

Comparative analysis of physical and technical performance at different levels in Finnish soccer

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<p>Soccer is a complex sport that requires a variety of physical and technical actions. Soccer players tactical skills refer to the skill of adapting and executing an adequate physical or technical action based on the changing configurations in the game. Time-motion and video analyses have been used to record and evaluate players' match play performance. In addition to individual physical capacity and skill level, a player's match performance is affected by several situational variables such as match status, level of opposition, tactical formations and team's style of play. These variables cause match-to-match variation in match performance.</p> <p>This study was completed in cooperation with the Football Association of Finland and its aim was to identify and compare the positional physical and technical performance characteristics of four different competitions. Comparison was made between two Finnish youth national teams (U17's and U19's), the Finnish U17 national league, and Kakkonen (senior 3rd tier). Physical performance data was collected using GPS-tracking and technical performance was evaluated through video analysis. In total 33 matches were monitored from which a total of 209 performance observations were recorded.</p> <p>Physical performance was shown not be a discriminative factor between competitions, but position-specific differences in physical activity between competitions were notable. Players performed a higher number of technical actions in youth national team matches, which can be an indication of higher technical demand levels of these competitions. Position-specific differences between competitions in both the physical and technical performance, highlight the effects of distinct characteristics of each competition and teams' style of play.</p>	
Keywords soccer, performance analysis, physical activity, technical skills, youth soccer	

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1 Introduction

Soccer is complex sport that has been described as an “open-skill” sport in which the environment is constantly changing, and movements must be continually adapted (Thelwell, Greenless & Weston 2006, 254-270). Oliveira, (2004 in Delgado-Bordonau & Mendez-Villanueva 2012, 28-34) state that in football tactical, technical, physiological and psychological elements are always present since “every action - - involves a decision (tactical dimension), an action or motor skill (technical dimension) that required a particular movement (physiological dimension) and is directed by volitional and emotional states (psychological dimension).”

FIFA (International Football Federation) regulations define minimum and maximum length and width for pitches used in official matches. Length of the pitch has to be between 90 meters to 120 meters and width between 45 meters and 90 meters (FIFA, 2016). Official soccer matches are 90 minutes in duration, and it is split into two 45 minutes halves (Maughan & Gleeson 2004, 150-151). Due to stoppages in play, active playing time, the time when the ball is in play, is variable. Average active playing time in the UEFA Champions League season 2017-2018 was 61 minutes 40 seconds (UEFA Champions League Technical report 2017/18, 40, 48).

Soccer playing systems and styles of play have evolved over time. Different strategies and styles of plays are deployed by coaches around the world. Throughout the history of playing systems, the trend has been reducing the attacking line players to strengthen the defensive line. In today’s structure, the most common formations of play are 4-4-2, 4-2-3-1, 4-3-3, 4-1-4-1 and 3-5-2. From these formations individual playing positions can be identified. Common distribution of positions is to six playing positions: goalkeeper, central defender, full-back (wide defender), central midfielder, winger (wide midfielder) and forward (Bangsbo & Peitersen, 2016 in book Soccer Science, 433-458).

The physiological demands of soccer have been studied through various time-motion analyses utilizing either computerized camera tracking or global positioning systems. These time-motion analyses depict the physiological demands through quality, direction and intensity of the activities, players engage in during match play. During a

soccer match, professional players perform from 150 to 250 different actions and change the direction of their movement nearly 1100 times. In addition to running activities of varied intensity, sport-specific movements include tackling, jumping, and directional changes. The knowledge of these activities is useful in understanding the physical load imposed on the players and more importantly this information can then be used to design effective training programs for physical preparation (Andrzejewski, Chmura, Konefal, Kowalczyk & Chmura 2018, 785-792).

Technical actions in soccer are difficult in terms motor skill demands because controlling of the ball is done by using the lower limbs (Kemppinen & Sunila 2005, 145). The basic technical skills used in football can be divided in to four categories: controlling the ball, running with the ball, passing the ball, and shooting. These four basic technical skills apply to any level of football and should be the base of football training from grassroots to elite level. Additionally, headers, volleys, defensive techniques, feints and goalkeeping techniques are considered as special technical skills. (FIFA, 2020.) Among these technical activities, the numbers of shots and passes, pass accuracy and the number of duels won are regarded as the most significant regarding team success (Konefal, Chmura, Zajac, Chmura Kowalczyk & Andrzejewski 2019, 143-153).

Because of the complex nature of the sport, evaluating soccer performance solely in terms of either physical or technical elements, doesn't provide a comprehensive view on the subject. Although technical activities are more important than physical in terms of their effect on team's success, physical activities do influence the technical efficiency during match. This relationship between the two elements indicates a need for more integrated approach (Konefal et al. 2019, 143-153).

Objective of this study was to identify and compare the physiological demands and technical performance characteristics of four different levels of competition. The comparison was done between two domestic leagues (youth and senior) and two youth national teams (U17's and U19's). The results of the study give insight to differences in performance between domestic and international competition. It will also provide practitioners with knowledge to further develop training practices. The study was

commissioned by and completed in cooperation with the Football Association of Finland.

2 Physiological characteristics of soccer

Analyzing the different characteristics of players' movement is important because most of the distance covered by the players occurs when they are not in possession of the ball. Di Salvo, Baron, Tschan, Calderon Montero, Bachi & Pigozzi (2007, 222-227) found that only 1,2 to 2,4 % of the total distance covered during match is covered in possession of the ball. Low intensity activities such as standing, walking and jogging, account for most of the total distance players cover during a match. Bradley, Di Mascio, Peart, Olsen & Sheldon (2010, 2343-2351) found that low-intensity activities (0-14,3 km/h) accounted for 91,0 % of total match time, which consisted of 5,2 % standing still (0-0,6 km/h), 59,4 % walking (0,7-7,1 km/h) and 26,4 % jogging (7,2-14,3 km/h). High-intensity activities (>14,4 km/h) represented the remaining 9,0 % of a match and they consisted of 6,4 % running (14,4 km/h – 19,7 km/h), 2,0 % high-speed running (19,8-25,1 km/h) and 0,6 % sprinting (>25,2 km/h).

The distances players cover during matches at elite level have also been recorded extensively. Studies on Europe's top soccer leagues show that players typically cover a total of 10-12 kilometers during matches with a peak recorded around 13,8 kilometers (Andrzejewski, Konefal, Chmura, Kowalczyk & Chmura 2016, 817-828; Barnes, Archer, Hogg, Bush & Bradley 2014, 1095-1100; Di Salvo et al. 2007, 222-227; Di Salvo, Pigozzi, González-Haro, Laughlin & De Witt 2013, 526-532; Longo, Sofi, Candela, Dinu, Cimmino, Massaroni, Schena & Denaro 2019, 469). Bradley et al. (2010, 2343-2351), reported a mean total distance of 980 m \pm 294 m covered at very high-intensity (19,8 km/h) and a sprinting distance (>25,2 km/h) of 264 m \pm 114 m which consisted on average of 36 \pm 13 individual sprints. Rampinini, Coutts, Castanga, Sassi & Impillizzeri (2007, 49-53), reported peak sprint speeds of 31-32 km/h during match play at professional level.

In addition to distances covered at different intensities, researchers have stated that accelerations and decelerations also constitute greatly to the total external load imposed on a player during match play. These activities can often be neglected when assessing physical performance through distance and speed variables, as most of the high-intensity accelerations may not reach a high-intensity running speed. A study on

Norwegian top-level team, showed that accelerations contributed to 7 %-10 % and decelerations 5 %-7 % of the total player load. The short duration (on average 2 to 4 s) and distance (<20 m) of sprint activities in soccer also highlight the importance of acceleration capabilities (Dalen, Ingebrigtsen, Gertjang, Geir Havard & Ulrik 2016, 351-359). Another study on the same team, reported a total number of $90,7 \pm 20,9$ accelerations of $>2 \text{ m/s}^2$ (Ingebrigtsen, Dahlen, Hjelde, Drust & Wisløff 2015, 101-110), while Bradley et. al (2010, 2343-2351) reported an average of 119 accelerations of $>2,5 \text{ m/s}^2$ in a higher-ranked league. When observing the number of high-intensity accelerations and decelerations ($> 3 \text{ m/s}^2$) at elite level U21 and U18 matches in England, Tierney, Young, Clarke & Duncan (2016, 1-8) reported a mean number of 33 accelerations and 54 decelerations.

Although sprinting and other high-intensity actions account for a relatively low percentage of the total distance covered during match play, their importance can't be underestimated as they are often crucial for the outcome of a match. Faude, Koch & Meyer (2012, 625-631) analyzed 360 goals scored in the German Bundesliga during the second half of the 2007/2008 season and found that 83% of the goals were preceded by at least one powerful movement (rotation, straight sprint, change-in-direction sprint or a combination of these) by the assisting or goal scoring player. Most common action leading to a goal was a straight sprint, which preceded 45% of all the goals analyzed. Studies have also shown that the distance covered at high-intensity during match play can be a differentiating factor between moderate and top-level teams. Top-level teams have been found to cover more distance at high-intensity than moderate level teams even though the total distance covered during match play was similar (Mohr, Krusturp & Bangsbo 2003, 519-528; Sæterbakken, Haug, Fransson, Grendstad, Gundersen, Moe, Ylvisaker, Riiser & Andersen 2019, E28-E88).

However, studies comparing top level teams with each other have found no correlation between the amount of high-intensity activities and team success. In the Spanish First Division no difference was found in the distance covered at high-intensity ($>21 \text{ km/h}$) between the teams finishing at the top, middle or bottom of the league (Asian Clemente, Requena, Jukic, Nayler, Hernández 2019, 1-9). Another study found that even though players in Spanish First Division covered more distance at high-intensity

(>21 km/h) than teams in the Second Division, there was no correlation between the different physical variables and soccer success indicators such as final league points, goals scored or conceded (Gomez-Piqueras, Gonzalez-Villora, Castellano & Teoldo 2019, 1-11). In fact, results suggesting that teams with higher level of technical and tactical skills might cover less distance at high-intensity than their less skilled opponents, have also been found. In a study comparing the English Premier League (1st league) and the English Championship (2nd league), Di Salvo et al. (2013, 526-532) found that players at the lower level covered greater distances at high speed running and sprinting compared to Premier League players. The same study found that players in the English Premier League covered more distance walking than their lower league counterparts, suggesting “that the most important characteristics to play at highest division are based on quality and not on quantity”.

2.1 Positional activity profiles

The performance analyses described above have been helpful in identifying the general physiological demands of the sport. Yet, in order to develop individualized training protocols and to ensure players’ optimal preparation, it is necessary to understand the differences in physical loads imposed on the players according to their positional roles during a competitive match. Extensive research at elite level soccer has shown that the differences between different positional roles are significant, and, especially in elite athletes, it is important that the training corresponds to the competitive performance in terms of energy use and biomechanics (Di Salvo et al. 2007, 222).

