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Soccer players' agility skills depending on their position on the field

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Abstract

Background: Soccer players, independent of positions, perform high-intensity movements such as agility for short periods and have longer periods of low-intensity and rest during a soccer game. Agility is considered to be dependent on perceptional and decision-making factors and physical factors related to changes in directions. Most research has displayed no differences in different preplanned agility test within playing positions. However, no studies have been done on reactive agility within different positions on the soccer field. **Aim:** The purpose of the study was to compare if soccer players´ reactive – and preplanned agility performance differs between their positions in the team. The study will also examine the level of correlation between results from reactive agility and preplanned agility. **Methods:** Thirty male soccer players, 17-19 years old, were tested in reactive agility and preplanned agility. The subjects were divided into three groups depending on their playing position, including defenders (n=10), midfielders (n=10) and forwards (n=10). Mean scores for both agility tests were analyzed with a one-way analysis of variance (ANOVA) and the criterion level for significance was set at 5 % ($p \leq 0.05$). Correlations were performed to study the relationship between reactive agility and preplanned agility. Following limits were used to determine the strength of the value of Pearson correlation; r=.10 to .29 small, r=.30 to .49 medium, r=.50 to 1.0 large. **Results:** No statistical significant differences between defenders, midfielders and forwards in neither reactive agility (p=0.624) or preplanned agility (p=0.481) were perceived. There was a small correlation (r=0.24) between all studied results from the reactive – and preplanned agility test. When positions were correlated within the two test, the highest correlation between reactive agility and preplanned agility was found in midfielders with a medium correlation (r=0.47) while small correlations appeared within defenders (r=0.28) and forwards (r=-0.11). **Conclusions:** The findings of this thesis showed no statistical significant differences between playing positions in reactive agility nor in preplanned agility. The impact of the soccer players' integration with different soccer coaches could be an explanation to the reactive agility results where some coaches may focus on developing perceptual skills more than other coaches. The absence of differences in preplanned agility may suggest that the physical abilities needed to perform the Zig-Zag test did not differ among defenders, midfielders or forwards. It can also be suggested that reactive agility and preplanned agility are two independent variables who do not share characteristics. Future research should focus on incorporating a more valid reactive agility test for soccer players and study larger samples who are specialized in their positions.

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Background

Soccer is one of the most popular sports in the world with more than 200 million professional players (Stojanovic & Ostojic, 2011), and soccer players require skills in technique, tactics and physics to succeed (Hoff, 2007). In addition to these skills, a soccer player also needs to function well socially and be mentally strong (Balsom, 2007). One of the reason that soccer is so popular is that players may not need to have maximum qualities within any of these skills and factors, but controls a reasonable level within all areas (Stølen, Chamari, Castagna & Wisløff, 2012). A soccer team consist of maximum eleven players including one goalkeeper and ten outfield players. The outfield players can be divided into defenders, midfielders and forwards (figure 1) (NE, n.d.).

Figure 1. Game system in soccer with one goalkeeper, four defenders, four midfielders and two forwards.

The major part for the defenders are too help their goalkeeper defending the goal, for example by winning the ball from the opposing team (Saunders, 1973). Midfielders are the link between the defenders and forwards. They have a couple of different roles, both in the defending part and in the team's offense (Saunders, 1973). The midfield players are the ones who generally covers most distance during a soccer game (Balsom, 2007). Forwards plays in the front of the team and their main task is to score goals in different ways, as for example with their feet or head (Saunders, 1973).

Soccer players, independent of position, performs high-intensity work such as agility for short periods and have longer periods of low intensity movements and rest (Balsom, 2007; Köklü, Alemdaroglu, Özkan, Koz & Ersöz, 2015). However, there is no global definition to the term agility (Little & Williams, 2005) and many authors' hade their own opinion about definitions regarding agility.

Definitions of agility

There is no global definition to the term agility but a player´s ability to change directions and start and stop quickly is known as skills in agility (Little & Williams 2005). In sports where agility is needed the practitioners must master sprints forwards, backwards and sideways while they changing movement and direction efficiently (Baechle & Earle, 2008). Walker and Turner (2009) definition of agility is the ability to change direction rapidly, without losing balance, using a combination of power, strength and neuromuscular coordination. With this in mind, agility has been considered to be dependent on two sub-components, perceptual and decision making factors and factors related to the actual mechanics of changing direction (Jones, Bampouras & Marrin, 2009). Balsom (2007) clarifies that being fast in soccer also means that a player is able to make quick decisions. The decision-making process, in soccer called game perception, means that the player will be able to perceive and evaluate situations and then make quick decisions that require immediate action. In soccer speed, these factors are as important as the physical ability to run quickly in different situations (Balsom, 2007). Zemková and Hamar (2014) found that agility skills involves three information processing stages; stimulus perception, response selection and movement execution, and represent a crucial part when performing in many sports. As described previously, many authors have their own opinion about agility and Sheppard and Young (2006) says that it is difficult to find an accepted definition of agility. Various disciplines within sports science might view agility skills differently. A motor learning scientist in sports psychology might view agility in different terms than a strength and conditioning coach, with more focus on decision making and reaction to a stimulus. The strength and conditioning coach might define agility in terms of the physical attributes involved in direction changes (Sheppard & Young, 2006).

In this thesis two different forms of agility; reactive agility and preplanned agility will be studied. Reactive agility is here defined as the players´ perceptual and cognitive abilities to recognize the need to change direction and then effectively perform the movement (Sekulic, Krolo, Spasic, Uljevic & Peric, 2014). Preplanned agility could be described as the ability to quickly change direction without losing balance but without involving the decision-making ability for the players (Sheppard & Young, 2006; Reilly, 2007).

Agility in soccer

A sprint, regardless of distance, in a soccer game is rarely performed in a straight line. Depending on where the ball lands, or where your opponents' locations are, changes in directions are a common variable in soccer (Balsom, 2007).

A study made on 55 professional soccer players representing various clubs in English FA Premier League presented results including turns and swerving among defenders, midfielders and forwards. The majority of turns within a match-play was between 0 to 90 degrees of range where defenders made approximately 700 turns, midfielders turned 500 times and forwards 600 times. Turns of 90 to 180 degrees was relatively evenly distributed in the various positions (Bloomfield, Polman & O´Donoghue, 2007).

