3.2 Second (Follower): Defender passes over the screen but loses his defensive posture and is either behind or side-by-side with the attacker in relation to the basket.
  - 5.3.3 Third (Middle): Defender passes between the screener and the defender of the screener in order to follow the attacker that received the screen.
  - 5.3.4 Fourth (Behind): Defender passes behind the defender of the screener in order to follow the attacker that received the screen.
  - 5.3.5 Switch: The defender of the ball player and the defender of the screener switch players being guarded.
  - 5.3.6 Deny: The defender of the ball player rotates his body obstructing the attacker's displacement in direction to the screen set by the screener.

**Figure 2.-** defense against receiver of the screen in out of the ball screens ; *\*table from original article by Santana et al., 2015(Space protection dynamics in basketball: Validation and application to the evaluation of offense-defense pattern)*

### Research methods and statistical analysis

Games were video analyzed with paid subscription to “NBA League Pass” and “EuroleagueTV”. These websites give unlimited access to all NBA and Euroleague games, and that provides lot of possibilities for wide array of basketball studies. Microsoft Excel software was used for notational analysis of occurring SPDs, and afterwards for statistical analysis. IBM SPSS statistical analysis software was used to calculate intra-rater reliability.

Statistical analysis methods conducted in this work are used to present descriptive statistics for frequency of occurrence of selected SPDs (counts and percentages) and SPDs per game/ball possession (averages). Furthermore, to determine the differences between two leagues and to compare regular season vs. playoffs, Chi-square analysis was conducted with significant difference threshold set at  $p < 0.05$ . To ensure the validity of investigated data, 4 random games (2 NBA; 2 EL games) were re-analyzed for intra-rater reliability test using Cohen’s-Kappa test, with criteria set according to Landis & Koch (1977) interpretation, where 0.81 to 1.0 coefficient indicates almost perfect or perfect agreement.

## Results

### Descriptive statistics

This section will present obtained results from the work done on investigating defensive actions that are used to contain offensive strategies, SPDs. Total of 32 games from NBA and Euroleague seasons 2020./2021. were subjected to video and notational analysis. Validity of investigated data was confirmed with intra-rater reliability test, as Cohen’s-Kappa test results returned Kappa value of agreement 0.98, which means almost perfect or perfect agreement according to Landis & Koch (1977).

As seen in Table 1., total of 37 teams were represented in this research (NBA 18; EL 19) while total sample of investigated set-offense ball possessions, and defense against was 4136 (NBA 2200; EL 1936). Although NBA matches are longer 8 minutes in duration, there was a higher frequency of SPDs in Euroleague (NBA 2841; EL 3370). If we look at Table 1., in Euroleague matches average of used SPDs per game was higher than the NBA (NBA 177.5; EL 210.6) which led to higher numbers of SPDs per ball possession. When taking all ball possessions in account, we conclude that NBA teams on average use 1.29 SPDs per possession opposing to Euroleague’s 1.74. If we consider only ball possessions that contain SPDs these numbers go up (NBA 1.55; EL 2.01).

Table 1.- Basic descriptive statistics-counts for all 32 games

	NBA	EUROLEAGUE
Number of analyzed games	16	16
Number of teams represented	18	19
Total BP	2200	1936
BP w/ SPD	1830	1680
BP w/o SPD	370	256
Number of SPDs	2841	3370
2vs2 SPD	1904	1853
3vs3 SPD	937	1517
SPDs per game	177.5	210.6
SPDs per possession (all BP)	1.29	1.74
SPDs per possession (BP w/ SPD)	1.55	2.01

*SPD-space protection dynamics; BP-ball possession; w/-with; w/o-without*

In NBA league 16,82% of defensive sequences did not contain selected SPDs while in Euroleague only 13,22% were without defensive actions against opponents on ball(2vs2) and off ball(3vs3) screens. NBA teams had to use SPDs to contain on and off ball screens in 83,28% of half court offenses, while in Euroleague this occurred in 86,78% of all set offenses (Table 2.)