Central midfielders and wide midfielders have been shown to cover the most total distance, with both covering around 11,5 to 12,5 km. On the contrary central defenders have consistently been shown to cover the least total distance (around 10km or less). Wide defenders and attackers usually cover around 10,5 to 11,5 km (Andrzejewski et al. 2016, 817-828; Bradley et al. 2010, 2343-2351; Di Salvo et al. 2007 222-227; Di Salvo et al. 2013, 526-532).

Differences in distances covered at high-intensity are also significant. The players in wide positions and central midfielders have been shown to cover the greatest distances

at high-intensity and central defenders covering significantly less distance at high-intensity comparing to other positions (Ingebrigtsen et al. 2015, 101-110; Bradley et al. 2010, 2343-2351; Di Salvo et al. 2007, 222-227). Bradley et al. (2010), found that wide midfielders covered the most distance at a very high-intensity ($> 19,8$ km/h) with 1273 m \pm 257 m followed by wide defenders (1046 m \pm 196 m) with central defenders covering the least (638 m \pm 154 m).

When observing sprinting distance, maximum speed and other high-intensity activities, it's been shown that the load imposed on players from these activities is the highest among wide defenders and wide midfielders. When comparing the total distance covered in sprinting ($>25,2$ km/h) in a Norwegian top-level team, wide midfielders (294 m \pm 76 m) and wide defenders (284 m \pm 123 m) covered close to equal sprinting distance. This was significantly more compared to attackers (181 m \pm 111 m), central midfielders (174 m \pm 89 m) and central defenders (123 m \pm 48 m). Similarly, the number of individual sprints was the highest with wide midfielders ($23,2 \pm 6,8$) and the lowest with central defenders ($11,2 \pm 5,0$) (Ingebrigtsen et al. 2015, 101-110). Similar positional differences in maximal sprint speeds during match play have been reported with wide midfielders, wide defenders and attackers reaching higher mean maximal speed than central midfielders and central defenders (Bradley et al. 2010, 2343-2351). Rampini et. al (2007, 1018-1024) reported complying results considering the peak match speed with central defenders ($31,7$ km/h \pm $1,5$ km/h) reaching lower maximum speed during match play compared to wide defenders ($32,3$ km/h \pm $1,0$ km/h). Central defenders have also consistently been shown to perform the fewest accelerations and decelerations during matches, with wide players performing a significantly higher number than other positions.

2.2 Physical activity profiles in youth soccer

In youth football, running performance during match play has only recently been assessed using time-motion analysis as youth players' athletic performance has mainly been assessed through laboratory and field testing. As with adult players, time-motion analysis can be used with youth players to create optimal, age-specific, training programs that accommodate the demand levels of competitive performances at a given

age-group. Match performance data can also be used to identify when talented youth players' running output is sufficient to meet the demands of senior matches (Palucci Vieira, Carling, Barberri, Aquino & Santiago 2019, 289-318).

Studies investigating elite youth players' running performance during match play, show similar characteristics to those observed at elite senior level. For example, positional differences in players' physical activity observed during top level Norwegian U17 matches were similar with the results consistently reported in senior matches (Pettersen & Brenn 2019, E18-E24). Additionally, the amount of distance covered at high-intensity and the amount of high-intensity actions during match play, have also been shown to be equal between youth and senior players. In a study comparing Norwegian senior 1st league matches to Norwegian U19's and U17's 1st league matches, no differences were found in distance covered at high-intensity or sprinting, and in fact, players performed a higher number of accelerations and decelerations during the U19 matches compared to senior matches (Vigh-Larsen, Dalgas & Andersen 2018, 1114-1122).

2.3 Factors influencing the differences in activity profiles

As players' positional activity profiles have shown large match-to-match variations, studies have identified several situational variables that can influence the physical performance at different positions. In addition to each player's individual physical performance capabilities, these variables include several external factors that have been found to cause match-to-match variation in physical performance.

Match status and outcome have been shown to affect players' physical performance. In general, players' physical performance has been shown to vary during the match according to the match status as the players respond to the evolving score line. It has been shown that players cover as much as 50 % less distance at high-intensity when their team is winning compared to when they're losing or when the game is level (Buchheit, Modunotti, Staffords, Gregson & Di Salvo 2018, 1-3; Lago, Casais, Dominguez & Sampaio 2010, 103-109). Depending on the final match outcome (won, drawn or lost), differences in match performance are position-specific (Andrzejewski et

al. 2016; Bradley & Noakes 2013, 817-828; Chmura, Konefal, Chmura, Kowalczyk, Zajac, Rokita & Andrzejewski 2018, 197-203). In a study on the German Bundesliga, Chmura et al. (2018, 197-203) found that the attackers and the wide midfielders covered significantly more distance at high-intensity in won matches as opposed to matches drawn or lost. With these positions, the distance covered in sprinting (<24 km/h) was also significantly greater in won matches. In turn, central defenders, central midfielders and full-backs covered less distance at high-intensity in won and drawn matches as opposed to matches lost. Among central defenders the amount of sprinting (< 24 km/h) was significantly greater in the matches lost than the won or lost ones. In addition, Bradley & Noakes (2013, 1627-1638) found that central defenders and wide defenders displayed a reduced amount of high-intensity running during the second half of critically important matches.

Whether a team is in possession or without possession of the ball has also been shown to influence the players' high-intensity activity profiles. It has been found that when a team is in possession of the ball wide defenders cover the greatest running distance at high-intensity followed by central and wide midfielders with central defenders and attackers covering the least. In turn, the attackers covered the greatest high-intensity distance when a team was out possession and wide midfielders following. Central defenders covered the least distance at high-intensity when out of possession as well (Di Salvo, Gregson, Atkinson, Tordoff & Drust, 2009, 205-212).

Ball possession has also been found to be a decisive factor, when evaluating the effect of playing formation on players' high-intensity running. (Bradley, Carling, Archer, Roberts, Dodds, Di Mascio, Paul, Diaz, Peart & Krusturp 2011, 821-830), found that players covered more distance at very high-intensity (>19,8 km/h) when their team was in possession playing in 4-4-2 or 4-3-3 formations compared with 4-5-1 formation. In turn, players 4-5-1 formation covered more distance at very high-intensity when their team was out of possession compared with 4-4-2 or 4-3-3 formations. They found that team formation also affected the positional differences in players' physical performance as attackers in 4-3-3 formation covered greater total, high- and very high-intensity running distance than player in 4-4-2 and 4-5-1 formations. Similarly,

defenders in a 4-4-2 covered greater total and high-intensity running distance than defenders in 4-3-3 and 4-5-1 formations.

Due to the lack of evidence of players' physical performance being a decisive factor in team success, combined with the large match-to-match variability and poor reliability, research suggests that other factors, such as technical and tactical effectiveness are more important to achieving success (Carling, 2013, 655-663). Still, physical training programs should be designed so that, in the worst-case scenario, based on their position players are able to perform to the maximum of their physical ability when needed.

3 Technical & tactical characteristics of soccer

Tactical skills in team sports have been defined as an ability of an individual to perform the right action at right moment and quickly adapt to new configurations of play and the circulation of the ball (Kannekens, Elferinks-Gemser & Visscher 2009, 807-812). “Tactical skills refer to the ability of an individual player to execute the right action at the right moment during the game” (Forsman 2016, 18-20).

In nature of all invasion team sports, the game can usually be categorized in to four phases. Different authors have used different terminology but Delgado-Bordonau & Mendez-Villanueva (2012, 28-34) used defined the four phases as offensive organization, defensive organization, transition from attack to defense and transition from defense to attack. Moments of the game are visible in Figure 1. Offensive organization phase is considered when a team is in possession of the ball, and in turn defensive organization phase when opponents possess the ball. Transition to offense or defense occurs when a ball possessing team loses the possession of the ball to an opposition team.



Figure 1. Moments of the Game in Soccer (Delgado-Bordonau & Mendez-Villanueva 2012, 28-34)

Garganta da Silva & Pinto, (1994) cited in Teoldo da Costa, Garganta da Silva, Greco & Mesquita (2009, 1-14), identified tactical principles of Soccer by defining core principles of offensive and defensive phases. Transitions were between attack and defensive phase. Operational principles were split to different tactical actions both in

attacking and in defensive phases. Tactical principles of soccer are demonstrated in Figure 2.

		Tactical Principles of Soccer			
General Principles		Seek for numerical superiority	Avoid numerical equality	Do not allow numerical inferiority	
Phases		Attack (with ball possession)		Defence (without ball possession)	
Operational Principles		Maintain ball possession Build up offensive actions Progress through the opponent's half Create shooting opportunities Shoot on goal	Prevent opponent's progression Decrease opponent's playing space Protect the team's goal Avoid shooting opportunities Recover ball possession		
Core Principles		Penetration - Destabilize the opponent's defensive organization; - Directly attack the opposite player or the opponent's goal; - Create advantageous attacking situations in numerical and spatial terms.	Defence-Attack transition and/or Attack-Defence		Delay - Decrease space the player in possession has for offensive action; - Direct the progression of the player in possession; - Block or delay opponent's attack or counter-attack; - Provide more time for defensive organization; - Restrict pass possibilities to other opponents; - Avoid dribbling moves that enable the progression in own defensive midfield and towards the goal; - Prevent shot on goal.
		Offensive Coverage - Support the player in possession by providing options to give sequence to the play; - Decrease opponents' pressure on the player in possession; - Create numerical superiority; - Unbalance the opponent's defensive organization; - Ensure conservation of ball possession.			Defensive coverage - Act as new obstacle to the player in possession, in case he dribbles the player performing Delay; - Insure and provide confidence to the player performing Delay in order to support his initiative in blocking the offensive actions of the player in possession.
		Width and Length - Use and enlarge the effective play-space of the team; - Expand the distances between the opponents' positions; - Make marking difficult for the opponents; - Facilitate the offensive actions of the team. - Move to a safer space; - Win time to make adequate decision for a better subsequent action; - Seek safe options through players in defensive position to give sequence to the play.			Balance - Ensure the defensive stability in the area of the challenge for the ball; - Support teammates performing Delay and Defensive Coverage; - Block potential passing options; - Mark potential players who could receive the ball; - Chase the player in possession and make an effort to recover the ball; - Regain the ball and move it away from the zone where it was recovered.
		Depth Mobility - Create actions to disrupt opponent's defensive organization; - Position oneself in a suitable space to score; - Create in-depth passing options; - Achieve ball control to give sequence to the offensive action (pass or shot on goal).			Concentration - Increase protection of the goal; - Drive opponent's offensive play towards safer areas; - Increase pressure within the game epicentre.
		Offensive Unity - Facilitate team dislocation onto opponent's midfield; - Allow team to attack in unity; - Make safer the offensive actions performed in the epicentre; - Allow more players to get in the game epicentre. - Diminish play-space in the defensive midfield.			Defensive Unity - Enable team to defend in unity; - Ensure the spatial stability and dynamic synchrony between longitudinal and transversal lines of the team in defensive actions; - Decrease the offensive amplitude of the opponent team in width and depth; - Ensure basic guiding lines that influence the players' technical-tactical behaviours positioned outside the game epicentre; - Constantly balance or rebalance the relative strengths in the defensive organization according to the playing situations; - Obstruct possible passing options for opponents that are in the epicentre of play; - Decrease the playing space using the offside rule; - Enable involvement in a subsequent defensive action; - Enable more players to get in the epicentre of play

Figure 2. Tactical principles of soccer. Teoldo da Costa et al. 2009, 4. (based on Garganta & Pinto, 1994).

