MODELLING AN ADEQUATE PROFILE FOR A MORE TARGETED WORK METHODOLOGY, WITH DEDICATED TECHNOLOGIES, FOR ELITE-LEVEL FOOTBALLERS: COMPARISON BETWEEN SUB 17 VS SUB 19, HIGHLIGHTS AND SHADOWS

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Abstract

Purpose: The aim of this study is to compare physical performance during official match (under 17 Championship Serie A and B, under 19Serie B) in two different professional football team and analyze which are the physical parameters that differentiates better under 17 (U-17) and under 19 (U-19) young elite-level football teams. Method: Forty-five (n=45) professional soccer players were analyzed (n=23 under 17; age 16.5±0.5 body weight 69.8±7.0 kg; height 177±8.0cm; fat mass 8.2±3.6 %) and (n=22 under 19; age 17±0.4 years, body weight 70.9±5.8 kg; height 180±5.3 cm; fat mass 8.9±3.6%),excluding goalkeepers, they have been analyzed during 50 official matches (2017-2018: 26 Matches U-17 and 24 Matches U-19 respectively) with K-GPS 20Hz (K-Sport Universal STATS, Montelabbate (PU), Italy).Results: Distance covered at very high intensity acceleration (D_A8, m) is significantly higher in U-19 vs U-17 (ES=1.14; p<0.05). Deceleration at very high intensity (D_A1, m) is significantly higher in U-19 vs U-17 (ES=0.70; p<0.05). Instead metabolic power average event (MPA(W/Kg)) is significantly higher in U-17 vs U-19 (ES=1.17; p <0.05). These events are very different in global analysis of season for under 17 and under 19 (first leg + second leg); we found the same situation in first leg period analysis (U-19 vs U-17). The situation changes in the second part of the season where only metabolic power average event (MPA, w/kg)changing significantly in U-17 being larger than U-19 (ES=1.44; p<0.05). In the second part of the season (second leg), other parameters are improved in U-17 and they are close to U-19 external training load. Conclusion: This comparison is important to understand better structural and body differences between two different ages in elite-level young footballers groups. This study confirm that high intensity acceleration (> 3m/s²), are greater in U-19 respect to U-17, in the entire season, in fact this parameter is correlated with the development of strength and muscle mass (growth process).This underline the importance to strength training from young ages respecting physiological processes of development.

Key words: *match performance, GPS, D_SHI(m), D_A8(m), D_A1(m), D_S5(m), AMP(W/Kg).*

