Technical and tactical aspects in Italian youth rugby union in relation to different academies, regional tournaments, and outcomes

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| Response to Reviewers: | Manuscript RE: JSCR-08-9236, entitled "Technical and tactical aspects in Italian youth rugby union in relation to different academies, regional tournaments, and outcomes."

Reviewer 1
I do not see how the strength and conditioning professional benefits from this study per se, can you make it relevant to them or how does it fit for this journal.
Answer: thanking the reviewer for his/her precious suggestion, we better developed the strength and conditioning practical applications, by rephrasing several parts of the manuscript (i.e., abstract, introduction, discussion, and practical application sections) to implement the potential connections with the technical and tactical aspects. In particular, we rephrased the following parts of the manuscript:

Abstract
"These results highlight that the technical and tactical aspects of the Italian under-18 Academy Rugby Union are quite homogeneous, suggesting that FIR coaching staffs are more oriented to players' skills than successful games. However, tactical, and strength and conditioning coaches can benefit from the findings of this study, focusing training on cognitive, strength, and repeated sprint abilities with and without change of direction for improving the occurrence of "set pieces won/regained" and "ball in play in opponent 22m area", which appear as the key of the game in this rugby competition level."

Introduction
"Similarly to other situational sports (4,12,20,21,27), notational and time-motion analyses suffer in terms of replication because of relevant situational nature complexity. Nevertheless, these methods have been shown to be effective tools for increasing the knowledge of team sports for better coaching (17). In addition, especially for rugby, performance and technical and tactical aspects could be effectively linked to provide valuable practical applications (9)."

Discussion
"A possible explanation of this result could be that the players of losing teams were not only less skilled but also less physically prepared. In fact, previous investigations (8,9) documented a significant correlation between tackling proficiency and players' physical characteristics (acceleration and lower body muscular power). In particular, the authors of this study suggested that strength and condition coaches should emphasize on these specific players' characteristics to improve tackling abilities.
However a similar interpretation might be provided also for the higher occurrence of the "possession lost due to an error" reported by winning academies, which emerged for effect of the higher values of the "possession lost on set pieces" reported by losers. As consequence, the winning game profile is more focused on proving a high number of offensive possessions than not committing errors during this game phase, thus speculating a substantial influence of the players' strength and conditioning levels. In fact, the obtaining of more ball possessions can be determined by a higher number of winning set pieces due to a better cognitive (i.e., better players' tactical arrangement) as well as by higher strength capabilities. Similarly, a higher number of ball possessions can be also due to a better repeated sprint capability with and without change of direction."

Practical applications
"As consequence, according to the Italian rugby academies tactical objective to prepare athletes to play at the international level, strength and conditioning coaches should stimulate this capability. In particular, for the conditional training, the players' enhancing of the repeated sprint ability with and without the ball possession can favour substantial improvements in getting the opponent 22m area, especially enhancing the capability to firstly resist against opponent tackles or during set pieces and then sprinting forward. Therefore, training sessions aiming to improve the players' strength level and the running speed could crucially improve the outcome of the game phases highlighted in the findings of this study. In particular, enhancing the difficulty of the exercises, focusing on unplanned and reactive drills, and reinforcing the proper execution of the acceleration and deceleration phases should be considered as the main training objectives by strength and conditioning coaches (2). In fact, a sharp execution of changes of direction should be emphasized because, at this stage of youth development, players are more able to perform sharper executions than rounded |

ones (2). However, in line to American football players (3), straight sprinting speed firstly requires to increase the linear acceleration. Therefore, strength and conditioning coaches should consider the enhancement of this ability by performing explosive movements, footwork, and repeated short-distance accelerations, highlighting elastic band, down and uphill, and sled as effective methods to obtain these performance improvements.

In line to this playing scenario, the "possession lost on set pieces" data, tactical, and strength and conditioning coaches should focus training on the development of skills to quickly regain the ball, also to improve the effectiveness of counterattacks. For example, the combination of cognitive (i.e., capability to "read" the playing situation before the opponents) and strength (i.e., capability to get ball during the set pieces) workouts could crucially stimulate players in effectively performing this particular phase of matches. Practically, a progression from simple (i.e., low number of involved offensive and defensive players) to complex (i.e., high number of players) set pieces where the aim is getting the ball to perform a quick offensive action could stimulate players both for tactical capabilities and the above mentioned physical aspects (i.e., cognitive, strength, and repeated sprint abilities with and without change of direction)."

Manuscript RE: JSCR-08-9236, entitled "Technical and tactical aspects in Italian youth rugby union in relation to different academies, regional tournaments, and outcomes."

Reviewer 2
A very interesting study of the sport but here I do not see what this has to do with the conditioning coach or that aspect of the rugby union team that will impact it or you did not specify it. The context of the findings need to have relevance to the conditioning coach. As one who works with these athletes I am not sure what to do after reading it. This seems like a coaches paper etc. but ok you must have thought it to be a impact paper for the journal so this needs to be brought out more as to the practical question and how it relates to the conditioning coach etc. Nice paper.

Answer: thanking the reviewer for his/her precious suggestion of mostly highlighting the practical question and how it relates to the conditioning coach, we better developed the strength and conditioning practical applications, by rephrasing several parts of the manuscript (i.e., abstract, introduction, discussion, and practical application sections) to implement the potential connections with the technical and tactical aspects. In particular, we rephrased the following parts of the manuscript:

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Turin, Italy, April 27, 2017

Dear Dr. Kraemer,

It is our pleasure to submit for publication in The Journal of Strength and Conditioning Research our paper "TECHNICAL AND TACTICAL ASPECTS IN ITALIAN YOUTH RUGBY UNION IN RELATION TO DIFFERENT ACADEMIES, REGIONAL TOURNAMENTS, AND OUTCOMES". This manuscript contains material that is original and not previously published in text or on the Internet, nor is it being considered elsewhere until a decision is made as to its acceptability by the Journal of Strength and Conditioning Research Editorial Review Board. The undersigned Authors transfer the ownership of copyright to The Journal of Strength and Conditioning Research should their work be published in this journal. They state that they are responsible for the research that they have designed and carried out; that they have participated in drafting and revising the manuscript submitted, which they approve in its contents. They also state that the research reported in the paper was undertaken in compliance with the Helsinki Declaration and the International Principles governing research on animals.

Best regards,

Corrado Lupo

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Technical and tactical aspects in Italian youth rugby union in relation to different academies, regional tournaments, and outcomes.

Running title: Technical and tactical aspects in Italian youth rugby union

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Abstract

This study aimed to analyze the technical and tactical aspects of the Italian under-18 Academy Rugby Union in relation to different academies, regional tournaments, and game outcomes. A notational analysis (forty-four indicators) was performed on 16 games (2014-15 season) to evaluate strong differences ($P \leq 0.05$; moderate-large effect sizes) according to variables. Among academies, strong differences were showed for defensive breakdown where the defending support is much (range=77-87%), equal (range=11-32%), and less (range=2-12%) numerous than the attacking support, total tackles (range=64-122) and passes (range=72-151), pass to possession ratio (range=6-10), possession lost due to an error (range=28-59%), and ball in play in own (range=8-25%) and opponent (range=7-31%) 22m area indicators. For tournaments, effects emerged for offensive breakdown when the ball is used quickly employing maximum 2 attacking supports (range=20-30%) and is not used quickly (range=28-41%), total penalty kicks (range=11-16), and sequences period 0-10 (range=26-35%) and 10-40 s (range=47-55%). Conversely, winning and losing academies reported differences with small effect sizes. These results highlight that the technical and tactical aspects of the Italian under-18 Academy Rugby Union are quite homogeneous, suggesting that FIR coaching staffs are more oriented to players' skills than successful games. However, tactical, and strength and conditioning coaches can benefit from the findings of this study, focusing training on cognitive, strength, and repeated sprint abilities with and without change of direction for improving the occurrence of "set pieces won/regained" and "ball in play in opponent 22m area", which appear as the key of the game in this rugby competition level.

