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Tactical knowledge is not dependent upon age or biological maturation in young soccer players

El conocimiento táctico no es dependiente de la edad o la maduración biológica en jóvenes jugadores de fútbol

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ABSTRACT

This study examined how chronological age and maturity status may affect tactical knowledge in young soccer players. Decimal age and maturity status of sixty-six U12 to U14 soccer players were calculated. Their tactical knowledge (declarative and procedural) was assessed using the TCTOF questionnaire. Pearson's correlation analysis was used to assess the relationship between declarative and procedural knowledge with chronological age and maturity status. Statistical differences in the declarative and procedural knowledge were examined according to age, maturity and field position-related groups. Neither the declarative nor the procedural knowledge showed a significant correlation to chronological age or maturity status ($p > .05$), nor was the declarative and procedural knowledge different between chronological age, maturity status or field position groups. These findings suggest that tactical knowledge is not age-, maturity- or field position-dependent, which has implications in talent identification, player selection and development programs in young soccer academies and clubs.

KEYWORDS

Talent identification; tactical knowledge; youth; field positions.

RESUMEN

Este estudio examinó cómo la edad cronológica y el estado madurativo puede afectar al conocimiento táctico en jóvenes jugadores de fútbol. Se calculó la edad decimal y el estado madurativo de sesenta y seis jóvenes jugadores de fútbol sub-12 a sub-14. Se evaluó su conocimiento táctico (declarativo y procedimental) mediante el cuestionario TCTOF. Los jugadores fueron clasificados según cuatro

puestos específicos (portero, defensa, centrocampista y delantero). El análisis de correlación de Pearson se utilizó para evaluar la relación entre el conocimiento declarativo y procedimental con la edad cronológica y el estado madurativo, y con el puesto específico. Se examinaron las diferencias estadísticas en el conocimiento declarativo y procedimental de acuerdo al grupo de edad, maduración y puesto específico de los jugadores. Ni el conocimiento declarativo ni el procedimental mostraron correlación significativa con la edad cronológica o el estado madurativo ($p > .05$), así como ni el conocimiento declarativo y procedimental fueron diferentes entre los grupos de edad, de maduración o de puestos específicos. Estos hallazgos sugieren que el conocimiento táctico no es dependiente de la edad, la maduración o el puesto específico, lo que tiene implicaciones en la identificación de talentos, la selección de jugadores y los programas de desarrollo en academias y clubs de jóvenes jugadores de fútbol.

PALABRAS CLAVE

Identificación de talentos; conocimiento táctico; jóvenes; puestos específicos.

1. INTRODUCTION

Performance in soccer is multifaceted and it is dependent upon physical, technical, tactical or psychological attributes (Pain & Harwood, 2007). Soccer clubs and teams try to identify and select young players with the potential to succeed in the future through talent identification and selection processes (Gil et al., 2014), and coaches and scouts usually take the players' physical, technical and tactical performance into account when selecting a player (Lago-Peñas et al., 2014). In the context of youth soccer, it has been shown that both physical and technical actions are carried out in a tactical environment in which the decision-making plays a crucial role for the correct development of these actions (González-Víllora et al., 2013). For this reason, tactical knowledge is for most researchers and professionals one of the main attribute to take into account when selecting a player at early ages (Kannekens et al., 2011). In this sense, the main factor related to the tactical knowledge in young soccer players is the players' own experience (Diaz del Campo et al., 2011). Thus, enhancing these tactical skills at early ages is essential for high levels of soccer performance, and high quality training and development programs carried out by expert coaches at these ages are crucial for the tactical development of players (Kannekens, Elferink-Gemser, & Visscher, 2009).

For training and development programs, young soccer players are traditionally grouped based on their chronological age (CA), trying to balance inter-individual differences regarding their growth

and maturation, and trying to make the talent identification, selection and development processes fairer (Cobley et al., 2009). However, it is well documented that high individual variability in the maturity status (MS) between players of the same age-group exists (Meylan et al., 2014). The MS of a young player refers to the point in which they are at in their maturation process, and it is related to the structural and functional changes in the young players' bodies during growth (Malina et al., 2015).

