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Actual and perceived motor competence mediate the relationship between physical fitness and technical skill performance in young soccer players

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ABSTRACT
This study examined the role of fundamental movement skills (FMS) and perceived competence in the relationship between physical fitness and technical soccer skills in children. Seventy boys aged 7-12 years of age (Mean ± SD = 9 ± 2 years) who were regularly engaged in grassroots soccer participated in the present study. The Test of Gross Motor Development-2 (Ulrich, 2001. *Test of gross motor development* (2nd ed.). Austin, TX: PRO-ED) was used to assess FMS and the Perceived Physical Ability Scale for Children (Colella, Morano, Bortoli, & Robazza, 2008. A physical self-efficacy scale for children. *Social Behavior and Personality: an International Journal, 36*, 841–848) was used to assess perceived competence. Technical skill was determined from three tests reflecting dribbling, passing and shooting. Z-scores of each measure were summed, creating a composite measure of technical skill. Three measures of physical fitness were employed; 15m sprint time, standing long jump, and seated medicine ball (1kg) throw. Z-scores for each measure were summed creating a composite measure of physical fitness. The relationship between technical skill and FMS, fitness, perceived competence and age was examined via path analysis. Results indicated two significant mediated pathways: from physical fitness to technical skills via FMS, and from physical fitness to technical skills via perceived competence. Once these mediators had been accounted for, there was no direct link from physical fitness to technical skills. Coaches should therefore seek to avoid one-sided delivery of practice by not solely focusing on football type drills, and focusing on a range of activities which enhance a broad foundation of FMS and promote strategies to positively influence a child's perception of their own competence.

KEYWORDS
Motor competence; children; grassroots; talent identification; path analysis

Highlights

- Fundamental movement skills (FMS) are considered the foundation for physical activity and sport performance yet they tend to be overlooked, in favour of physical fitness, in the development of soccer talent.
- We examined mediating effects of FMS and perceived competence in the relationship between physical fitness and technical soccer skills in 70, 7-12 year old grassroots soccer players.
- We suggests there is no direct effect of physical fitness on technical skills in soccer but both FMS and perceived competence act as mediators of the physical fitness-technical skill relationship in children aged 7-12 years old.
- Coaches should therefore look to develop a broad base of FMS and a higher perception of competence to improve children's technical soccer skills.

Introduction

Grassroots soccer defined as recreational soccer, particularly with children from the age of 6 years on (Fifa, 2011), is a dynamic activity, comprising technical, tactical, physical and psychological demands (Forsman et al., 2016). Recreational soccer is played by over 3.3 million children in England alone (The FA, 2015) and can provide health enhancing physical activity for children but can also provide a path to more specialised sport performance through talent development programmes employed by national governing bodies in various countries (North et al., 2014; The FA, 2016). Although the development of soccer related motor skills are considered essential for success in soccer (Rampinini, Impellizzeri,

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Castagna, Coutts, & Wisløff, 2009), there has been a tendency to focus on physical fitness as key indicators of game performance in elite and recreational youth players (Höner, Leyhr, Kelava, & Buekers, 2017; Meylan, Cronin, Oliver, & Hughes, 2010; Serrano, Pizarro, García-González, Domínguez, & Álvarez, 2017; Unnithan, White, Georgiou, Iga, & Drust, 2012). Recently, there has however been acknowledgement that scientists and coaches need to go beyond physical fitness and consider multidimensional characteristics of potential talent in soccer (Sieghartsleitner, Zuber, Zibung, & Conzelmann, 2019).

The importance of motor competence and the development of fundamental movement skills (FMS) has only recently become a more prominent consideration in the development of soccer related talent in children (Jukic et al., 2019; Kokstejn, Musalek, Wolanski, Murawska-Cialowicz, & Stastny, 2019; Rommers et al., 2019). Although the terms motor competence and FMS are not identical, motor competence has been defined as a person's proficiency to execute FMS, or the basic motor skills that form the foundation of specialised skills needed to engage successfully in sports, games, dance and other contexts of physical activity (Utesch & Bardid, 2019). Despite FMS being considered as the foundation for subsequent sports skills (Utesch & Bardid, 2019), there remains a lack of research examining how FMS influences soccer specific skills in childhood. Although research has described the direct relationships between physical fitness with technical skill, the importance of FMS in the process of acquiring technical skills in young soccer players has been largely ignored (Kokstejn et al., 2019). This is despite the fact that developing FMS is a feature of governing body coaching awards in soccer (North et al., 2014; The FA, 2016) and is key in the Athletic Skills Model (Wormhoudt, Savelsbergh, Teunissen, & Davids, 2017) as a framework for children's movement development.