Key words: notational analysis, match analysis, technical and tactical indicators, youth performance, coaching.

Introduction

Although rugby has been recognized as a professional sport union only in 1995, this game is characterized by increasing performance requirements (26), and played all over the world, containing 118 national members (30).

Senior and junior competitions share the majority of the rules, except for playing time (40 vs 35 minutes for each half), scrum (max 1.5 m push), replacements and substitutions (31). Coherently to guidelines for youth rugby training (28), deliberate practice and programming are the main focus in developing young players. Consequently, Italian Rugby Federation (FIR) established thirty-two not-residential training centers, nine residential academies, and one national academy for under-16 players, under-18 players, and under-20 players, respectively, all aiming to develop players' abilities and skills for an excellence performance level (7). According to this selecting structure, the passage from the under-18 residential academies to the under-20 national academy could be considered as the most significant opportunity of playing as professional athlete in a close future. Therefore, to tend to the excellence performance level, at present, the FIR staffs of the nine residential academies try to share a common technical and tactical training strategy, aiming to concretely promote the development of technical and tactical skills, which could contribute the performance development of twenty-four rugby players of the Italian national team (7). As consequence, a specific monitor and plan of training sessions and game performances result as necessary.

Although abilities and skills assessments (2,10,11) and anthropometric measurements (2) are generally applied for talent identification or team selection, the evaluation of the technical and tactical skills are equally essential. For this reason, notational analysis plays a crucial role on the investigation of rugby performance (18), and its aim is to describe an objective and simplified profile of sport performance based on indicators, which are defined as the selection and combination of variables that define some aspect of performance (16). However, rugby is characterized by complex and chaotic game dynamics, with heterogeneous conditions such as weather, strategies, and tactics, which make extremely difficult an observational and analysis

system (29). Similarly to other situational sports (4,12,20,21,27), notational and time-motion analyses suffer in terms of replication because of relevant situational nature complexity. Nevertheless, these methods have been shown to be effective tools for increasing the knowledge of team sports for better coaching (17). In addition, especially for rugby, performance and technical and tactical aspects could be effectively linked to provide valuable practical applications (9).

In senior rugby union, technical and tactical notational analyses have been mostly focused on defining winning tactical profiles (6). Useful information already emerged for the Eighties World Cup games, where successful teams were mainly characterized by *contact* and *greater ball retention* game situations (23). More recently (19), the notational analysis method was applied to discriminate tactical aspects between winning and losing European professional teams, highlighting only *lineouts won on oppositions throw* and *tries scored* as main predictors of game successful among twenty-two considered indicators. For the same rationale, three authors (24) analyzed 58 games from the 2003-2006 seasons of Six Nations tournament and highlighted that: a) in the phases of obtaining the ball and more specifically in *scrummage* and *line-out*, winning teams lose fewer balls than losing teams; b) winning teams tend to play more with their feet when they obtain the ball, to utilize the *maul* as a way of attacking, and to break the defensive line more often compared to losing teams; and c) on defence, winning teams recovered more balls and completed more *tackles* than losing teams. Coherently to this experimental approach, another study focused on the analysis of International Rugby Board and Southern Hemisphere Regional teams (29) reported that, only for the latter competition level, technical and tactical aspects such as kicking the ball away and making more tackles than the opposition were able to significantly discriminate winning and losing teams' performances, whereas the key of success in the higher championship resulted rather obscured by differences playing styles.

Although elite senior rugby union performance was abundantly investigated in terms of physical demands and technical and tactical aspects (6,18,19,23,24,29), only a few studies are available on the elite youth rugby players. In particular, for the latter rugby player category, studies

were mainly focused on injuries (13,22) and talent identification (5,25), whereas no study was provided about notational analyses of technical and tactical aspects specifically related to this category.

Therefore, the aim of this study was to analyze the technical and tactical aspects of the Italian under-18 elite rugby academies, during the 2014-15 Academies Elite Championship, assessing the differences between FIR academies (i.e., Torino, Milano, Prato, Remedello, Mogliano Veneto, Rovigo, Roma, Benevento, and Catania academies), regional tournaments (i.e., North, Centre, South), and outcomes (i.e., winning, loosing) by means of strong differences ($p \leq 0.05$ with moderate-large ES).

Methods

Experimental Approach to the Problem

The local Institutional Review Board approved this study to investigate the rugby technical and tactical aspects of the Italian under-18 academies competing during the 2014-15 season. In particular, this championship has been played according to the international youth rugby rules (31), and consisted of two phases. In the first one, 18 matches of two halves of 35 min were played into 3 different regional tournaments; in the second one, each academy played two 40-min games against other academies selected according to the results of the regional tournaments. For the analyses of this study, only the matches of the first competition phase were considered.

In line to previous studies on senior rugby (6,18,19,23,24,29), it seems reasonable to hypothesize that differences would emerge in terms of technical and tactical aspects between winning and losing teams, as well as between different teams and regional tournaments. Nevertheless, common technical and tactical strategies eventually provided by the FIR training staffs working in all nine Academies to mainly obtain the development of players' performance skills, could minimize the expectations of several strong differences ($p \leq 0.05$ with large ES) between teams.

However, from the data of this study focused on Italian youth rugby matches, differences were expected between teams, regional tournaments and in terms match outcome. For this purpose, the data related to the technical and tactical indicators of these teams have been considered as dependent variables, whereas the outcome, FIR Academies, and regional tournaments have been considered as between factors.

Participants

The coaches of the Italian under-18 residential rugby academies gave their approval for the analyses of the matches, after having received the signed consent form from the players' parents to video record the rugby matches, even considering the risks and benefits of the study. Italian Rugby Academies competing into the Elite Championship 2014-15 were split in 3 regional tournaments (i.e., North, Centre, South) consisting of 3 academies each one, and each academy played two games (against to the other two academies of the same regional tournament) which were valid to achieve the best possible ranking position in each tournament, and to access to following national competition phase.

According to the coaches of the Italian Rugby Academies, the Italian under-18 rugby players enrolled in the residential academies usually perform a minimum of four to a maximum of six 120-180 min training sessions per week, with at least 3 years of previous rugby practice. Physical, and technical and tactical training portions represent the 20-30%, and 70-80% of the entire training time, respectively.

Procedures

The 16 Italian under-18 rugby games played among residential academies were recorded by a video camera (Canon Legria HF R46 camera, © Canon Inc) positioned along a side of the rugby court, at the level of the midfield line, at a height of 10 m and at a distance of 20 m from the court. The operator panned the camera to cover each game action of all considered matches, making it possible to collect all the data of this study. The analyzed matches were played between 4 and 7 p.m., on Saturdays or Sundays.

The notational analysis of the technical and tactical aspects was performed on 16 (of total 18) games played during the 3 regional tournaments by means of SportsCode Gamebreaker V8 software (Sportstec, Sydney, Australia), and in relation to forty-four performance indicators (Table 1) which were structured according to previous literature (29), and coaches' expertise (>10 years experience of competitions recognized by the FIR).

To avoid inter-observer variability, a single observer (more than two years of experience) scored all the matches. However, to assess reliability, the analyst who completed this study investigated a randomly chosen game twice, each observation separated by 14 days, reporting a high intra-observer test-retest reliability (Intraclass Correlations, ICC = 0.99). In addition, two randomly chosen halves were investigated by another expert analyst (more than two years of experience) to assess also the inter-observer reliability (ICC range = 0.91- 0.99).