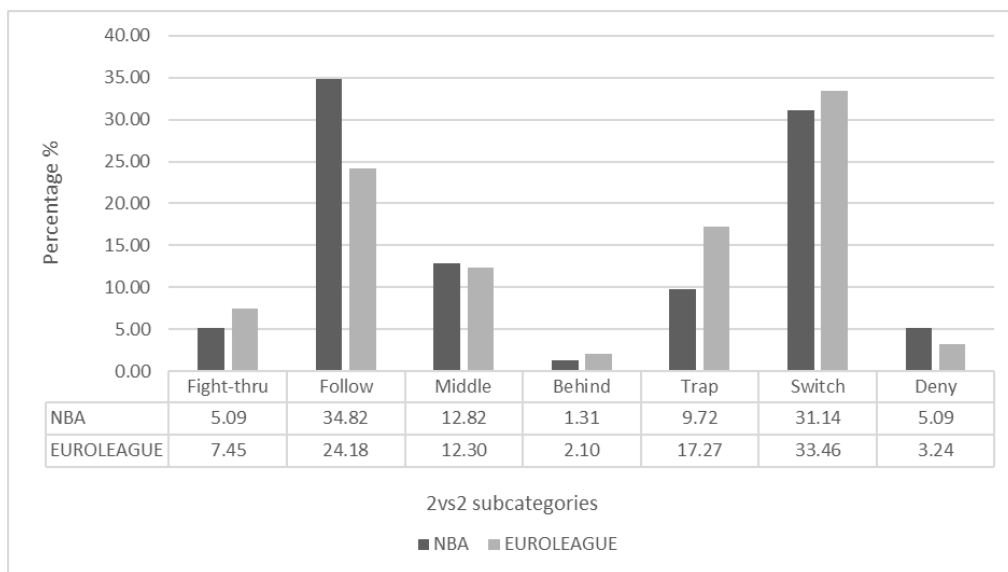
**Table 2.-** Basic descriptive statistics -percentages for all 32 games

	NBA	EUROLEAGUE
Total BP	100	100
BP w/ SPD	83.18	86.78
BP w/o SPD	16.82	13.22
Total of SPDs	100	100
2vs2 SPD	67.02	54.99
3vs3 SPD	32.98	45.01
SPDs per game	100	100
SPDs per game (2vs2)	67.02	54.99
SPDs per game (3vs3)	38.98	45.01

All values presented as percentage of (%)

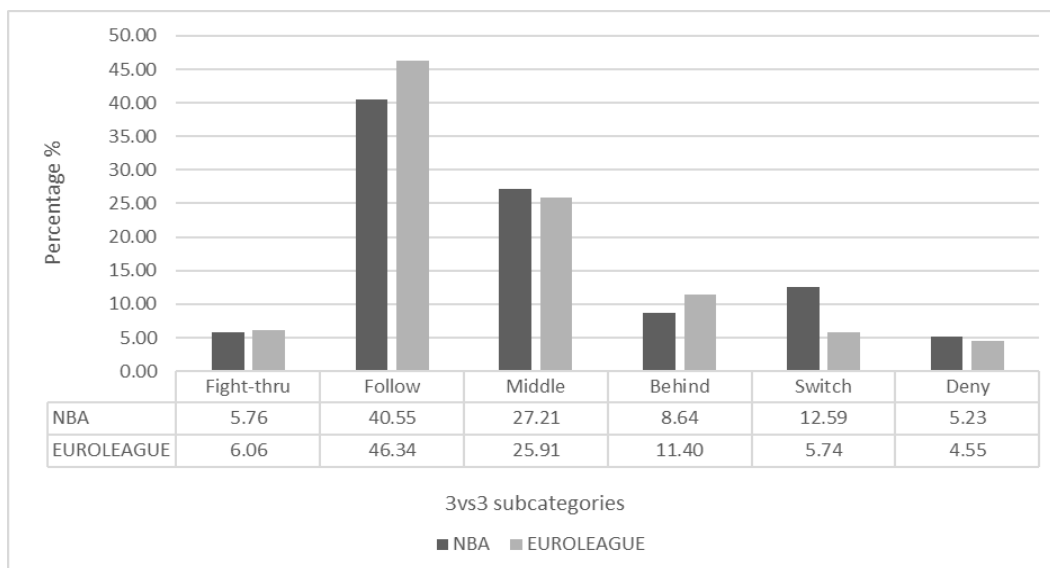
*Frequency of occurrence of investigated SPDs in NBA and Euroleague*