High-intensity movements in soccer

It is possible to categorize the high-intensity movements during a soccer game in three categories; top speed, acceleration and agility. These qualities over shorter sprint distances are basic success factors for soccer players to perform in soccer (Köklü et al., 2015). A general evaluation of elite soccer is that all games are played at a higher tempo. This in turn means that each player must run more and faster to create time and space for oneself on the field. Every player, regardless of position, needs to make these high-intensity movements, often in response to a stimulus (Balsom, 2007)

Activities such as sprinting short distances are largely anaerobic and the energy for rapid development of muscle force is provided through anaerobic pathways. Within the muscles there is stored ATP, which is the primary source of energy for muscle contractions during very short periods of exercise performed at high-intensity. The stored ATP is limited and will be depleted within a few seconds. ATP must be reformed from Phosphocreatine (PCr), which also is stored within the muscles, if the exhausting exercise continues. PCr is broken down by creatine kinase which allows ATP to be regenerated and muscle activity to be continued. The PCr stores may be reduced to very low levels if the recovery period between high-intensity activities is too short or if successive sprints are performed (Reilly, 2007). The anaerobic breakdown of glycogen stored within the muscles is the next available source of energy. Glycolysis is the muscles major mean of anaerobic energy production, and the capacity is much higher compared to PCr, due to a larger supply of glycogen and glucose (Baechle &

Earle, 2008). Anaerobic training can help soccer players increase the activity of creatine kinase, the enzymes in the glycolytic pathway and also increase the amount of glycogen stored within the active muscles (Reilly, 2007).

Perceptual and decision making in reactive agility

The decision-making process are at least as important in soccer as the physical attributes (Balsom, 2007). Soccer is one of the sports which are ranked highest for agility that require changes in directions in response to a stimulus (Zemková, Vilman, Kovácikovà & Hamar, 2013).

The nervous system

The nervous system is the master system of the body in controlling and communicating and the nervous system has three overlapping functions; sensory input, integration and motor output. Sensory input is the gathered information that the nervous system sensory receptors monitor occurring changes outside the body. Changes in the environment are called stimuli and the sensory receptors are specialized to respond to stimuli. The process called integration is the nervous system way of process and interpret sensory inputs and decide what should be done at each moment. The interpretation of sensory inputs occurs in the cerebral cortex and our perception will determine how we will respond to stimuli. After integration, the nervous system causes a response, called motor output, by activating the muscles and glands (Marieb & Hoehn, 2010).

Reactive agility tests

Higher-skilled players in team sports have consistently shown greater perceptual skills than their less-skilled counterparts (Tanner & Gore, 2013). A recent study investigated the speed, change of direction speed and reactive agility performances of higher – and lesser-skilled rugby league players. No differences were found between groups in physical abilities but significant differences were detected in perceptual qualities where higher-skilled rugby players performed better than less-skilled players. Similar results have been found in netball and Australian Rules Football (Tanner & Gore, 2013). Studies made on professional soccer players and amateur soccer players showed a significantly better ability on reactive agility for the professionals compared to the amateurs (Poplu, Ripoll, Mavromatis & Baratgin 2013;

Vestberg, Gustafsson, Maruex, Ingvar, Petrovic, 2012). The professionals were better at recognizing and recalling structured soccer game patterns (Poplu et al., 2013).

Differences in reactive agility time has been shown at different positions in basketball players and between hockeyball players and hockeyball goalkeepers (Zemková & Hamar, 2014), but with the author´s knowledge, there have been no studies comparing reactive agility on different playing positions in soccer.

It has also been shown that the importance of a certain stimulus could influence the ability to react. Causer, McRobert and Williams (2013) compared the importance of soccer players´ game jersey. The subjects task was to strike a decisive pass to a simulated team player, in a simulated environment, with videos on about five seconds where the team players either wore black or colorful game jerseys. The study showed that the pass from the subjects was both faster and more accurate when the simulated team player wore a colorful game jersey.

Physical skills in preplanned agility

Preplanned agility includes several physical attributes such as top speed, acceleration, strength, power and reactive strength (Jones et al., 2009).

Top speed and acceleration

Soccer players rarely run longer than 60 meters at top speed (Balsom, 2007) Sprint distances normally do not exceed 30 meters and the most common sprint distances are between 10 to 15 meter. Although these sprint distances represent less than 10 % of soccer players totally distance during a game, these distances are the most critical and a soccer game´s output may depend on the player´s ability to run faster than his opponent (Abrantes, Macas & Sampaio, 2004). The fastest players in elite soccer are forwards and some studies shows that they sprint the longest distances during a soccer game (Gil, Gil, Ruiz, Irazusta and Irazusta, 2007).

Soccer players needs to accelerate quickly to reach top speed in a minimum amount of time. Little and Williams (2005) defines acceleration as following: “Acceleration is the rate of change in velocity that allows a player to reach maximum velocity in a minimum amount of time.” (s.76) Acceleration movements are more energetically demanding than constant velocity running and even a low running speed impose a high metabolic load on a soccer player when acceleration is elevated (Terje, Ingebrigtsen, Ettema, Hjelde & Wisløff, 2016). A soccer player´s ability to achieve high movement accelerations involves a high amount of rates of force development across a range of power outputs and muscle actions. The percentage of fast-twitch (type II) motor units of a soccer player, and the ability to activate and coordinate them, will determine the player´s capability to rapidly accelerate or decelerate. The ability to increase the activation of motor units begins in the motor cortex with the intent to produce muscular force and power at maximal levels. When the level of force development increases, the activity in the primary motor cortex also increases (Baechle & Earle, 2008).

Strength, power and reactive strength

Strength has commonly been described as the "maximal force production capabilities of a muscle" (Tanner & Gore, 2013, s. 208), but a definition which is more accurate explains strength as "the ability of a muscle to produce force" (Tanner & Gore, 2013, s 208). A study with 82 top-class Danish male soccer players showed that midfield players had the lowest strength of the leg muscles, compared to forwards and central defenders (Bangsbo, 2008). An another study, with young elite soccer players, presented results where defenders had a better lower limb strength compared to midfielders and forwards (Portes, Canhadas, Silva & Oliveira, 2015).