****Table 1 near here****

Data Analysis

For each of the 44 performance indicators means and standard deviations (SD) were calculated for each academy, regional tournament and winning and losing academies. Statistical analyses were conducted using SPSS (21.0; SPSS, Inc., Chicago, IL) and the criterion for significance was set at *p* ≤ 0.05.

To assess whether data were normally distributed, Shapiro-Wilk normality test was applied for each dependent variable. In case of satisfied normality, a one-way ANOVA was used to test differences between single academies, regional tournaments, as well as winning and losing academies, in relation to each performance indicator. Then, for each significant difference between academies and between regional tournaments, Bonferroni post-hoc test was applied. In case of not-satisfied normality of the performance indicator values, a logarithmic transformation (base-10) was applied before retesting the normality (Shapiro-Wilk normality test), and eventually (in case of

normality) reapplying the successive parametric approach above mentioned (one-way ANOVA and Bonferroni post-hoc tests). Finally, for the performance indicators characterized by non-normally distributed value even after the logarithmic transformation, non-parametric approach tests (Kruskal-Wallis and Mann-Whitney test for the analyses related to academies, and regional tournaments; and only Mann-Whitney test for those related to winning-loosing comparisons) were applied.

Finally, Cohen's effect sizes (ESs) (1) were calculated for differences emerging in parametric statistical analysis, considering an ES ≤ 0.2, from 0.3 to 0.6, from 0.7 to 1.2, and > 1.2, as trivial, small, moderate, and large, respectively (14). On the other hand, for the differences evaluated by means a non-parametric approach, the phi ESs were applied, considering 0.1, 0.3, and 0.5 as small, medium, and large ESs, respectively (15). Mean difference (95% confidence interval) was calculated only for differences emerging for parametric statistics.

Results

Descriptive statistics (mean $\pm$ SD) of the forty-four parameters were calculated in relation to different academies (Table 2), tournaments (Table 3), and outcome (Table 4). As specifically reported in the corresponding tables (Tables 2, 3, and 4), among all forty-four performance indicators: twenty-eight ones were normally distributed; twelve ones resulted normally distributed after logarithmic transformation, whereas four ones were definitely considered as non-normally distributed.

For the comparisons between academies, fifteen indicators (i.e., 1, $P = 0.024$; 6, $P = 0.021$; 8, $P = 0.028$; 10, $P = 0.001$; 11, $P = 0.031$; 12, $P = 0.022$; 13, $P = 0.016$; 19, $P = 0.014$; 22, $P = 0.002$; 31, $P = 0.008$; 33, $P = 0.019$; 36, $P = 0.037$; 37, $P = 0.01$; 40, $P = 0.002$; 42, $P = 0.031$) reported a main effect. However, only for ten indicators, differences between academies were reported (Table 2). For the regional tournaments, eight indicators reported a main effect (i.e., 4, $P = 0.037$; 7, $P = 0.007$; 10, $P = 0.03$; 11, $P = 0.013$; 22, $P = 0.006$; 23, $P = 0.022$; 41, $P = 0.003$; 42, $P = 0.001$) and specific differences between tournaments (Table 3). Finally, for the comparison

between winning and losing academies, seven indicators (i.e., 1, 17, 30, 31, 34, 37, and 40) showed the significant difference (Table 4).

****Tables 2, 3, and 4 near here****

Discussion

Although studies focused on technical and tactical aspects of team sports suffer in terms of replication because of relevant situational nature complexity (12,20,21,27), notational analysis demonstrated to be an effective tool for increasing the knowledge of team sports and for better coaching (17). At present, even though several studies on the notational analysis of rugby game have been provided (6,18,19,23,24,29), research on technical and tactical aspects of youth rugby is lacking. Therefore, to our knowledge, this is the first study applying a notational analysis of junior elite (Italian under-18 academy category) rugby performance, with the purpose to analyse technical and tactical parameters in relation to different academies, tournaments, and game outcomes.

The main finding of the present study is that youth rugby games has a significant impact on the occurrence of technical and tactical indicators of team performance, highlighting divergences among performances of some academies and regional tournaments. However, the first two aims could be partially achieved because strong differences emerged only for ten and eight indicators (over the forty-four ones analyzed) of the comparisons between different academies and tournaments, respectively. In addition, even though seven indicators reported differences between winning and losing academies, these effects resulted less strong because of their small ESs, limiting the relative interpretations and suggesting the hypothesis that the development of technical and tactical skills of players encouraged by FIR staffs has been mostly promoted with respect to the obtaining of a winning game.

Among the differences emerged from the comparisons between academies, academies 2 and 9 resulted as the worst and best academy during the defensive phases (i.e., indicator 10, 11, and 12),

respectively, showing a different number of defenders with respect to that of opponent attackers, and providing the opportunities of maintain and getting back the ball possessions, which could potentially influence the game success (24,29). Another success association could be suggested also for the "time in possession" parameter, which showed Academy 1 and Academy 7 as the worst and best team in maintaining the possession of the ball during games, respectively, thus highlighting a divergent capability to limit opponent ball possession. However, this difference is reported with a small ES, limiting the substance of this interpretation. On the other hand, Academy 7 and Academy 4 played the lowest time in its own 22m area, and the opposite trend (only for Academy 7) emerged for the time of play spent in the opponents 22m area, suggesting strong divergences in the offensive and defensive team skills, which could be linked directly to a different probability of scoring points. Also the higher occurrence of tackles (29) performed by Academy 1 with respect to that of Academy 4 and Academy 7 could be associated to success, however, this indicator is able just to highlight the occurrence of total tackle attempts regardless of its efficiency, which actually resulted as the worst in absolute terms (i.e., indicators 14 and 15). In addition, Academy 7 reported the highest values of passes, even though no success application has been provided for this aspect (29), whereas Academy 9 reported the best "pass to possession ratio", which could be considered as a better indicator to evaluate the ball-handling capabilities of a rugby team.

For the comparisons between tournaments, results showed clear differences between technical and tactical aspects between the North and South regional subgroups. In particular, academies of the South and North regional tournaments performed a higher occurrence of quick offensive breakdowns (≤ 3 s) employing maximum 2 attacking supports and not quickly offensive breakdowns (> 3 s) regardless the number of attacking supports, respectively, speculating different offensive capabilities. However, similarly to previous studies on other team sports (20) where technical and tactical aspects related to the offensive game phases could be useful also to interpret defensive aspects, the different quickness of the offensive breakdowns could be also determined by the higher and lower opponents' defensive skill levels reported by the North and South academies,

respectively. In fact, despite for effect of differences with small ESs, the same interpretation seems to be confirmed in the analysis of the defensive breakdowns (i.e., indicator 10 and 11) where the defending support resulted stronger (according to the number of defenders per each defensive phase) in the North than in South academies. As consequence, the "pass to possession ratio" parameter reported that the South academies have the opportunity to mostly pass the ball among teammates with respect to North ones. Different game styles emerged also for the higher penalty occurrences, which were associated to a successful game profile in senior rugby (29), and were more performed by the North than South academies in the Italian under-18 Academy Rugby Union. Finally, in the North tournament, academies usually play for short periods (0-10 s), speculating that defences are able to promptly face opponent attackers to interrupt their active ball possessions and limit the consequent advancing, whereas for the sequences lasting 11-40 s, the academies of the South tournament reported higher number of cases with respect to those of Centre and North ones.