Game performance indicators are selected variables that are used to indicate individuals' or team's performance in soccer. Lago-Penas & Lago-Ballesteros, (2011, 465-471) defined game performance indicators as a "selection and combination of variables that define some aspect of performance and that help achieve athletic success". Quantitative and qualitative analysis at individual or team level is often made using these factors. Development of video recording and analysis technology has made

a number of statistical video analysis tools available (Stats, Opta, Wyscout) and currently many statistical reports are available for comparison of different performance indicators (Modric, Versic, Sekulic & Liposek 2019, 2).

When discussing team's key performance indicators, winning competitions is on top, after that comes winning a single match. For winning a match a team has to score more goals than the opponent team. When a single game performance is evaluated, a more detailed analysis on the effect of these key performance indicators can be made. Combined, these indicators demonstrate the nature of a single match. Team key performance indicators most often connected to success are ball possession, passes, passing accuracy, shot attempts and set-piece actions (InStat, 2020).

Hook & Hughes, (2001, 295-302) indicated that teams with the ability to retain possession of the ball longer periods were more successful, and many additional studies have also identified ball possession as being a common factor between successful soccer teams (Vänttinen, Lehto & Kalema 2012, 9-10; Jones, James & Mellalieu 2004, 98-102).

Situational variables affect also the match technical performances, for example home teams' winning percentage was 61,95 % in Spanish league in 2008/09 season (Lago-Penas & Lago-Ballesteros, 2011, 465-471). Evolving match status, match venue and identities of playing teams have been identified as the most significant situational variables affecting to differences in time on ball possession. (Lago & Martin 2006, 969-974.) In offensive organization phase 250–300 ball possessions were found between both teams in the Finnish Premier League and the European Championship Qualification matches. Number of ball possessions was greater in youth matches. Teams in the Finnish U17's national league and in Finnish U17's national team matches had 350-400 ball possessions between both teams. One average ball possession per team lasted 14 seconds in adults matches and 10 seconds in youth matches (Vänttinen et al. 2012, 7-14). In the UEFA Champions League during 2016-2017 season, Bayern München had the highest ball possession percentage of 63% ball possession, and Rostov had the lowest percentage with 35 % ball possession (UEFA Champions League Technical Report 2016/17, 2017, 60). Among fourteen sample

matches from four different levels (Euro 2012 Qualifications, Finnish Premier League, Finland U17's national team matches and U17's Finnish Championship), ball possession high and low ratios were 62 % and 38 % (Vänttinen et al. 2012, 5).

Passing and passing accuracy are also key performance indicators connected to team success. At the 2017 UEFA U21 European Championship, teams passed on average 431 passes in a match. Spain recorded the highest average number of 611 passes, and Czech Republic had the lowest average with 335 passes per match. Passing accuracy in tournament varied between 75-89 %. Average passes completed and accuracy of passing are shown in Figure 3. Analysis of fourteen matches on four different levels of competition from Finland (Euro 2012 Qualifications, Finnish Premier League, Finland U17's national team, U17's Finnish Championship) indicated that in a single match an average of 427 passes per team was executed in senior matches and 373 passes per team in youth matches. Passing accuracy was 84 % in men's matches and 77 % in youth's matches (UEFA Tournament Review 2017, 28-29; Vänttinen et al. 2012, 21-22).

	COUNTRY	PASSES	ACCURACY
AVERAGE COMPLETED PASSES	Spain	611	89%
	Germany	508	88%
	Slovakia	463	87%
	Portugal	461	83%
	Sweden	444	84%
	Serbia	415	80%
	Italy	407	81%
	England	406	84%
	Denmark	397	83%
	Poland	384	84%
	FYR Macedonia	341	83%
	Czech Republic	335	75%

Figure 3. U21 European Championships 2017. Average of passes complete and accuracy of passing per game (UEFA Tournament Review 2017, 28).

The number of goal scoring attempts has been shown to be a differentiating factor between successful and less successful teams. An average of 14,5 goal scoring attempts per team was recorded during eight matches in UEFA Euro 2012 Qualifications and Finnish Premier League. Similar results were found in the 2017 UEFA Under 21's European Championships where teams averaged 14,7 scoring attempts per match, total attempts and average attempts per match are demonstrated in Figure 4. In Finnish

youth football an average of 13 scoring attempts per match was recorded when observing U17's national team and U17's national league matches (Vänttinen et al. 2012, 98-101; UEFA Tournament Review 2017, 33-34).

TEAM	ATTEMPTS	AVERAGE
Germany	113	22.6
Portugal	57	19
Czech Republic	48	16
FYR Macedonia	46	15.33
Spain	72	14.4
England	54	13.5
Slovakia	40	13.33
Italy	52	13
Denmark	38	12.67
Poland	38	12.67
Serbia	32	10.67
Sweden	31	10.33

Figure 4. U21's European Championships 2017. Total attempts and average attempts. 21 games overall were played (UEFA Tournament Review 2017, 34).

3.1 Individual key performance indicators

During match play, players execute a different number of technical actions related to different moments of the game. On average a player possesses the ball 47 times during a match. The duration of a single possession has been found to be on average one second and players average two touches on the ball in a single possession (Carling, 2010, 11). Hughes, Caudrelier, James, Redwood-Brown, Donnelly, Kinkbride & Dushesne. (2012, 402-412) brought together a group of sport science students and arranged an intensive program in performance analysis in soccer. With the lead of the most experienced experts they made a technical analysis of soccer. As a result, they demonstrated the skill requirements for different positions in soccer also known as key performance indicators, these indicators are presented in Figure 5.

PERFORMANCE INDICATORS	GK	Full Backs	Centre Backs	HM	AM	WM	Strikers
Technical – Def	Shot stopping	Tackle	Tackle	Tackle	Tackle	Tackle	Tackle
	Coordination	Pressing	Defensive	Pressing	Pressing	Pressing	Pressing
	Recovery speed	opposition	header	opposition	opposition	opposition	opposition
	Save	Interception – anticipation	Pressing	Interception – anticipation	Interception – anticipation	Cover full-back	Interception – anticipation
	Punch	Clearance	Interception – anticipation	Heading	Heading	Interception – anticipation	Heading
Technical – Att	Passing	Tackle	Passing	Passing	Passing	Passing	Shooting
	Throw	Interception – anticipation	Heading	Running with the ball	Running with the ball	Running with the ball	Heading
	Ball control with feet	Dribbling	Running with the ball	Dribbling	Dribbling	Dribbling	Reception
	Kick	Running with the ball	Support play	Support play	Support play	Support play	Dribbling
	Tackle	Clearance	Dribbling	Crossing	Crossing	Crossing	Support play
		Defensive header	Crossing	Shooting	Shooting	Shooting	Running with the ball
			Shooting	Heading	Heading	Heading	Support play
							Crossing

Figure 5. Performance indicators per position (Hughes et al. 2012, 407).

Hughes et al. (2012, 406-411) described the use of these key performance indicators in performance evaluation as follows: “Individual’s actions in soccer can be measured by doing quantitative analysis of key performance indicators. Use of indicators vary a lot by person using it. Every coach and analyst will also have their own views on the relative importance of the order of the skills within the categories of technical and tactical KPI’s.” Differences between player’s technical skills can be measured in field tests outside of the game. Sami Hyypiä Academy tests players and teams in age groups between 10-17 years old. Under 17’s age group demonstrated in technical tests that national team players get greater results in passing and change of direction with ball tests in closed environment (Koskinen, 2017, 33-35). These differences in field test results also show during match play as higher number of successful technical actions.

Additionally, studies have been done about tactical skills in soccer. Tactical skills are referred as an individual’s capability to use cognitive competencies, knowledge of the game and its goals and actions, knowledge of monitoring skills and use knowledge of actions within the context of the game (Thomas, French & Humphires., 1986, 259-272). Kannekens et al., (2009, 807-812) executed study and compared Dutch and Indonesian youth soccer player’s tactical skills. Results demonstrated that Dutch players who had completed almost every stage of their talent development program scored higher results in tactical skill test. Results demonstrated that individual tactical skills might be connected to soccer success. It is relevant to say that different level players have different tactical capabilities.

As we can see in table below, different playing positions reach different number of actions in soccer. Selected players are part of Liverpool FC 2019/2020 season's English Premier League team. Players represent different positions. Difference between positions is notable in total actions/90 mins and passes/90mins. Central defender and wide defenders have notably higher number of these actions compared to central midfielders, wide midfielders and forward. On the other hand, forward had completed higher number of attempts/90mins and challenges/90mins (InStat, 2020).

Individual's performed action can be classified as defensive or attacking action, as we can see in Table 1. Defensive challenges and tackles are classified to defensive actions and passes and attempts to attacking actions.

Table 1. Statistics from different playing positions. Liverpool FC 2019/2020. Modified from InStat statistics. InStat definitions in Appendix 1. (Based on InStat, 2020.)

Player	Position	Total Actions/ 90mins	Challenges /90mins	DEFENSIVE ACTIONS		ATTACKING ACTIONS		
				Defensive Challenges/ 90min	Tackles /90min	Passes/90 mins	Accurate passes/90 min	Attempts/90 mins
Virgil Van Dijk	Central Defender	104,8	11,5	8,9	1,1	76,6	70,2	0,7
Trent Alexander-Arnold	Wide Defender	111,7	10,2	7,1	3,9	84,9	64,0	1,1
Andrew Robertson	Wide Defender	103,0	10,2	6,1	2,8	75,2	62,9	0,6
Jordan Henderson	Central Midfielder	96,6	11,1	7,0	3,9	69,1	59,9	0,7
Georginio Wijnaldum	Central Midfielder	72,9	12,3	5,3	2,1	46,6	43,0	1,3
Mohamed Salah	Wide Midfielder	67,0	18,9	4,5	2,1	34,2	27,8	2,1
Sadio Mane	Wide Midfielder	61,0	16,7	3,1	1,3	29,9	22,8	3,6
R Firmino	Forward	61,6	15,3	4,5	2,8	33,6	27,6	2,5

4 Research methods

4.1 Research questions

This study was conducted as an experimental quantitative study to discover the characteristics of players' physical and technical performance at four different levels of play in Finnish soccer. The study was based on the following study problems.