Introduction

Soccer is an intermittent sport characterized by about 1200 acyclical and unpredictable changes in activity (each lasting from 3 to 5 sec.) involving, among others, 30 to 40 sprints, more than 700 turns and 30 to 40 tackles and jumps (Altavilla, 2019, D'Isanto et al., 2019, Iaia et al., 2009). This team sport involves periods of high-intensity activity, interspersed with lower intensity actions, as well as technical and tactical components (Sparkes et al., 2018). Recent studies have pointed out that soccer players cover between 8000 m and 14000 m during a match (Aguiar et al., 2012) showing that several physical skills such as running, kicking, dribbling and tackling can affect soccer player's performance (D'Elia et al., 2019). These efforts increase the physical demands of the players and contribute to characterize soccer, as a sport with high metabolic and physiological demands(Iaia et al., 2009; Arslan et al., 2017). Moreover, computerized time motion and video analyses have revealed that top class football players perform 2 to 3 km of high-intensity running (>15 km/h) and about 0.6 km of sprinting (>20 km/h). In addition, the less successful teams exhibit greater decrements in the total speed distance covered during the match, suggesting the importance to perform high intensity activities through football specific exercises (Iaia et al., 2009).In the last few years, different training methods such as endurance training, high-intensity interval training (HIIT) and strength training have been proposed to develop physical, technical and tactical skills (Hammami et al., 2017). A number of studies have examined the effect of performing high-intensity training through football-specific exercises, showing that is possible to achieve an elevated exercise intensity using the ball, as demonstrated by elevated heart rates, marked blood lactate accumulations and high rate of perceived exertions (Raiola, D'Isanto, 2016, Iaia et al., 2009). Recently, specific sport training method like Small-Sided Games (SSGs) have been proposed in order to develop the team-specific performance of players (Hammami et al, 2017). SSG is a training method used by coaches to optimize training time and to replicate the demands of match play (Brandes et al., 2012). This type of training is often played with modified games on reduced pitch areas, using adapted rules and involving a smaller number of players then traditional games (Hammami et al, 2017).SSGs are increasingly to be more suitable than traditional interval training for the development of particular physical characteristics required for matches such as technical skills, decision-making ability and physical fitness (Arslan et al., 2017). Several factors can influence the physiological responses associated with SSGs and the impact on this form of training's ability to be a useful means for physical training: dimensions of the pitch, number of players, coach encouragement, training modality, game duration and rule modifications (Halouani et al., 2017). Both pitch dimensions and number of players are considered two of the variables that most influence the physiological responses during the SSGs. Newer GPS may provide an acceptable tool for the measurement of constant velocity, acceleration, and deceleration during straight-line running, showing sufficient sensitivity for detecting changes in performance in team sport. The evolution of GPS now permits valid and reliable estimates of the external load incurred during SSGs but, the multifactorial nature of these games, characterized by a great number of explosive actions and changes in velocity, implies a higher complexity in the quantification of the workload (Izzo et al., 2019, Varley et al, 2012) [21;22].Previous investigations (Di Prampero et al., 2005; Osgnach et al 2010), have shown that the energy expenditure and distance covered at different metabolic power categories better inform about the true physical demands imposed on players, as this method takes into account accelerations and decelerations besides speed and distance values. It's important to understand better what is training solution to improve performance in this young players and reduce age difference during season. In fact big differences between two different group are in acceleration at high intensity (> 3 m/s²). This parameters for U-17 during season don't arrive close to U-19 performance: probably it's necessary to improve strength condition for U-17 group, to achieve good physical result during match.[19;20].Two team were trained in two different modalities: U-19 mixed training with ball and without ball the other way around U-17 with ball (periodization training), not without ball.The aim of this study is to compare physical performance during official matches (under 17 Championship Serie A and B, under 19 Serie B) in two different professional football teams and analyze what is the physical parameter that differentiates U-17 and U-19.

Materials and methods

Forty-five (n=45) professional soccer players (experience 8±2 years) were analyzed (n=23 under 17; age 16.5±0.5 body weight 69.8±7.0 kg; height 177±8.0cm; fat mass 8.2±3.6 %) and (n=22 under 19; age 17±0.4 years, body weight 70.9±5.8 kg; height 180±5.3 cm; fat mass 8.9±3.6%), without goalkeepers, during 50 official championship matches (2017-2018: 26 Matches U-17 (Allievi Serie A e B), and 24 Matches U-19 (Primavera 2) respectively).All athletes are elite players by Italian football championship. In order to be included in the study subjects had to 1) ensure regular participation in all the training sessions, 2) have competed regularly during the previous competitive season, and 3) possess medical clearance. Before entering the study, participants were fully informed about the study aims and procedures, and they provided written informed consent before the testing procedure. The study protocol was conformed to the code of Ethics of the World Medical Association (Declaration of Helsinki).The junior professional soccer team trained for approximately 10hfive times per week (always on Monday, Tuesday, Wednesday, Thursday and Friday) plus the official match played on Saturday or Sunday. The study was conducted during the competitive season 2017-2018 (i.e. from July to June) and we examined and recorded during this period, 50 matches in two different categories. Between team systematically playing in a 4-3-3 module. All participants during the week were followed by video analysis, GPS (20Hz, K-Sport Universal STATS Italy)and heart rate monitoring during training, at the end of each session RPE (rating perceived of exertion) has been recorded. The same protocol is followed during match on Saturday or Sunday to analyze the external load difference between U-17 and U-19.

