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Comparison between under 20 and Over 20 amateur football players with the use of hi-tech Gps (K-Gps 20Hz)

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Abstract
It is being understood that technical and tactical qualities are the most important values for a football player, anyway during the last years the physical performance became crucial to determinate the result of a game. Normally, the physiological component is a discrimination that permit to differentiate between professional and amateur player. But what are the real differences between an “Over 20 years old” and a “Under 20 years old” player, evaluated in amateur context which parameters emerge to determine the level of an athlete and which elements are crucial to move on to senior category. The performance parameters data collection, has been possible through the use of GPS (Global Position System). In our case were analyzed 6 matches in First Category championship (Marche, Italy), corresponding at the seventh level of Italian league and 6 games of the Juniors Provincial championship (Marche, Italy), using 10 GPS, 5 for each team, each divided into positions, to give larger specificity to the study. Afterward data were analyzed, dividing two control groups, substituted players (outgoing) calling them "Full Match Sub" and players who have played the entire game, calling them "Full Match".

Keywords: Performance analysis, GPS, players performance model, amateur, over 20, under 20

1. Introduction
The purpose of this study is to determine the aspects that differentiate an over 20 player by under 20 ons in amateur enviroment, in order to establish which physical parameters are crucial to define the potential category of a player. Also with this analysis it will be possible to achieve parameters that may be indicative to understand if one player can compete with elite levels or not. Moreover purpose of this study is to determinate objective assessment of athletes, even for talent research, taking into account, as already told, that these parameters only takes physical values and not technical or tactical ones. This work was carried out through the use of GPS tracking systems, GPS 20Hz (K-Sport, Italy) and using the K-Fitness data analysis software in performed by Sport Advanced Research Group by University of Urbino, School of Sport and Health Science and K-Sport Universal, Italy.
Football is a sport that requires a significant effort from the physical point of view, it use aerobic-anaerobic metabolism; concerning this sport, over the past years, numerous scientific studies have been conducted to try to revise the training methods, using more or less consciously a series of computer dedicated technology to assessing the performance during the match and training.
Professional football players in a first league game run through approximately a distance of about 11 km, performs about 1300 variations of intensity of gesture, which of course produce a different metabolic effort and consequent expenditure of energy, compared to jogging running. This energy is performed by metabolic aerobic-anaerobic alternating type. Observation of heart rate indicate that a top player keeps an exercise average intensity equal to about 70% of the maximum oxygen consumption. An activity of such intensity that lasts for about 90 minutes, activates the oxygen transport system, and the overall strength in muscles [1].
This paper therefore proposes to indirectly investigate and reposition the physiological components of performance model of a player, produced by an under 20 and an over 20. It was also treated fatigue (energy expenditure), in order to provide the importance of knowing how to build the right training schedule, taking into account, in a conscious way, physiological,

biochemical and psychological components that forming sports performance. Obviously the performance is also achieved by technical, tactical and strategic components that will not be taken into account in this work.

1.1 Player Performance Model (PPM)

The player performance model is made by many components that helps to create sports performance itself. A sports performance model tends to organize in simple way all the aspects and elements that converge together to create the sports performance itself, in this way is simple to evaluate the level of a single player or of an entire team, linking it with reference data obtained from surveys and statistical analyzes. The performance model (PPM) describes the individual elements that form a totality which, in our opinion, can't be considered a simple sum of its components. Each editing action on one or more elements, influences in toto all the others, both positively and negatively. It should be well know that the specific performance model (SPM) of sports is constantly changing, especially in recent years, which have seen remarkable growth of utilization of applied technologies, as well as an exponential attention by sports scientists in particular in soccer area.

The PPM then is a set of complex interactions, formed, as mentioned, by various components at the same time, and it must be dynamic and adaptable to the match situations, in fact it varies for istance from the category or from country to country, according to the game styles and the characteristics of the athletes involved in the matches.

Football, as mentioned, is characterized by an aerobic-anaerobic metabolic alternating engagement, with load on muscular system that varies between short phases with high commitment and phases with lower intensity. We could say that the physical performance, in this case is given by the sum of different components that can be described in a very simple formula [2].

Athletic Performance = Fitness State - State of Fatigue

The state of fitness is formed by a set of conditional skills and their subgroups that have relevance in football. The Conditional skills are: Strength (functional strength, explosive strength, endurance strength), Resistance (aerobic power, repeated sprint ability), Speed (acceleration and deceleration) and Agility.

1.2 State of Fatigue

The state of fatigue is highlighted by:

- "Doms" (muscle pain after exercise, usually are found 24-48 hours post workout)
- From supercompensation, body adjusts to the training load. In the coming period of training you have a performance decrease but later with the super-compensation mechanism the 'individual skills" get an increase, but only if the training loads are appropriate to the subject
- Overreaching, short-term performance decrease
- Overtraining, overtraining syndrome.