Power evaluates the athlete´s ability to apply force rapidly where high levels of power is generated (Tanner & Gore, 2013). Same study that examined lower limb strength on young elite soccer players also examined muscle power among these players and their soccer field positions. The study revealed that defenders had better lower limb muscle power than midfielders and forwards (Portes et al., 2015).

Reactive strength is the ability to change rapidly from an eccentric to a concentric action. Sheppard and Young (2006) investigated the relationship between reactive strength and change of direction speed, and found a statistically significant correlation between the two variables. They also suggest that reactive strength has a stronger relationship with change of direction speed than the relationship between strength and power and change of direction speed.

Preplanned agility tests

A study made by Kaplan, Erkmen and Taskin (2009) investigated preplanned agility performance between positions and found no statistical differences between mean scores. Their sample included 108 professional male soccer players and 79 amateur male soccer players and their results showed a higher preplanned agility performance for the professionals. When positions were included, the results indicated no significant differences between preplanned agility performance. Taskin (2008) found similar results on preplanned agility performance when different positions were investigated. This study included professional soccer players and Taskin (2008) concluded similarities in physiological abilities regarding preplanned agility between playing positions. Gil et al (2007) measured young soccer players (14-21 years) on their physiological abilities according to their playing position. When preplanned agility performance was measured, forwards performed best and there were statistical differences between forwards and goalkeepers.

Köklü et al. (2015) found a moderate to strong correlation between acceleration, maximum speed and preplanned agility when investigating young soccer players. These findings demonstrated that acceleration, maximum speed and preplanned agility share common physiological determinants. An another study with young soccer players determined the effect of a 12-week conditioning program involving speed, agility and quickness on agility performance. There were statistically significant improvements between pre and post training and agility performance which suggests that there are effective ways of improving preplanned agility among young soccer players (Milanović, Sporiš, Trajković, James & Šamija, 2013).

Relationship between reactive agility and preplanned agility

There has been research done studying the relationship between reactive – and preplanned agility. Matlák, Tihanyi, Rácz (2015) studied sixteen amateur soccer players completing reactive agility and preplanned agility and found no significant correlations between the two variables. Sheppard, Young, Doyle, Sheppard and Newton (2006) evaluated reactive agility and its relationship to preplanned agility in Australian soccer players. They found differences between groups of higher and lower performance in reactive agility but did not observed differences between the groups in preplanned agility.

Measuring agility in soccer

Many existing agility tests commonly used involve no decision-making and could be better described as change of direction speed tests (Sheppard & Young, 2006). There is no “gold standard” agility test for use in the assessment of soccer players due to the fact that different tests may examine special factors associated with agility. For example, one preplanned agility test could be strongly correlated with velocity whereas one another preplanned agility test correlates well with acceleration (Svensson & Drust, 2005). Considering that soccer generally include agility in response to a stimulus, it would seem important to provide tests that mimics this demand to increase specificity (Sheppard & Young, 2006).

An interesting study would therefore be to see if soccer players´ reactive – and preplanned agility abilities differs between different positions in the team on the soccer field, due to the fact that their requirement profile in high-intensity movements are the same. Regarding to Balsom (2007) the decision-making process are at least as important as the physical attributes. Still, most of the existing agility test involves no decision-making for the players (Sheppard & Young, 2006). This motivates to investigate reactive agility performance in different playing positions. Moreover, the majority of turns within a match-play is between 0^o and 90^o of range where defenders make around 700 turns, midfielders 500 turns and forwards 600 turns (Bloomfield et al., 2007). Even though agility performance seems to be similar between positions, a preplanned agility test with 90^o of turns may evaluate if there are differences between playing positions, due to the fact that 0^o – 90^o turns differs between playing positions within a soccer game. Studies have been made to measure the relationship between reactive – and preplanned agility in soccer players, but no research has been found taking the players positions in account. Therefore, a comparing between the results in the agility tests will investigate the level of correlation between reactive agility and preplanned agility between soccer players and between playing positions.

Aim

The purpose of the study was to compare if soccer players´ reactive – and preplanned agility performance differs between their positions in the team. The study will also examine the level of correlation between results from reactive agility and preplanned agility.

Research questions

1) Is there a difference between soccer players, depending on their position (defenders, midfielders and forwards) on the field, in reactive agility and preplanned agility?

2) What is the association between reactive agility and preplanned agility? Does the association differ between the soccer players´ position on the field?

Methods

Study design

The design of the study was a cross-sectional design where the subjects were tested on their reactive agility skills and on their ability to run fast with changes in directions (preplanned agility).

Subjects

All subjects were recruited from Aspero Sports High School and were male soccer players between 17-19 years. The selection of the subjects was done with help from their soccer coaches in order to get even sub-groups. Thirty players participated (n=30) and sub-groups were made to split up the players in defenders (n=10), midfielders (n=10) and forwards (n=10). If a subject had played in several positions, the position that the player had played most frequently during the past season was used for the study. The inclusion criteria in the study were male soccer players attending Aspero Sports High School. The exclusion criteria were lower extremity injuries in the time of the tests. The subjects were asked to do normal daily routines prior testing. Table 1 presents the soccer players´ age, height and weight characteristics.

Table 1. Descriptive statistics (n=30).

	All players N=30 Means (±SD)	**Defenders N=10 Means (±SD)**	**Midfielders N=10 Means (±SD)**	**Forwards N=10 Means (±SD)**
Age (years)	18 (±0.8)	18 (±0.3)	18.2 (±0.2)	17.8 (±0.2)
Height (cm)	179.6 (±6.8)	175.4 (±2.2)	182.2 (±2.0)	181.2 (±1.6)
Weight (kg)	72.4 (±8.0)	69.7 (±3.1)	74.3 (±1.7)	73.3 (±2.6)

Testing procedures

Two agility tests were performed; reactive agility was tested by using a computerized test called FiTRO Agility Check (FiTRONIC s.r.o., Bratislava, Slovakia) and preplanned agility was tested with a variation of a soccer-field test called the Zig-Zag test. FiTRO Agility Check was performed indoors on an artificial grass pitch and the subjects were performing the test with socks on their feet. The Zig-Zag test was also performed indoors on an artificial grass pitch and the subjects were wearing soccer shoes while conducting the test. It was two to three weeks between the two tests.