Equipment

The players' physical activity during the matches and each training session was monitored using portable global positioning system (GPS) technology 20 Hz (GPS, K-Sport, Universal STATS Montelabbate, PU, Italy) positioned on the upper back in a pocket of a custom made vest (K-Sport/STATS Vest). Several studies have investigated the validity and reliability of GPS devices for measuring movements and speeds (Rampinini et al., 2015), and as reported in recent studies [20,21,22], a sample rate of 20 Hz is strongly more accurate than old devices such as, for example, Gps 10 Hz with a proved higher error rate, to quantify the very high intensity acceleration and deceleration running phases in team sports.

Data analysis

The external load measures, as the distance run at high speed (D_SHI; >16km·h^{-1}) (Di Salvo et al., 2009), the distance run at very high intensity speed (D_S5 > 20Km/h) (Rampinini et al. 2009), the number of very high intensity accelerations (D_A8; ≥ +3m·s^{-2}) and decelerations (D_A1; ≤ −3 m·s^{-2}) (Osgnach et al., 2010) were recorded. With regards to the predicted metabolic parameters the average metabolic power (AMP; W·kg^{-1}) was calculated (Di Prampero et al., 2005). Immediately after each match and training session, all players were asked to state their rate perceived exertion (RPE) of the game just completed, using a printout of Borg's CR10 scale (Borg, 1998). Each subject was previously familiarized on the use of Borg CR10 scale, including anchoring procedures.

Statistical Analysis

We analyzed variables with d-Cohen (effect size; ES), to compare between U-17 and U-19 distance run at high speed, very high intensity speed distance, very high intensity accelerations, very high intensity decelerations, average metabolic power. An alpha level of $p < 0.05$ was chosen. The statistical analyses were performed with SPSS (SPSS, Inc., Chicago, IL, USA). Data are presented as means ± standard deviation. Effect size dimension is low from 0 to 0.4, moderate from 0.5 to 0.6 and large from 0.7 to 1.0.

Results

From the analysis of the data there are physical differences (statistically significant) between first leg championship, under 19 vs under 17, as of distance covered at high intensity running > 16Km/h and very intensity running > 20Km/h (respectively, ES: 0.64 (+7.27%) and ES:1.29 (+8.79%); p<0.05) (see tab 1 and fig.1 and 2). This condition highlights that in the first part of season there are big physical differences between the two categories: under 17 don't have a great experience in that level (players are near to performance under 16 and far to performance under 19). The same situation for very high intensity acceleration (> 3m/s²) and deceleration (< - 3m/s²) (respectively, ES:1.47 (+20.02%) and ES: 1.11(+20.50%); p<0.05) (see tab 1 and fig. 3 and 4). This analysis of external load, underline that strength parameters (acceleration and deceleration) are closely linked with age: U-17 have not completed yet the physical development of the strength parameters and they have difficult to produce high level of acceleration and deceleration if compared with U-19. Only a physical parameter it is higher respect to U-19: metabolic power (ES: 0.91; (+5.49%) p<0.05)(fig.5). In fact U-17 during training used a lot of ball possession and play on horizontal lines respect to U-19 that created more vertical actions. The U-17game produce more metabolic power respect to U-19, probably, because there is a position game in tactics requests.

This situation let us understand that staff and coach idea influence a football game: it's important run with logical idea and not run fast with any idea. It's necessary to have a good physical condition to support team performance. In the second leg the relationship between U-19 and U-17 change completely, not statistically significant, from D_SHI and D_S5 (respectively ES:0.09 (+1.40%) and ES: 0.04 (+0.86%),p<0.05, fig.6-7).The same from deceleration D_A1 (ES:0.32 (+7.32%), p<0.05, fig.8.). From very high intensity acceleration (D_A8) the difference is moderately significant (ES: 0.66 (+12.17%) p<0.05, fig.9) in favor to U-19 (same reason first leg). Metabolic power is equal to first leg (ES: 1.44 (+7.92%); p<0.05, fig.10) in favor to U-17 (same reason first leg.). The important analysis is that in the second part of the season, physical aspect of high intensity run (>16Km/h) and very intensity running (>20Km/h) is improved in U-17 and is close to U-19. This highlight shows it's necessary to work respecting the physiology of development and exercise. It's important specific training with the ball and not specific training without the ball (balance during training program and avoid only ball or only simple run or gym), it's necessary to have training mix and balanced.