1. Are there differences in players physical performance between different competitions?
2. Are there positional differences in physical performance between different competitions?
3. Are there differences in players technical performance between different competitions?
4. Are there positional differences in technical performance between different competitions?

It was hypothesized that there are no large differences in the physical demand levels between different levels (Pettersen & Brenn 2019, E18-E24; Vigh-Larsen et al., 2018, 1114-1122). The youth national team matches were expected to be more demanding in terms of technical performance, indicated as higher amount of technical actions performed during match play (Vänttinen et al. 2012, 7-97). Position-specific differences between competitions were expected to be noticeable, as a consequence of different characteristics and playing styles of each competition.

4.2 Research subjects

The performance data for this study was collected between March 2018 and October 2019, during Finnish football seasons 2018 and 2019. Competitions and participating teams were selected with the help of the Football Association of Finland. Match play performances were observed on four different levels of competition: Finland U17's and U19's youth national teams, Finnish U17's national league (U17 1st tier) and Kakkonen (men's 3rd tier in Finland). Finnish U17's national league and Kakkonen are considered to be top level domestic competitions in Finnish football and a high

number of the U17's and U19's Finnish national team players are selected from these two competitions.

In total 33 matches were observed of which 24 were youth national team matches (8 U17's and 16 U19's) and 9 domestic club matches (4 U17 NL and 8 Kakkonen). The international matches consisted of both competitive qualification matches and international friendly matches. The domestic matches were all competitive league matches played during the 2019 football season.

Teams used multiple different tactical formations during the observed matches of which the 4-4-2 was the most common tactical formation, followed by 4-2-3-1. 4-3-3 and 3-4-3 formations were also used but to a significantly lesser extent. The amount of each formation used by teams observed, is depicted in minutes in the Table 2 below.

Table 2. Formations used in competitions.

	4-4-2	4-3-3	4-2-3-1	3-4-3
U17 national team	700 mins		20 mins	
U19 national team	929 mins		511 mins	
U17 national league	495 mins		135 mins	90 mins
Kakkonen	540 mins	90 mins	90 mins	90 mins
Overall	2664 mins	90 mins	756 mins	180 mins

Performance data from the players who played the full 90 minutes in observed matches were accounted for in the study. In total 209 performance observations were gathered from 125 individual players. Players were divided into five groups according to their playing position during the match and the number of observations at each position are indicated in Table 3. Team formations and playing positions were determined by the InStat game analysis. Performance data from U17s national team central midfielders wasn't available. The process of the game analysis procedure is demonstrated later.

Table 3. Performance observations by playing position from each competition.

	Central Defender	Wide Defender	Central Midfielder	Wide Midfielder	Forward	All positions
Under 17's national team	14	10	0	3	9	36
Under 19's national team	25	18	17	9	6	75
Under 17's national league	14	9	13	5	5	46
Kakkonen	13	12	14	8	5	52
Overall	66	49	44	25	25	209

4.3 Data collection

The teams participating in the domestic league matches were contacted beforehand, and permission certificates (Appendix 2) were sent out to teams to be read and signed by the players. Players under the age of 18 were permitted by their legal guardian. In addition, before the start of the game the participating players were asked for their consent to data gathering and processing. The process of performance data gathering was also similar in the youth national team matches which were recorded and provided by the teams' coaching staffs.

For the collection of physical activity data players wore portable chest mounted GPS units (Polar Team Pro) during the observed games. The Polar Team Pro uses GPS tracking at the frequency of 10Hz which has been shown to be reliable for tracking movement distances at different velocities, peak velocity and changes in velocity (Hoppe, Baumgart, Polglaze & Freiwald, 2018; Rampinini, Alberti, Fiorenza, Riggio, Sassi, Borges & Coutts. 2015, 49-53; Varley, Fairweather & Aughey. 2012, 121-127). The GPS data gathered by the portable units during match play was synchronized and uploaded to the Polar Team Pro online service where it was exported to Microsoft Excel. In this study the distance covered during match play was measured as the total distance covered and the total distance covered at high-intensity (THIR) which was further divided into high-speed running (HSR) and sprinting (SPR). Similar velocity thresholds have also been used in previous studies (Pettersen & Brenn 2019, E19-E24; Sæterbakken et al. 2019, E82-E88; Ingebrigtsen et al. 2015, 101-110). The number of individual sprints constituting the sprint distance was also observed. The maximum

speed was measured as the highest velocity the player reached at any given time during match play. Changes of velocity were measured as the number of high-intensity accelerations ($> 3,0 \text{ m/s}^2$) and decelerations ($> 3 \text{ m/s}^2$). These thresholds are similar to those used in previous research and have been identified as being important to the game (Tierney et al. 2016, 1-8).

All the selected matches were filmed, and club team staffs and national team staffs delivered video files from matches for analyzing. Recorded matches were sent to InStat, a company that provides sports statistic and analysis services. Based on the video recordings, InStat conducted technical and tactical analysis and provided match data from all 33 observed matches. The technical performance data was defined by each players' playing position and the technical reports provided data on more than 200 different technical actions. Of these 200 actions, 26 key performance indicators were selected to reflect the most significant actions affecting match play.

5 Results

5.1 Physical performance characteristics

The results depicted in Table 4 indicate only slight differences in overall physical characteristics between different competitions. In terms of total distance covered, players in Kakkonen (10886,3 m \pm 817,6 m), and the U17's (10869,2 m \pm 906,0 m) and U19's national teams (10715,9 m \pm 902,8 m) covered close to same distance with players in the U17's national league covering slightly less total distance (10406,2 m \pm 893,0 m) compared to others. The total amount of high-intensity running, in turn, was the highest in the U17's national team matches (684,6 m \pm 262,7 m) and the lowest in the U19's national team matches (590,0 m \pm 200,1 m). Sprinting distance and the average number of sprints was also the lowest in U19's national team followed by the U17's national team with both domestic leagues having higher amount sprinting distance and average number of sprints. Players in the U17's national league also performed the most high-intensity accelerations (16,6 m \pm 7,0 m) followed by the U19's national team (16,2 m \pm 6,5 m) and Kakkonen (15,9 m \pm 6,9 m) with the players in the U17's national team performing slightly less high-intensity accelerations compared to others.

Table 4. Physical performance characteristics

		Max speed (km/h)	Total distance (m)	THIR >19,8 km/h (m)	HSR 19,8-25,19 km/h (m)	SPR >25,2 km/h (m)	Dec. > 3.0 m/s ²	Acc. >3.0 m/s ²	Sprints
U17, n=36	Mean	29,6	10869,2	684,6	562,6	121,9	25,9	13,1	8,4
	SD	1,3	906,0	262,7	209,2	80,2	12,6	7,3	4,8
U19, n=75	Mean	30,2	10715,9	590,0	490,5	99,5	25,4	16,2	8,0
	SD	1,9	902,8	200,1	171,7	53,6	9,4	6,5	3,8
U17 NL, n=46	Mean	30,1	10406,2	591,0	464,2	126,9	24,2	16,6	9,1
	SD	2,2	893,0	252,9	169,4	98,5	8,5	7,0	6,0
KAKKONEN, n=52	Mean	30,1	10886,3	634,8	505,7	129,1	28,5	15,9	9,5
	SD	1,8	817,6	208,3	150,5	83,4	10,8	6,9	4,0

Positional physical performance data (Table 5, Table 6, Table 7, Table 8, Table 9) indicates that central defenders covered notably less total distance compared to other playing positions. Wide midfielders covered the greatest total distance at high-intensity

and sprinting with central midfielders and central defenders covering notably less distance at high-intensities compared to other positions. Wide midfielders, together with forwards, also executed the greatest number of high-intensity accelerations and decelerations. No large positional differences were found in peak velocities reached during match play.

When observing the position-specific differences between different competitions, more notable differences can be observed. Performance data from central defenders depicted in Table 5, indicates that players in the U17's national team and Kakkonen covered the most total distance, but the players in both national teams covered less distance at high-intensity and sprinting than those in domestic league matches as. The number of sprints and high-intensity changes of velocity were also lower in the youth national team games with U17's national team central defenders showing notably lower number of high-intensity accelerations compared to other competitions.

Table 5. Central defenders' positional physical performance data

		CENTRAL DEFENDER (CD)							
		Max speed (km/h)	Total distance (m)	THIR >19,8 km/h (m)	HSR 19,8-25,19 km/h (m)	SPR >25,2 km/h (m)	Dec. > 3.0 m/s ²	Acc. >3.0 m/s ²	Sprints
U17, n=14	Mean	29,3	10034,4	447,6	357,4	90,2	16,4	6,4	5,6
	SD	1,1	299,6	109,8	62,8	52,4	4,0	2,9	2,7
U19, n=25	Mean	30,0	9741,6	430,0	350,5	79,5	18,4	15,1	5,9
	SD	1,9	384,6	112,9	90,3	38,0	6,2	5,8	2,6
U17 NL, n=14	Mean	30,3	9595,9	473,4	376,5	96,9	20,0	15,6	6,6
	SD	2,2	687,2	174,5	109,1	72,3	6,9	5,7	3,9
KAKKONEN, n=13	Mean	30,5	10157,3	508,6	392,5	116,2	23,5	13,8	7,9
	SD	1,3	461,4	124,2	72,6	61,3	7,6	5,0	3,3
TOTAL	Mean	30,0	9882,3	464,9	369,2	95,7	19,6	12,7	6,5

Wide defenders' performance resulted in differing results when comparing differences between competitions as shown in Table 6. Both youth national teams' players recorded a greater total distance covered and total distance covered in high-intensity. Despite this the total sprinting distance was the lowest in the U19's national team at 112,9 m ± 54,8 m which represents 1,0 % of the total distance covered with U17's

national team (1,7 %), U17 National League (1,6 %) and Kakkonen (1,4 %) all recording larger ratios of sprinting. The number of sprints and high-intensity accelerations were also the lowest in the U19's national team matches.