FiTRO Agility Check

To measure reactive agility, a computer-based system named FiTRO Agility Check (FiTRONIC s.r.o., Bratislava, Slovakia) were used (Zemková et al., 2013).

FiTRO Agility Single (figure 2) was used when testing the subjects. The start position for the test was in the middle of four mats (30 x 30 cm) placed outside of a 40 x 40 cm square (figure 3). The procedure for the test was to react to a stimulus that randomly appeared on the computer screen (figure 2). If the stimulus for example appeared on the upper right corner on the computer screen, the subject had to touch the mat placed at the upper right on the artificial grass (figure 3). (Zemková et al., 2013).

Figure 2. A participant performing FiTRO Agility Check (Zemková et al., 2013).

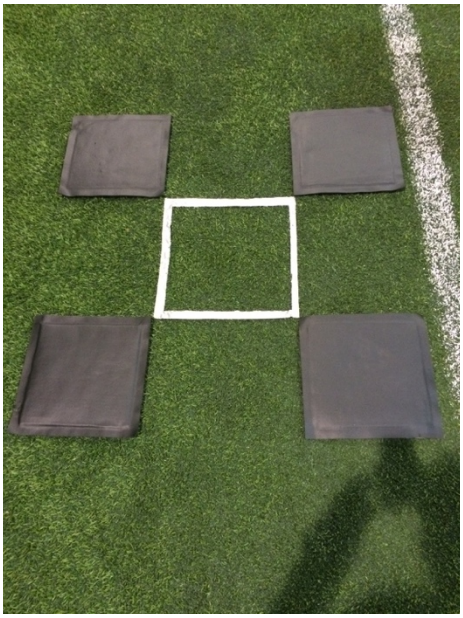

Figure 3. The placement of the mats and start position.

Each subject performed a soccer-specific warm-up, held by their soccer coaches, before the test with the other players. The test leaders gave an oral explanation about the test followed by a familiarization, where each subject performed a testing session with 10 stimuli that appeared on the screen randomly in form of blue circles, with 400-600 milliseconds apart. The entire test included 30 stimuli that appeared on the screen randomly with between 400-600 milliseconds, and when the test started, the subject had to touch 1 of the 4 mats as fast as possible, with either left or right foot, corresponding to the location of the stimulus that was shown in one of the corners of the computer screen. When the test was finished, the response time between the appearance of the stimulus and touching the mat was measured (Zemková et al., 2013). The means (measured in milliseconds) of the two best responses from each of the four mats were used for analysis. A former study verified the reliability of the test procedure by examination of 196 subjects. The most reliable parameter was the mean of the best eight reaction times in each direction in a test consisted of 3 sets of 60 stimuli (Zemková et al., 2013). The subjects completed the 30 stimuli test once.

Zig-Zag test

The soccer players´ ability to run fast with changes in directions were measured by a variation of a preplanned agility test called Zig-Zag test. This test was chosen because it requires both acceleration and deceleration combined with balance control. The relative simplicity also minimized learning effects (Sekulic, Spasic, Mirkov, Cavar & Sattler, 2013). The test course of the Zig-Zag test consisted of five 5-m sections set at 90° angles and the whole distance was 25 m. Every section was finished by a cone that the subjects would turn around to start run in another direction (figure 4). An attempt where one ore more of the cones fell were not approved. The subjects remain stationary in the starting position and when the test leaders gave the green light, the subjects started at their own initiative.

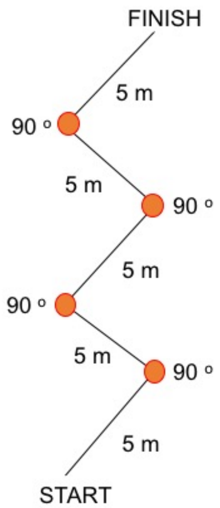

Figure 4. Zig-Zag test. Five 5-m sections set at 90 ° angles.

To measure time, Musclelab Model 4000 (Ergotest Technology, Norway) with associated photocells were used. The photocells were placed at the start of the test and at the finish line. The subjects started the test 50 cm behind the first pair of photocells. The height of the first photocells was 60 cm and the photocells placed at the finish line had a height of 80 cm. It was 1.5 m between the photocell and the associated reflex.

Before the Zig-Zag test started, the subjects were given an oral introduction and also conducted a practice trial to get an understanding of the test. These moments were followed up by three approved attempts, where the best attempt (best time measured in seconds) was used for analysis. The warm up before the Zig-Zag test consisted of a 5-minute jog at self-selected pace, followed by a specific warm up that involved walking knees to chest, lunge walks, lateral lunges, high knees, butt kicks and high skips (for repetition scheme, see appendix 3) (Meylan, McMaster, Cronin, Mohammad, Rogers & Deklerk, 2009). The Zig-Zag test used in this study were a variation of a valid and reliable Zig-Zag test (four 5-m sections set out at 100 ° angles). (Mirkov, Nedeljkovic, Kukolj, Ugarkovic & Jaric, 2008).

Statistical analysis

All data were checked for normal distribution with Shapiro-Wilks test were a p-value of ≥0.05 indicated normality. Since data was found to be normally distributed, a one-way analysis of variance (ANOVA) were performed to compare the mean scores for both tests among the three sub-groups. The criterion level for significance was set at 5 % ($p \leq 0.05$) (Pallant, 2007). The Pearson correlation coefficient (r) was used to study relationships between the two agility tests. Correlations were performed in the total group and in the sub-groups to study the relationship between reactive agility and preplanned agility. Following limits were used to determine the strength of the value of Pearson correlation: r=.10 to .29 small, r=.30 to .49 medium, r=.50 to 1.0 large (Pallant, 2007). The statistical software SPSS, version 20.0 (SPSS Inc. Chicago, IL, USA) was used to complete the statistical analysis.