Analyzing the entire season, it's possible to see the differences from U-19 and U-17 in a more complete order. D_SHI and D_S5(ES:0.20 (+5.61%) and ES:0.28 (+8.38%), p<0.05, fig.11 and 12), D_A1 and D_A8 (ES:0.70 (+17.65) and ES:1.14(+18.20%), p<0.05, fig. 13 and 14.). Metabolic Power (ES:1.17(+5.38%), p<0.05 fig.15.)(See table 1). U-17 all of the season have high parameters in Metabolic Power (training program based on ball possession), no differences in all season from distance covered at >16 km/h and >20km/h respect to U-19. But have great differences in acceleration and deceleration, respect to under-19 in all season.

Table 1. Under 19 vs Under 17 Championship physical parameters compared (p<0.05; *statistical meaningfulness).

UNDER 19	AMP (W/Kg)	D_SH(mt)	D_S5 (mt)	D_A1 (mt)	D_A8 (mt)
Average first leg + second leg	9.23	11639	**3002***	**1333***	**1543***
SD First leg + second leg	0.47	1168	401	184	167
Average first leg	9.22	**12458***	**3241***	**1417***	**1640***
SD first leg	0.35	672	229	121	113
Average second leg	9.48	10819	2764	1248	**1446***
SD second leg	0.4	967	339	201	158

UNDER 17	AMP (W/Kg)	D_SH (mt)	D_S5 (mt)	D_A1 (mt)	D_A8 (mt)
Average first leg + second leg	**9.90***	11293	2859	1169	1328
SD first leg + second leg	0.52	1817	482	220	229
Average first leg	**9.76***	11614	2979	1175	1366
SD first leg	0.67	1624	392	187	208
Average second leg	**10.03***	10973	2740	1163	1289
SD second leg	0.26	2005	548	258	252

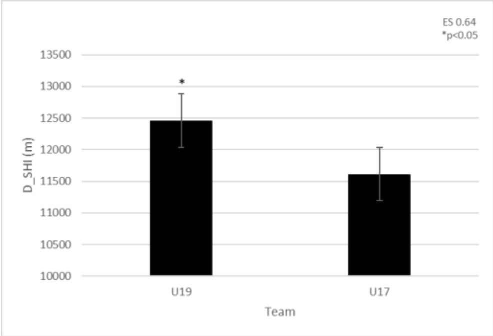

Figure 1. Differences in high intensity speed distance > 16Km/h(D_SHI): whole season (first leg) U19 vs U17; ES: 0.64, p<0.05* (statistically significant).

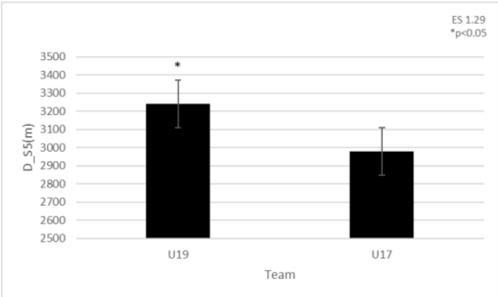

Figure 2. Differences in very high intensity speed distance > 20Km/h(D_S5): whole season (first leg) U19 vs U17; ES: 1.29, p<0.05* (statistically significant).

