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DEVELOPMENTAL TRAJECTORIES OF SOCCER-SPECIFIC DRIBBLING AND PASSING SKILLS IN YOUNG SOCCER PLAYERS

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ABSTRACT

The purpose of this study was to examine developmental trajectories of soccer-specific dribbling and passing skills including birth cohort, birth month, and sex differences in young soccer players. A total of 3108 (860 girls, 2248 boys) Finnish competitive soccer players were followed through six measurement phases from the age of 10 years continuing until turning 14. The present findings showed that dribbling and passing skills appeared to improve over time. Girls achieved similar dribbling and passing skill scores as boys at the baseline more than two years later. The relative age effect was evident, as younger players (born in Jul-Dec) achieved the same dribbling and passing scores as older players (Jan-Jun) at the baseline a half year later. An unexpected finding was that a difference between older and younger players existed in changes of dribbling, not in passing test scores. Current findings indicated that skill development in soccer is a slow process with a great variation between individuals. It would be beneficial to all players but especially to girls and younger players to practice a wide range of soccer-related skills outside organized events, as practicing a variety of soccer skills may help to learn other specific skills.
***Keywords:** Skill acquisition, development, longitudinal, latent growth curve modelling.*

1. INTRODUCTION

Skill acquisition in team sports is a complex process, which makes it difficult to predict long-term development in young players (Phillips, Davids, Renshaw, & Portus, 2010). An essential prerequisite for young soccer players to be successful is that they possess a certain level of fundamental soccer related skills such as dribbling and passing (Huijgen, Elferink-Gemser, Post, & Visscher, 2010). To date, a little is known about longitudinal patterns of soccer-specific skills in young players covering early adulthood years, instead of comparing birth cohorts through cross-sectional study designs (Ali, 2011; Forsman, Gråstén, Blomqvist, Davids, Liukkonen, & Konttinen, 2015a; Huijgen *et al.*, 2010; Reilly, Williams, Nevill, & Franks, 2000). The present study examined the reciprocal developmental trends of dribbling and passing skills in young competitive soccer players from the age of 10 years until turning 14 years.

Dribbling is running with the ball while keeping it close to feet and under control and such ability is a characteristic of a skilled player, and therefore, an often-measured element of soccer-specific technical skills (Forsman *et al.*, 2015a; Forsman, Gråstén, Blomqvist, Davids, Liukkonen, & Konttinen, 2015b; Haaland & Hoff, 2003; Malina, Cumming, Kontos, Eisenmann, Ribeiro, & Aroso, 2005; Reilly *et al.*, 2000; Vaeyens, Malina, Janssens, van Renrghem, Bourgois, Vrijens, & Philippaerts, 2006). Dribbling speed of an individual player is critical to the success in

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the game, since elite soccer players may perform nearly two hundred brief intense actions during a game (Bangsbo, Iaia, & Krustrup, 2008; Huijgen *et al.*, 2010; Mohr, Krustrup, & Bangsbo, 2003). Previous studies have indicated that soccer-specific dribbling skills appear to improve with age (Ali, 2011; Forsman, 2016; Forsman *et al.*, 2015b; Huijgen *et al.*, 2010; Vanderford, Meyers, Skelly, Stewart, & Hamilton, 2004; Vänttinen, 2013). Typically, boys seem to perform better than girls in dribbling tests (Forsman *et al.*, 2015a; Vänttinen, 2013). However, most previous dribbling skill tests were implemented around cones placed 2 to 4 meters away from each other in a figure-of-eight fashion (Haaland & Hoff, 2003), although there is a greater reliance on sprinting ability rather than soccer-specific skills (Bate, 1996). Furthermore, past studies investigating differences between girls and boys (Ali, 2011; Forsman, 2016; Forsman *et al.*, 2015b) used the combined mean score of the dribbling and passing tests as players' soccer-specific technical skill score so that clear conclusions regarding the development of dribbling skills were limited.

An ability to accurately pass the ball to a teammate is another essential technical skill in soccer and many researchers have designed tests to examine this aspect (Forsman *et al.*, 2015a; 2015b; Huijgen *et al.*, 2010; Malina *et al.*, 2005; Rostgaard *et al.*, 2008). Passing skills require players to demonstrate ability under constraints of time and opposing defenders, decisions of who to pass to, and not only the accuracy but also the strength of the pass (Ali, 2011). Previous studies have shown that passing skills, similar to dribbling, have a tendency to improve with age (Forsman et al., 2015b; Vänttinen, 2013) with boys performing better than girls (Forsman *et al.*, 2015a; Vänttinen, 2013). In turn, Malina *et al.* (2005) found that age contributed relatively little to variation in performance in passing accuracy test scores in adolescent footballers aged 13 to 15 years. According to the large review of Ali (2011), previous short and long distance passing tests may have been too simplistic to assess soccer skills, as the skill element requires players to demonstrate passing ability under constraints of time and opposing defenders (Ali, 2011). In addition, past findings were mainly derived from the repeated cross-sectional data in early adulthood without latent variables capturing individual differences (Byrne, 2012).