In Figure 3. we can see comparison between NBA and Euroleague and which defensive strategies are used to defend ball handler in pick situations. NBA teams mostly use follow (34.82%), switch (31.14%) and middle (12.82%) to defend player with the ball, while European teams use switch (33.46%) more than follow (24.18%) and trap (17.27%). Least used actions against picks were behind (NBA 1.31%; EL 2.10%), deny (NBA 5.09%; EL 3.24%) and fight thru (NBA 5.09%; EL 7.45%).



**Figure 3.-** distribution of 2vs2 SPDs for on ball screen- NBA (16) vs. EL (16); 32 games

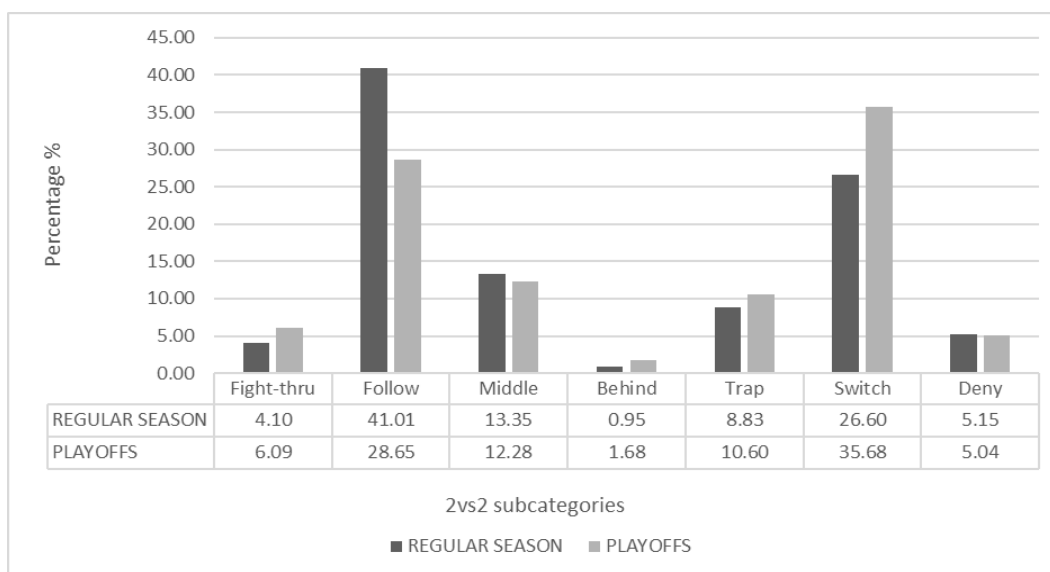
As seen in Figure 5., most frequent defensive action to contain screen receiver offense were follow (NBA 40.55%; EL 46.34%) and middle (NBA 27.21%; EL 25.91%). NBA teams have higher tendency of switching in weak side screens (12.59%) then Euroleague's (5.74%). Best shooters and athletes in the world are playing in NBA league and switch is effective way of defending shots and penetrations after off ball screens. For this same reason, EL teams can take a bit more risk and go under in these situation (NBA 8.64%, EL 11.40%). Least used defensive action were deny (NBA 5.23%; EL 4.55%) and fight-thru (NBA 5.76%; EL 6.06%).