Ethical and social considerations

Subjects were recruited through collaboration with the soccer coaches at Aspero Sports High School. An initial meeting with the subjects, before the tests began, was arranged where an oral presentation about the study was presented. During the meeting, written study information was handed out (appendix 1) to the subjects.
In the information document there was a summary of the study with background and purpose. There was also a piece of the approach as well as one paragraph emphasizing that participation was voluntary and subjects may terminate their participation at any time, without mentioning the reason (World Medical Association, 2013). The subjects signed the informed consent (appendix 1) under approval from their soccer coaches and according to datainspektionen (n.d.) a minor (under 18) can provide valid consent if he or she is capable of understanding the implications of consent. A person who turned 15 years is normally able to take a position on the consent issue (datainspektionen, n.d.). All personal information was kept confidential (SFS 2003:460).

Since both agility tests don´t require any high physical loads, there should be no increased injury risks for the subjects. The subjects received their individual results if they wanted and the results will be made public through the database DiVA (www.hh.diva-portal.org).

Research within sports and health is important to the society and to the development of people's health. Studies made on soccer players are an established area, and this study could be useful for further research in order to investigate soccer players' possible physical variances within agility depending on different positions on the soccer field. Soccer, as with other activities, is not a science, but science may help improving soccer performance (Stølen et al., 2012) and a greater knowledge about this area may help physiotherapists and soccer coaches in their arrangement of the soccer season.

Results

Twenty-nine subjects (defenders n=10, midfielders n=9, forwards n=10) completed FiTRO Agility Check measuring reactive agility and thirty subjects (defenders n=10, midfielders n=10, forwards n=10) completed the Zig-Zag test measuring preplanned agility. The reason that twenty-nine subjects completed FiTRO Agility Check was due to illness at the time of testing. The age of the players ranged from 17-19 years.

Differences between positions in the agility tests

Table 2 illustrates means (±SD) for all players, defenders, midfielder and forwards in FiTRO Agility Check and the Zig-Zag test. The fastest time in FiTRO Agility Check was 411.9 ms and performed by a midfielder and the slowest time was 588.1 ms, performed by a defender. The fastest time in the Zig-Zag test was 6.05 s and was performed by a forward and the slowest time was 6.68 s, performed by a midfielder. The one-way ANOVA showed no statistical significance difference between the three groups in reactive agility measured with FiTRO Agility Check (p=0.624) nor in preplanned agility measured with the Zig-Zag test (p=0.481).

Table 2. Results from FiTRO Agility Check And The Zig-Zag test for total sample and sub-groups.

	Total N=30 Means (±SD)	**Defenders N=10 Means (±SD)**	**Midfielders N=10 Means (±SD)**	**Forwards N=10 Means (±SD)**
FiTRO Agility Check	498.2 (±37.3)	507.1 (±41.7)	496.7 (±44.4)	490.6 (±26.1)
Zig-Zag test	6.41 (±0.18)	6.40 (±0.18)	6.46 (±0.17)	6.36 (±0.19)

Values are means (± SD). FiTRO Agiliy Check measured results in milliseconds (ms) and the Zig-Zag test measured results in seconds (s).

Relationship between reactive agility and preplanned agility

The relationship between reactive agility measured with the FiTRO Agility Check and the preplanned agility measured with the Zig-Zag test for all the soccer players (figure 5) was investigated on the twenty-nine subjects who performed both tests. There was a small, positive correlation between the two variables (r=0.24, p=0.216).

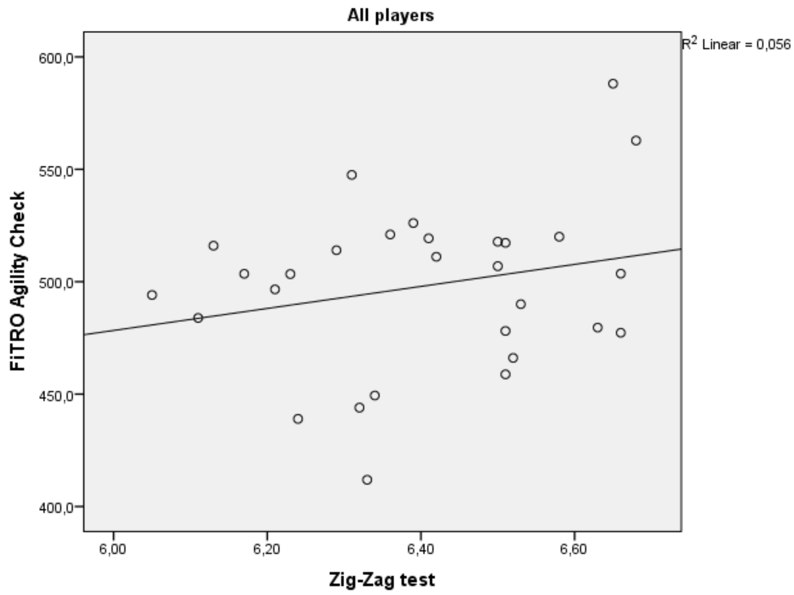

Figure 5. Relationship between FiTRO Agility Check (ms) and Zig-Zag test (s) for all soccer players, r=0.24, r2=0.056.

The level of correlation between reactive agility and preplanned agility were also studied based on positions (defenders, midfielders and forwards) and the highest correlation was found in midfielders. In defenders (n=10) the relationship between the defenders results in FiTRO Agility Check and Zig-Zag test showed a small, positive correlation (r=0.28, p=0.442), please see figure 6. Midfielders had a medium, positive correlation (r=0.47, p=0.217), please see figure 7. A small, negative correlation (r=-0.11, p=0.774) was seen in forwards results, please see figure 8.