The comparisons between winning and losing Italian under-18 rugby teams reported differences with small ESs, determining less strong conclusion and strengthening the intrinsic meaning of the Italian rugby academies for which the development of technical and tactical skills is more important than winning a game. Nevertheless, in line with the winning game profile of senior rugby competitions (19,23,24,29), the high occurrences of "all own and opponents' scrums, lineouts, starts and restarts won or regained, respectively" (i.e., indicator 1) and "ball in play in opponent 22m area" (i.e., indicator 40), as well as the low occurrences of "possession lost total" (i.e., indicator 31), "possession lost on set pieces" (indicator 34), and "ball in play in own 22m area" (i.e., indicator 37), are able to confirm the substance of this playing events in terms of game success. In addition, despite the higher occurrence of the losing academies for the "tackles which stops the opponent but not the ball" (i.e., indicator 17) appears as controversial (absolute mean values: winning academies, 12; losing academies, 11), this result represents the percentage balance to the high frequency of the "dominant tackle which stops the opponent and the ball" indicators (i.e., 14 and 15) reported by the winning academies. A possible explanation of this result could be

that the players of losing teams were not only less skilled but also less physically prepared. In fact, previous investigations (8,9) documented a significant correlation between tackling proficiency and players' physical characteristics (acceleration and lower body muscular power). In particular, the authors of this study suggested that strength and condition coaches should emphasize on these specific players' characteristics to improve tackling abilities.

However a similar interpretation might be provided also for the higher occurrence of the "possession lost due to an error" reported by winning academies, which emerged for effect of the higher values of the "possession lost on set pieces" reported by losers. As consequence, the winning game profile is more focused on proving a high number of offensive possessions than not committing errors during this game phase, thus speculating a substantial influence of the players' strength and conditioning levels. In fact, the obtaining of more ball possessions can be determined by a higher number of winning set pieces due to a better cognitive (i.e., better players' tactical arrangement) as well as by higher strength capabilities. Similarly, a higher number of ball possessions can be also due to a better repeated sprint capability with and without change of direction.

Youth rugby coaches should be aware that specific technical and tactical aspects of rugby game could be useful to plan and monitor substantial training sessions and workouts. In fact, coherently to the encouragement of Vaz, Van Rooyen, & Sampaio (29) to promote further researcher on northern and southern hemisphere senior teams, the present study should be the starting point to provide information on actual technical and tactical demands of youth rugby games, even analyzing different international championships and variables, without remaining approximate and referring to alternative competition profiles. Similarly, from the analysis of the technical and tactical aspects, crucial interpretation on physiological issues can be equally provided, also encouraging future studies to mainly focus on the identification of the rugby players' physical parameters in relation to different FIR academies, regional tournaments and game outcomes.

Practical applications

The present study contributes to the systematic identification of the actual rugby demands occurring during youth games, showing an essential process to define training programmes fully designed to meet the demands of competition (6). In fact, the present findings not only offer general information to coaches about technical and tactical rugby aspects, but also identify the game aspects which can mostly differ between academies, as well as in relation to different Italian geographic areas, and winning and losing outcomes, also from a strength and conditioning point of view.

In conclusion, this study has demonstrated that only a few indicators (over the forty-four considered) were able to discriminate the technical and tactical performances of Italian under-18 rugby players in relation to different academies, tournaments, and game outcomes. Therefore, it could be also speculated that same effects reported for these indicators probably emerged because of heterogeneous coaches' teaching and players' learning capabilities, and were quite limited by a common technical and tactical training strategy of the FIR academy staffs, which operated more towards the development of players' skills than the obtaining of success in single games. For example, regarding the attacking phase, the attitude to always attack, obtaining the "ball in play in opponent 22m area" (i.e., indicator 40) represents a game aspect directly linked to the winning performance, even in the case that players' technical skills are quite poor. As consequence, according to the Italian rugby academies tactical objective to prepare athletes to play at the international level, strength and conditioning coaches should stimulate this capability. In particular, for the conditional training, the players' enhancing of the repeated sprint ability with and without the ball possession can favour substantial improvements in getting the opponent 22m area, especially enhancing the capability to firstly resist against opponent tackles or during set pieces and then sprinting forward. Therefore, training sessions aiming to improve the players' strength level and the running speed could crucially improve the outcome of the game phases highlighted in the findings of this study. In particular, enhancing the difficulty of the exercises, focusing on unplanned and reactive drills, and reinforcing the proper execution of the acceleration and deceleration phases should be considered as the main training objectives by strength and conditioning coaches (2). In

fact, a sharp execution of changes of direction should be emphasized because, at this stage of youth development, players are more able to perform sharper executions than rounded ones (2). However, in line to American football players (3), straight sprinting speed firstly requires to increase the linear acceleration. Therefore, strength and conditioning coaches should consider the enhancement of this ability by performing explosive movements, footwork, and repeated short-distance accelerations, highlighting elastic band, down and uphill, and sled as effective methods to obtain these performance improvements.

In line to this playing scenario, the "possession lost on set pieces" data, tactical, and strength and conditioning coaches should focus training on the development of skills to quickly regain the ball, also to improve the effectiveness of counterattacks. For example, the combination of cognitive (i.e., capability to "read" the playing situation before the opponents) and strength (i.e., capability to get ball during the set pieces) workouts could crucially stimulate players in effectively performing this particular phase of matches. Practically, a progression from simple (i.e., low number of involved offensive and defensive players) to complex (i.e., high number of players) set pieces where the aim is getting the ball to perform a quick offensive action could stimulate players both for tactical capabilities and the above mentioned physical aspects (i.e., cognitive, strength, and repeated sprint abilities with and without change of direction).

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Table 1. Definition of technical and tactical indicators used for the notational analysis performed on Italian under-18 academy games.

Table 2. Means, standard deviations (differences; effects size), and mean differences (95% confidence interval) of all performance indicators in relation to each Italian under-18 rugby academy.

Table 3. Means, standard deviations (differences; effects size), and mean differences (95% confidence interval) of all performance indicators in relation to each Italian under-18 regional tournament (North, Centre, South).

Table 4. Means, standard deviations (differences; effects size), and mean differences (95% confidence interval) of all performance indicators, in relation to winning and losing Italian under-18 academies.

Table 1

Table 1. Definition of technical and tactical indicators used for the notational analysis performed on Italian under-18 academy games.