During adolescence, usually considered from the age of 10 to the late teens, girls and boys undergo remarkable physical and physiological changes, for instance a growth spurt (Steinberg, 2001). At this ages, less than one-year age difference may be very significant in terms of current skill performance level, as the timing and speed of physical development varies greatly even between players of the same chronological age (Meylan *et al.*, 2010). Previous research has revealed that players born earlier in each birth cohort often have physical and physiological advantages over players born later on the same year (Carling *et al.*, 2009; Malina *et al.*, 2005; Malina *et al.*, 2007; Musch & Grondin, 2001). This relative age effect can partly explain why competitive soccer team selections are often favourable to players born earlier (Cobley *et al.*, 2009; Musch & Grondin, 2001). This is problematic, as it can lead to drop outs of late-developing players who could have the potential to attain excellence in the future (Meylan *et al.*, 2010). Previous studies have not tested the individual patterns of soccer-specific dribbling and passing skills including birth month effects in girls and boys across several measurement points.

A limitation of previous research incorporating development of soccer-specific skills is that studies were targeted to male players (Forsman *et al.*, 2015a; Huijgen *et al.*, 2010), cross-sectional study designs (Ali, 2011; Vänttinen, 2013), small sample sizes (Malina *et al.*, 2005; 2007; Vänttinen, 2013), or insufficient skill measurement protocols (Ali, 2011; Bate, 1996; Haaland & Hoff, 2003). Finally, most previous studies that were designed to identify soccer-specific skills examined technical skills as a part of battery of tests examining other parameters of fitness components (Reilly *et al.*, 2000). Based on the existing evidence, several scholars have suggested specified study designs to monitor soccer skill development over a prolonged period (Forsman *et al.*, 2015a; Huijgen *et al.*, 2010; Reilly *et al.*, 2000). This reinforces the potential for substantial methodological variation regarding developmental trends of soccer-specific skills. The present study extends previous findings by investigating developmental trends of dribbling and passing skill performance in a large sample of 3108 young girls and boys using soccer-specific skill tests with controlled constraints.

The aims of this study were to examine 1) developmental trajectories of dribbling and passing skills, 2) birth month, birth cohort, and sex differences on development of dribbling and passing skills, and 3) reciprocal relationship between dribbling and passing test scores over time in (Fig. 1). Based on previous findings, it was hypothesized that dribbling and passing skill test scores would improve across the six measurement phases (Forsman *et al.*, 2015a; 2015b; Huijgen *et al.*, 2010; Vänttinen, 2013). In addition, boys were expected to achieve better test scores than girl players (Forsman *et al.*, 2015a; Vänttinen, 2013) and older (born in Jan-Jun) players in each birth cohort were assumed to have better skill performance scores than younger (Jul-Dec) players (Malina *et al.*, 2005; Malina *et al.*, 2007).

2. METHODS AND MATERIALS

2.1 Participants

A total of 3108 (860 girls, 2248 boys) competitive soccer players with a mean age of 10.45 (± .27) years in the beginning of the data collection were followed from the age of 10 years continuing until turning 14 years. The sampling followed the total distribution of 31 772 registered female (24%) and male (76%) players in Finland (Football Association of Finland, 2017). Players were born in 1998−2006 and represented 16 soccer clubs, which had been selected for the player development events organized by the Training and Research Centre for Finnish Soccer. Each player typically received 5 to 8 hours of organized soccer practices and games per week (approximately 200 to 300 hours per year), focusing on technical (dribbling, passing, shooting) and tactical skills (offensive skills, 1 vs. 1 skills, defensive skills).

2.2 Procedure

The data were collected from teams participating in the player monitoring event organized by the Training and Research Centre of Finnish Soccer twice a year, at the beginning (February to April) and the end of the competitive season (October to December) in 2009-2017. The data collection comprised six measurement phases during a period of 2.5 years. Players completed technical skills tests under the supervision of the investigator during test sessions. All tests were executed in indoor soccer hall on an artificial grass under equal conditions. Participants were told that their involvement was voluntary and they were allowed to terminate their participation at any time without consequences. The written approvals of the study protocols were obtained from players, parents, and the Human Research Ethics Committee of the local university.