It has been demonstrated that young players with an advanced MS show better results in physical performance (i.e. strength, power, speed and agility tests) than those players with a delayed MS (Peña-González et al., 2019). This is because during the maturation process there is an increase of the muscle size, there are changes in neuromuscular properties and there are also structural changes in the muscle fibres and the connective tissue, as fascicles and tendons (Radnor et al., 2018). This fact makes players with advanced MS be more likely to be selected as talented players at early ages than those with a delayed maturation, who could reach the same (or even better) physical performance with the correct training stimulus over time (Cumming et al., 2017), but who usually end up giving up sport practice due to a lack of opportunities (Crane & Temple, 2015).

Regarding the influence of maturation in cognitive skills, the literature from the academic field reports that some cognitive skills (i.e. processing speed or voluntary response) mature during the adolescence period, which coincides temporarily with the physical maturation process (Luna et al., 2004). However, the literature that has examined the cognitive skills differences regarding the physical MS is scarce and the results are controversial (Waber et al., 1985). It reveals that it is challenging to determine the degree to which this cognitive development is a result of age, experience or maturity.

Tactical knowledge has been previously assessed in young soccer players through the declarative and the procedural knowledge (Serra-Olivares et al., 2015). Declarative knowledge ("knowing what to do") refers to the conceptual or descriptive knowledge according to the game, and procedural knowledge ("doing it") refers to the appropriate decision about a specific action in a specific context during the game (Kannekens, Elferink-Gemser, Post, et al., 2009). Although tactical knowledge has been previously studied in young soccer players focusing on the players' age and experience (Serra-Olivares et al., 2015), there is a lack of research about the relationship between the tactical knowledge and the MS. A higher selection of young soccer players with advanced maturity status has been linked to a higher physical performance but there is not information about possible

tactical advantages of these players. Thus, the purpose of the present study was to examine if the MS of young soccer players affects their tactical knowledge (both the declarative and procedural knowledge).

2. METHODS

2.1. Participants

Sixty-six U12 to U14 young male soccer players from an elite soccer academy took part in the study. Descriptive data of the participants is shown in Table 1. All players had a minimum of five years´ experience in soccer participation and they participated in the study voluntarily. Players and their parents/guardians signed an informed consent in which the aims and procedures of the study were explained. The study was approved by an Ethics Committee and conformed to the recommendations of the Declaration of Helsinki.

Table 1. Descriptive data

Variables	CA (years)	Body Weight (kg)	Height (cm)	PHV	Declarative Knowledge (%)	Procedural Knowledge (%)
N=66						
Min	11.0	31.3	143.6	-2.36	44.4	12.5
Max	14.1	74.2	187.0	0.85	88.9	75.0
Mean	12.6	51.3	165.9	-0.85	68.9	51.3
SD	0.7	10.3	10.7	0.8	8.7	12.7

CA: Chronological age; kg: Kilograms; cm: Centimetres; PHV: Peak height velocity; Min: Minimum; Max: Maximum; SD: Standard deviation

2.2. Measures

The CA of the participants was obtained as a decimal number being this the date of their measurement minus their date of birth. For further analysis, players were divided according to their age into the specific age-groups established by federations (U12, U13 and U14). The years from/to their peak height velocity (PHV) were assessed for the evaluation of their MS (Mirwald et al., 2002; Sherar et al., 2005). This is the most used method to assess MS in the sports field (Müller et al., 2015) and it indicates the time to reach or the time since a player reached his/her PHV. This point is

usually reached at 14 years in boys and at 12 years in girls, indicating the theoretical point of maximum growth during adolescence (Malina et al., 2004). This measure allows to compare the MS of young athletes, being specially accurate in boys from 12 to 16 years old (Malina & Kozieł, 2014). For the present study, participants were divided into three maturity groups (MG) to compare their declarative and procedural knowledge. These groups were established as follows: MG1 (players who are 1.5 years or more from their PHV), MG2 (players who are between 1.5 and 0.5 years from their PHV) and MG3 (players who have already reached or are less than 0.5 years from their PHV).

Declarative and procedural knowledge was assessed using the offensive tactical knowledge in soccer (TCTOF) (Serra-Olivares et al., 2015). TCTOF is a multiple-choice test with images that is divided into two parts regarding the declarative and the procedural knowledge respectively. In the first part, players can reach a maximum of 36 points and in the second one the maximum is 16 points. For further analysis, both parts were expressed as a percentage. The test used was the original test designed for 7-a-side soccer but the off-side rule was adapted to 11-a-side soccer. Additionally, the specific field position of players was registered as goalkeeper (GK), defender (DF), midfielder (MF) and forward (FW).