#	Performance indicator	Definition
1	Set pieces won/regained	All own and opponents' scrums, lineouts, starts and restarts won or regained, respectively. Indicates the number of own possession useful to start attacking
2	Set pieces lost	All own and opponents' scrums, lineouts, starts and restarts won by the opponents. Indicates the opponents' number of possession useful to start attacking.
3	Offensive breakdown total	Sum of the following indicators 4-8.
4	Offensive breakdown "v++" (%)	An offensive breakdown when the ball is used quickly (≤ 3") employing maximum 2 attacking supports.
5	Offensive breakdown "v+" (%)	An offensive breakdown when the ball is used quickly (≤ 3") with maximum 3 attacking supports
6	Offensive breakdown "v-" (%)	An offensive breakdown when the ball is used quickly (≤ 3") with more than 3 attacking supports.
7	Offensive breakdown "l" (%)	An offensive breakdown when the ball is not used quickly (> 3") regardless the number of attacking supports.
8	Offensive breakdown "- -" (%)	An offensive breakdown that results in a turnover or penalty/free kick against
9	Defensive breakdown total	Sum of the following indicators 10-12.
10	Defensive breakdown ">>" (%)	A defensive breakdown where the defending support is much numerous than the attacking support.
11	Defensive breakdown "=" (%)	A defensive breakdown where the defending support is as numerous as the attacking support.
12	Defensive breakdown "<<" (%)	A defensive breakdown where the defending support is less numerous than the attacking support.
13	Tackles total	Sum of the following indicators 14-17.
14	Tackle "++" (%)	Dominant tackle which stops the opponent and the ball (stops the ball carrier from making a pass) and drives opposition player one or more steps backwards.
15	Tackle "+" (%)	Tackle which stops the opponent and the ball (stops the ball carrier from making a pass) and the event happens on the collision point (opponent makes no more steps forward).
16	Tackle "-" (%)	Tackle which stops the opponent and the ball (stops the ball carrier from making a pass) and the tackler is driven backwards one or more steps by the ball carrier.
17	Tackle "- off" (%)	Tackle which stops the opponent but not the ball (allows the ball carrier to recycle the ball).
18	Missed tackle (%)	Tackle which does not stop the opponent.
19	Pass total	Sum of the following indicators 20-21.
20	Pass "+" (%)	Pass which centers the target (receiver's hands) and allows receiver to maintain speed and acceleration.
21	Pass "-" (%)	Pass forward or which does not center the target (receiver's hands) or which does not allow to maintain speed and acceleration.
22	Pass to possession ratio	Ratio between number of attempted passes ("+" + "-") and minutes of possession.
23	P.k. Total	Sum of the following indicators 24-28.
24	P.k. On set piece (%)	A penalty kick conceded on a set piece situation (i.e., start, restart, scrum, line-out).
25	P.k. On breakdown (%)	A penalty kick conceded on a breakdown situation (i.e., ball non released, hands in ruck, entering a ruck or maul from the side, illegaly collapsing a maul).
26	P.k. On tackle (%)	A penalty kick conceded on a tackle situation (i.e., dangerous tackle/shoulder charge/push, tackled not released. tackling or holding an opponent who is not in possession of the ball, obstructing an opponent from tackling the ball carrier-crossing).
27	P.k. On offside (%)	A penalty kick conceded on a offside situation.
28	P.k. Unsportsmanlike (%)	A penalty kick conceded on a unsportsmanlike situation (i.e., violent or foul play: punching, elbowing, kicking, head- butting, tripping, ecc. throwing or knocking the ball forwards or out of play in any direction, any other action the referee considers to be "contrary to good sportsmanship").
29	P.k. Quick played (%)	A penalty kick assigned for played quickly in order to immediate attack.
30	Possession lost total	Sum of the following indicators 31-34.
31	Possession lost due to an error (%)	Ball possession lost because the responsibility of the possessor (i.e., ball handling error, forward pass).
32	Possession lost on kicks (%)	Ball possession lost on a kicking situation without gaining any territorial advantage (i.e., kicking the ball directly in touch out of the 22-m area or kicking the ball without contrasting the opponents attack).
33	Possession lost on turnover (%)	Ball possession lost on a turnover situation because a prompt and opportune action by the opponents.
34	Possession lost on set pieces (%)	Ball possession lost on a set piece situation (own set piece lost during play or because a penalty/free kick).
35	Ball in play	Ball in play period is considered since the scrum sets or since hooker throw in line-outs or since starts/restarts are kicked until referee stops the game. Kicking to touch, conversions are not considered as BIP period.
36	Time in possession (%)	Ball in play time spent in own possession.
37	Ball in play in own 22m area (%)	Time spent playing (defending or attacking) in own 22 area.
38	Ball in play in own 22m- halfway lines (%)	Time spent playing (defending or attacking) in the area between own 22 and halfway lines.
39	Ball in play in opponent halfway - 22m lines (%)	Time spent playing (defending or attacking) in the area between halfway and opponents' 22 lines.
40	Ball in play in opponent 22m area (%)	Time spent playing (defending or attacking) in the opponents' 22 area.
41	Sequences period 0-10 s (%)	Numbers of sequences last from 0 to 10 seconds.
42	Sequences period 11-40 s (%)	Numbers of sequences last from 11 to 40 seconds.
43	Sequences period 41-60 s (%)	Numbers of sequences last from 41 to 60 seconds.
44	Sequences period > 60 s (%)	Numbers of sequences last more than 60 seconds.

Table 2

Table 2. Means, standard deviations (differences; effects size), and mean differences (95% confidence interval) of all performance indicators in relation to each Italian under-18 rugby academy.

#	Performance indicators	Team 1 (4 games)	Team 2 (β) (4 games)	Team 3 (χ) (3 games)	Team 4 (δ) (4 games)	Team 5 (ε) (3 games)	Team 6 (φ) (3 games)	Team 7 (γ) (4 games)	Team 8 (η) (3 games)	Team 9 (†) (4 games)
1*	Set pieces won/regained	24 ± 2.82	21.2 ±3.86	26.6 ± 2.51	27.2 ± 0.95	23 ± 3.60	23 ± 1.73	25.2 ± 2.36	28 ± 1	24.5 ± 1.29
2*	Set pieces lost	23.2 ± 2.06	26 ± 2.70	23.6 ± 0.57	26 ± 2.70	27.6 ± 1.52	26.6 ± 2.08	21.2 ± 3.59	25 ± 4.35	24 ± 2.44
3*	Offensive breakdown total	34 ± 7.65	56.2 ± 25.0	54 ± 15.3	48.7 ± 7.41	48.3 ± 5.50	52 ± 8.66	59.2 ± 13.0	47 ± 16.0	44.5 ± 5.19
4*	Offensive breakdown "v++" (%)	28.5 ± 9.03	24.5 ± 7.50	23 ± 4.58	27.7 ± 9.63	21.3 ± 16.4	16.6 ± 4.04	37.7 ± 11.7	31 ± 9.16	19 ± 4.54
5*	Offensive breakdown "v+" (%)	10.7 ± 8.18	22.7 ± 3.77	25.3 ± 5.68	20.7 ± 8.01	17 ± 4	18 ± 5.56	22.2 ± 3.68	20.6 ± 4.04	18 ± 6.37
6¥	Offensive breakdown "v-" (%)	14.5 ± 11.3	12.2 ± 3.59	2.66 ± 0.57	9.25 ± 2.21	4.66 ± 2.30	14 ± 7.81	8.25 ± 3.30	7.33 ± 4.04	10.5 ± 4.93
7*	Offensive breakdown "l" (%)	31.2 ± 5.61	28 ± 5.41	42.6 ± 9.50	33.5 ± 15.5	36.3 ± 13.4	43.3 ± 10.4	25.7 ± 5.43	30.3 ± 9.07	38 ± 4.39
8¥	Offensive breakdown "- -" (%)	15.7 ± 7.97	12.7 ± 8.88	6.33 ± 1.52	8.75 ± 2.75	21.3 ± 4.50	8 ± 2.64	6.75 ± 2.98	10 ± 2	14.7 ± 7.5
9*	Defensive breakdown total	66 ± 18.0	44.2 ± 13.8	55 ± 15.5	41.7 ± 8.05	49.6 ± 12.0	41.3 ± 3.05	35.5 ± 14.4	53.3 ± 4.04	51 ± 7.39
10¥	Defensive breakdown ">>" (%)	77 ± 4.24 β(0.014;0.7), 0.14 (0.02, 0.27)	56 ± 11.6 χ(0.017;0.7), -0.15 (-0.29, -0.02) δδ(0.007;0.7), -0.15 (-0.28, -0.03) εε(0.005;0.8), -0.17 (-0.31, -0.04) φφ(0.004;0.8), -0.17 (-0.31, -0.04) γγ(0.005;0.7), -0.16 (-0.29, -0.03) †††(<0.001;0.8) -0.20 (-0.32, -0.07)	79 ± 12	78.7 ± 7.58	82 ± 4.35	82.6 ± 8.14	79.7 ± 8.69	75 ± 3	87 ± 5.47
11¥	Defensive breakdown "=" (%)	21.5 ± 2.64	32.2 ± 9.97 ††(0.01;0.8), 0.50 (0.08, 0.92)	18 ± 8.54	15.7 ± 5.25	15.6 ± 4.50	15 ± 6.24	16.5 ± 6.55	16 ± 4.35	11 ± 6.73
12η	Defensive breakdown "<<" (%)	1.5 ± 1.91 β(0.02;0.8), δ(0.037;0.7), η(0.032;0.8)	12 ± 4.96 φ(0.034;0.8), †(0.028;0.8)	3.33 ± 4.16	5.25 ± 1.89	2.33 ± 2.51	2.33 ± 2.08	3.75 ± 2.62 η(0.034;0.8)	9 ± 2 †(0.032;0.8)	2 ± 2.44
13*	Tackles total	122 ± 19.6 δ(0.015;0.8), 55.5 (6.5, 104.5) γγ(0.009;0.8), 58.5 (9.5, 107.5)	90.2 ± 29.2	85.6 ± 7.63	66.7 ± 14.0	88 ± 23.8	77.6 ± 16.9	63.7 ± 18.2	86.3 ± 16.5	88.7 ± 15.2
14*	Tackle "++" (%)	5.5 ± 3.51	6 ± 1.82	5.66 ± 0.57	8 ± 1.15	6.33 ± 5.03	7.33 ± 1.15	5.5 ± 4.79	5.66 ± 2.51	5.75 ± 3.09
15*	Tackle "+" (%)	19 ± 3.74	23.2 ± 6.07	21 ± 5.56	25.2 ± 7.18	21.6 ± 7.57	29.3 ± 3.05	22.7 ± 3.30	29 ± 3.60	25 ± 4.24
16*	Tackle "-" (%)	38.2 ± 5.18	39.2 ± 9.53	39 ± 1.73	39 ± 8.04	36.3 ± 8.08	33.3 ± 3.05	41.2 ± 10.3	41.3 ± 12.8	42.7 ± 4.11
17¥	Tackle "- off" (%)	12.5 ± 5.50	15.7 ± 9.94	11 ± 2	7.25 ± 2.62	15 ± 6.55	11.6 ± 7.23	10.5 ± 4.35	7.66 ± 4.04	8.75 ± 2.62
18*	Missed tackle (%)	24.7 ± 5.56	16 ± 5.59	23 ± 4.58	20.2 ± 2.5	20.3 ± 6.02	17.6 ± 3.78	20.2 ± 6.18	16.3 ± 6.65	17.5 ± 3.69
19¥	Pass total	73.5 ± 12.3 γ(0.019;0.9), -0.32 (-0.6, -0.03)	101. ± 41.2	83 ± 14	104. ± 20.5	80 ± 8.54	81 ± 16.8	151 ± 15.3 †(0.017;1.0), 0.32 (0.03, 0.61)	87.3 ± 39.5	72.2 ± 7.80
20*	Pass "+" (%)	87.5 ± 5.74	85.7 ± 4.85	81.6 ± 4.04	83.2 ± 4.64	80.6 ± 10.0	84 ± 1	85.5 ± 0.57	83.6 ± 5.03	82 ± 5.09