2.3 Dribbling and Passing Skill Tests

Soccer-specific dribbling and passing skills were measured using the tests presented in Fig. 2. The dribbling test started when a player took his first touch, while passing test started when a player kicked his first pass against the wall. Task, in both of these tests, was to complete the test track as quickly as possible. In both tests, the best out of two competitive trials was selected to present skill levels. The mean score of these two tests represented players' technical skills (max. 60 seconds). The reliability of these tests for young soccer players has been confirmed in earlier studies (Forsman et al., 2015a; 2015b; Huijgen et al., 2010; Vänttinen, 2013). Vänttinen (2013) reported that for a sample of 87 Finnish young soccer players with one month interval test-retest correlation coefficient for dribbling was $r = 0.82$ ($p < .001$) and passing $r = 0.81$ ($p < .001$). Recently, the construct validity ($\chi^2 = 141.39$, $df = 12$, $p < .001$, $TLI = 1.00$, $CFI = 1.00$, $RMSEA = .00$, $SRMR = .018$) of the tests was supported in a sample of 288 Finnish competitive male soccer players across a 1-year follow-up study with three measurement points (Forsman *et al.*, 2015b).

2.4 Data Analysis

First, normal distribution, outliers, and missing values were determined. The data was normally distributed and significant outliers were not detected (Tabachnick & Fidell, 2007). Only 84 missing values occurred, because some players missed testing because of injuries, school exams, or dropouts. Apart from this, the number of participants ranged between 1401 (T0), 1431 (T1), 1497 (T2), 1461 (T3), 1546 (T4), and 1537 (T5) over time, as participation in these monitoring events was purely voluntary. Little's missing completely at random (MCAR) -test ($\chi^2 = 1072.25$, $df = 702$, $p < .001$) indicated a difference between cases with and without missing values. A closer examination of frequencies showed that the missing values did not represent any particular team or group. Based on this, the missing values were assumed to be missing at random (MAR) (Little & Rubin, 2002). Missing values were not imputed but estimated using the full information maximum likelihood (FIML), which has been shown to produce unbiased parameter estimates and standard errors under MAR conditions (Muthén & Asparouhov, 2003). Thus, the final dataset had 3108 players with at least one wave of data, which is the requirement needed to properly run the FIML procedure (Burant, 2016).

Descriptive statistics including correlations, means, and standard deviations of observed variables were determined. To answer to the research questions, that is to examine 1) individual developmental trajectories of dribbling and passing skills, 2) birth month, birth cohort, and sex differences in dribbling and passing skills, and 3) reciprocal relationships over time in dribbling and passing test scores, a series of latent growth models were implemented. The latent variables ($Level_1$, $Slope_1$, $Level_2$, $Slope_2$) based on the observed variables with residuals (ε) were estimated. $Level_1$ (dribbling) and $Level_2$ (passing) refer to the initial mean values at the baseline. $Slope_1$ and $Slope_2$ referred to the growth patterns when the initial levels were determined. The default models for longitudinal development were constructed by fixing the loadings of latent variables to 1 on the initial level, and 0 to 5 on the growth variables. In case of poor data fit, alternative non-linear models were fitted (Muthén & Asparouhov, 2002). Sex, birth cohort, and birth month were added into the models as covariates. Differences were also confirmed using two-group protocol, in which two nested models can be tested by constraining subsequent parameters to be equal (Muthén & Asparouhov, 2002).

Chi-square test ($\chi 2$) was used as a test of the model's overall goodness-of-fit to the data. A non-significant difference between observed and theoretical distribution had an acceptable fit to the data. However, the statistical significance of the Chi-square test is typical in the case of large sample sizes (Browne & Cudeck, 1993). To determine the appropriateness of the model the standardized root mean square residual (SRMR) and the root mean square error of approximation (RMSEA), the comparative fit index (CFI), the Tucker-Lewis index (TLI) were also examined (Kline, 2005). A value of .05 or less for SRMR indicate the reasonable magnitude of a varying quantity, a value of .05 or less for the RMSEA indicate an acceptable fit of the model in the relations to the degrees of freedom. The CFI and TLI indices greater than .95 are indicative for an excellent model fit (Kline, 2005). The missing value analysis was performed using SPSS Version 22.0 and all subsequent analyses using Mplus Version 7.4.