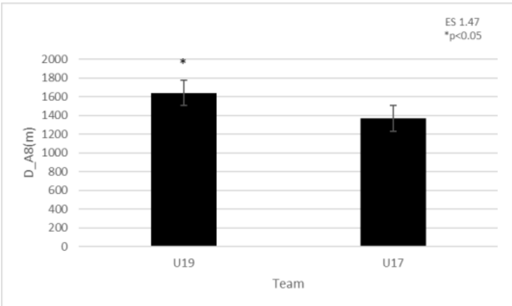

Figure 3. Differences in very high intensity acceleration > 3m/s²(D_A8): whole season (first leg) U19 vs U17; ES:1.47, p<0.05* (statistically significant).

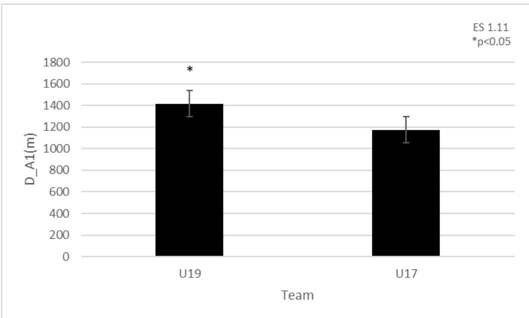

Figure 4. Differences in very high intensity deceleration < - 3m/s²(D_A1): whole season (first leg) U19 vs U17; ES:1.11, p<0.05* (statistically significant).

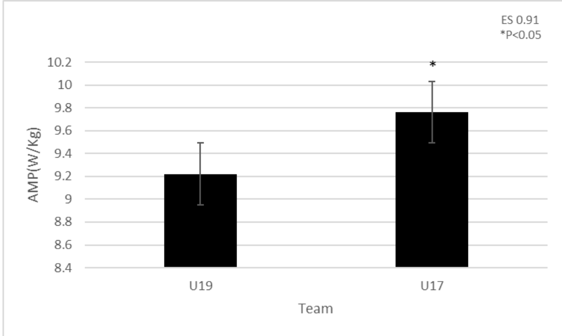

Figure 5. Differences in average metabolic power, W/Kg, (AMP): whole season (first leg) U19 vs U17; ES:0.91, p<0.05* (statistically significant).

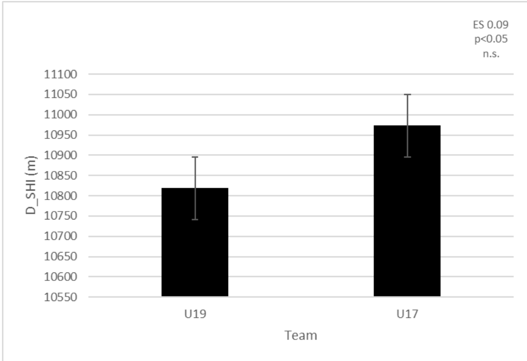

Figure 6. Differences in high intensity speed distance > 16Km/h(D_SHI): whole season (second leg) U19 vs U17; ES: 0.09, p<0.05 (n.s.).

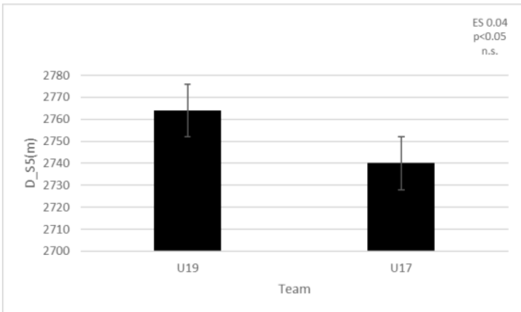

Figure 7. Differences in very high intensity speed distance > 20Km/h(D_S5): whole season (second leg) U19 vs U17; ES: 0.04, p<0.05 (n.s.)