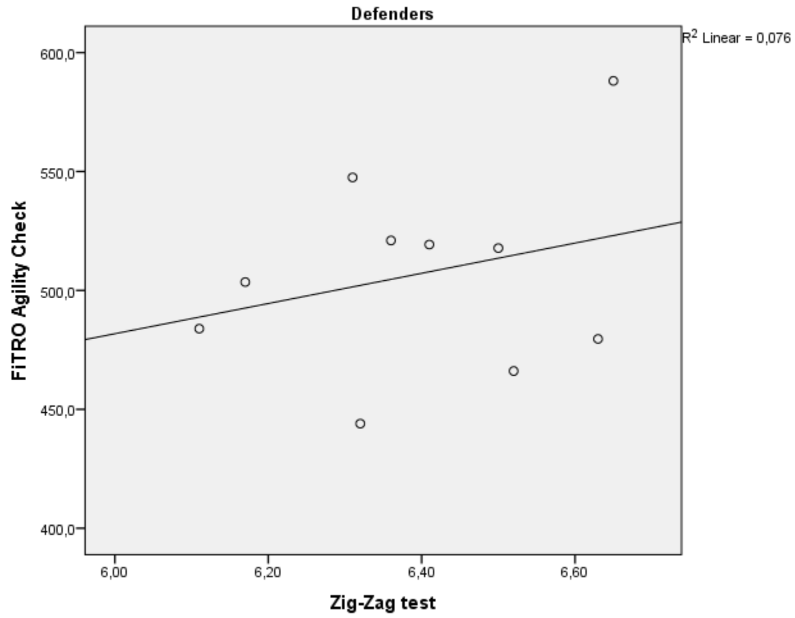

Figure 6. Relationship of defenders results between FiTRO Agility Check (ms) and Zig-Zag test (s), r=0.28, r2=0.076.

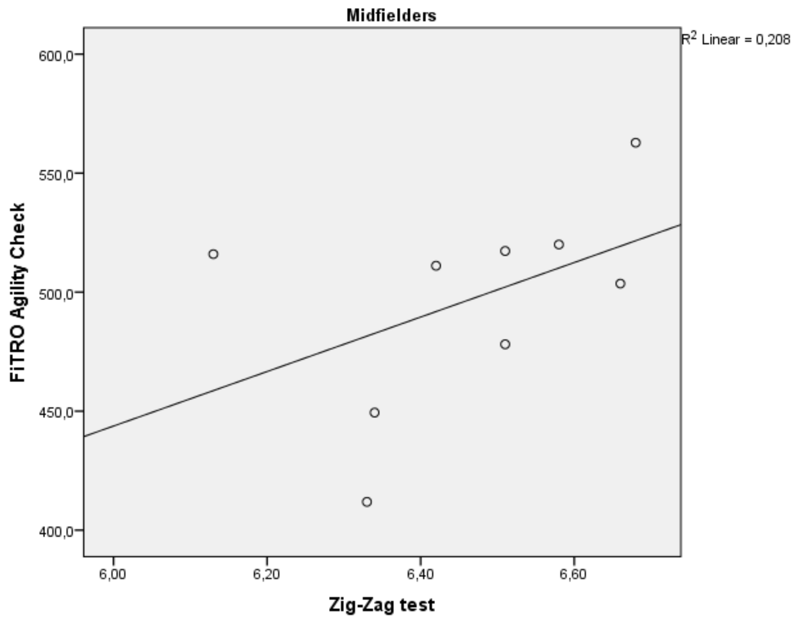

Figure 7. Relationship of midfielders results between FiTRO Agility Check (ms) and Zig-Zag test (s), r=0.47, r^2=0.208.

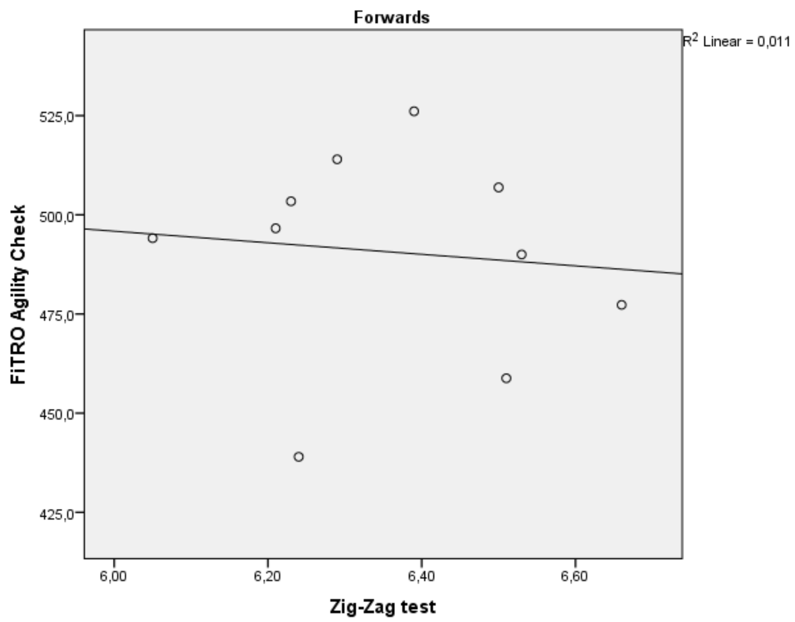

Figure 8. Relationship of forwards results between FiTRO Agility Check (ms) and Zig-Zag test (s), r=-0.11, r^2=0.011.

Discussion

The purpose of this thesis was to compare if soccer players´ reactive – and preplanned agility performance differed between their positions on the field and investigate the level of correlation within these results. The results showed no statistically significant difference between defenders, midfielders and forwards in neither reactive agility or preplanned agility. There was a small correlation between reactive – and preplanned agility test for all soccer players combined and when positions were correlated within the two tests, the highest correlation was found in midfielders with a medium correlation while small correlations appeared within defenders and forwards.

Results discussion

Reactive agility performance was investigated and present results revealed no statistically significant differences between playing positions. No studies have been found measuring reactive agility between positions in soccer and therefore, a part of the thesis was to investigate possible differences. A general tendency is that midfielders have the ball more than defenders and forwards (Balsom, 2007). This makes it possible to believe that the game is mostly played in the middle of the field and most of the situations with different stimuli appears in the middle. If that is the case, midfielders need to be good at perceiving situations quickly and make decisions from there. A more soccer-specific reactive agility test might make it more fair for midfielders to perform well. In the current study, soccer players attending Aspero Sports High School were measured. Even though the players practice soccer in their school environment, every player also practices soccer in their club and therefore have different coaches. It is possible but difficult to develop soccer players' perceptual skills (Williams, 2000). Soccer coaches often stop soccer drills in the training session to highlight informative areas of the display and clarifies the importance within development of soccer performance. Using these instructional techniques to develop perceptual skills may be merely to highlight general rules and relationship in soccer and thereby providing the players with the opportunity to indirect acquire knowledge (Williams, 2000). Depending on the coach in the club, various players, regardless of positions, may have developed their perceptual abilities in different levels. The results in the current study may have been influenced by the differences of the players' club environment and also of their development in the early years. Research indicates that decision-making skills can be improved by specific instructions in 12 – to 14-year-old soccer players (Williams, 2000) which values the soccer coach´s ability to develop players' perceptual skills, even in the early years. According to Swedish Soccer Association, soccer players should play at different positions in adolescenc (Andersen, Halling & Petersen, 1990). This makes it difficult to assess the subjects' development in reactive agility in a particular position if the subjects have played in several positions during younger age. A part of the players may have specialized themselves earlier than other players, but it could be discussed if the majority of the players have developed their reactive agility ability more general and not according to their position.