Table 6. Wide defenders' positional physical performance data

WIDE DEFENDER (WD)									
		Max speed (km/h)	Total distance (m)	THIR >19,8 km/h (m)	HSR 19,8- 25,19 km/h (m)	SPR >25,2 km/h (m)	Dec. > 3.0 m/s ²	Acc. >3.0 m/s ²	Sprints
U17, n=10	Mean	30,6	10942,9	859,0	673,1	185,9	26,4	16,2	12,3
	SD	1,7	700,3	261,6	178,6	110,4	9,7	7,0	5,5
U19, n=18	Mean	30,3	11115,3	715,6	602,6	112,9	29,7	14,4	8,9
	SD	2,1	471,1	172,1	143,0	54,8	8,3	5,1	4,2
U17 NL, n=9	Mean	30,3	10277,6	684,8	520,7	164,1	28,4	16,3	12,6
	SD	1,1	762,3	253,4	169,4	104,8	4,7	5,3	5,9
KAKKONEN, n=12	Mean	30,7	10754,8	698,2	548,0	150,2	28,5	18,7	10,7
	SD	1,5	637,9	167,0	111,7	75,2	9,0	3,8	3,9
TOTAL	Mean	30,5	10772,6	739,4	586,1	153,3	28,3	16,4	11,1

Central midfielders in the U19's national covered the most total distance and distance at high-intensity but sprinting distance was the highest in Kakkonen, as shown in Table 7. Central midfielders in the U17's national league covered notably less distance at high-intensity and sprinting. Central midfield was also the only position where the U17's national league players recorded notably lower peak velocity than their counterparts in the U19's national team and Kakkonen.

Table 7. Central midfielders' positional physical performance data

CENTRAL MIDFIELDER (CM)									
		Max speed (km/h)	Total distance (m)	THIR >19,8 km/h (m)	HSR 19,8- 25,19 km/h (m)	SPR >25,2 km/h (m)	Dec. > 3.0 m/s ²	Acc. >3.0 m/s ²	Sprints
U17	Mean								
	SD								
U19, n=17	Mean	29,9	11643,7	600,4	517,6	82,8	23,0	15,4	7,2
	SD	1,7	578,8	204,8	179,3	50,1	7,0	5,9	2,4
U17 NL, n=13	Mean	28,4	11134,5	471,0	409,0	62,0	21,4	13,2	4,8
	SD	1,5	655,9	167,2	137,7	46,1	9,9	4,9	3,3
KAKKONEN, n=14	Mean	29,2	11141,9	528,8	440,1	88,6	25,0	11,0	7,9
	SD	2,0	676,3	151,9	109,8	55,9	11,5	4,3	3,1
TOTAL	Mean	29,1	11306,7	533,4	455,6	77,8	23,1	13,2	6,6

A notable difference between international and domestic matches is observed in Table 8 among wide midfielders in the U17's age group, as the players covered around 10 % more total distance and distance at high-intensity in international matches than in domestic league. Sprinting performance and explosive actions, however, indicated opposing results between international and domestic matches. In the U17's national team matches sprinting distance ($108,0 \text{ m} \pm 42,5 \text{ m}$) represented 0,9 % of the total distance, whereas, in domestic U17s matches sprinting ($233,6 \text{ m} \pm 126,2 \text{ m}$) made up 2,2 % of the total distance covered. Similarly, the number of sprints was 33 % higher in the U17's national league compared to the national team of the same age group. In this age group, the mean peak velocity was also notably lower among players in the international matches. Sprinting distance was also notably lower at the U19's national team matches, compared to both the U17's national league and Kakkonen.

Table 8. Wide midfielders' positional physical performance data

WIDE MIDFIELDER (WM)									
		Max speed (km/h)	Total distance (m)	THIR >19,8 km/h (m)	HSR 19,8-25,19 km/h (m)	SPR >25,2 km/h (m)	Dec. > 3.0 m/s ²	Acc. >3.0 m/s ²	Sprints
U17, n=3	Mean	28,7	11830,3	907,0	799,0	108,0	43,7	19,0	10,3
	SD	0,1	176,5	198,1	156,4	42,5	12,2	6,6	3,2
U19, n=9	Mean	30,7	10936,8	737,2	597,1	140,1	37,3	19,9	11,0
	SD	1,7	573,0	180,7	159,8	68,3	7,5	6,6	4,8
U17 NL, n=5	Mean	32,2	10719,2	803,6	570,0	233,6	25,6	23,4	15,4
	SD	3,3	447,1	300,1	189,7	126,2	8,4	11,2	6,4
KAKKONEN, n=8	Mean	30,7	11646,5	876,3	676,9	199,4	35,1	23,3	12,9
	SD	2,4	882,5	255,0	173,2	137,8	10,9	10,4	5,3
TOTAL	Mean	30,6	11283,2	831,0	660,7	170,3	35,4	21,4	12,4

Similar trend in the U17's age group can be noticed in Table 9 with forwards, where both the total sprinting distance and its percentage of the total distance covered, is notably higher in the domestic league matches. Similar differences also exist in the number of sprints and mean peak velocity reached. All in all, forwards in the U17's national league stand out from other competitions in terms of their high amount of high-intensity activities.

Table 9. Forwards' physical performance data

FORWARD (F)									
		Max speed (km/h)	Total distance (m)	THIR >19,8 km/h (m)	HSR 19,8-25,19 km/h (m)	SPR >25,2 km/h (m)	Dec. > 3.0 m/s ²	Acc. >3.0 m/s ²	Sprints
U17, n=9	Mean	29,4	11765,6	785,2	680,3	104,9	34,2	18,2	8,0
	SD	0,7	639,4	171,3	132,8	47,2	12,9	4,6	4,0
U19, n=6	Mean	30,6	10617,3	629,2	500,5	128,7	31,0	22,3	11,3
	SD	2,5	809,8	135,4	132,1	46,9	4,2	10,2	3,1
U17 NL, n=5	Mean	31,2	10700,4	851,2	645,6	205,6	33,8	22,2	14,8
	SD	1,2	702,4	249,8	186,1	77,5	3,6	7,6	3,8
KAKKONEN, n=5	Mean	29,6	11165,4	721,4	608,6	112,8	41,0	16,6	10,4
	SD	1,6	808,6	111,2	113,7	24,6	7,4	4,3	2,4
TOTAL	Mean	30,2	11062,2	746,7	608,8	138,0	35,0	19,8	11,1

5.2 Technical and tactical performance characteristics

Team statistics from observed matches are depicted in table 10 and it indicates differences in technical match performance between competitions. Quantity of ball possession isn't notably different among competitions. Differences are notable in entrances to the opposition half. U17's national team opponents recorded the highest mean by $70,5 \pm 18,0$ in entrances to the opposition half and U19's national team opponent the lowest mean $58,8 \pm 16,0$. Finland U17's national team had lower number in entrances to the final third and entrances to the opponent's box compared to others. Finland U17's also set the lowest mean number of shots and shots on target per match.

Additionally, results depicted in table 10 (appendix 1) indicate a high difference in number of passes, accurate passes, key passes and accurate key passes. Finland U17's national team's mean passing number per match was $546,8 \pm 147,3$, which is the highest among the competitions. The lowest mean in results is $411,5 \pm 70,6$ passes in match, which was set by U19's national team opponents. Positional attacks, counter attacks and set-piece attacks demonstrates style of the play on attacking situations in sample matches.

Table 11(appendix 1) indicates U17's and 19's national teams have higher mean in passes and accurate passes than U17's national league or Kakkonen. U19's national team have higher number ($3,6 \pm 3,3$) of long passes than other competitions. U17's national team obtained the lowest number of passes in opposition half ($12,2 \pm 8,7$) and least actions in opponent's third ($4,2 \pm 5,1$). However, U17's national team recorded the most passes into the defensive third of the pitch ($17,5 \pm 12,8$) and the most actions in own third ($24,0 \pm 15,6$). U17's national league was the competition with the lowest mean in total actions ($80,1 \pm 21,0$).

Notable difference, in central defender's comparison, is in U19's national team. This can be observed in Table 12 (appendix 1). U19's national team central defenders passed the most ($67,5 \pm 26,7$) passes in mean. They also registered the most medium passes ($53,7 \pm 22,1$) and long passes ($6,0 \pm 3,9$). Short pass values among competitions were almost equal. U19's national team ($4,2 \pm 2,5$) and Kakkonen ($3,8 \pm 2,0$) had more

air challenges than U17's national team ($2,2 \pm 1,4$) and U17's national league ($2,9 \pm 2,1$).

Table 13 (appendix 1) indicates that U17's national league players registered the lowest number of passes ($43,6 \pm 13,8$) and total actions ($75,4 \pm 16,8$) in wide defender sampling. Under 19's national team and Kakkonen were the competition with most air challenges. Under 17's national team wide defenders had the highest number of passes into the defensive third of the pitch ($22,8 \pm 15,7$) and the lowest number into the final third of the pitch ($10,0 \pm 5,6$).

U19's national team central midfielders passed the most $58,9 \pm 24,9$ in mean which can be noticed in Table 14 (appendix 1). Additionally, U19's national team registered the most passes in opposition half ($28,9 \pm 13,2$), the most passes into the final third of the pitch ($21,4 \pm 10,5$), the most attacking passes ($42,8 \pm 15,4$) and the most total actions ($97,8 \pm 24,6$). U17's national league central midfielders had the highest mean number of lost balls with $8,5 \pm 4,1$ per match.

Table 15 (appendix 1) indicates that U17's national team and U17's national league wide midfielders lost ball evidently more than U19's national team or Kakkonen wide midfielders. In terms of passes ($24,8 \pm 7,6$) and total actions ($54,9 \pm 13,6$), U19's national team gained the lowest numbers. U17's national league wide midfielders registered the most actions ($17,0 \pm 2,9$) and passes ($20,0 \pm 4,8$) in opponent's third compared to other competitions.

Forwards' technical performance data is demonstrated in Table 16 (appendix 1). U19's national team forwards recorded notably lowest numbers in challenges ($14,5 \pm 5,3$), dribbles ($1,8 \pm 2,3$), passes ($19,0 \pm 7,5$), total actions ($33,7 \pm 14,7$). U17's national team forwards gained significantly more passes into the defensive third of the pitch ($6,0 \pm 4,5$) and actions in own third ($7,1 \pm 6,1$). Despite the differences, number of shots were close to equal in all competitions.

6 Discussion

As hypothesized, the physical performance data recorded in this study, indicates that the youth players performed as much or even a higher numbers of high-intensity activities as senior player. This observation is in compliance with that of Vigh-Larsen, Dalgas et al. (2018, 1114-1122) in that it shows that high-intensity performance is not a directly discriminative factor between these competitions. In terms of technical performance, the youth national team matches seem to be more demanding, as players in the U17's and U19's national teams performed higher number of total actions and completed higher number of passes compared to domestic competitions, complying with the results found by Vääntinen et al. (2012, 21-23). The differences found between competitions in both the physical and technical performance are also highly position-specific.