Overreaching [3], is a physical state in which is seen a decrease in the short performance, which, however, is easily recovered in a generally short period of time, we would say a few days. The overreaching can be defined in other terms such as "short-term overtraining", which can be more easily managed and contained before it can degenerate into real overtraining syndrome. The overreaching can also be the result of a microcycle (approximately one week) arranged intentionally in a particularly intense and stressful way, or still can be the result of an excess of psychophysical stress not compensated by adequate recovery. If the overreaching is a scheduled event, and the recovery is sufficient, this turned into a positive path and thus an improvement in performance. However, if this process is not controlled, and overreaching will be repeated for several times, it can degenerate into overtraining[4]. The overtraining is a workout imbalance, not only compared with ages, that occurs when physical activity is too intense and unbalanced, so body can't recover, during rest time, to eliminate the accumulated fatigue. This adaptive imbalance, also known as overtraining, causing a constant state of physical and psychological stress, which impairs athletic performance and the need for long periods of rehabilitation. Obviously player performance is not conditioned only by conditional factors, but by technical, tactical and mental areas also.

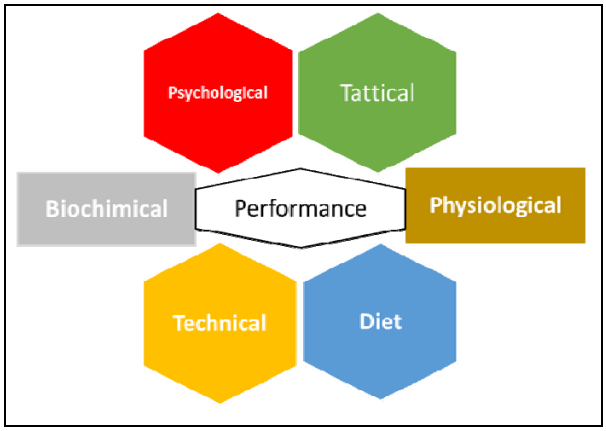

Fig 1: Performance Model Scheme, R. Izzo, 2016

1.3 Performance Model

The P.P.M of elite footballer was built through evidence based data compared with the studies in scientific literature, below will describe the main components.

Medium anthropometric characteristics of the player are as follows:

- Height (cm): 184 ± 6
- Weight (kg): 80 ± 5
- BMI (kg / m2): 23.7 ± 1.0
- Fat (%): 13 ± 3

The total average distance traveled in a game is plus minus 11 Km, it is obviously influenced by the different roles, from the adopted module and the tactical settings of the game[5]. Usually players who travel more kilometers are midfielders to following the attackers and at last defenders.

Another main aspect in our point of view, is connected to the distance traveled to the various racing intensity[6]. Following we took as data examples information derived from some recent studies of elite footballers[7]:

- ± 3700m Walk (0.2 to 7.2 km / h)
- ± 4400m Low intensity/jogging (7.3 to 14.4 km / h)
- ± 1800m Medium intensity (14.5 to 19.8 km / h)
- ± 750m high intensity (19.9 to 25.2 km / h)
- ± 270m Sprint (> 25.2 km / h)

During a match a player makes about 1100 activity changes, for example switching from the low intensity walk to sprint intensity. It is important to note that the distance traveled with the ball is approximately equal to 2% of the total distance [8].

Another important aspect in the player performance, is number and intensity of sprint, during games. There is a sprint every 90 seconds, each with an average of 2-4 seconds duration, their covered the 0.5 -3% of total playing time. Normally they are in 96% of cases shorter than 30 mt and in the 50% shorter than 10 mt[9]. The players that travel the farthest distance in sprint are the attackers, followed by side-backs and the side midfielders, while the central defenders and central midfielders are the ones who make the fewest meters.

Accelerations and decelerations are another determinant aspect, respectively for accelerations is calculated from 2.5 to 4 ms^2 and decelerations -2.5 to -4 ms^2, players produce an average of 100 variation for each match [10]. Are also evaluated the intense accelerations (IA> 4ms^2) and intense decelerations (ID <- 4ms^2) that are around 10 per game. Their number, obviously decrease during the second half [11].

Another key indicator, used to evaluate internal load, is the heart rate (HR) who determined to discovers soccer performance effort. During a match is between the 75% and 90% of Max H.R. and as for the other variables tends to be higher during the first half and decrease in the second [12].

The VO2Max average is 53 ± 7 (ml / kg / min) with a range of values ranging from a minimum of 50 to a maximum of 75 ml / kg / min [13].