Most recently, research by Jukic et al. (2019) identified, in a sample of 23, 9–10 year olds, that children classed as first team players had better FMS, based on effect sizes, but similar physiological fitness to second team selected players. Another study by Kokstejn et al. (2019) extended the focus on FMS as important in youth soccer development by examining relationships between FMS, fitness and speed dribbling in 40 elite, Czech youth players. Unlike Jukic et al. (2019), the inclusion of a technical skill (dribbling) within the work of Kokstejn et al. (2019) demonstrated a link between FMS, fitness and soccer specific motor skill. Using path analysis, inclusion of FMS in the model presented by Kokstejn et al. (2019) significantly strengthened the association between fitness and dribbling performance. This led Kokstejn et al. (2019) to conclude that FMS plays an important role in the acquisition of soccer specific motor skill. Despite this, Kokstejn et al. (2019) only considered one form of motor skill related to soccer and did not consider any influence of psychological variables in the relationship between physical fitness and soccer specific motor skills, noting this as a need for future research. A child's perception of their own competence may be one such psychological construct that is influential in the context of the work conducted by Kokstejn et al. (2019). Perceived competence is an assumed contributor to the impact of FMS on habitual physical activity (Robinson et al., 2015; Stodden et al., 2008) and research suggests that children who have lower perceived motor competence have poorer movement skills (Duncan et al., 2020). There is also evidence that perceived competence relates to a child's FMS (Barnett, Morgan, Van Beurden, Ball, & Lubans, 2011). Although historically, studies have suggested that self-perception of competence becomes more accurate as children age (Harter, 1987) and the Stodden et al. (2008) conceptual model suggests age as an important moderator, of the association between actual and perceived competence, the most recent meta-analysis on this topic found no such association (De Meester et al., 2020). No research has examined how perceived competence might influence sport specific technical skills in children, despite suggestion it may be important (Kokstejn et al., 2019).

This study sought to address noted limitations of the work by Kokstejn et al. (2019) by examining the role of FMS and perceived competence in the relationship between physical fitness and technical skills in prepubescent soccer players.

Methods

Participants

Seventy boys aged 7–12 years of age (Mean ± SD = 9 ± 2 years, 135.2 ± 10.1 cm, 31.8 ± 9.1 kg) who were regularly engaged (i.e. were registered and had played for a grassroots soccer team for at least one season) in grassroots soccer participated in the study following institutional ethics approval, informed parental consent and child assent. Children were recruited from grassroots football clubs within Birmingham County FA. The researchers contacted club secretaries informing them of the aims of the study, which were subsequently passed to individual teams at each age group. Parents of players from those teams then contacted the researchers to volunteer to participate. Mean ± SD of formalised playing experience was 3.1 ± 1.5 years and mean ± SD of time spent in grassroots soccer training and matches was 163.7 ± 50.9 min per week with a trend ($r = .88$) to increasing time spent in training and matches with age.

Procedures

All assessment took place over two days. On day 1, psychometric questionnaires were completed and followed by anthropometric assessment. On day 2, technical skill and fitness assessments were conducted.

Anthropometry

Height (cm) and body mass (kg) were assessed to the nearest 0.1 cm and 0.1 kg using a SECA stadiometre and weighing scales (SECA Instruments Ltd, Hamburg, Germany).

Fundamental movement skills

The Test of Gross Motor Development-2 (TGMD-2; Ulrich, 2001) was used to assess FMS. Assessment comprised of run, jump, hop, overhand throw, catch, and strike skills to reflect a balance of locomotor and object control skills, without the inclusion of kick to avoid confounding the assessment of FMS and technical soccer skills. Trials of each skill were video-recorded (Sony Handicam CX405b, Sony, UK) and subsequently edited into single film clips of individual skills with Quintic Biomechanics analysis software v21 (Quintic Consultancy Ltd., UK). Scores from two trials were summed to create a total FMS score (scored 0–50) following recommended TGMD-2 test administration guidelines (Ulrich, 2001). Two researchers experienced in the use of the TGMD-2 to assess FMS analysed the video clips. Prior to data collection each researcher had undertaken two separate 2–3 h sessions by watching videos of children's skill performances and rating these against a previously rated "gold standard" rating. Congruent with prior research (Barnett, Minto, Lander, & Hardy, 2014), training was considered complete when each observer's scores for the two trials differed by no more than one component per trial from the instructor score for each skill (>80% agreement) (Barnett et al., 2014). We performed inter- and intra-rater reliability analysis for all skills between the two raters on 10% of all the videos. Intraclass correlation coefficients for inter and intra-rater reliability were .93 and .98 respectively. To provide an indication of the competence level of participants, the proportion of children achieving "advanced skill proficiency" in each of the skills was calculated (O'Brien, Belton, & Issartel, 2016). Advanced skill proficiency was 35%, 62%, 60% for run, jump and hop respectively, and 59%, 62% and 40% for the throw, catch and strike respectively. Such values are better than those previously reported for non-specifically trained British children (Lawson, Eyre, Tallis, & Duncan, in press).