3. RESULTS

3.1 Descriptive Statistics

Table 1: Correlations, means and standard deviation of the variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	M	SD
1 Dribbling T0	-	.77***	.60	.75**	.64*	.62	.65***	.60	.64	.54	.48*	.44	.05	.23***	31.53	3.28
2 Dribbling T1	.64***	-	.69***	.80***	.69	.77*	.61***	.59***	.66	.50**	.55	.39	.03	.17	30.54	2.90
3 Dribbling T2	.73***	.57*	-	.64	.73	.76	.47	.45	.64*	.57**	.57	.41	.02	.16	29.83	3.19
4 Dribbling T3	.51	.44	.55**	-	.71	.78***	.61	.56	.63***	.54***	.52	.40	.03	.19	28.90	2.38
5 Dribbling T4	.56	.58	.60***	.47***	-	.76***	.58	.57	.62**	.52	.58***	.44	-.01**	.27***	28.53	2.59
6 Dribbling T5	.46	.41	.46	.36*	.36***	-	.58	.48	.55	.52	.54***	.47***	-.02	.18	27.92	2.38
7 Passing T0	.49***	.41**	.47**	.37*	.42	.37**	-	.54***	.59**	.54**	.57*	.46*	.06	.05**	49.95	6.35
8 Passing T1	.45**	.46***	.38	.31	.34	.27	.38***	-	.57***	.41	.45**	.31	.08	.04	47.81	6.16
9 Passing T2	.37	.35	.42***	.30**	.34*	.35**	.33***	.29**	-	.51***	.55***	.35	.07	.13	45.50	5.66
10 Passing T3	.42	.36	.41**	.45***	.32**	.28	.33**	.37***	.31***	-	.59***	.42**	.02*	.15**	44.75	5.99
11 Passing T4	.29	.25	.33	.28	.30***	.32*	.34**	.25	.25**	.29***	-	.40***	.08	.12	42.93	5.55
12 Passing T5	.39*	.28	.35	.28	.26*	.39***	.26	.28**	.28**	.31***	.31***	-	.04	.14	42.30	6.06
13 Birth month	.12**	.08	.07	.04	.06	.06	.07	.09	.03	.07	.05	.07	-	.03		
14 Birth cohort	-.18	-.15	-.05	.02***	-.13***	.04	-.11	-.10	.05*	-.13***	-.05	-.01	.03	-		
M	28.32	27.84	27.23	26.70	26.44	26.14	43.72	42.79	41.58	40.36	39.43	38.15				
SD	2.48	2.58	2.24	2.13	2.43	2.84	6.33	6.07	6.19	5.81	5.90	5.94				

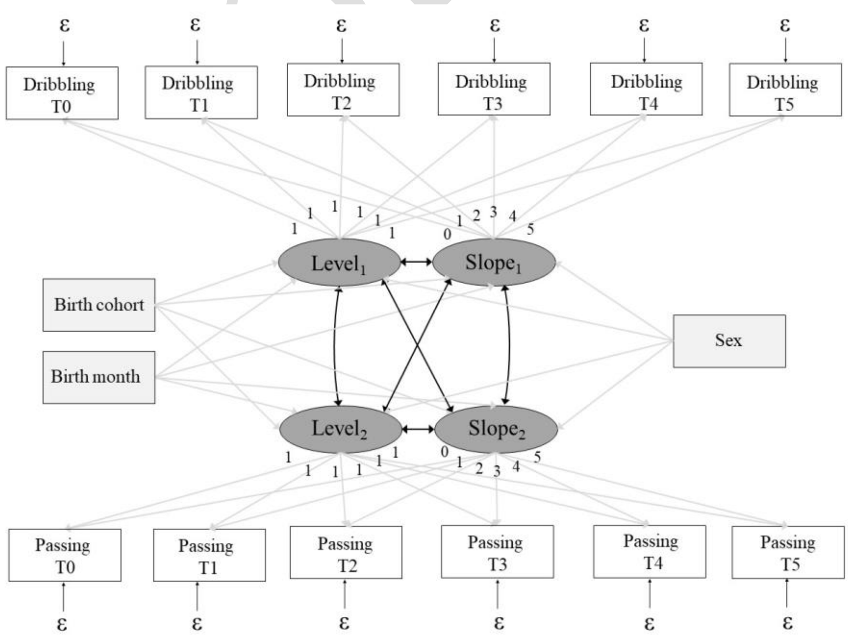
Note 1. Correlations for girls (n = 860) are presented above and for boys (n = 2248) below the diagonal.

Note 2. Means (M) and standard deviations (SD) for girls are presented in vertical columns and for boys in horizontal columns.

Note 3. $^{***}p < .001$, $^{**}p < .01$, $^{*}p < .05$.