#	Variable									
21*	Pass "-" (%)	12.5 ± 5.74	14.2 ± 4.85	18.3 ± 4.04	16.7 ± 4.64	19.3 ± 10.0	16 ± 1	14.5 ± 0.57	16.3 ± 5.03	18 ± 5.09
22¥	Pass to possession ratio	6.65 ± 0.46	6.87 ± 1.12	6.36 ± 0.83	7.02 ± 1.25	6.26 ± 1.28 γ(0.044;0.8), -0.2 (-0.4, -0.01)	5.66 ± 0.90 γγ(0.007;0.9), -0.24 (-0.45, -0.04)	9.97 ± 1.68 ηη(0.008;0.7), 0.24 (0.04, 0.44) †††(0.001;0.9), 0.26 (0.08, 0.45)	5.83 ± 1.67	5.4 ± 0.31
23*	P.k. Total	12.2 ± 6.44	11 ± 3.16	16.3 ± 5.50	12.7 ± 5.05	15 ± 6.55	16 ± 1.73	9 ± 1.41	12.3 ± 4.61	16.2 ± 4.78
24*	P.k. On set piece (%)	8 ± 6.05	14.2 ± 10.9	27.3 ± 8.50	20.7 ± 17.9	19.3 ± 13.0	23.6 ± 11.3	21.7 ± 8.01	6.66 ± 6.50	27.5 ± 15.7
25*	P.k. On breakdown (%)	35.5 ± 27.3	58.5 ± 11.2	46.6 ± 7.37	49.7 ± 19.0	50.3 ± 17.5	40.3 ± 18.1	49.7 ± 5.31	36.3 ± 6.35	33.2 ± 17.6
26η	P.k. On tackle (%)	15.2 ± 17.7	6 ± 6.97	4 ± 6.92	1.75 ± 3.5	2.33 ± 4.04	8.33 ± 2.30	12.5 ± 12.0	20.6 ± 8.02	9 ± 12.7
27¥	P.k. On offside (%)	39.2 ± 17.9	21 ± 9.79	16 ± 3.46	27.5 ± 4.20	27.6 ± 11.9	23.6 ± 11.3	16 ± 12.5	32 ± 7	23.5 ± 11.4
28¥	P.k. Unsportsmanlike (%)	1.75 ± 3.5	0 ± 0	5.33 ± 6.11	0 ± 0	0 ± 0	4.33 ± 3.78	0 ± 0	4.66 ± 8.08	6.5 ± 2.08
29*	P.k. Quick played (%)	36.1 ± 16.0	26.6 ± 7.23	34.6 ± 6.11	34 ± 27.3	48.1 ± 8.52	34.1 ± 12.1	41.1 ± 17.2	16.7 ± 18.1	28.2 ± 11.4
30*	Possession lost total	29.5 ± 8.06	35.5 ± 5.80	31 ± 5.56	30 ± 6.27	36.6 ± 0.57	26.6 ± 4.16	27.2 ± 6.07	30.6 ± 3.51	30.2 ± 5.73
31*	Possession lost due to an error (%)	29.5 ± 9.94 γ(0.018;0.6), -29.3 (-55.5, -3)	30.5 ± 11.2 γ(0.025;0.5), -28.3 (-54.5, -2)	35.6 ± 11.0	44.2 ± 8.65	28.3 ± 3.78 γ(0.026;0.7), -30.4 (-58,7, -2.1)	42.6 ± 9.07	58.7 ± 14.4 η(0.049;0.8), 28.4 (0.1, 56.7)	30.3 ± 3.78	38.7 ± 11.6
32*	Possession lost on kicks (%)	16.5 ± 6.95	12 ± 4.96	15.6 ± 6.65	15.5 ± 4.93	7.33 ± 7.02	18 ± 5	7.5 ± 5.74	13.3 ± 3.78	13.5 ± 4.93
33¥	Possession lost on turnover (%)	23.7 ± 7.45	19 ± 4.69	13.3 ± 4.72	13.5 ± 5.19	27.3 ± 4.61	11 ± 2	11.5 ± 4.04	20.3 ± 10.0	16.2 ± 5.67
34*	Possession lost on set pieces (%)	30 ± 15.4	38.5 ± 9.29	34 ± 4	27 ± 2.44	37 ± 8.66	28 ± 6.92	22.5 ± 13.3	36 ± 12.1	31.2 ± 9.5
35η	Ball in play	26.2 ± 1.66	29.3 ± 3.43	27.3 ± 2.58	26.9 ± 0.29	26.8 ± 2.15	26.5 ± 1.52	29.2 ± 3.46	27.7 ± 2.38	27.3 ± 1.07
36*	Time in possession (%)	40.9 ± 2.84 γ (0.022;0.5), -17.3 (-33.1, -1.5)	50.9 ± 11.7	49.4 ± 2.91	54.8 ± 3.71	45.7 ± 2.49	51.7 ± 3.87	58.1 ± 8.32	47.6 ± 7.31	49.1 ± 2.47
37*	Ball in play in own 22m area (%)	21.8 ± 6.95	24.8 ± 12.7 δ(0.049;0.7), 17.3 (0.1, 34.5) γ(0.048;0.7), 17.3 (0.1, 34.5)	19 ± 6.84	7.55 ± 2.60	22.2 ± 5.75	14.0 ± 5.09	7.52 ± 2.43	12.5 ± 4.74	15.9 ± 6.00
38¥	Ball in play in own 22m- halfway lines (%)	38.4 ± 7.72	30.9 ± 5.34	38.0 ± 12.3	29.1 ± 3.35	46.1 ± 7.72	30.7 ± 9.79	26.1 ± 2.52	36.6 ± 14.7	32.7 ± 6.69
39*	Ball in play in opponent halfway - 22m lines (%)	28.6 ± 4.78	31.8 ± 10.8	29.8 ± 4.47	45.7 ± 7.35	24.7 ± 4.15	32.5 ± 8.65	35.0 ± 5.41	35.9 ± 7.88	37.5 ± 11.8
40¥	Ball in play in opponent 22m area (%)	10.7 ± 5.04 γ(0.016;0.8), -0.49 (-0.93, -0.06)	12.2 ± 5.19	13.0 ± 4.00	17.5 ± 4.08	6.8 ± 2.02 φ(0.029;0.7), -0.54 (-1, -0.03) γγ(0.001;0.9), -0.67 (-1.1, -0.19)	22.8 ± 3.43	31.2 ± 6.47	14.7 ± 11.0	13.8 ± 4.18
41η	Sequences period 0-10 s (%)	27.5 ± 3.69	23.2 ± 3.86	35.6 ± 3.78	29.2 ± 7.80	27.3 ± 9.29	35 ± 5.56	25.7 ± 5.90	23 ± 9.53	33 ± 2.94
42*	Sequences period 11-40 s (%)	52.5 ± 2.08	56.2 ± 5.05	44.6 ± 1.15	54 ± 5.94	53.3 ± 2.30	49.6 ± 3.21	56.2 ± 4.64	53.3 ± 7.09	47.7 ± 4.34
43*	Sequences period 41-60 s (%)	11.5 ± 4.04	12.2 ± 4.11	12 ± 4.58	11 ± 2.44	12.6 ± 5.68	10 ± 2.64	10.7 ± 4.99	14.6 ± 4.04	13 ± 2.16
44*	Sequences period > 60 s (%)	8.25 ± 3.30	8.25 ± 2.62	8.33 ± 1.52	5.75 ± 2.98	7 ± 5.29	5.66 ± 2.30	7.5 ± 2.08	9.33 ± 4.04	7 ± 2.94