Perceived competence

The Perceived Physical Ability Scale for Children (PPASC, Colella et al., 2008) was used to assess perceived competence and administration followed guidelines for completion (Colella et al., 2008). The PPASC is a valid and reliable tool for children of the ages taking part in this study which comprises 6-items reflecting strength, speed and coordinative abilities. Items are structured in response scales with a 1–4 format with labels attached to each response scale to assist giving meaning to the items for the children (e.g. from 1 (I run very slowly) to 4 (I run very fast)). The children were asked to think of themselves when playing/training in soccer and were asked to choose the response that best represented their perceived physical competence. Potential scores ranged from 6 to 24 with higher scores representing a higher self-perception of physical competence. The PPASC has demonstrated acceptable reliability (Cronbach's $\alpha = .72$) and validity via factor analysis in children aged 8–10 years (Colella et al., 2008) and 6–7 years of age (Morano, Bortoli, Ruiz, Vitali, & Robazza, 2019).

Technical skills

Technical soccer skill was determined from three tests of technical skills, reflecting dribbling, passing and shooting. All testing took place on a sports hall surface with participants wearing soccer training shoes. Testing was completed with the official ball size for age band (Size 3 for U8-U9, Size 4 for U10-12) as recommended (The FA, 2016).

The Ghent University (UGent) dribbling test, as described by Vandendriessche et al. (2012), was employed to determine dribbling ability. Participants completed a set circuit with four left and four right turns at different angles with a distance between cones ranging between 1 and 2.2 m (Vandendriessche et al., 2012). Following familiarisation and a practice trial, each participant undertook two attempts at the test. Each test was performed as quickly as possible in two phases: the first phase was undertaken without the ball and the second phase with the ball. The time of each attempt was measured to the nearest 0.01 s with a handheld stopwatch. The time taken to complete the dribbling course without the ball was deducted from the time with the ball to give a skill differential reflecting dribbling skill. This test has a good reliability, shown by an intra-class correlation coefficient (ICC) of 0.81 (Vandendriessche et al., 2012) and an ICC of .82 in a sub-sample ($n = 30$) of the current sample.

The Haaland and Hoff (2003) passing test was used to assess passing ability. The ball was passed by a research assistant from the side of the participant with the participant being asked to pass the ball to a target, measuring 1m wide X 40 cm high, 10 m in front of the participant. A pass was received from the right and left hand side respectively. The definition of a successful pass was that the ball had to be rolling and not jumping, and that the ball moved until the pass was completed, as per guidelines for administration (Haaland & Hoff, 2003). The ball was passed using one touch towards the target and unsuccessful passes to the participant were not counted. Fifteen passes were attempted using each foot with one point awarded per successful attempt, with a total score possible of 30. ICC for the Haaland and Hoff (2003) passing test in the sub-sample of 30 participants was .87.

The Rosch et al. (2000) shooting test was employed to assess shooting ability. A 10 m pass was played by a researcher from the side of the penalty area towards the penalty spot. Using a short run up the participant shot the ball toward the goal, which was divided into six segments with points awarded for accuracy of shot. Five attempts were executed and unsuccessful passes were not counted. Shots were awarded six points if the ball hit the top right or left segments of the goal, two points if the participant hit the ball into the top middle segment of the goal, one point if the ball hit the lower segments of the goal, the crossbar or the goal-posts. ICC for the Rosch et al. (2000) shooting test in the sub-sample of 30 participants was .89.

Once all the tests were completed, a Z-score was determined for each of the three measures of soccer technical skill and then all Z-scores were summed to create a composite measure of technical skill reflecting dribbling, passing and shooting performance.