When looking at all the observed physical match performance data, positional activity profiles revealed similar positional differences than those found in previous studies. (Andrzejewski et al. 2016, 817-828; Bradley et al. 2010, 2343-2351; Di Salvo et al. 2007 222-227; Di Salvo et al. 2013, 526-532). Only contrasting result was the low amount of high-intensity running performed by central midfielders as they only covered slightly more distance at high-intensity than central defenders with a notable difference compared to other positions. Despite similar characteristics, in all positions, the amount high-intensity activities observed in this study are notably lower compared to those recorded at elite level in both senior and youth matches (Pettersen & Brenn. 2019, E19-E24; Ingrebitsen et. al 2015, 101-110; Tierney et al. 2016, 1-8).

In terms of technical performance, the average number of passes in a match recorded in this study, were higher in all competitions than those reported by Vääntinen et al. (2012, 21-22), which also included match data from Finnish Premier League and the senior national team. The average number of passes in this study was also higher than the average number of passes recorded at the 2017 U21 European Championships. Passing accuracy of the U17's national team and national league was higher in this study, than that recorded by Vääntinen et. al. (2012, 21-22). The average number of

goal scoring attempts in the competitions observed in this study, was lower than those previously recorded (Vänttinen et al. 2012, 98-101; UEFA tournament review. 2017).

These differences in high-intensity activities compared to elite level, might be an indication of lower physical performance capabilities, especially the low number of high-intensity accelerations might indicate a need for development of explosive power. Also, the ability to maintain performance levels throughout the 90-minute match should be developed to decrease the effect of diminutions of physical performance on the total amount. Higher average number of passes recorded in this study, might be an indication of game philosophy development towards more possession-based playing style in recent years. The development of training conditions and methods might have also had an impact on the technical skill development of the players.

When the positional physical activity profiles are evaluated together with the technical performance, possible connections between the two elements of the game can be found. These are affected by individual player traits and situational variables, and might give indications of distinctive characteristics of each competition and different playing styles deployed in them.

The notably lower amount of distance covered at high-intensity and sprinting by central defenders in the youth national teams can possibly be explained by analysing the teams' passing performance indicators. Central defenders typically cover more distance when out of possession and the effects of this can be seen, especially, with the central defenders in the U17's national team. Comparably low number of passes in the opposition half and the high number of passes in the defensive third, by defensive players, might be the reason why central defenders didn't perform as much high-intensity running. The lower number of passes into the final third by defensive players might be connected to the lower number of sprints and high-intensity accelerations among the U17's national team wide midfielders and forwards, as often wide midfielders and forwards are the receiving player of these passes. The lower number of high-intensity activities might also be connected to the team's lower numbers in entrances into final third and opposition box as these are often preceded by an explosive movement by the players at these positions.

The low amount of high-intensity running by central midfielders in all competitions might be explained by their low rate of participation in the final third of the pitch. Central midfielders in the U17's national league and Kakkonen covered less total distance and total distance at high-intensity than those in the U19's national team, and also had a higher number of passes and total actions in their own third, even though they had less total actions and passes completed. The greater involvement by the U19's national team central midfielders in the final third, might explain the higher total distance and distance covered at high-intensity, as they are involved in the game at larger area and often activities in the final third are high-intensity in nature because of greater presence of opposition. It can also be noted that the amount of total actions in the final third by central midfielders was equal to that of wide defenders, highlighting the balancing role of central midfielders and the growing amount of attacking duties imposed on wide defenders.

The higher amount of both total high-intensity running distance and sprinting activities observed in the U17's national team and U17's national league can be related to the style of play and transitional nature of youth matches. This is highlighted by the higher number of lost balls, especially noticeable among U17's national league central and wide midfielders. After a transition attacking players are looking to exploit open spaces, and defensive players, especially at wide areas, are forced to return to defensive positions quickly. This might explain the high number of high-intensity and sprinting distance observed among wide players and forwards in the U17 competitions. Vigh-Larsen, Dalgas et al. (2018, 1114-1122) also suggested that youth players might not be able to pace themselves during match play in the same way more experienced players are. The much lower amount of sprinting distance and number of high-intensity activities observed in the U17's national team wide midfielders and forwards is most likely more connected to the team's style of play rather than difference in physical capabilities or demand levels. This difference in tactical playing role, might be indicated by the high number of actions executed by forwards in the center and defensive third of the pitch.

In the U19's national team and matches in Kakkonen, a higher number of air challenges was recorded at all positions and the number of long passes was also notably higher among U19's central defenders and midfielders compared to other competitions. In addition to the effect of tactical choices, this high quantity of air duels and long passes might be the reason why wide midfielders and forwards, players at attacking roles, in the U19's national team executed less total actions compared to players in same positions in other competitions. The high quantity of air challenges might also be connected to the low amounts of high-intensity running and sprinting observed among wide midfielders and forwards in the U19's national team and Kakkonen, and it also highlights the importance of other physical traits such as strength, when moving to older age-groups and senior matches. It should also be noticed that the large differences in high-intensity activities among wide midfielders and forwards weren't connected with the number of shots taken by players in these positions, which is an important performance indicator for attacking players. (Liu, Gomez, Lago-Penas & Sampaio, 2014, 1205-1213) This highlights the importance of technical and tactical efficiency over physical activity.

When interpreting the results of this study, certain limitations should be considered. Because the study only observed players who played the full 90 minutes in a match and players in certain positions being more likely to be substituted mid-match, it caused the sample size on certain position to only consist of 3 to 5 match observations. Because of this, statistical significance couldn't be tested, and reliability of the results couldn't be proven. The low number of samples highlights individual playing roles and traits. In addition, the nonexistent positional data of U17's national team central midfielders affected the overall performance results of the competition. These limitations in the sample size mean that no conclusive positional interpretations can be made based on these findings.

The process of conducting this study gave more insights on the importance of concurrent analysis of the different elements of the game. The large impact of situational variables on the results also highlighted the difficulty of evaluating game performance on the basis of numbers and statistics. This development of knowledge base and the experience of using different tools to gather and analyze performance

data, have been useful in developing personal coaching skills. The experience in conducting an experimental research using data collection and analysis tools also enables the participation in further research.

This further research on the subject is needed to better identify the physical and technical performance indicators that are related to success in soccer. An integrated approach to analyzing physical match performance, suggested by Bradley & Ade (2018, 656-664), could be an example of a way to contextualize the high-intensity physical actions players perform during match play. Analyzing the effects of match outcome on the physical and technical performance could also give a better indication of the performance indicators most relevant to team success.

In conclusion, this study describes the physical and tactical characteristics of different playing positions at different levels of domestic and international competitions in Finland. These findings also highlight the importance of evaluating physical performance and technical effectiveness concurrently. This information can be used to develop individualized training programs for physical preparation and to enhance technical and tactical effectiveness.

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Appendices

Appendix 1. Technical performance data.

Table 10. Team statistics from selected competitions.

TEAM STATISTICS														
		Ball possession, quantity	Entrance to the opposition half	Entrance to the final third	Entrance to the box	Shots	Shots on target	Passes	Accurate passes	Key Passes	Accurate Key Passes	Positional attacks	Counter attacks	Set-piece attacks
U17 FINLAND, n=8	Mean	116,1	61,3	35,5	10,5	10,9	3,5	546,8	454,3	15,1	6,3	69,1	11,1	5,0
	SD	12,3	11,7	6,9	2,6	4,5	1,9	147,3	143,2	7,8	2,7	10,5	3,6	2,7
U17 OPPONENT, n=8	Mean	117,6	70,5	46,3	17,0	19,4	7,5	456,6	356,4	16,3	7,8	64,0	18,5	11,3
	SD	14,1	18,0	14,9	6,7	4,7	2,9	121,8	121,9	12,8	7,6	15,7	6,7	4,4
U19 FINLAND, n=16	Mean	111,8	64,3	44,1	15,5	12,9	5,2	529,1	442,9	10,6	6,3	70,0	12,6	9,9
	SD	11,5	13,4	13,2	8,6	8,0	3,4	99,4	101,0	5,1	3,8	9,4	4,6	4,1
U19 OPPONENT, n=16	Mean	113,4	58,8	40,5	15,7	12,5	4,5	411,5	323,1	8,9	5,0	62,3	14,4	10,6
	SD	14,4	16,0	14,9	6,4	5,2	2,5	70,6	69,1	5,4	3,2	13,3	3,2	5,9
U17 NATIONAL LEAGUE, n=4	Mean	116,3	62,9	44,5	16,6	11,9	5,0	457,4	378,5	11,0	6,4	61,8	13,5	10,1
	SD	6,3	8,5	7,7	6,2	3,8	2,1	109,7	112,0	8,7	5,2	9,8	4,4	3,5
KAKKONEN, n=5	Mean	112,7	62,6	42,0	18,2	13,6	6,3	489,0	406,2	10,6	5,4	63,6	13,1	9,0
	SD	10,3	11,7	10,7	8,4	5,6	3,4	88,3	86,4	4,8	2,7	9,2	3,0	3,1

Table 11. Technical performance indicators of all positions.

		ALL POSITIONS																									
		Air Challenges	Challenges	Challenges/won	Dribbles	Interceptions	Lost Balls	Passes	Passes Accurate	Short Passes	Medium Passes	Long Passes	Passes in opposition half	Accurate passes in opposition half	Passes into the defensive third of the pitch	Accurate passes into the defensive third of the pitch	Passes into the middle third of the pitch	Accurate passes into the middle third of the pitch	Passes into the final third of the pitch	Accurate passes into the final third of the pitch	Attacking passes	Non-attackin passes	Shots	Total Actions	Actions in center	Actions in own third	Actions in opp. thrid
U17, n=36	Mean	2,3	14,9	7,5	2,9	7,2	6,8	51,5	43,1	10,4	38,8	2,6	12,2	8,8	17,5	16,1	24,3	20,9	9,9	6,0	30,7	19,6	0,9	84,5	56,3	24,0	4,2
	SD	1,9	6,9	3,6	3,2	4,5	1,9	24,4	24,1	5,5	22,8	1,9	8,7	6,6	12,8	12,3	15,4	14,9	6,0	4,2	11,0	17,5	1,7	25,4	24,0	15,6	5,1
U19, n=75	Mean	3,5	15,9	8,2	2,1	5,3	5,7	53,8	45,1	11,5	38,8	3,6	18,0	14,3	12,4	11,6	26,2	23,2	14,9	10,2	34,6	18,3	0,9	87,2	64,2	16,8	6,3
	SD	2,4	6,5	3,8	2,0	3,3	2,9	26,6	24,9	6,7	22,3	3,3	12,3	10,3	9,5	9,1	15,6	15,1	8,8	7,0	15,3	15,3	1,2	28,9	26,1	11,7	6,3
U17 NL, n=46	Mean	2,1	17,4	9,7	4,1	4,7	7,1	45,2	37,1	11,1	32,0	2,0	17,1	13,0	13,1	12,2	18,0	15,5	14,0	9,4	29,7	14,4	1,1	80,1	54,6	17,2	7,8
	SD	2,0	6,8	4,2	3,3	2,5	4,2	17,7	17,0	6,7	15,0	2,2	10,4	8,6	9,6	9,7	9,8	9,4	8,3	6,6	11,1	11,2	1,5	21,0	19,8	12,1	6,6
KAKKONEN, n=52	Mean	3,6	17,2	8,9	3,5	4,8	7,2	48,4	40,4	10,5	35,6	2,1	18,8	15,0	11,4	10,5	23,2	20,2	14,0	9,7	31,8	15,6	0,9	82,4	58,5	16,9	7,0
	SD	2,6	7,8	4,4	3,0	3,3	3,7	17,5	17,0	5,0	15,7	1,9	9,9	8,6	9,1	8,8	10,6	10,2	7,7	6,3	10,3	12,6	1,2	21,1	17,8	11,1	5,4