2.3. Procedures

Body height, sitting height, leg length, body mass and the date of birth were registered for the assessment of the MS. The body and sitting heights were measured with a fixed stadiometer (± 0.1 cm, SECA LTD., Germany), and leg length was obtained as the result of body height minus sitting height. Body mass was measured using a digital scale (± 0.1 kg, Oregon scientific® GA101/GR101, USA). Players were asked directly for their date of birth and field position.

The declarative and procedural knowledge parts of the test were administered to players on the same day in the afternoon, after the anthropometrical measurements. The players had not seen the questionnaire previously and they were instructed on how to complete the test correctly. And if the players had any doubt on how to proceed, the examiners answered them. When all players finished the first part, the second one was given to all of them. No time limits were required to perform the tests.

2.4. Statistical analysis

Pearson’s correlation analysis was performed to determine both, the relationship between CA and MS with the declarative and the procedural knowledge. Pearson’s values were interpreted as:

trivial (<0.09), small (0.10–0.29), moderate (0.30–0.49), high (0.50–0.69), very high (0.70–0.89) and almost perfect (>0.90) (Hopkins et al., 2009). One-way analysis of variance (ANOVA) was used to compare the declarative and procedural knowledge between players with different CA, different MS and between players from different field positions. A Bonferroni post-hoc test was carried out to analyse the pairwise comparison between groups in each ANOVA. Effect size (ES) was also calculated with the Cohen's d value and it was interpreted as trivial (<0.25), small (0.25 - 0.50), moderate (0.50 - 1.0), and large (>1.0) (Rhea, 2004). All calculations were carried out using Microsoft Excel (Microsoft, Seattle, Washington, USA) and SPSS Statistics® (Statistical Package for the Social Sciences, Version 17.0), and the level of significance was set at $p < 0.05$.

3. RESULTS

Pearson's correlation analysis did not show any relationship between CA or the MS and the declarative and procedural knowledge (Table 2). The ANOVA did not show statistical differences between the declarative or the procedural knowledge according to the CA or the MS (Table3). The pairwise comparison assessed by the post-hoc analysis did not show any statistical differences between groups. ES for each group comparison is also provided in Table 3. The comparison analysis according to the players' field position was not included in Table 3, but no significant difference was observed between groups. Trivial to small ES were found for all pairwise comparisons between the different field positions, except for GK and DF (ES = 0.58; moderate) in the declarative knowledge. It must be highlighted that, although the ES were small and moderate (ES = 0.43 to 0.58), the GKs were consistently better in declarative knowledge than the rest of positions, whereas for procedural knowledge, the ES showed trivial to small values, but always when compared with the GKs.

Table 2. Pearson's correlation analysis (r [p]).

Variable	**CA**	**PHV**
Declarative Knowledge	0.03 (0.83)	0.04 (0.76)
Procedural Knowledge	0.03 (0.81)	0.02 (0.90)

CA: Chronological age; PHV: Peak height velocity

Table 3. ANOVA and ES for both Declarative and Procedural Knowledge according to CA and PHV.

Factor	Variable	Descriptive Data (M ± SD)			F	p	ES (90%CI)
		U12 (n=17)	U13 (n=41)	U14 (n=8)			
CA	Declarative Knowledge (%)	69.9 ± 14.1	68.5 ± 6.4	69.1 ± 4.0	0.16	0.85	U12-U13: 0.15 (-0.42:0.71) U12-U14: 0.07 (-0.78:0.91) U13-U14: 0.10 (-0.66:0.85)
	Procedural Knowledge (%)	51.1 ± 9.9	50.6 ± 12.9	55.5 ± 17.2	0.48	0.62	U12-U13: 0.04 (-0.52:0.61) U12-U14: 0.35 (-0.51:1.18) U13-U14: 0.36 (-0.41:1.11)
		MG1 (n=17)	MG2 (n=25)	MG3 (n=24)			
PHV	Declarative Knowledge (%)	68.5 ± 8.9	69.3 ± 9.2	68.9 ± 8.4	0.05	0.95	MG1-MG2: 0.09 (-0.53:0.70) MG1-MG3: 0.05 (-0.58:0.67) MG2-MG3: 0.05 (-0.52:0.60)
	Procedural Knowledge (%)	52.2 ± 10.6	49.3 ± 14.4	52.9 ± 12.5	0.54	0.58	MG1-MG2: 0.22 (-0.40:0.84) MG1-MG3: 0.06 (-0.56:0.68) MG2-MG3: 0.27 (-0.30:-0.82)