Physical fitness

Three measures of physical fitness were employed; 15 m sprint time, standing long jump, and seated medicine ball (1 kg) throw. Each participant's 15-meter sprint time was assessed using infra-red timing gates (Fusion Sport, Coopers Plains, Australia) with sprint time converted to speed in m/s. Two infra-red gates were set up 15 m apart. Each participant had a flying start (1 m before the start gate) to ensure that sprint time was measured independently of the acceleration phase and reflected running speed. Standing long jump was determined as distance from take-off line to the back of the closest heel on landing and assessed using a tape measure. With the toes behind the starting line, each child used a countermovement before jumping forwards as far as possible. Participants performed the seated medicine ball throw, as a measure of upper body strength, using a 1 kg medicine ball. Participants sat on the floor, with legs outstretched and ensuring their back was upright, before throwing the medicine ball forward like a chest pass three times. Distance thrown (in centimetres) was assessed with a tape measure. For sprint speed and long jump, the best of two trials (fastest speed in m/s; longest jump in centimetres) were selected for analysis and for seated medicine ball throw the furthest distance thrown was used for subsequent analysis. Administration of fitness tests followed recommended protocols for the assessment of speed and power (Miller, 2012). Intraclass correlation coefficients, based on our subsample ($n = 30$) of children in the current study, for the three product measures of fitness were .9 for the 10 m sprint, .94 for the standing long jump, and .86, for the seated medicine ball throw indicating good reliability. As with technical skills, we calculated a Z-score for each of our three measures of fitness and summed these Z-scores to create a composite product measure of physical fitness.

Statistical analysis

To examine the relationship between technical skills and FMS, fitness, perceived competence and age path analysis was used. Path analysis is widely used to test hypothesised mediated pathways between observed variables (e.g. Kokstejn et al., 2019). Path analysis is essentially a succession of multiple regression equations resulting in path coefficients with the benefit that covariances can be estimated, and fit statistics are produced to provide an indication of how well the model fits the data (Tabachnik & Fidell, 2019). We report five fit statistics: Chi square (χ^2), the Normed Fit Index (NFI), the Comparative Fit Index (CFI), the Incremental Index of Fit (IFI), and the root mean square error of approximation (RMSEA) plus its 90% confidence interval. For NFI, CFI and IFI, values greater than .85 indicate a reasonable fit, greater than .90 represent a good fit, while values greater than .95 represent a very good fit. RMSEA values less than .06 indicate a good fit, values up to .08 indicate a reasonable fit, and values greater than .10 represent a poor fit (Tabachnik & Fidell, 2019). Models were built in AMOS 26.0 using maximum likelihood estimation.

We tested a hypothesised model which specified fitness (predictor) predicting FMS (mediator) and self-

Table 1. Mean ± SD and 95% confidence intervals of age, technical skill z-score, physical fitness z-score, total FMS and perceived competence.

	Mean	SD	95% CI
Age (Years)	9.4	1.6	9.0–9.8
Technical Skill (z-score)	−.01	2.5	−.64–.61
Physical Fitness (z-score)	−.03	2.4	−.63–.57
Total FMS (0–50)	34.1	7.4	32.2–35.8
Perceived Competence (6–24)	18.5	2.3	18.1–19.2

perception of skill (mediator), which in turn predicted technical skills (outcome), while controlling for age. A direct link from fitness to technical skills was also included. Variables that act as predictors but are not predicted by other variables in the model are known as exogenous variables, while variables that are predicted by other variables in the model are known as endogenous variables. In the current model, fitness and age acted as exogenous variables, while FMS, self-perception, and technical skills were endogenous variables. Following the recommendations for mediation analysis in Hayes (2018), we tested two models. First, we tested the full model, which included all hypothesised links (based on previous literature, we would expect all variables to be linked). Second, non-significant links were removed until we reached the most parsimonious model that did not result in a significant reduction in model fit, resulting in the final model.

Results

Mean ± SD and 95% confidence intervals for all variables are presented in Table 1.