* parametric statistics; ¥ parametric statistics after logarithmic transformation; η non-parametric statistics

β, χ, δ, ε, φ, γ, η, † ($p \leq 0.05$); ββ, χχ, δδ, εε, φφ, γγ, ηη, †† ($p \leq 0.01$); βββ, χχχ, δδδ, εεε, φφφ, γγγ, ηηη, ††† ($p \leq 0.001$) difference with respect to Team 2, 3, 4, 5, 6, 7, 8, 9, respectively.

Table 3

Table 3. Means, standard deviations (differences; effects size), and mean differences (95% confidence interval) of all performance indicators in relation to each Italian under-18 regional tournament (North, Centre, South).

#	Performance indicators	Italian regional tournaments		
		North	Centre (η)	South (†)
1*	Set pieces won/regained	24.7 ± 1.8	26.1 ± 2.7	23.5 ± 2.0
2*	Set pieces lost	24.8 ± 1.6	26.2 ± 1.3	23.5 ± 2.4
3*	Offensive breakdown total	50.2 ± 5.0	48.0 ± 0.9	49.8 ± 13.8
4*	Offensive breakdown "v++" (%)	19.6 ± 3.2 †(0.035;0.7), -10.8 (-20.9, -0.6)	26.7 ± 4.9	30.3 ± 6.8
5*	Offensive breakdown "v+" (%)	20.4 ± 4.2	19.5 ± 2.1	18.6 ± 6.8
6¥	Offensive breakdown "v-" (%)	9.1 ± 5.8	7.1 ± 2.3	11.7 ± 3.2
7*	Offensive breakdown "l" (%)	41.3 ± 2.9 ††(0.005;0.9), 12.7 (3.3, 22)	33.4 ± 3.0	28.3 ± 2.8
8¥	Offensive breakdown "- -" (%)	9.7 ± 4.5	13.4 ± 6.9	11.8 ± 4.6
9*	Defensive breakdown total	49.1 ± 7.0	48.3 ± 5.9	48.6 ± 15.7
10¥	Defensive breakdown ">>" (%)	82.9 ± 4.0 †(0.032;0.5), -0.08 (-0.15, -0.01)	78.6 ± 3.5	70.9 ± 13.0
11¥	Defensive breakdown "=" (%)	14.7 ± 3.5 †(0.13;0.5), 0.23 (0.04, 0.43)	15.8 ± 0.2	23.4 ± 8.0
12η	Defensive breakdown "<<" (%)	2.6 ± 0.7	5.5 ± 3.3	5.8 ± 5.5
13*	Tackles total	84.0 ± 5.7	80.4 ± 11.8	92.1 ± 29.3
14*	Tackle "++" (%)	6.3 ± 0.9	6.7 ± 1.2	5.7 ± 0.3
15*	Tackle "+" (%)	25.1 ± 4.2	25.3 ± 3.7	21.7 ± 2.3
16*	Tackle "-" (%)	38.4 ± 4.7	38.9 ± 2.5	39.6 ± 1.5
17¥	Tackle "- off" (%)	10.5 ± 1.5	10.0 ± 4.4	12.9 ± 2.6
18*	Missed tackle (%)	19.4 ± 3.1	19.0 ± 2.3	20.3 ± 4.4
19¥	Pass total	78.8 ± 5.7	90.7 ± 12.7	108.8 ± 39.2
20*	Pass "+" (%)	82.6 ± 1.3	82.5 ± 1.6	86.3 ± 1.1
21*	Pass "-" (%)	17.4 ± 1.3	17.5 ± 1.6	13.8 ± 1.1
22¥	Pass to possession ratio	5.8 ± 0.5 ††(0.006;0.6), 0.13 (0.03, 0.22)	6.4 ± 0.6	7.8 ± 1.9
23*	P.k. Total	16.2 ± 0.2 †(0.018;0.9), 5.5 (0.8, 10.1)	13.4 ± 1.4	10.8 ± 1.6
24*	P.k. On set piece (%)	26.2 ± 2.2	15.6 ± 7.8	14.7 ± 6.9
25*	P.k. On breakdown (%)	40.1 ± 6.7	45.5 ± 7.9	47.9 ± 11.6
26η	P.k. On tackle (%)	7.1 ± 2.7	8.3 ± 10.8	11.3 ± 4.8
27¥	P.k. On offside (%)	21.1 ± 4.4	29.1 ± 2.6	25.4 ± 12.2
28¥	P.k. Unsportsmanlike (%)	5.4 ± 1.1	1.6 ± 2.7	0.6 ± 1.0
29*	P.k. Quick played (%)	32.4 ± 3.6	33.0 ± 15.7	34.6 ± 7.3
30*	Possession lost total	29.3 ± 2.3	32.4 ± 3.7	30.8 ± 4.3
31*	Possession lost due to an error (%)	39.0 ± 3.5	34.3 ± 8.7	39.6 ± 16.6
32*	Possession lost on kicks (%)	15.7 ± 2.3	12.1 ± 4.2	12.0 ± 4.5
33¥	Possession lost on turnover (%)	13.5 ± 2.6	20.4 ± 6.9	18.1 ± 6.2
34*	Possession lost on set pieces (%)	31.1 ± 3.0	33.3 ± 5.5	30.3 ± 8.0
35η	Ball in play	27.1 ± 0.5	27.2 ± 0.5	28.3 ± 1.7
36*	Time in possession (%)	50.1 ± 1.4	49.4 ± 4.8	50.0 ± 8.7
37*	Ball in play in own 22m area (%)	16.3 ± 2.5	14.1 ± 7.5	18.1 ± 9.3
38¥	Ball in play in own 22m - halfway lines (%)	33.8 ± 3.8	37.3 ± 8.5	31.8 ± 6.2
39*	Ball in play in opponent halfway - 22m lines (%)	33.3 ± 3.9	35.5 ± 10.5	31.8 ± 3.2
40¥	Ball in play in opponent 22m area (%)	16.6 ± 5.4	13.0 ± 5.6	18.1 ± 11.5
41η	Sequences period 0-10 s (%)	34.6 ± 1.4 †††(<0.001;0.8)	26.5 ± 3.2	25.5 ± 2.1
42*	Sequences period 11-40 s (%)	47.4 ± 2.5 †††(0.001;0.9), -6.2 (-11.1, -1.3)	53.6 ± 0.4 ††(0.009;0.4), -7.6 (-12.2, 3)	55.0 ± 2.2
43*	Sequences period 41-60 s (%)	11.7 ± 1.5	12.8 ± 1.8	11.5 ± 0.8
44*	Sequences period > 60 s (%)	7.0 ± 1.3	7.4 ± 1.8	8.0 ± 0.4