**Figure 4.-** distribution of 3vs3 SPDs for out of the ball screen-NBA(16) vs. EL(16);32 games

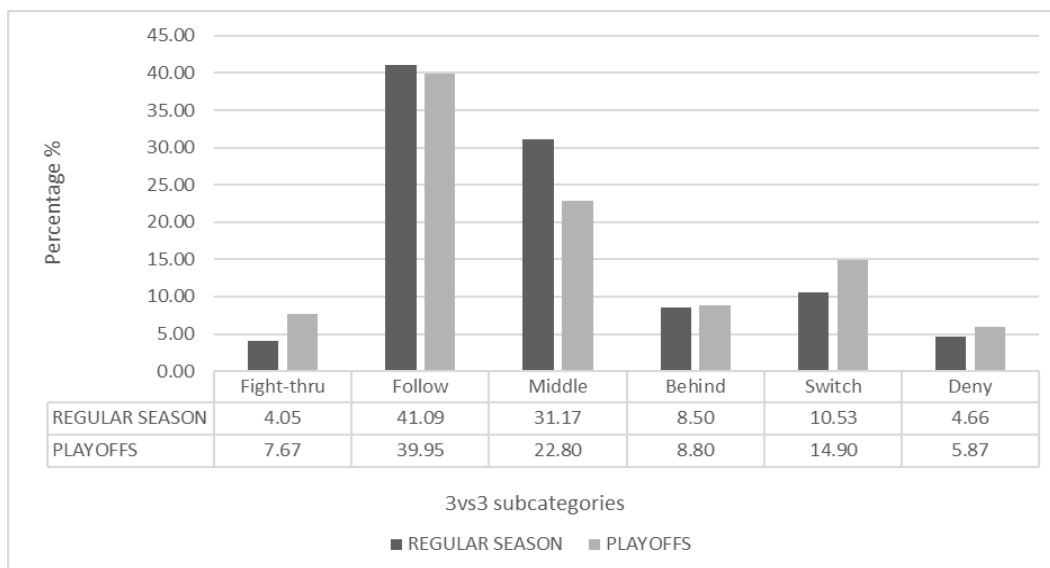
*Frequency of occurrence of investigated SPDs in regular season and playoffs*

**NBA regular season vs. playoffs:** Figure 5. shows that NBA teams defend ball player during pick actions by switching more than in regular season (35.68% and 26.60%), while follow SPD usage drops down from 41.01% to 28.65%.



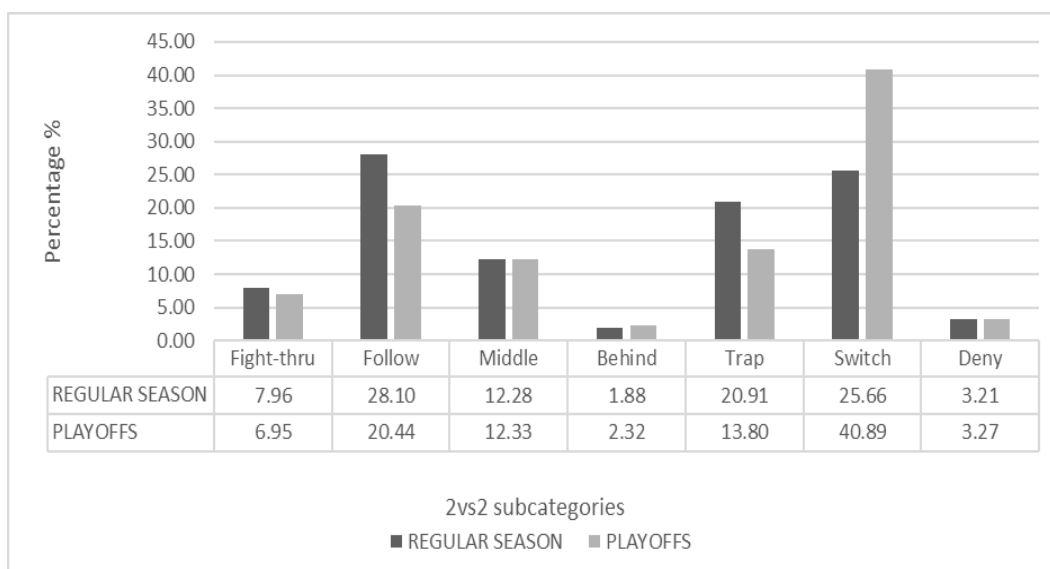
**Figure 5.-** distribution of 2vs2 SPDs for on ball screen- NBA RS (8) vs. PO (8); 16 games