The hypothesised model (Figure 1) showed an excellent fit to the data; $\chi^2(1) = 0.093$, $p = .760$, NFI = 1.000 IFI = 1.000, CFI = 1.000, RMSEA = .000 (CI .000–.217). The model displayed three links that were non-significant;

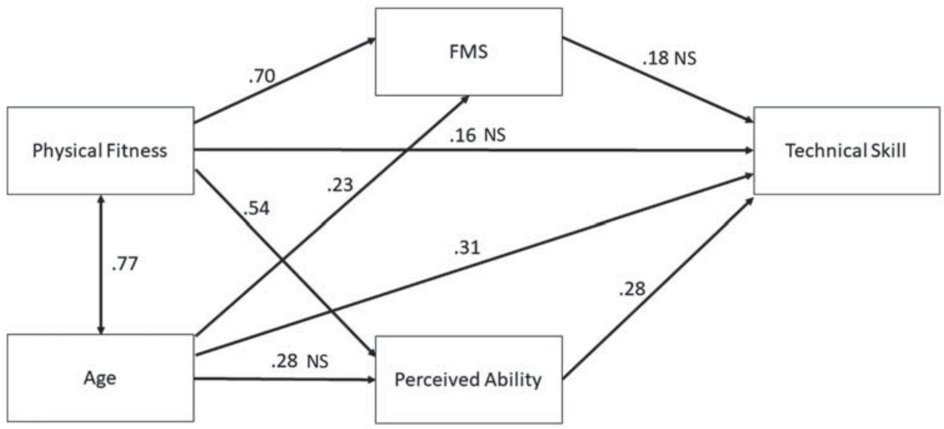

Figure 1. The hypothesised model. Path analysis showing all hypothesised links between variables. Standardised regression coefficients (betas) are shown next to each link. All links are significant ($p < .05$), unless marked with NS (non-significant).

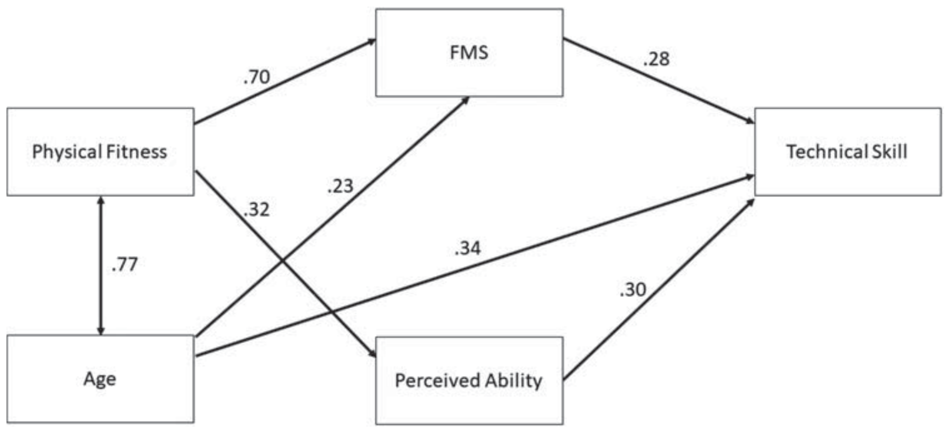

Figure 2. The final model. Path analysis showing significant links between variables once non-significant links have been removed. Standardised regression coefficients (betas) are shown next to each link. All links are significant ($p < .05$).

physical fitness to technical skills; $b = .16$, $p = .402$, FMS to technical skills; $b = .18$, $p = .325$, and age to perceived competence; $b = -.28$, $p = .107$. Removal of the direct link physical fitness to technical skills resulted in the FMS to technical skills link becoming significant, $b = .28$, $p < .05$. Therefore, we retained this link. Removal of the two remaining non-significant links (physical fitness to technical skills, and age to perceived competence) resulted in a non-significant change in model fit, $\Delta\chi^2(2) = 3.3$, $p = .192$. Therefore, the model without these links was accepted (Figure 2). The final model displayed a very good fit to the data, $\chi^2(3) = 3.38$, $p > .337$, NFI = .985, IFI = .998, CFI = .998, RMSEA = .043 (CI .000–.212).

The final model

The final model (Figure 2) showed two significant mediated pathways: from fitness to technical skills via FMS, and from fitness to technical skills via perceived competence. Once these mediators were taken into account, there was no direct link from physical fitness to technical skills. The size of the mediated pathways (indirect links) can be calculated by multiplying the standardised betas together. The size of the fitness to technical skills link, via FMS was 0.20 (1 SD increase in fitness resulted in 0.20 SD change in technical skills through improvements in FMS), and the size of the link from fitness to technical skills, via perceived competence was 0.10 (1 SD increase in fitness resulted in 0.20 SD change in technical skills through improvements in perceived competence).

Discussion

This study examined, for the first time, the relationship between physical fitness, FMS, perceived competence and technical soccer skills in grassroots youth soccer players. The results of the current study suggest no direct effect of physical fitness on technical skills but that both FMS and perceived competence act as mediators of the physical fitness-technical skill relationship in children aged 7–12 years old.