First, the correlation coefficients, means, and standard deviations of the study variables were examined (Table 1). The correlations between observed variables ranged from moderate to strong. The strongest positive correlations were found between dribbling test scores at T1 and T3 in females and at T0 and T2 in males, respectively. Correlations between birth month, birth cohort, and technical skill test scores were relatively weak in both girls and boys. About 60% of girls and 64% of boys were born in January to June and the rest later on the same year.

Figure 1: The theorized latent growth curve model of dribbling and passing over time



3.2 Developmental trajectories of dribbling and passing skills

The developmental trajectories of dribbling and passing were separately examined. A linear latent growth curve model revealed a non-acceptable model fit for the dribbling data ($\chi^2(16) = 44.694$, $p < .001$, $CFI = .85$, $TLI = .86$, $RMSEA = .024$, *90% CI* [.02, .03], $SRMR = .214$). Based on the results, the model was established as a non-linear latent growth curve model by allowing the parameters of level and slope at T3 to T5 to be freely estimated. The non-linear model showed an excellent model fit for the data ($\chi^2(10) = 8.798$ $p = .551$, $CFI = 1.00$, $TLI = 1.00$, $RMSEA = .000$, *90% CI* [.00, .02], $SRMR = .056$). The standardized model results highlighted that Level_1 ($\beta = 10.79$, $\sigma_{\bar{x}} = .47$) $p < .001$) and Slope_1 ($\beta = -2.30$, $\sigma_{\bar{x}} = .78$, $p < .01$) were statistically significant with a mean level of 29.21 seconds and a change of -0.65 seconds over time. The model including covariate effects indicated that level of dribbling correlated with birth month ($\beta = .08$, $\sigma_{\bar{x}} = .02$), $p < .001$), birth cohort ($\beta = -.06$, $\sigma_{\bar{x}} = .02$, $p < .05$), and sex ($\beta = -.48$, $\sigma_{\bar{x}} = .03$), $p < .001$). Similarly, the change over time related with birth month ($\beta = -.12$, $\sigma_{\bar{x}} = .06$, $P < .05$), birth cohort ($\beta = .27$, $\sigma_{\bar{x}} = .07$), $p < .001$), and sex ($\beta = .39$, $\sigma_{\bar{x}} = .8$), $p < .001$). Two-group tests confirmed statistically significant group differences in dribbling tests scores with boys performing better than girls at T0 to T5 (Fig. 3) and older players (Jan-Jun) performing better than younger players (Jul-Dec) at T0 to T2 (Fig. 4).

Figure 2: The test courses of dribbling (above) and passing (below) skills (adapted with permission by Forsman et al., 2015a; 2015b

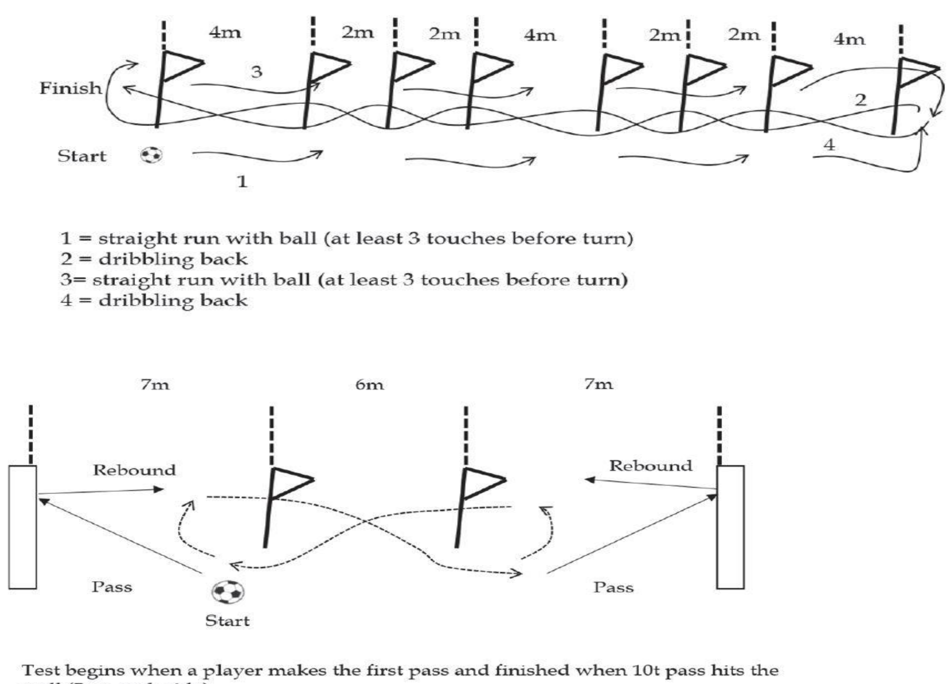


Figure 3: The development trends of girls and boys in dribbling and passing skills over time