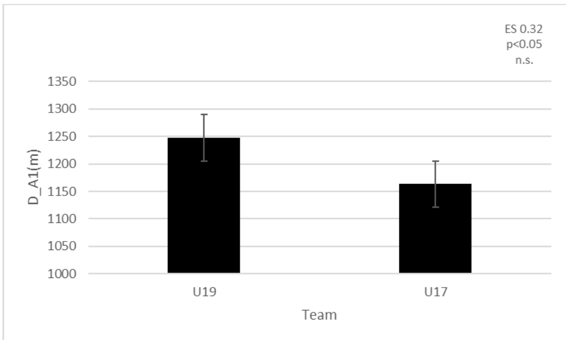

Figure 8. Differences in very high intensity deceleration < - 3m/s²(D_A1): whole season (second leg) U19 vs U17; ES:0.32, p<0.05(n.s.)

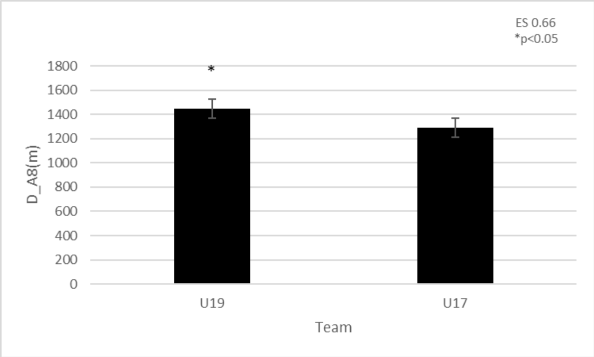

Figure 9. Differences in very high intensity acceleration > 3m/s²(D_A8): whole season (second leg) U19 vs U17; ES:0.66, p<0.05* (statistically significant).

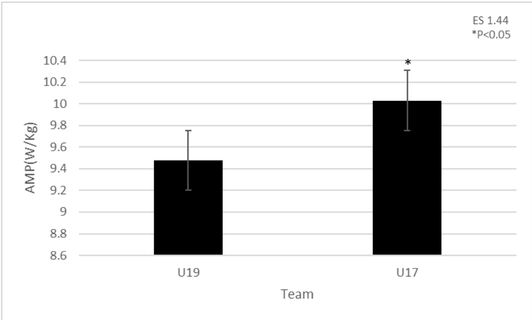

Figure 10. Differences in average metabolic power, W/Kg, (AMP): whole season (second leg) U19 vs U17; ES:1.44, p<0.05* (statistically significant).

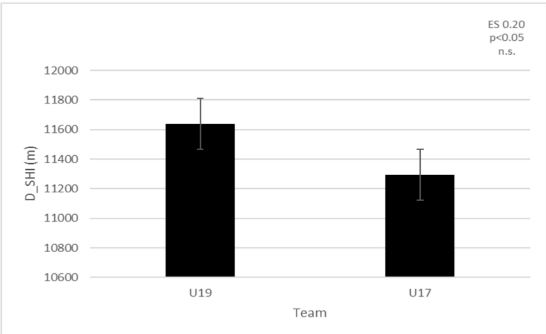

Figure 11. Differences in high intensity speed distance > 16Km/h(D_SHI): whole season (first leg + second leg) U19 vs U17; ES: 0.20, p<0.05 (n.s).

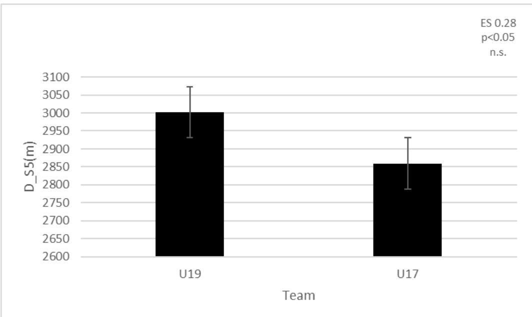

Figure 12. Differences in very high intensity speed distance > 20Km/h(D_S5): whole season (first leg + second leg) U19 vs U17; ES: 0.28, p<0.05 (n.s.).