Defensive tactics in playoffs used to contain off ball screens also differ from regular season, as seen in Figure 6. Although follow SPD stays most common way of defending screen receiver, middle SPD frequency drops down from 31.17% to 22.80% while switching increases from 10.53% to 14.90%. There is a slight increase in fight-thru defensive action (4.05% to 7.67%), as defensive intensity and effort increases in playoffs.



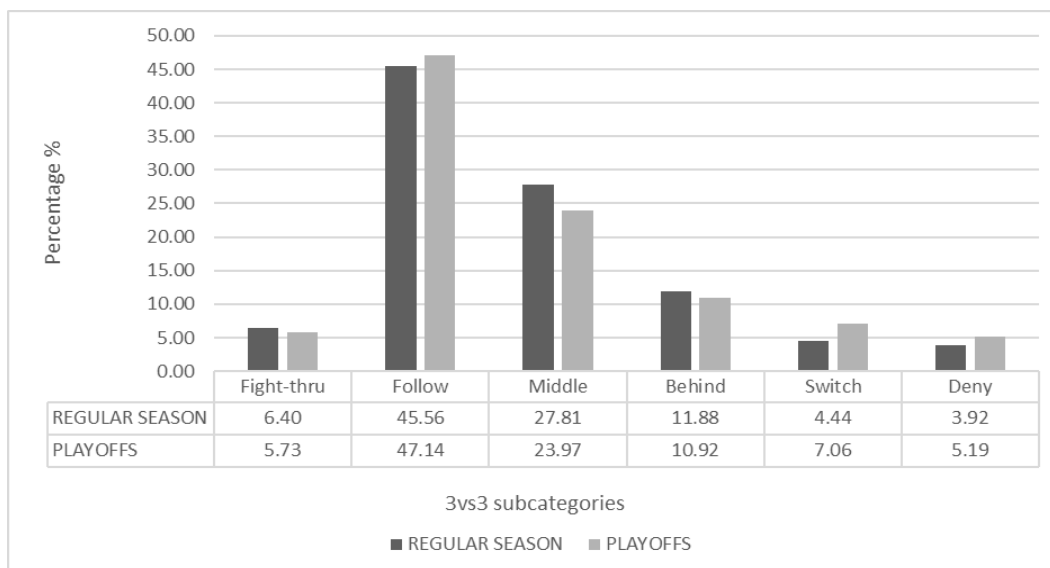
**Figure 6.-** distribution of 3vs3 SPDs for out of the ball screen-NBA RS (8)vs. PO (8); 16 games

**Euroleague regular season vs. playoffs:** In Figure 7. we can see how Euroleague teams adjust their defensive strategies against pick in playoff games. Defending ball player by following him becomes less frequent (28.10% to 20.44%), same as traps (20.91% to 13.80%). Biggest adjustment is made in usage of switch, which is significantly more common in EL playoff games in comparison with regular season (20.66% to 40.89%). Other subcategories frequency mostly stays similar between phases of competition.



**Figure 7.-** distribution of 2vs2 SPDs for on ball screen- EL RS (8) vs. PO (8); 16 games

According to results from Figure 8., Euroleague teams seem to make less adjustments of defensive strategies against weak side screens in playoff than NBA teams. Most frequent actions to contain off ball screens and defend screen receiver are follow (45.56% to 47.14%) and middle (27.81% to 23.97%). With slight decrease in frequency of middle SPD, we can see increase in usage of switch (4.44% to 7.06%) and deny (3.92% to 5.19%).