ES: Effect size; CI: Confidence interval; CA: Chronological age; PHV: Peak height velocity; MG: Maturity group.

4. DISCUSSION

The aim of the present study was to analyse the tactical knowledge (declarative and procedural knowledge) of young soccer players, and to examine the possible age-related and maturity-related differences in their tactical knowledge. The main finding of the present study was that both, the CA and the MS of young soccer players do not seem to affect their tactical knowledge.

The results from this study showed that CA did not correlate with the declarative and procedural knowledge. The ANOVA did not present any statistical difference for both, the declarative and procedural knowledge between the age groups either. Although traditionally it has been suggested that cognitive skills and knowledge improve together with age, there are controversial results from the sports field (Serra-Olivares et al., 2015). As previous literature, this study did not find differences between age-groups for the declarative or for the procedural knowledge, even when comparing groups with two years of age difference, which was suggested as necessary to find age-related differences in tactical knowledge (Diaz del Campo et al., 2011; Serra-Olivares et al., 2015).

Regarding the MS, correlational analysis did not show any significant correlation between the players' years from/to their PHV and the declarative or procedural knowledge, and the ANOVA

showed no differences between any maturity groups in the declarative or procedural knowledge in the pairwise comparison. To the authors' knowledge, this is the first study that examines the tactical knowledge of young soccer players according to their MS. In this sense, studies from the academic field usually linked maturation to the CA, without taking the possible biological inter-individual differences between people of the same age into account (Keating, 2004). Similarly to our results, those studies that do differentiate the CA and the MS did not find differences in some aspects of cognition such as spatial ability (Davison & Susman, 2001; Susman et al., 1998), or in other specific cognitive abilities (Waber et al., 1985) according to the MS. Although the somatic maturity may have influence in the physical development, it does not imply that somatic maturity has to be linked to the cognitive development, and probably, cognitive and physical maturation are two independent variables.

Although it was not the main aim of the present study, differences in tactical knowledge according to the players' field position were assessed. Players who had different roles in the game (different field positions) did not seem to show differences in the declarative nor in the procedural knowledge in this study. In this regard, a longitudinal approach from Kannekens et al., (2009) showed that defenders and midfielders did not change their tactical knowledge from 14 to 18 years of age but the forwards improved some aspects of their tactical knowledge in these ages. In addition, different components of the tactical knowledge (i.e. acting in changing situations, positioning and deciding or knowing about ball actions) were associated to different field positions (defenders, midfielders and forwards, respectively), suggesting that players from different field positions have specific tactical skills according to their specific experience (Kannekens, Elferink-Gemser, Post, et al., 2009).

This study has some limitations that should be considered when interpreting the results. Although it is the most used method found in the literature, the estimation of somatic maturity status with the Mirwald equation has been recently criticised (Malina et al., 2020).

5. CONCLUSIONS

As a conclusion, the tactical knowledge for U12 to U14 soccer players may not be influenced by their CA, their MS or their field position. This may indicate that the declarative and procedural knowledge is mainly dependent on the other factors as the level and teaching methods of coaches (Kannekens, Elferink-Gemser, Post, et al., 2009; Moreno et al., 2011) and on the individual cognition capacity of players (Tan et al., 2012). In this regard, young soccer players' tactical knowledge may

be a good indicator of the players' talent to take into account in talent identification and selection processes by teams and academies because it does not seem to be age or maturity dependent. Besides, coaches could train tactical skills in their training and development programs without considering the inter-individual variability in the MS of their players. Developmental programs based on the MS could be interesting for physical performance characteristics (Ford et al., 2011; Lloyd & Oliver, 2012) whereas they would not be useful for cognitive or tactical skills.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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