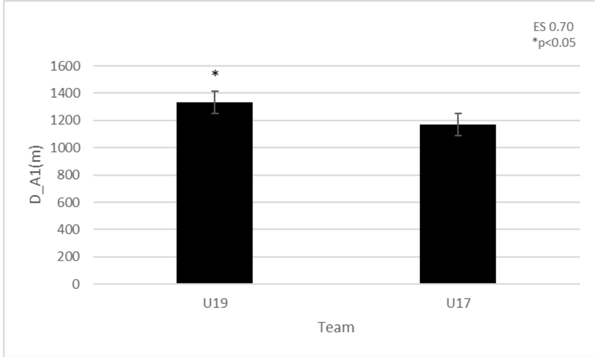

Figure 13. Differences in very high intensity deceleration < - 3m/s²(D_A1): whole season (first leg + second leg) U19 vs U17; ES:0.70, p<0.05* (statistically significant).

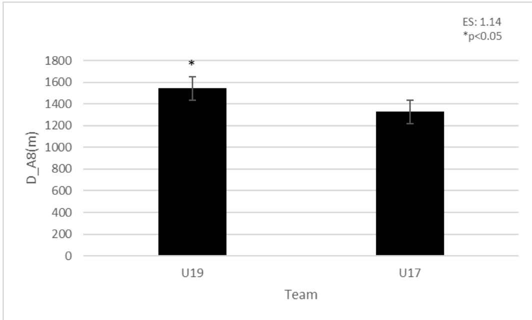

Figure 14. Differences in very high intensity acceleration > 3m/s²(D_A8): whole season (first leg + second leg) U19 vs U17; ES:1.14, p<0.05* (statistically significant).

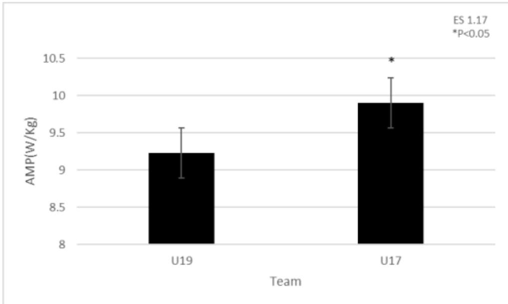

Figure 15. Differences in average metabolic power, W/Kg, (AMP): whole season (first leg + second leg) U19 vs U17; ES:1.17, p<0.05* (statistically significant).

Conclusion

The purpose of this study was to compare the workload responsesduring championship in elité young team under 19 and under 17, to verify the physical eventual differences during matches. In this research under 17 was trained for a little percentage with non specific work (e.g. HIIT training session, strength training, repeated sprint ability etc.), and have great problem to compete against older player. Infact in the first part of season have a great performance difference during match respect under 19. In the second part this differencehas been reduced because was improved a physical strength program (2 times per week) and hiit training program (1-2 times per week with ball SSG and without the ball). in under 17.Infact the under 19 to 6.1% of time in all season has done no specific training instead under 17 to 2.3% of time in all season. This difference respects match analysis data. In the second part of season (january to june), the high intensity work is improved to 4-5% for under 17. Distribution of percentage high intensity training for U-19 is 8-10% total workload in each week (with 1 match for week), instead for under 17 is 5-6% for week (Castagna C. et al. 2011). Over the past years, the soccer training focus on the SSGs integrated into the players physical training of players in terms of endurance developing. This study served as a means in directing the trainer toward the most appropriate utilization of SSGs types for achieving the objectives and helps them draw up a more adequate training program. In conclusion training program it should respect players age development and it's necessary to have a balance between specific training with ball and not specific training without the ball. It's important for U-17 to propose correct strength program to improve ability in acceleration and deceleration and it's important during week to have high intensity interval training, to improve distance covered at high intensity during match but above all to have a best performance to arrive before over the ball. In fact the problem is that U-17 players not achieve correct physical parameters to compete against older players: it's perfect to use the ball but is not sufficient if not achieving high intensity work (e.g. 90-95% HRmax, RPE 8-9 strong effort etc) during for example aerobic power session.

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