According to present results, there were no statistical significant difference between positions in the preplanned agility test and these results were similar to results from the study made by Kaplan et al (2009). They investigated preplanned agility performance between positions and found no statistical differences ($p>0.05$) between mean scores. Taskin (2008) found comparable results on preplanned agility performance when different positions were investigated. This study included professional soccer players and Taskin (2008) concluded similarities in physiological abilities between playing positions. Gil et al. (2007) measured young soccer players (14-21 years) on their physiological abilities according to their playing position. When agility performance was measured, forwards performed best and there were significant differences between forwards and goalkeepers. Forwards, in elite soccer, are the fastest players and some studies shows that they sprint the longest distances during a soccer game (Gil et al., 2007). Sprint ability is one factor when performing in preplanned agility, and a possible explanation to forwards results compared to other positions in Gil et al. (2007) study results could be because of their sprinting ability. Leg power is an another variable in preplanned agility performance, and a study that investigated leg power, measured with vertical jumps, showed that forwards and defenders jumped higher than midfielders (Gil et al., 2007). Portes et al. (2015) revealed that defenders had a better lower limb muscle power than midfielders and forwards, and these results appear to be different from Gil et al. (2007). In the study with 82 top-class Danish male soccer players, midfielders had the lowest strength of the leg muscles compared to forwards and central defenders. Due to previous research, a hypothesis could be that forwards perform well at preplanned agility compared to midfielders according to forwards sprint ability and their performance in strength and power studies. However, non of the mentioned preplanned agility test nor the results in current study showed statistically differences between positions. According to Svensson and Drust (2005), its difficult to compare results between different preplanned agility tests, since they may examine different physical abilities associated with preplanned agility. The absence of a "gold-standard" preplanned agility test makes it complicated to confirm the hypothesis that forwards performs better in preplanned agility than midfielders. It is also not possible to see if forwards or defenders are performing best on preplanned agility based on previous research or results in the current study. A general thought could be that they require to perform similar as these positions always face each other in soccer games.

Reactive agility and preplanned agility are dependent on different qualities and it can be suggested that reactive – and preplanned agility are independent of each other. Reactive agility performance is dependent on perceptual and decision making skills while preplanned agility performance needs physical attributes (Sekulic et al., 2014; Sheppard & Young, 2006; Reilly, 2007). The small correlation between the Zig-Zag test and FITRO Agility Check for all players combined confirms the independency of reactive – and preplanned agility. Sheppard et al (2006) evaluated reactive agility and its relationship to preplanned agility in Australian soccer players. They found differences between groups of higher and lower performance in reactive agility but did not observed differences between the groups in preplanned agility. Matlák et al. (2015) research of the relationship between reactive agility and preplanned agility are in line with Sheppard et al (2006) and these findings may suggest that preplanned agility are unlikely to be adequate in assessing cognitive demands of soccer (Sheppard et al., 2006). No research has been found studied playing positions and its relationship between reactive – and preplanned agility and findings from this thesis showed small correlations within defenders and forwards and a medium correlation appeared within midfielders, when reactive – and preplanned agility results were correlated. The r^2 value of midfielders was 0.208 which indicates that nearly 21 % share variance in performance of reactive agility and preplanned agility. Even if the correlation for midfielders were medium, the rather low r^2 value is an indicator for the independency of reactive – and preplanned agility, regardless of position. Future research should incorporate a soccer-specific field test with changes in directions with soccer-specific stimuli involved, and measure playing positions to investigate possible differences.

Methods discussion

Statistical tests involving correlation coefficient provides an indication of a relationship between two variables. However, the correlation does not indicate that one variable causes the other and changes in one variable will not automatically cause changes in the other variable (Pallant, 2007). The relatively small correlations between reactive agility and preplanned agility can likely be explained by the disparities in qualities in the two tests, but a third variable considering the warm-up should be taking into account. A study made by Zemkova et al. (2013) used a standardized warm-up before performing the reactive agility test. The subjects in this study did not perform a standardized warm-up before the reactive agility test and this method error may have affected the result since the subjects performed a standardized warm-up before the preplanned agility test.

The validity of FiTRO Agility Check can be questioned when it is used on soccer players. When using a generic cue, such as computerized direction indicator, there is no opportunity for a soccer player to anticipate the direction or timing of this stimulus (Sheppard et al., 2006). The most reliable parameter when testing reaction time in FiTRO Agility Check is the mean of the best eight reactions times in each direction of the test consisting of 3 sets of 60 stimuli. However, there was a significant improvement in reaction time after each trial and the subjects were clearly able to remember the position of initial stimuli (Semková et al., 2013). Therefore, the execution of the test included only one set. The numbers of stimuli used was chosen based on previous attempts involving students that performed the test in order to avoid fatigue.

Sprinting over various distances, including rapid changes in direction, is an important part in soccer. A review of testing methods in soccer concluded that agility tests could provide the best differentiation among nonplayers and elite and recreational performers (Mirkov et al., 2008). Mirkov et al. (2008) claims the validity of the Zig-Zag test and did also study the reliability of the test with good results. Since the Zig-Zag test used in this study was a variation of a Zig-Zag test consisted of four 5-m sections with 100 ^{o} angle its reliability can be discussed. You can still argue for the validity as the test still includes changes in directions over a 25 m track. As described earlier, a sprint distance in soccer normally does not exceed 30 m (Balsom, 2007). However, the reliability is more difficult to argue for since the longer track may involve more anaerobic capacity and not only stored ATP in the muscles (Reilly, 2007).