The notion of a direct link between physical fitness and technical soccer skills is not new and physical fitness has been identified as a key determinant of game performance in youth soccer (Höner et al., 2017; Serrano et al., 2017; Unnithan et al., 2012). From a theoretical perspective, children and youth with better physical fitness have been shown to receive more minutes playing time resulting in more opportunity to develop technical skills (Deprez et al., 2015). As a consequence fitter players during adolescence are more likely to play at a higher standard as adults (Le Gall, Carling, Williams, & Reilly, 2010). Within the literature measures of physical fitness, such as those measured in the present study, are identified as key components of physical fitness related to technical performance in soccer (Deprez et al., 2015; Gonaus & Muller, 2012; Le Gall et al., 2010).

It is also important to contextualise the development of the wider motor development literature. Clark and Metcalfe (2002) proposed the mountain of motor development, a framework to describe global changes in motor development through life. In the model, the period from one to seven years, termed the fundamental motor pattern period, is characterised by the acquisition of basic coordinative patterns that form the basis of later emerging skills, such as those used in sport. Following this, the context specific skill period is entered (approximately 7–11 years) where skills are refined for a specific purpose, such as those needed in soccer. The results of the present study align with this model suggesting that those FMS, developed during in childhood, contribute to the performance of sport specific technical skills, and that focusing on physical fitness, (as previously documented, Vaeyens et al., 2008), without an emphasis on FMS is likely to be less effective in the development of technical ability in grassroots soccer players. Such a suggestion aligns with the Athletic Skills Model (Wormhoudt et al., 2017) as a key theoretical framework for youth sports development. In addition, the present study supports assertions that perceived competence is a key variable related to children's physical activity and sport participation and performance (Barnett et al., 2011). Previous research by Kokstejn et al. (2019) also recently suggested that FMS was a key factor in the relationship between fitness and soccer dribbling performance in elite youth players. The results presented here extend this research providing evidence that FMS, alongside perceived competence are key mediators in explaining technical performance in soccer using an assessment of technical skills reflecting the main aspects of children's soccer performance (dribbling, passing and shooting). A key question that should be asked is why is it plausible to accept that both FMS and perceived competence mediate the relationship between physical fitness and technical skill. There is evidence that non-specific motor coordination (Deprez et al., 2015) and FMS (Kokstejn et al., 2019) are important, alongside physical fitness in development of high level youth soccer performance. Better FMS is theorised to enable more flexible solutions to movement problems in sport specific scenarios (Wormhoudt et al., 2017) as well as providing children with the broad base of movement skills to successfully engage in sport (Stodden et al., 2008). Similarly, children with higher self-perceptions will be more motivated to participate in physical activities and, thus, further develop their skills (Harter, 1987; Stodden et al., 2008). Therefore, it would seem reasonable to suggest that children with better FMS and higher perceived competence are better able to engage in different types and forms of movement, and are more motivated to develop their skills. This in turn would segment the effect of higher fitness on technical skills.

The results of the current study suggest that coaches should be mindful to develop FMS and promote perceptions of competence in the children they work with. This is a key practical implication of the current study and coach behaviour is crucial within this. A well-developed base of FMS and high perception of competence should be encouraged in players aged 7–12 years for the benefit of soccer specific technical skills. In addition, age also contributed to significantly explaining the model related to technical skills, with older age associated with better technical skills. Such a finding is not unexpected as technical proficiency increases with age (Rommers et al., 2019).

The current study is not without limitations. The results are cross sectional and, although we assessed a larger number of participants than in prior similar work (e.g. Kokstejn et al., 2019), additional research is needed to verify the findings presented here. The lack of direct effect of fitness on technical skills may possibly be due to the age and developmental stage of the children involved. This is especially the case as prior work has demonstrated a more direct link between fitness and success in soccer with older adolescents (Deprez et al., 2015; Le Gall et al., 2010). We employed a composite measure of both physical fitness and technical skills as a means to address limitations of prior work where only one aspect of soccer skill was examined (Kokstejn et al., 2019). In this way, we provide a holistic overview reflecting technical skills for soccer. A useful next step would be to establish how FMS might relate to tactical as well as technical ability in youth soccer. Our inclusion of a measure of perceived competence addresses a need for considering psychological factors alongside FMS, fitness and technical skills. However, there is potential that other psychological constructs might influence the development of technical skills in grassroots soccer, and as such, should be considered in subsequent research. We acknowledge that the measurement tools for FMC and perceived motor competence are not directly aligned in terms of perceived competence items directly mapping onto the FMS skills that were assessed.