* parametric statistics; ¥ parametric statistics after logarithmic transformation; η non-parametric statistics

† ($p \leq 0.05$), †† ($p \leq 0.01$), ††† ($p \leq 0.001$) differences with respect to South.

Table 4

Table 4. Means, standard deviations (differences; effects size), and mean differences (95% confidence interval) of all performance indicators, in relation to winning and losing Italian under-18 academies.

#	Performance indicators	Outcome	
		Winning academies	Losing academies
1*	Set pieces won/regained	25.8 ± 1.9 †(0.037;0.4), 24.7 (23.6, 25.8)	23.6 ± 3.5
2*	Set pieces lost	23.6 ± 3.5	25.8 ± 1.9
3*	Offensive breakdown total	50.0 ± 11.6	48.3 ± 15.6
4*	Offensive breakdown "v++" (%)	27.7 ± 9.8	23.8 ± 10.3
5*	Offensive breakdown "v+" (%)	18.8 ± 7.5	19.9 ± 5.5
6¥	Offensive breakdown "v-" (%)	10.3 ± 6.7	8.7 ± 5.4
7*	Offensive breakdown "l" (%)	33.8 ± 11.5	33.9 ± 8.2
8¥	Offensive breakdown "- -" (%)	9.62 ± 4.7	13.6 ± 7.7
9*	Defensive breakdown total	49 ± 16.5	48 ± 10.8
10¥	Defensive breakdown ">>" (%)	76.6 ± 11.2	77.7 ± 11.3
11¥	Defensive breakdown "=" (%)	18.6 ± 8.7	17.7 ± 7.9
12η	Defensive breakdown "<<" (%)	4.75 ± 3.6	4.5 ± 5.0
13*	Tackles total	81.6 ± 25.2	89.6 ± 22.1
14*	Tackle "++" (%)	6.81 ± 2.6	5.5 ± 2.8
15*	Tackle "+" (%)	25.0 ± 6.0	22.6 ± 4.8
16*	Tackle "-" (%)	38.9 ± 6.2	39.3 ± 8.3
17¥	Tackle "- off" (%)	8.87 ± 3.6 †(0.014;0.4), 1 (0.92, 1.48)	13.3 ± 6.4
18*	Missed tackle (%)	20.1 ± 4.2	19.0 ± 6.1
19¥	Pass total	102. ± 31.9	85.5 ± 29.6
20*	Pass "+" (%)	84.0 ± 3.2	83.8 ± 6.2
21*	Pass "-" (%)	15.9 ± 3.2	16.1 ± 6.2
22¥	Pass to possession ratio	7.11 ± 1.8	6.3 ± 1.4
23*	P.k. Total	14.1 ± 4.8	12.3 ± 4.5
24*	P.k. On set piece (%)	17.5 ± 11.4	20 ± 13.6
25*	P.k. On breakdown (%)	44.7 ± 14.5	44.5 ± 18.6
26η	P.k. On tackle (%)	9.68 ± 10.3	8.1 ± 10.8
27¥	P.k. On offside (%)	26.1 ± 8.9	24.2 ± 14.7
28¥	P.k. Unsportsmanlike (%)	1.62 ± 3.3	3.1 ± 4.5
29*	P.k. Quick played (%)	35.1 ± 16.7	31.4 ± 14.9
30*	Possession lost total	28 ± 5.6 ††(0.005;0.5), 30.8 (28.7, 32.9)	33.5 ± 4.6
31*	Possession lost due to an error (%)	44.3 ± 14.0 ††(0.005;0.5), 38.1 (33.3, 42.8)	31.8 ± 8.6
32*	Possession lost on kicks (%)	13.8 ± 6.3	12.5 ± 5.7
33¥	Possession lost on turnover (%)	16 ± 6.1	18.5 ± 8.1
34*	Possession lost on set pieces (%)	25.5 ± 8.7 †††(<0.001;0.6), 31.3 (27.7, 35)	37.1 ± 7.9
35η	Ball in play	27.5 ± 2.3	27.5 ± 2.3
36*	Time in possession (%)	52.0 ± 7.0	47.9 ± 7.2
37*	Ball in play in own 22m area (%)	12.3 ± 6.7 †(0.011;0.4), 16.1 (13, 19.1)	19.7 ± 8.6
38¥	Ball in play in own 22m - halfway lines (%)	33.9 ± 8.3	33.8 ± 9.8
39*	Ball in play in opponent halfway - 22m lines (%)	33.8 ± 9.8	33.9 ± 8.3
40¥	Ball in play in opponent 22m area (%)	19.7 ± 8.6 ††(0.006;0.5), 1.15 (1.06, 1.23)	12.3 ± 6.7
41η	Sequences period 0-10 s (%)	28.6 ± 6.9	28.6 ± 6.9
42*	Sequences period 11-40 s (%)	52.1 ± 5.3	52.1 ± 5.3
43*	Sequences period 41-60 s (%)	11.9 ± 3.6	11.9 ± 3.6
44*	Sequences period > 60 s (%)	7.43 ± 2.9	7.4 ± 2.9

* parametric statistics; ¥ parametric statistics after logarithmic transformation; η non-parametric statistics

† (p ≤ 0.05), †† (p ≤ 0.01), ††† (p ≤ 0.001) differences with respect to Losing teams.