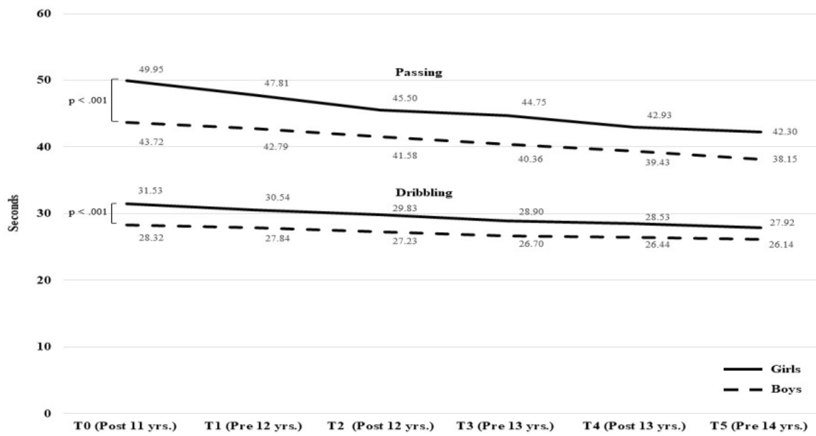
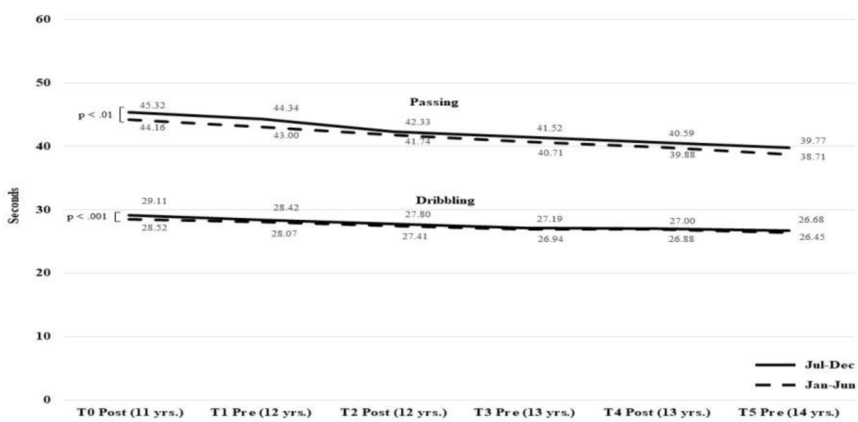


Figure 4: The developmental trends of older (Jan-Jun) and younger (Jul-Dec) players in dribbling and passing skills over time



A linear growth curve model revealed an excellent model fit for the passing data ($\chi^2(16) = 13.039$, $p = .670$, $CFI = 1.00$, $TLI = 1.00$, $RMSEA = .000$, *90% CI* [.00, .01], $SRMR = .042$). The results showed that $Level_2$ ($\beta = 9.73$, $\sigma_{\bar{x}} = .34$, $p < .001$) and $Slope_2$ ($\beta = -2.36$, $\sigma_{\bar{x}} = .66$, $p < .001$) were statistically significant with the initial level of 45.15 seconds and a decrease of -1.19 seconds over time. The covariate results revealed that level of passing test significantly correlated with birth month ($\beta = .08$, $\sigma_{\bar{x}} = .03$), $p < .01$) and sex ($\beta = -.51$, $\sigma_{\bar{x}} = .03$), $p < .001$), whereas the change over time related only with sex ($\beta = .37$, $\sigma_{\bar{x}} = .12$, $p < .01$). Two-group tests showed that boys performed better than girls did across the passing tests T0 to T5 (Fig. 3), whereas older players (Jan-Jun) performed better than younger players (Jul-Dec) at T0, T1, T3, T4, T5 (Fig. 4).