Conclusions

This study suggests there is no direct effect of physical fitness on technical skills in soccer. However, both FMS and perceived competence act as mediators of the physical fitness-technical skill relationship in children aged 7–12 years old. As a broad base of FMS may enable children to move more effectively, and as a higher perception of confidence is associated with greater engagement in activities to improve skills, coaches should be mindful of these constructs when working with players aged 7–12 years old.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

Avery, E, & Park , s.. (2016). Effects of crisis efficacy on intentions to follow directives during crisis. *Journal of Public Relations Research*, *28*, 72–86. https://doi.org/10.1080/1062726X.2016.1165681

Barnett, L. M., Minto, C., Lander, N., & Hardy, L. L. (2014). Interrater reliability assessment using the Test of Gross Motor Development-2. *Journal of Science and Medicine in Sport*, *17*, 667–670.

Barnett, L. M., Morgan, P. J., Van Beurden, E., Ball, K., & Lubans, D. R. (2011). A reverse pathway? Actual and perceived skill proficiency and physical activity. *Medicine and Science in Sports and Exercise*, *43*, 898–904.

Clark, J. E., & Metcalfe, J. M. (2002). The mountain of motor development: A metaphor. In J. E. Clark & J. H. Humphrey (Eds.), *Motor development: Research and reviews* (Vol. 2, pp. 163–190). Reston, VA: National Association for Sport and Physical Education.

Colella, D., Morano, M., Bortoli, A., & Robazza, C. (2008). A physical self-efficacy scale for children. *Social Behavior and Personality: an International Journal*, *36*, 841–848.

De Meester, A., Barnett, L. M., Brian, A., Bowe, S. J., Jiménez-Díaz, J., Van Duyse, F., … Haerens, L. (2020). The relationship between actual and perceived motor competence in children, adolescents and young adults: A systematic review and meta-analysis. *Sports Medicine*, *50*, 2001–2049.

Deprez, D., Valente-Dos-Santos, J., Coelho-e-Silva, M. J., Lenoir, M., Philippaerts, R., & Vaeyens, R. (2015). Longitudinal development of explosive leg power from childhood to adulthood in soccer players. *International Journal of Sports Medicine*, *36*, 672–679.

The FA. (2015). *State of the game*. Staffordshire: Author. https://www.thefa.com/news/2015/jun/10/11-million-playing-football-in-england.

The FA. (2016). *Fundamental movements in the foundation stage*. Staffordshire: Author. http://www.thefa.com/learning/coaching/fundamental-movements-in-the-foundation-phase.

FIFA. (2011). *Grassroots football*. Zurich: Author. https://www.fifa.com/who-we-are/news/grassroots-goes-live-fifa-com-1462069.

Forsman, H., Gråstén, A., Blomqvist, M., Davids, K., Liukkonen, J., & Konttinen, N. (2016). Development of perceived competence, tactical skills, motivation, technical skills, and speed and agility in young soccer players. *Journal of Sports Sciences*, *34*, 1311–1318.

Gonaus, C., & Muller, E. (2012). Using physiological data to predict future career progression in 14- to 17-year-old Austrian soccer academy players. *Journal of Sports Science*, *30*, 1673–1682.

Haaland, E., & Hoff, J. (2003). Non-dominant leg training improves the bilateral motor performance of soccer players. *Scandinavian Journal of Medicine and Science in Sports*, *13*, 179–184.

Harter, S. (1987). The determinants and mediational role of global self-worth in children. In N. Eisenberg (Ed.), *Contemporary topics in developmental psychology* (pp. 219–242). New York: Wiley.

Hayes, A. F. (2018). *Introduction of mediation, moderation, and conditional process analysis: A regression-based approach*. London: Guildford Press.

Höner, O., Leyhr, D., Kelava, A., & Buekers, M. (2017). The influence of speed abilities and technical skills in early adolescence on adult success in soccer: A long term prospective analysis using ANOVA and SEM approaches. *PLoS One*, *12*, e0182211.

Jukic, I., Prnjak, K., Zoellner, A., Tufano, J. J., Sekulic, D., & Salaj, S. (2019). The importance of fundamental motor skills in identifying differences in performance levels of U10 soccer players. *Sports*, *7*, 178.

Kokstejn, J., Musalek, M., Wolanski, P., Murawska-Cialowicz, E., & Stastny, P. (2019). Fundamental motor skills mediate the relationship between physical fitness and soccer-specific motor skills in young soccer players. *Frontiers in Physiology*, *10*, 596.