It is observed that the blood lactate during a game is between 8-12 mmol / L, as usual, the value recorded during the first half is higher, in relation to the fact that the distance traveled in the second half and the intensity of entire game is turn-over to be lower [14].

2. Materials and methods

Were analysed using K-GPS 20hrz (from K-Sport International, Italy), 4 championship matches, in first category Marche, Italy (7th Italian championship series) and 6 games of the provincial junior championship, under 20, Marche Italy. They were used 10 GPS to track every game, 5 for team divided into positions. For every team and every game were analysed a central striker, a central midfielder, a winger, a central defender and a defending winger. This was done to give greater specificity and differentiation to performance indicators, in order to define both the peculiarities of the various roles, both obtained relevant and reliable ideal parameters. The GPS, is easy to use, have been added to 'inside of specific sport shirts with a pocket placed on their back, in a position that does not cause a impediment to the player. As we said already, 10 GPS where divided 5 for each team, one for every role: a central defender, a side back, a central midfielder, a winger or outside striker and a central striker. The GPS were weared and turned on before warm-up. Data were collected by downloading them all from the GPS devices with a dedicate software (K-Fitness, K-Sport International, Italy). The information files, on ".cvs", were filtered and analysed through the software automatically, and directly have been stored in online portal (K-Sport Online, K-Sport International, Italy). Through the portal, it was possible to download the Excel spreadsheet containing all the data of the matches. Analysing final data it was possible to create the appropriate conclusions by comparing the examined categories.

2.1 Parameters

The following parameters are taken into account according to the protocol:

- Distance (D)
- Relative Distance (D_{Rel})
- Energy Expenditure (EEE)
- High Speed Distance (S_HI) => 16 km / h
- High Acceleration Distance (AccHI) => 2 m / s / s
- High Deceleration Distance (DecHI) = <-2 m / s / s
- High Metabolic Power Distance (D_MPHI)
- Equivalent Distance (ED)
- % High Speed Distance (% S_HI)
- % High Acceleration (% ACCHI) => 2 m / s / s
- % High Deceleration (% DECHI) = <-2 m / s / s
- % High Metabolic Power Distance (% D_MPHI)
- Metabolic Power Average (AMP)
- % Equivalent Distance (% ED)
- % Anaerobic Index (% AI)

Have been taken into account the distance travelled in speed thresholds from DS1 to DS6; It follows the list of threshold parameters:

- DS1 = 0-10 km/h
- DS2 = 10-14 km/h
- DS3 = 14-16 km/h
- DS4 = 16-21 km/h
- DS5 = 21-24 km/h
- DS6> 24 km/h

3. Results and Discussion

The obtained data from the two under 20 and over 20 categories were divided into two different sub-groups named: Full Match (players who have played for the entire match) and Full Match Sub (players who have been substituted during the various match). After we have made the average for all obtained data. The tables below "Table 1 and 2" show the data averages collected in analysed matches. We can see that the performance average parameters in Full Match group "Table 1" is higher in under 20 category, for almost all values. In Full Match Sub group over 20 show high values in almost all parameters.

Table 1: Over 20 and under 20 Full Match groups' performance parameters

Full Match Average															
Category	D	Drel	EEE	D_SHI	D_AccHI	D_DecHI	D_MPHI	%D_SHI	%D_AccHI	%D_DecHI	%D_MPHI	AMP	EDRel	%ED	%AI
O-20	8743,7	91,7	48,7	1048,2	427,0	448,3	2014,9	11,8	4,9	5,1	22,8	8,5	109,7	19,7	37,0
U-20	8896,5	93,9	49,7	1272,4	484,1	432,5	2264,9	14,2	5,4	4,9	25,3	8,7	112,8	20,2	39,9

Table 2: Over 20 and under 20 Full Match Sub groups' performance parameters

Full Match Sub Average															
Category	D	Drel	EEE	D_SHI	D_AccHI	D_DecHI	D_MPHI	%D_SHI	%D_AccHI	%D_DecHI	%D_MPHI	AMP	EDRel	%ED	%AI
O-20	5976,1	94,9	33,1	748,8	283,0	294,6	1382,9	12,5	4,8	4,9	23,1	8,8	113,1	19,3	37,3
U-20	5365,6	84,1	30,2	708,5	312,5	276,9	1247,4	13,5	5,8	5,2	23,4	7,9	101,7	21,0	38,2

The tables below show the comparison between full match and full match sub, in both category was, in order to understand the differences between the performance of a player that played all the game and a substituted one.