3.3 Parallel Patterns of Soccer-Specific Dribbling and Passing Skills

The parallel growth curve model for dribbling and passing tests was estimated in order to detect reciprocal relationship between levels ($Level_1$, $Level_2$) and changes over time ($Slope_1$, $Slope_2$). The parallel model including the non-linear growth curve model of dribbling and the linear model of passing revealed an acceptable model fit for the data ($\chi^2(59) = 137.983$, $p < .001$, $CFI = .94$, $TLI = .93$, $RMSEA = .021$, *90% CI* [.02, .03], $SRMR = .057$). The initial level of dribbling correlated with the level of passing ($\beta = .90$, $\sigma_{\bar{x}} =.03$), $P < .001$) and changes over time in dribbling ($\beta = -.82$, $\sigma_{\bar{x}} =.07$), $p < .001$), and passing ($\beta = -.33$, $\sigma_{\bar{x}} = .10$), $P < .001$). Similarly, the initial level of passing associated with changes over time in dribbling ($\beta = -.56$, $\sigma_{\bar{x}} = .11$), $p < .001$) and passing ($\beta = -.57$, $\sigma_{\bar{x}} = .08$, $p < .001$). Variances of dribbling ($p < .001$) and passing ($p < .001$) level and passing slope ($p < .05$) indicated that individual scores varied widely between players. Squared multiple correlations showed that the model explained 49% to 79% of the variability of observed variables in dribbling and 39% to 50% in passing skill scores.

4. DISCUSSION

The purpose of this study was to examine longitudinal development of dribbling and passing skills in young Finnish soccer players including birth month, birth cohort, and sex differences. The results showed that the dribbling skill test scores improved over time until players turned 14 years. This was in line with previous findings, which have shown that soccer-specific skills appear to improve with age (Ali, 2011; Forsman, 2016; Forsman *et al.*, 2015b; Huijgen *et al.*, 2010; Vanderford *et al.*, 2004; Vänttinen, 2013). However, the average improvement appeared to be smaller in the current large sample of players including both girls and boys than in a smaller sample (Ali, 2011; Vänttinen, 2013) and gender-specific studies (Forsman *et al.*, 2015b; Huijgen *et al.*, 2010). For instance, the study by Forsman et al. (2015b) was targeted at male players, Huijgen *et al.* (2010) did not specify gender distribution of the participants, and the follow-up study of Vänttinen (2013) covered a small sample of 40 players. From this perspective, the average improvements of dribbling the test with 3108 young players can be considered reasonable. Players in the current sample were at the age, when physical development can rapidly change (Meylan *et al.*, 2010), and further, influence on the skill improvements throughout the measurements.

As expected, sex differences with boys scoring better than girls were consistent with previous studies (Forsman *et al.* 2015a; Vänttinen, 2013). An extension for previous research findings was that girls achieved similar dribbling and passing skill scores as boys at the baseline more than two years later. There is some existing evidence that skilled young soccer players may have bigger body sizes (Gil *et al.*, 2007; le Gall *et al.*, 2010) and less body fat (Vaeyens *et al.*, 2006) than less skilled players. Similarly, boys may have physical and physiological advantages over girls (Musch & Grondin, 2001), which can lead to better performances in soccer-specific technical skill tests including dribbling skills. This may also explain the differences between birth cohorts, since some cohorts included more females than some other cohorts did. Specifically, the proportion of female players ranged from 11% to 33% between the cohorts.

Additionally, the relative age effect was evident, as players born in the first half of year in each cohort performed better in dribbling tests than players born in the second half on the same year did. This result followed previous research findings (Malina *et al.*, 2005; Malina *et al.*, 2007) with more details, as later born players (Jul-Dec) seemed to achieve the same dribbling score levels as older players (Jan-Jun) at the baseline approximately a half year later. It could be argued that older players might have, for instance higher running speed and strength over younger players, which materialized as established skill differences. However, both of these tests required high-quality ball control using several cones as “defenders” and time limitations, which means that only physical or physiological development does not lead to higher performance (Malina *et al.*, 2005; Malina *et al.*, 2007). Nevertheless, the age related differences in dribbling seemed to disappear when players turned 13 years. An explanation behind this may be that older players have simply had more time to practice soccer related skills, which appeared as significant differences in the first measurement points.

The passing test scores improved across a period of 2.5 years. This finding supported previous studies (Forsman *et al.* 2015a; 2015b; Huijgen *et al.*, 2010; Vänttinen, 2013), although the improvement was almost unnoticeable. The large sample size and variation between players may be the reasons why greater improvement did not materialize. Recognizing that previous longitudinal studies had significantly smaller sample sizes (e.g. Deprez *et al.*, 2012; Huijgen *et al.*, 2010; Vänttinen, 2013) or gender-specific study design (Forsman *et al.* 2015b), the present small improvement was not unexpected.