**Figure 8.**-distribution of 3vs3 SPDs for out of the ball screen-EL RS (8)vs. PO (8); 16 games

#### Chi-Square Analysis

Comparison between NBA and Euroleague for main defensive classes of selected SPDs and all of belonging subcategories (Figure 3.and 4.) identified significant differences in distribution of SPDs between two leagues. As seen in Table 3., Chi-square test determined that there are significant differences in distribution of SPDs used to contain on ball and off ball screens during basketball games in NBA and EL ( $p < 0.001$ ). Furthermore, comparison of SPD subcategories also showed that distribution of SPDs to defend ball player in pick situations and screen receiver in weak side screens is significantly different ( $p < 0.001$ ).

**Table 3.-** Chi-Square analysis comparison- NBA vs Euroleague; 32 games

NBA vs. Euroleague comparison	P Value
2vs2 and 3vs3 SPD	$p < 0.001$
2vs2 subcategories (4.1.1-4.1.7)	$p < 0.001$
3vs3 subcategories (5.3.1-5.3.6)	$p < 0.001$

Significance level  $p < 0.05$

In comparison of regular season and playoffs, no significant differences in the distribution of main categories of SPDs were identified (Table 4.), both in NBA and Euroleague ( $p > 0.05$ ). NBA comparison of all subcategories when defending ball player in pick action or screen receiver in weak side screens showed significant difference in distribution of both SPDs (2vs2  $p < 0.001$ ; 3vs3  $p < 0.05$ ). Although Euroleague comparison determined significant differences in distribution between 2vs2 subcategories ( $p < 0.001$ ), no differences were identified for 3vs3 ( $p > 0.05$ ).

**Table 4.-** Chi-square analysis comparison-regular season vs. playoff

Regular season vs. playoff comparison	NBA	Euroleague
	P Value	P Value
2vs2 and 3vs3 SPD	$p > 0.05$	$p > 0.05$
2vs2 subcategories (4.1.1-4.1.7)	$p < 0.001^*$	$p < 0.001^*$
3vs3 subcategories (5.3.1-5.3.6)	$p < 0.05^*$	$p > 0.05$

Significance level  $p < 0.05$

#### Discussion

Main aim of this study was to investigate which technical and tactical defensive strategies are used by teams in elite levels of basketball. More exactly, usage of defensive Space Protection Dynamics (SPD) that counteract against offensive Space Creation Dynamics (SCD) was investigated in top basketball championships. SPDs are key components of every defensive strategy in basketball, and according to Santana et al. (2015) all defensive system are comprised of these defensive actions. NBA and Euroleague are widely considered as best leagues in the world, and differences between offensive preferences of teams from these two leagues are thoroughly studied (Jorgensen et al. 2021, Selmanovic et al. 2015, Milanovic et al. 2014). These studies were important in investigation of SPDs, because usage of SCD leads to usage of corresponding SPDs. There are limited scientific sources investigating defensive systems in basketball, as well about defensive preferences of NBA and

Euroleague teams. This comparative study tried to determine if there are any differences in defensive strategies between two leagues through comparison of distribution of SPDs.

To decide which SPDs to select, literature review about most used offensive modalities was conducted. After reviewing scientific works, selected SPDs were *defense of the ball player in on ball screens(2vs2)* and *defense of the screen receiver in off ball screens(3vs3)*. According to Remmert & Chau (2019), up to 40% of all finishing actions in modern basketball directly result from ball screens (Gómez et al., 2015), while off ball screens were identified by Zukolo et al. (2019) as one of the most effective finishing actions in 2013 European Championship. After selection, desired data was collected through video-analysis of NBA and Euroleague games from season 2020./2021., and later statistically analyzed.

Results from this study confirmed the first hypothesis that there will be significant differences in distribution of SPDs between NBA and Euroleague teams. Chi-square analysis determined significant differences in distribution of two main categories of SPDs (2vs2  $p<0.001$ ; 3vs3  $p<0.001$ ). Furthermore, comparison of both subcategories of selected SPDs against on ball (pick) and off ball screens found significant differences in distribution between two leagues (2vs2  $p<0.001$ ; 3vs3  $p<0.001$ ). Results from this investigation confirm studies by authors that studied differences in offensive systems between NBA and Euroleague (Jorgensen et al. 2021, Selmanovic et al. 2015, Milanovic et al. 2014). Usage of different SCDs to disrupt defense subsequently leads to usage of corresponding SPDs to contain offense.