Table 12. Central defenders' technical performance data

		CENTRAL DEFENDER (CD)																									
		Air Challenges	Challenges	Challenges/won	Dribbles	Interceptions	Lost Balls	Passes	Passes Accurate	Short Passes	Medium Passes	Long Passes	Passes in opposition half	Accurate passes in opposition half	Passes into the defensive third of the pitch	Accurate passes into the defensive third of the pitch	Passes into the middle third of the pitch	Accurate passes into the middle third of the pitch	Passes into the final third of the pitch	Accurate passes into the final third of the pitch	Attacking passes	Non-attackin passes	Shots	Total Actions	Actions in center	Actions in own third	Actions in opp. thrid
U17, n=14	Mean	2,2	10,1	6,2	1,1	10,1	4,1	58,9	51,0	6,7	49,2	3,5	4,7	3,5	24,1	22,2	29,6	25,6	5,7	3,2	32,2	26,1	0,0	89,3	51,7	37,3	0,3
	SD	1,4	2,8	2,3	1,3	4,1	1,7	23,9	23,1	3,2	21,5	1,3	3,8	3,4	7,3	6,6	19,8	19,5	2,9	2,4	11,5	13,6	0,0	24,6	26,8	9,9	0,6
U19, n=25	Mean	4,2	12,3	6,9	0,5	7,0	4,2	67,5	58,8	7,9	53,7	6,0	8,6	7,1	21,4	20,4	35,8	32,2	10,3	6,1	36,2	30,6	0,5	99,8	69,3	27,8	3,1
	SD	2,5	4,8	3,4	0,8	3,6	2,3	26,7	24,8	4,1	22,1	3,9	6,0	5,6	9,4	9,2	16,4	16,2	6,2	4,0	15,1	16,9	0,7	27,2	27,8	8,9	8,6
U17 NL, n=14	Mean	2,9	12,3	8,8	2,1	6,0	4,3	52,4	45,6	7,4	41,4	3,5	7,1	5,7	22,4	21,6	23,6	20,6	6,4	3,4	27,0	24,8	0,4	84,4	51,9	29,9	0,9
	SD	2,1	5,1	4,1	2,8	2,8	2,9	18,7	17,6	4,2	15,5	2,5	6,7	6,3	7,9	8,3	12,0	11,9	4,1	3,0	11,7	11,4	0,6	21,3	24,0	8,8	0,9
KAKKONEN, n=13	Mean	3,8	12,9	7,6	1,4	8,1	6,0	59,2	50,8	8,5	47,2	3,5	10,4	8,1	20,1	18,9	31,4	27,1	8,3	4,8	33,1	25,8	0,2	88,8	57,3	29,2	2,3
	SD	2,0	6,3	3,6	1,6	4,2	2,8	16,5	17,9	4,0	14,6	2,4	4,1	3,8	11,3	11,3	11,5	12,4	4,2	3,4	7,0	16,3	0,4	21,1	20,8	7,9	2,8

Table 13. Wide defenders' technical performance data

		WIDE DEFENDER(WD)																									
		Air Challenges	Challenges	Challenges/won	Dribbles	Interceptions	Lost Balls	Passes	Passes Accurate	Short Passes	Medium Passes	Long Passes	Passes in opposition half	Accurate passes in opposition half	Passes into the defensive third of the pitch	Accurate passes into the defensive third of the pitch	Passes into the middle third of the pitch	Accurate passes into the middle third of the pitch	Passes into the final third of the pitch	Accurate passes into the final third of the pitch	Attacking passes	Non-attackin passes	Shots	Total Actions	Actions in center	Actions in own third	Actions in opp. third
U17, n=10	Mean	1,8	14,7	8,8	3,2	7,7	5,2	61,2	53,3	15,1	44,7	2,4	16,0	13,3	22,8	21,3	28,4	24,5	10,0	7,5	34,4	26,3	0,2	93,3	64,0	26,2	3,1
	SD	1,5	4,1	2,6	2,6	3,8	2,9	26,0	26,5	5,7	25,2	1,9	7,3	6,2	15,7	15,8	10,5	10,7	5,6	4,4	8,9	23,6	0,6	26,3	26,3	9,1	2,2
U19, n=18	Mean	3,9	18,2	10,1	2,6	5,8	7,1	56,1	45,3	14,7	39,0	2,4	24,6	19,1	11,6	10,3	25,1	22,0	18,9	13,0	38,5	17,2	0,3	90,1	63,2	18,8	8,1
	SD	2,7	6,6	4,9	1,7	3,0	2,9	16,6	15,1	7,3	12,4	1,6	10,2	8,8	4,5	3,7	10,1	9,4	7,8	6,0	11,2	7,3	0,8	17,2	17,9	9,2	4,5
U17 NL, n=9	Mean	1,2	16,0	10,1	3,4	5,8	6,1	43,6	33,8	12,7	29,7	1,2	20,2	15,3	10,8	9,6	15,9	12,4	16,9	11,8	32,6	10,2	0,4	75,4	49,4	16,8	9,2
	SD	1,2	6,1	4,1	2,1	1,7	3,0	13,8	14,1	6,7	11,9	1,3	7,8	6,8	7,2	7,6	6,3	5,9	6,7	5,3	8,5	5,7	1,0	16,8	12,6	6,9	5,3
KAKKONEN, n=12	Mean	4,3	18,1	10,8	3,5	5,5	7,0	53,2	44,6	12,4	38,7	2,1	21,5	17,7	11,2	10,2	25,8	22,7	16,3	11,8	36,0	16,7	0,3	88,3	61,5	19,7	7,2
	SD	2,2	7,2	4,4	2,6	2,1	3,2	8,4	8,2	6,0	9,4	1,4	8,3	6,4	6,1	5,7	7,0	6,9	6,1	4,5	8,2	7,4	0,7	15,3	11,7	7,9	3,9

Table 14. Central midfielders' technical performance data.

		CENTRAL MIDFIELDER(CM)																									
		Air Challenges	Challenges	Challenges/won	Dribbles	Interceptions	Lost Balls	Passes	Passes Accurate	Short Passes	Medium Passes	Long Passes	Passes in opposition half	Accurate passes in opposition half	Passes into the defensive third of the pitch	Accurate passes into the defensive third of the pitch	Passes into the middle third of the pitch	Accurate passes into the middle third of the pitch	Passes into the final third of the pitch	Accurate passes into the final third of the pitch	Attacking passes	Non-attackin passes	Shots	Total Actions	Actions in center	Actions in own third	Actions in opp. third
U17, n=0	Mean																										
	SD																										
U19, n=17	Mean	2,5	19,0	9,5	3,4	5,5	6,1	58,9	49,4	15,4	39,8	3,6	28,9	23,6	8,7	8,4	28,2	25,1	21,4	15,9	42,8	14,8	1,3	97,8	80,6	9,7	7,4
	SD	1,6	7,7	3,1	2,1	2,6	2,4	24,9	24,5	7,6	19,1	2,6	13,2	11,3	4,8	4,4	13,6	13,8	10,5	8,6	15,4	10,7	1,2	24,6	22,7	4,4	4,9
U17 NL, n=13	Mean	1,6	20,5	11,4	4,9	4,2	8,5	50,7	41,3	13,6	34,8	2,3	22,4	16,7	12,8	11,8	20,0	17,4	17,9	12,2	35,2	13,9	1,6	89,3	66,1	14,2	9,0
	SD	1,7	5,8	4,9	3,5	2,1	4,1	17,7	17,5	8,6	12,9	2,2	11,0	9,8	6,3	6,4	8,4	8,3	9,2	7,7	12,0	8,9	1,2	22,6	20,1	8,6	6,1
KAKKONEN, n=14	Mean	2,6	17,1	7,5	3,3	3,3	6,0	48,1	40,8	9,5	36,5	2,1	21,6	17,6	10,6	9,8	22,1	19,7	15,4	11,3	31,5	15,1	1,1	82,1	63,5	11,6	7,0
	SD	2,0	5,1	3,5	2,0	1,7	3,7	18,3	17,3	4,2	15,6	1,7	10,0	9,4	5,5	5,3	7,9	8,1	9,3	7,7	11,9	10,2	1,0	21,7	18,5	5,5	5,0

Table 15. Wide midfielders' technical performance data.

		WIDE MIDFIELDER(WM)																									
		Air Challenges	Challenges	Challenges/won	Dribbles	Interceptions	Lost Balls	Passes	Passes Accurate	Short Passes	Medium Passes	Long Passes	Passes in opposition half	Accurate passes in opposition half	Passes into the defensive third of the pitch	Accurate passes into the defensive third of the pitch	Passes into the middle third of the pitch	Accurate passes into the middle third of the pitch	Passes into the final third of the pitch	Accurate passes into the final third of the pitch	Attacking passes	Non-attacking passes	Shots	Total Actions	Actions in center	Actions in own third	Actions in opp. third
U17, n=3	Mean	1,3	21,7	7,3	7,0	4,0	12,0	35,3	25,7	9,7	25,0	0,7	23,7	14,3	3,7	3,7	12,3	11,0	19,3	11,0	27,3	5,3	2,0	74,0	55,7	5,3	13,0
	SD	1,5	7,2	2,3	4,4	3,5	1,7	12,1	10,0	5,5	7,5	0,6	12,5	10,1	1,5	1,5	4,9	3,5	6,8	6,1	11,2	3,8	1,7	18,7	12,6	3,5	4,6
U19, n=9	Mean	2,4	16,6	7,3	3,4	3,2	5,6	24,8	19,2	8,4	15,0	1,3	13,4	10,2	3,2	3,1	10,7	8,3	10,9	7,8	20,4	3,4	1,6	54,9	41,3	5,7	7,9
	SD	1,9	4,7	2,1	2,2	2,0	3,4	7,6	8,0	4,4	5,8	0,5	5,9	5,2	2,5	2,6	3,9	4,3	4,9	3,8	5,3	3,0	1,0	13,6	13,2	3,8	1,9
U17 NL, n=5	Mean	1,4	24,4	8,8	7,4	2,6	10,4	32,6	26,4	14,4	17,8	0,4	24,6	19,0	2,8	2,4	9,8	9,4	20,0	14,6	26,2	5,0	1,6	74,6	51,4	6,2	17,0
	SD	0,9	5,4	2,2	2,9	1,5	2,5	7,4	6,3	5,7	4,2	0,5	5,2	4,2	2,5	2,7	4,1	3,9	4,8	4,0	6,2	3,4	1,7	10,9	9,9	4,5	2,9
KAKKONEN, n=8	Mean	3,1	20,6	10,6	6,0	3,1	8,8	38,6	30,5	13,5	22,6	1,3	23,8	18,6	5,6	4,4	16,4	14,4	16,6	11,8	31,0	5,6	1,3	78,5	55,8	11,6	11,1
	SD	2,3	7,6	3,8	3,0	1,6	3,6	15,7	13,8	6,0	8,8	1,3	13,7	12,1	3,6	2,4	7,4	6,5	9,5	7,7	12,9	2,6	1,2	19,3	16,2	8,5	6,7

Table 16. Forwards' technical performance data.