Lawson, C., Eyre, E., Tallis, J., & Duncan, M. J. (In Press). Fundamental movement skill proficiency among British primary school children: Analysis at a behavioral component level. *Perceptual and Motor Skills*, *128*(2), 625–648.

Le Gall, F., Carling, C., Williams, A. M., & Reilly, T. (2010). Anthropometric and fitness characteristics of international, professional and amateur male graduate soccer players from an elite youth academy. *Journal of Science and Medicine in Sport*, *13*, 90–95.

Meylan, C., Cronin, J., Oliver, J., & Hughes, M. (2010). Talent identification in soccer: The role of maturity status on physical, physiological and technical characteristics. *International Journal of Sports Science and Coaching*, *5*, 571–592.

Miller, T. (2012). *NSCA's guide to tests and assessments* (pp. 217–252). Champaign, IL: Human Kinetics.

Morano, M., Bortoli, L., Ruiz, M. C., Vitali, F., & Robazza, C. (2019). Self-efficacy and enjoyment of physical activity in children: Factorial validity of two pictorial scales. *PeerJ*, *7*, e7402.

North, J., Lara-Bercial, S., Morgan, G., Rongen, F., Broche, D., Nentwig, G., … Sargison, J. (2014). *The identification of good practice principles to inform player development and coaching in european youth football*. Zurich: UEFA.

O'Brien, W., Belton, S., & Issartel, J. (2016). Fundamental movement skill proficiency amongst adolescent youth. *Physical Education and Sport Pedagogy*, *21*, 557–571.

Rampinini, E., Impellizzeri, F. M., Castagna, C., Coutts, A. J., & Wisløff, U. (2009). Technical performance during soccer matches of the Italian serie a league: Effect of fatigue and competitive level. *Journal of Science and Medicine in Sport*, *12*, 227–233.

Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Medicine*, *45*, 1273–1284.

Rommers, N., Mostaert, M., Goossens, L., Vaeyens, R., Witvrouw, E., Lenoir, M., & D'Hondt, E. (2019). Age and maturity related differences in motor coordination among male elite youth soccer players. *Journal of Sports Sciences*, *37*, 196–203.

Rosch, D., Hodgson, R., Peterson, L., Graf- Baumann, T., Junge, A., Chomiak, J., & Dvorak, J. (2000). Assessment and evaluation of football performance. *The American Journal of Sports Medicine*, *28*, S29–S39.

Serrano, J. S., Pizarro, A. P., García-González, L., Domínguez, A. M., & Álvarez, F. V. (2017). Evolution of tactical behavior of soccer players across their development. *International Journal of Performance Analysis in Sport*, *17*, 885–901.

Sieghartsleitner, R., Zuber, C., Zibung, M., & Conzelmann, A. (2019). Science or coaches' eye? – Both! beneficial collaboration of multidimensional measurements and coach assessments for efficient talent selection in elite youth football. *Journal of Sports Science and Medicine*, *18*(1), 32–43.

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest*, *60*, 290–306.

Tabachnik, B. G., & Fidell, L. S. (2019). *Using multivariate statistics* (7th ed.). London: Pearson.

Ulrich, D. A. (2001). *Test of gross motor development* (2nd ed.). Austin, TX: PRO-ED.

Unnithan, V., White, J., Georgiou, A., Iga, J., & Drust, B. (2012). Talent identification in youth soccer. *Journal of Sports Sciences*, *30*, 1719–1726.

Utesch, T., & Bardid, F. (2019). Motor competence. In D. Hackfort, R. Schinke, & B. Strauss (Eds.), *Dictionary of sport psychology: Sport, exercise, and performing arts* (1st ed., p. 186). Amsterdam: Elsevier.

Vaeyens, R., Lenoir, M., Williams, A. M., & Philippaerts, R. M. (2008). Talent identification and development programmes in sport: Current models and future directions. *Sports Medicine*, *38*(9), 703–714.

Vandendriessche, J. B., Vaeyens, R., Vandorpe, B., Lenoir, M., Lefevre, J., & Philippaerts, R. M. (2012). Biological maturation, morphology, fitness, and motor coordination as part of a selection strategy in the search for international youth soccer players (age 15–16 years). *Journal of Sports Sciences*, *30*, 1695–1703.

Wormhoudt, R., Savelsbergh, G., Teunissen, J., & Davids, K. (2017). *The athletic skills model*. London: Routledge.