As in the dribbling test scores, significant sex differences were found in passing skill tests with boys performing better than girls over time. Furthermore, the initial level of passing test significantly correlated with birth month with players born earlier scoring better than players born later in each birth cohort. This finding was also in line with past soccer-skill research (Malina *et al.*, 2005; Malina *et al.*, 2007) and repeated results of dribbling skill tests presented above. More likely, both dribbling and passing require similar open skills and abilities, which improve over time by practising a range of fundamental skills (Gallahue & Cleland, 2003). For instance, the study examining the elite soccer players under 16 years from Brazil, England, France, Ghana, Mexico, Portugal and Sweden showed that successful players engaged in organized soccer activities more than 200 hours and other soccer related activities 200 hours per year (Ford et al., 2012). On average, most players in the current sample received organized and other soccer activities roughly 200 to 300 hours per year. It seems that the total amount of organized and non-organized soccer related activities contribute to present skill level. Haugaasen, Toering, and Jordet (2014) found that time spent in non-soccer activities did not contribute to present differences in performance attainment in football, but also that potential advantages of such activities may be possible. Moreover, the quality of participation seems to be an important factor that enables some players to gain more from practice than others (Haugaasen & Jordet, 2014). On this basis, to transform a less skilled player to a skilled one, it would be beneficial that coaches encourage players to practice a wide range of soccer skills including dribbling and passing with multiple deliberate touches on the ball (Coughlan *et al.*, 2014) in their leisure time, not only during the organized sessions.

Although Malina *et al.* (2005) showed that age contributed relatively little to variation in performance in passing accuracy test scores, a somehow unexpected finding was that the developmental change over time in passing did not relate with birth month, while the relationship between the change over time in dribbling skills and birth month was evident. It may be that the dribbling skill test requires, nonetheless, some different physical qualities compared to the passing skill test. Accordingly, players born earlier in each cohort with possible greater amount of time and effort put in soccer skill practices could have improved better dribbling skills but not visible differences in the development of passing skills, as practice is more significant rather than month of birth concerning skills improvements (Coughlan *et al.* 2014).

This study was the first to examine parallel patterns of passing and dribbling skills using latent variables across several measurement points, including pre- and post-season measurements. Specifically, the parallel model for soccer-specific skills was estimated in order to detect reciprocal relationships between initial levels of and changes in dribbling and passing over time. The results showed that the higher initial skill test scores in dribbling positively related with the higher level of passing and skill improvements over time. Similarly, passing skill test scores had a significant association with improvements in both dribbling and passing over time. A possible explanation for the strong relationships between test scores is that both skills require similar open skills, for instance, perceptual motor skills to control speed, eye-foot coordination to control the ball, and movement skills to maintain balance and high-intensity running (Gallahue & Cleland, 2003). This has also been proven by several previous soccer skill studies with smaller samples (Forsman *et al.* 2015b; Huijgen *et al.*, 2010; Malina *et al.*, 2005; Malina *et al.*, 2007; Vänttinen, 2013), however, studies examining the relationships between individual dribbling and passing skills, not as a combination have been lacking. From this perspective, the current study provided important insights into soccer-specific dribbling and passing skill development with this information reproduced by latent growth curve modelling.

A key strength of the present study was the longitudinal study design with a large sample of 3108 young girls and boys across six pre- and post-season measurement points. Compared to most previous studies (Ali, 2011; Haaland & Hoff, 2003), the current skill tests included constraints of time and opposing defenders, i.e. cones. Although sport-specific skill tests are particularly vulnerable to the adverse impacts of external factors, for instance running speed, the present test protocols have been used in several past soccer-specific skill studies (Forsman *et al.*, 2015a; 2015b; Huijgen *et al.*, 2010; Vänttinen, 2013). On this basis, the results may be considered reliable. Nonetheless, this study was not free of limitations. First, the test results should not be directly applied to outdoor conditions, as Andersson *et al.* (2008) found that players tend to perform more passes on flat artificial surfaces relative to playing on grass. Furthermore, the longitudinal studies are always vulnerable for missing values. Although the sample size was quite large across the study, the size varied between the measurement points. Second, the study could have benefitted from the more detailed analysis of quantity of free practice sessions, especially outside organized events. This would have required more resources, which were not available for the current long-term data collection. Therefore, future studies could examine the quality and quantity of skill practice sessions with more details. Since the present study sample consisted of Finnish young soccer players only, a larger international study with female and male players at different ages could provide interesting results about soccer-specific skill development processes.

5. Conclusions

The study indicated that skill development in soccer is a slow process with a great variation between individuals. Acknowledging current findings, boys and players born earlier in each birth cohort performed better in both dribbling and passing skill tests. Practicing a wide range of soccer related skills might also help to learn specific soccer skills, respectively. In other words, young soccer players could benefit widely from technical drills, in which they get multiple deliberate touches on the ball. The biggest challenge for all sport coaches, not only soccer trainers, in the modern world is that young players have multiple other options to spend their leisure time. To transform a less skilled player to a skilled one requires that players spend more time with a variety of technical skill practices on their leisure time, not only during the organized sessions.

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