The current study managed to recruit thirty subjects divided in three groups. Future studies on agility performance within different soccer positions should try to repeat this method with a larger sample size. It is important to have a large sample size to be able to draw conclusions from studies and to avoid type II errors. A small sample size limits the opportunity to get groups that represents the tested population and the ability to present results which represent the actual relationship in the tested population will thereby be limited (Thomas, Nelson & Silverman, 2011).

The age of the players was between 17-19 years. A limitation when testing young soccer players and field positions may be that younger soccer players most often plays on different positions in younger age and have qualities representing various positions. One of Swedish Soccer Association guiding principles is that adolescents should play at different positions because of the difficulty to assess how the adolescents develop in older age (Andersen et al., 1990). The players in this study were divided into defenders, midfielders or forwards depending on which position they had played the most during the past year. This approach of sectioning could have influence the results since some players might not have specialized in a certain position.

Conclusions

The findings of this thesis showed no statistical significant differences between playing positions in reactive agility nor in preplanned agility. The impact of the soccer players' integration with different soccer coaches could be an explanation to the reactive agility results where some coaches may focus on developing perceptual skills more than other coaches. The absence of differences in preplanned agility may suggest that the physical abilities needed to perform the Zig-Zag test did not differ among defenders, midfielders or forwards. It can also be suggested that reactive agility and preplanned agility are two independent variables who do not share characteristics. Future research should focus on incorporating a more valid reactive agility test for soccer players and study larger samples who are specialized in their positions.

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Appendix 1

Information till deltagare i studien ”fotbollsspelares reaktionsförmåga”

Hej!

Jag heter Mikael och läser sista året på Biomedicin – inriktning fysisk träning vid Högskolan i Halmstad. Under denna sista termin kommer jag att arbeta med ett examensarbete där jag testar fotbollsspelares reaktionsförmåga i två olika test för att se om det finns samband mellan bra reaktionsförmåga och snabbhet i riktningsförändringar. Jag undrar om du skulle vilja ställa upp och hjälpa mig genomföra detta examensarbete eftersom du läser på Aspero Idrottsgymnasium med fotbollsinriktning.

Det går att kategorisera högintensiva rörelser under en fotbollsmatch i tre kategorier: maxhastighet, acceleration och agility. Agility kan definieras som riktningsförändringar och att starta och stanna snabbt. Dessa kvaliteter över korta distanser är grundläggande framgångsfaktorer för fotbollsspelare men är också de kvaliteter som är mest kritiska under en match. Det finns flertalet tester som mäter fotbollsspelares förmåga att göra en snabb riktningsförändring men desto färre tester där de mäter spelares reaktionsförmåga. Innan en fotbollsspelare tempoväxlar framåt, bakåt eller i sidled måste han/hon reagera och hur snabbt man reagerar får till konsekvens hur snabbt man kan genomföra sin tempoväxling.

Syftet med studien är att jämföra fotbollsspelares reaktionsförmåga beroende på vilken position de har i laget genom ett sportspecifikt agility test som heter FiTRO Agility Check, och att testa samma fotbollsspelare i ett Zig-Zag Agility test för att kolla sambandet mellan reaktionsförmåga och snabbhet i riktningsförändringar.

Förfrågan om deltagande

Du tillfrågas för att du kategoriseras som fotbollsspelare och antingen har positionen back, mittfältare eller forward och studerar vid Aspero Idrottsgymnasium. För att delta i studien bör du vara skadefri och frisk vid testtillfällena.

Tillvägagångssätt

Om du väljer att delta i studien kommer du erbjudas två testtillfällen. Vid det första testtillfället kommer du som deltar kunna ställa frågor om det är något som är oklart. Innan Zig-Zag Agility test börjar kommer en uppvärmning ske och totalt sett tar uppvärmningen och testet cirka 20 min. Testet som mäter reaktionsförmåga kommer utföras utan uppvärmning och tar ca 10 min att genomföra. Ditt deltagande i studien medför inga risker som inte förekommer under dina vanliga träningspass.

Frivilligt deltagande

Du som testperson har rätt att avbryta ditt deltagande i studien när som helst utan att ange orsak. Om så önskas kommer då redan insamlad data att förstöras.

Sekretess

Information om deltagare kommer att hanteras konfidentiellt. I redovisningen av studien kommer resultatet presenteras på gruppnivå i en kandidatuppsats så att ingen personlig information kan utläsas. Huvudman för studien är Högskolan Halmstad och ansvarig för projektet är jag, Mikael Alm. Du har möjlighet att få tillgång till dina egna resultat om så önskas. Har du några frågor eller vill ha information om resultaten så är du välkommen att kontakta mig, Mikael Alm, enligt kontaktuppgifterna nedan.

Vänligen,
Mikael Alm

Ansvariga

Ansvariga för studien är:
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Samtycke till deltagande i forskningsstudie

Nedan ger du ditt samtycke att delta i den studie som jämför reaktionsförmågan för fotbollsspelare beroende på deras position samt en jämförelse mellan reaktionsförmåga och snabba riktningsförändringar. Läs igenom informationen noga och ge ditt medgivande genom att signera ditt namn nederst på sidan.

Jag medgiver att jag:

- Har tagit del av informationen kring studien och förstår vad den innebär.
- Har fått ställa de frågor jag önskar och vet vem som är ansvarig huvudman och vem jag ska vända mig till om jag har fler frågor.
- Deltar frivilligt i studien och förstår varför jag har blivit tillfrågad.
- Vet att jag när som helst kan avbryta mitt deltagande i studien utan att ange orsak.

Jag intygar att jag har läst det informerade samtycket och tagit del av informationen kring studien. Jag förstår vad deltagande i studien innebär och ställer upp frivilligt.

Ort och datum

____

Underskrift

____

Namnförtydligande

____

Appendix 2

Test form

Name:

Position:

The Zig-Zag test

Test 1: Test 2: Test 3:

FiTRO Agility Check

Results:

Appendix 3

Repetition scheme for the specific warm-up before the Zig-Zag test

- Walking knees to chest	10 x 2	(ten for each leg)
- Lunge walks	5 x 2	(five for each leg)
- Lateral lunges	5 x 2	(five for each leg)
- High knees	10 x 2	(ten for each leg)
- But kicks	10 x 2	(ten for each leg)
- High skips	10 x 2	(ten for each leg)

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