Comparison of regular season and playoff games in the NBA showed no significant differences found in distribution between the two main categories of SPDs ( $p>0.05$ ). However, when subcategories of selected SPDs were compared, significant difference was found both for 2vs2 ( $p<0.001$ ) and 3vs3 ( $p<0.05$ ). Euroleague comparison of regular season and playoff games determined that there was no significant difference in distribution of main categories of SPDs ( $p>0.05$ ) nor 3vs3 subcategories ( $p>0.05$ ). Only significant difference was found in distribution between 2vs2 subcategories ( $p<0.001$ ). Teams in NBA adjusted their offensive strategies for playoffs, that led to different distribution of SPDs as defensive intensity and importance of containing offense became crucial. Significant differences found in both subcategories in NBA comparison could coincide with statement that NBA teams do not play their strongest basketball during the regular season (Štrumbelj et al., 2013; Jungić et al., 2015.).

Differences identified in EL for 2vs2 subcategories indicate the importance of pick game in modern basketball, as coaches considered it is crucially important to defend on ball screens and containing ballhandlers in P&R. According to Zukolo et al. (2019), elite men basketball teams more often use P&R ball handler as an end of the ball possession, and that could be the reason for determined differences. No differences found in 3vs3 subcategories could indicate that Euroleague teams play with highest effort during the whole season, so defensive strategies for containing off ball screens were similar in regular season and playoffs, unlike NBA. That coincides with findings by Mandić et al.(2019), that stated once winning becomes more important, teams put more emphasis on tactical play and defence. This is something that European teams do more consistently, as there are no substantial differences between regular season and playoff games. (Mandić et al., 2019)

Collected data on frequency of occurrence (32 games) proved that although there are differences between the NBA and Euroleague in offensive systems, defensive strategies are pretty similar. During pick situation(2vs2) in NBA games, most occurrent SPDs against the ballhandler are follow (34.82%), switch (31.14%), middle (12.82%) and trap (9.72%) while less frequent are deny & fight-thru (5.09%) and behind (1.31%). Gomez et al. (2015) obtained similar results, as it was revealed that after the most Pick and Roll situations the defender of the ball handler follows him and does not change.

Euroleague teams defend ball player in pick situations quite similar, as switch and follow are most frequent SPDs (33.46% and 24.18%), followed by trap and middle (17.27% and 12.30%) while less frequent are fight-thru (7.45%), deny (3.24%) and behind (2.10%). We can conclude that most frequent SPDs against the ball player in pick and roll/pop situations used by elite teams are follow and switch. Middle and trap are also vital component of defensive strategies, while fight-thru, behind and deny are used mostly when they present most efficient tactical solution. Results on frequency of the switch in NBA and especially Euroleague coincide with Remmert (2003) conclusion that basketball players should focus on switching when defending on ball screens.

Analysis of defense against the off ball screens (3vs3) also showed similarities in frequency of occurrence. To contain screen receiver shot or penetration after off ball screens, NBA teams use mostly follow and middle SPDs (40.55% and 27.21%), along with switch (12.59%). Less frequent are behind (8.64%), fight-thru (5.76%) and deny (5.23%). Euroleague teams have the tendency to guard screen receiver by following (46.34%) or slicing through the middle between screener and defender of the screener (25.91%). While NBA's third most used SPD is switch, Euroleague coaches prefer to go behind (under) during off ball screens (11.40%). Fight-thru (6.06%), switch (5.74%) and deny (4.55%) are least likely to occur against off ball screens in EL.