		FORWARD(F)																									
		Air Challenges	Challenges	Challenges/won	Dribbles	Interceptions	Lost Balls	Passes	Passes Accurate	Short Passes	Medium Passes	Long Passes	Passes in opposition half	Accurate passes in opposition half	Passes into the defensive third of the pitch	Accurate passes into the defensive third of the pitch	Passes into the middle third of the pitch	Accurate passes into the middle third of the pitch	Passes into the final third of the pitch	Accurate passes into the final third of the pitch	Attacking passes	Non-attacking passes	Shots	Total Actions	Actions in center	Actions in own third	Actions in opp. third
U17, n=9	Mean	3,3	20,1	8,0	4,2	3,1	11,1	34,4	25,2	11,2	20,8	2,4	15,7	10,0	6,0	5,1	15,6	13,0	12,9	7,1	25,2	6,9	2,7	70,8	55,2	7,1	8,4
	SD	2,6	8,8	5,9	3,8	2,1	3,6	15,6	12,4	4,4	11,8	2,5	5,2	3,8	4,5	3,4	8,0	7,5	4,6	2,9	11,5	4,2	2,4	24,1	20,3	6,1	4,8
U19, n=6	Mean	4,3	14,5	6,0	1,8	2,5	7,3	19,0	13,8	10,0	8,7	0,3	13,7	9,3	1,0	0,8	7,5	6,7	10,5	6,3	14,7	2,3	2,7	44,5	33,7	1,8	9,0
	SD	3,3	5,3	2,2	2,3	2,4	3,1	7,5	6,4	3,2	5,4	0,5	4,9	4,9	1,3	1,0	5,2	4,7	4,0	3,0	6,3	1,4	2,2	15,9	14,7	1,6	1,1
U17 NL, n=5	Mean	3,6	19,6	7,6	5,4	2,2	10,0	26,0	19,4	9,0	16,8	0,2	18,2	13,4	2,2	1,8	9,6	7,8	14,2	9,8	21,2	3,4	2,6	57,8	44,4	1,2	12,2
	SD	3,4	5,7	3,8	3,5	1,5	5,8	9,7	5,9	3,7	8,6	0,4	6,2	3,4	2,6	2,2	2,9	2,9	5,4	2,3	8,8	1,3	2,7	15,0	15,6	1,6	2,9
KAKKONEN, n=5	Mean	5,4	21,4	9,0	5,4	2,0	11,6	25,0	18,0	9,0	15,8	0,2	18,4	13,2	1,2	1,0	9,4	7,4	14,4	9,6	20,4	3,6	3,0	58,0	45,0	1,2	11,8
	SD	5,2	15,1	8,0	5,0	1,2	3,9	6,3	5,2	1,0	6,6	0,4	4,7	4,0	1,3	1,4	3,8	3,8	3,4	2,7	5,5	1,9	1,7	22,3	20,7	0,8	3,8

Appendix 2. InStat definition of actions.

InStat definitions

Ball possession quantity. Number of Possessions (calculated as the amount of Single Ball Possessions).

Entrance to the opposition half. Number of crossing the half-way line.

Entrance to the final third. Number of crossing "line" to final third of the pitch.

Entrance to the box. Number of crossing line to the opponent's box.

Shots. Sending ball to the opponent's goal with the purpose of score.

Shots on target. A shot reflected by the goalkeeper. Even if there is doubt about the accuracy of the shot, but it was saved, it is noted as shot on target. If the goalkeeper saves after a ricochet without significant change of trajectory, shot on target is also noted.

Passes. Number of actions where player with the ball tries to move the ball to a teammate. Successful/unsuccessful action. (Incl. crosses and set-piece passes).

Accurate passes. Number of successful passes to teammate.

Key passes. A pass creating a goal-scoring opportunity. It takes a player one-on-one with the goalkeeper or to a scoring position. This kind of pass usually leaves behind all the opponent's players.

Accurate key passes. An accurate pass, creating a goal-scoring opportunity. It takes a player one-on-one with the goalkeeper or to a scoring position. This kind of pass usually leaves behind all the opponent's players.

Attack. Ball possession with crossing half-way line.

Positional attacks. An attack in open play or after set-pieces (throw-in or free-kick). Positional attack in open play either lasts more than 20 seconds or speed of moving the target in ball possession is less than 3 meters/sec.

Counter attacks.

The term Speed of Attack is introduced to determine counterattacks.

Speed of Attack is calculated in the following way. Every ball possession contains the starting point and the points of possession.

- The first action of possession can't be a set-piece
- The length of possession must be not more than 8 sec. or if the length is from 8 to 30 sec., the speed of attack must be more than 2.6 m/s
- A counterattack can't begin with a pass from a goalkeeper if he controlled the ball for more than 4 seconds before the action. Conditions for the end of counterattack:

- End of possession
- Expiry of 8 seconds
- Expiry of 30 seconds and the speed of possession being more than 2.6

The rest of the attacks are classified as position attacks. The condition for their end is the end of possession or the start of a new attack of any type.

Set-piece attacks.

- Corner attack – the first action of possession is a set-piece from the corner
- Throw-in attack – the first action of possession is a set-piece from the throw in and is at the same time a pass into the opposition penalty area
- Free-kick attack – the first action of possession is a shot or a goal from a free kick or during the first five actions including the first one. At least one of the actions has happened inside the opposition penalty area; it should be within 5 seconds of the first action
- Penalty attack – the first action of possession is a set-piece from the penalty spot

Air challenges. Two rivals fighting for the ball above shoulder height, the rivals play or try to play with their heads.

Challenges. All types of challenges on a field. It is summary measure, which includes struggle for neutral ball, air challenges, dribbles, tackles, losses of a ball after opponent's tackles.

Challenges/won. Successful challenges.

Dribbles. Active action of a player possessing the ball, an attempt to pass opponent by using dribbling succeeds, the opponent has unsuccessful tackle registered.

Interceptions. Regaining the ball possession after opponent's accurate pass or shot. As opposed to pick up, interception is an active action that interrupts opponent's attack. Interception usually means blocking shots on target or accurate attacking passes.

Lost balls. Player's action (inaccurate pass, lost challenge, etc.) that lead to losing a ball. Loss of the ball is not registered if the ball possession is finished with a foul suffered or a shot.

Passes. Number of actions where player with the ball tries to move the ball to a teammate. Successful/unsuccessful action. (Incl. crosses and set-piece passes).

Accurate passes. Number of successful passes to teammate.

Short passes. Pass length of less than 15meters pass.

Medium passes. Pass length from 15 meters to 40 meters

Long passes. Pass length of more than 40 meters.

Passes in opposition half. Number of passes in opposition half.

Accurate passes in opposition half. Number of accurate passes in opposition half.

Passes into the defensive half of the pitch. Number of passes into the defensive half of the pitch.

Accurate passes into the defensive half of the pitch. Number of accurate passes into the defensive half of the pitch.

Passes into the middle third of the pitch. Number of passes into the middle third of the pitch.

Accurate passes into the middle third of the pitch. Number of accurate passes into the middle third of the pitch.

Passes into the final third of the pitch. Number of passes into the final third of the pitch.

Accurate passes into the final third of the pitch. Number of accurate passes into the final third of the pitch.

Attacking passes. is a pass aimed at the development of the attack. Usually such passes leave behind one opponent player.

Non-attacking passes. is a pass performed in order to control the ball without the development of the attack. Usually such passes do not leave behind any opponents.

Shots. Sending ball to the opponent's goal with the purpose of score.

Total actions. Total number of all types of passes (incl. crosses and set-piece passes), challenges, interceptions, picking-ups free balls, dribbles the ball, bad ball controls and all kinds of shots (incl. goals)

Action in center. Total number of all types of passes (incl. crosses and set-piece passes), challenges, interceptions, picking-ups free balls, dribbles the ball, bad ball controls and all kinds of shots (incl. goals) in center third of the pitch.

Actions in own third. Total number of all types of passes (incl. crosses and set-piece passes), challenges, interceptions, picking-ups free balls, dribbles the ball, bad ball controls and all kinds of shots (incl. goals) in own third of the pitch.

Actions in opponent third. Total number of all types of passes (incl. crosses and set-piece passes), challenges, interceptions, picking-ups free balls, dribbles the ball, bad ball controls and all kinds of shots (incl. goals) in opponent third of the pitch.

Appendix 3. Permission certificate.



APPROVAL TO PARTICIPATE IN A STUDY

We are conducting a research studying the in-game performance of youth national team players. The target of the study is to compare the youth national team players' performances in the international games to domestic club team games. The study is a part of a bachelor's thesis for a Degree Programme in Sports Coaching and Management at Haaga-Helia University of Applied Sciences. The research is conducted by university students Saku Mikkola and Petri Hyrkkänen, in co-operation with the Finnish Football Association.

The study is conducted to discover the differences in demand levels between the youth national team games and domestic league games. By comparing the results, we can identify aspects of the game which require further development. By identifying and developing certain aspects of the game we can improve youth players' readiness to succeed in international games.

The study compares the technical and tactical aspects of the game as well as players' physical loading during the game. For the purpose of the study, the data of physical loading is gathered from the participating players by using GPS-heart-rate monitors. The selected games are also videoed for video-analysis.

All the data gathered in the study, is processed by playing position. Names and personal details of the participating players are not to be published in the study.

By signing the document, a person of age or the guardian of a minor approves the player's participation in the study and the gathering of the above-mentioned data

Player's name: _____

Player's or guardian's signature: _____

For additional information, contact the students conducting the study

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DP in Sports Coaching and Management

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