#### *Research Deficiencies*

Most of the research deficiencies are lack of scientific literature that investigates defensive systems in basketball, as well as SPDs that are key part of the defensive strategies. Before this study, no research has characterized SPDs in elite basketball, so comparing results with other authors data is not possible. Studies about

defense in basketball are mostly focused on defensive systems used (i.e., man-to-man, zone defense) and there is a need to investigate which tactical patterns are most reoccurring in modern basketball defense.

#### *Recommendations*

Scientific sources are lacking studies about the defensive systems in basketball and especially on individual and team tactics of players in defensive phase. SPDs provide a perfect opportunity to investigate how best players and teams contain offensive actions. When SPD classes were validated, most reoccurring defensive maneuvers were taken in account, so analysis of SPDs could cover all elements of defense in basketball. Bigger sample of investigated SPDs could provide coaches, players, and decision makers with valuable information about defensive strategies. Further investigation of defending on ball and off ball screens could include different approach and analyze the SPDs to defend screeners in pick and roll and weak side actions. Along with results from this research, that would provide full insight to the coaches and players what are best and most prevalent defensive maneuvers to contain on ball and off ball screens. Also, there is a possibility to evaluate the impact of SPDs on winning outcome by investigating distribution of SPDs between winning and losing teams. Most successful teams have better cooperation on offense and defense in terms of technical-tactical abilities than less successful teams. Scientific literature investigated discriminating factors between the winning and losing outcomes but mostly from the offensive standpoint or game related statistics. There are limited sources on how defensive elements affect success in basketball match, so these information could give coaches more tools when creating winning strategies. Additionally, it would be time saving if SPDs were included in analysis software such as "Synergy Sports Technologies". Notational analysis is time consuming and could be prone to human error. Including SPDs in modern performance analysis software would produce bigger sample size and more opportunities for investigation. Furthermore, spatiotemporal dynamics of defensive systems could be analyzed to fully understand this crucial phase of each basketball match.

#### **Conclusions**

Main aim of this study was to determine are there any differences between NBA and Euroleague teams when defending on ball and off ball screens. More exactly, which SPDs are used by elite teams to contain offense of ballhandlers in pick situations and screen receivers during off ball screens. Investigation showed although there are similarities between NBA and EL teams when it comes to frequency of occurrence, significant differences were found in distribution of SPDs. Analysis of all main SPD categories and belonging subcategories against on ball and off ball screen determined that: 1) SPDs are used on defense to obstruct opponents offensive SCDs, so obtained data could provide insight on how elite teams defend accordingly to opponents' style of play; 2) most frequent SPDs for defending ballhandler in pick situation (2vs2) are follow and switch while screen receivers in off ball screens (3vs3) are defended with follow and middle SPDs.

Significant differences found in distribution between SPDs used in NBA and Euroleague confirm that there are different preferences in offensive strategies between two leagues, as use of SCDs leads to use of corresponding SPDs. No significant differences found between the regular season and playoff games could indicate that selected SPDs could be crucially important in all basketball matches.

This study can help coaches with preparation and planning of defensive systems, especially defensive tactical maneuvers against on ball and off ball screens which are very frequent offensive modalities. Additionally, it can help coaches when teaching young players how to properly defend screens in basketball.

**Conflicts of interest:** The authors declare no conflicts of interest.

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ANNEX B



# ANNEX C



Peraica Dino

Lithuanian Sports University 2nd cycle full time

Basketball training and management study program MNLKTV -20-1 group student Tel

. no.

Research Ethics Commission To  
the Chairman

## APPLICATION To grant an approval to conduct social research

2021-10-12 (No. 24428)

Kaunas

I request to issue the permission to implement a social research project entitled [Name of the research project] **Investigating space protection dynamics in Euroleague and NBA**

Submitted by: **Peraica Dino** 2021-10-12

Received by: **Professor of the Department of Sports and Tourism Management Edmundas Jasinskas** 2021-10-25

Comments:

Implemented by: **Department of Sports and Tourism Management Edmundas Jasinskas** 2021-11-03

Comments: **Approved. Protocol No. SMTEK-66**