Table 3: Comparison of Performance parameters between over 20 full match and over 20 full match groups

Over-20 Comparison																
Category	D	Drel	EEE	D_SHI	D_AccHI	D_DecHI	D_MPHI	SD_SHI	SD_AccHI	SD_DecHI	SD_MPHI	AMP	EDRel	%ED	%AI	
O-20 Full	↑	6748.7	↓	91.7	↑	46.7	↑	1348.2	↑	427.0	↑	446.3	↑	2314.9	↓	11.6	↑	4.9	↑	5.1	↓	22.6	↓	6.5	↓	106.7	↑	15.7	↓	37.0
O-20 Subs	↓	3578.1	↑	94.5	↓	33.1	↓	748.8	↓	253.0	↓	254.9	↓	1362.9	↑	12.5	↓	4.6	↓	4.9	↑	23.1	↑	6.6	↑	113.1	↓	15.3	↑	37.3

Table 4: Comparison of Performance parameters between under 20 full match and under 20 full match sub groups

Under-20 Comparison																
Category	D	Drel	EEE	D_SHI	D_AccHI	D_DecHI	D_MPHI	SD_SHI	SD_AccHI	SD_DecHI	SD_MPHI	AMP	EDRel	%ED	%AI	
U-20 Full	↑	6858.3	↑	93.5	↑	46.7	↑	1272.4	↑	464.1	↑	432.3	↑	2254.5	↑	14.2	↓	5.4	↓	4.5	↑	25.3	↑	6.7	↑	112.6	↓	23.2	↑	35.5
U-20 Subs	↓	3355.5	↓	84.1	↓	31.2	↓	708.5	↓	312.3	↓	275.9	↓	1247.4	↑	13.5	↑	5.6	↑	5.2	↓	23.4	↓	7.5	↓	101.7	↑	21.0	↓	35.2

The following tables show the distance values covered in different speed thresholds between over 20 and under 20, in full match and full match sub.

Table 5: Over 20 and under 20 Full Match groups' speed threshold parameters

Full Match Average												
Category	D_S1		D_S2		D_S3		D_S4		D_S5		D_S6	
O-20	↑	2782	↑	2840	↓	2073	↓	684	↓	271	↑	93
U-20	↓	2630	↓	2686	↑	2308	↑	832	↑	350	↓	91

Table 6: Over 20 and under 20 Full Match Sub groups' speed threshold parameters

Full Match Sub Average												
Category	D_S1		D_S2		D_S3		D_S4		D_S5		D_S6	
O-20	↓	1780	↑	1978	↑	1469	↑	504	↓	194	↓	52
U-20	↑	1856	↓	1602	↓	1199	↓	428	↑	199	↑	81

Table 7: Comparison between speed threshold parameters of over 20 Full Match and over 20 Full Match Sub groups

Over-20 Speed Threshold Comparison												
Category	D_S1		D_S2		D_S3		D_S4		D_S5		D_S6	
O-20 Full	↑	2782	↑	2840	↑	2073	↑	684	↑	271	↑	93
O-20 Sub	↓	1780	↓	1978	↓	1469	↓	504	↓	194	↓	52

Table 8: Comparison between speed threshold parameters of under 20 Full Match and under 20 Full Match Sub groups

Over-20 Speed Threshold Comparison												
Category	D_S1		D_S2		D_S3		D_S4		D_S5		D_S6	
U-20 Full	↑	2630	↑	2686	↑	2308	↑	832	↑	350	↑	91
U-20 Sub	↓	1856	↓	1602	↓	1199	↓	428	↓	199	↓	81

The purpose of the study was to identify performance parameters of the two categories considered, and to search indexes that could differentiate, or not, the performance between an over 20 to an under 20. Through the investigation it has been found, as already known, that quantitative performance indexes are lower for substitutes players. In our case this is proved for both groups. The indices expressed in percentage (% S_HI, %AccHI, % DecHI, %D_MPHi, % DC, % AI) however are less affected by time, indeed they generally suffer a decrease during the game "Table 1 and 2".

Tables 3 and 4 show the comparison of the same category between players who played the entire games and players which was subsisted. Tables 2 shows that in senior category in full match group, it was a drop in Drel, %D_SHI, % D_MHPI, AMP, EDRel, and % AI parameters. In the group under 20 full match the parameters that show a decline are %D_AccHI, and %D_DecHI and %AI, these are all performance values influenced by the decrease due to fatigue. The quantitative parameters instead have positive values, this is to indicate that values of those who played full match, obviously in average, are higher than those who comes out prematurely from the match. We can note that the data form under 20 "Table 1, 2, 3 and 4", have a superiority in almost all the parameters, this is a demonstration that in a homogeneous group (same age) physical performance is roughly homogeneous, thing that cannot be detected in a group over 20 which is formed by several subjects with a different ages. On the country the converse comparison between the over 20 and over 20 Full Match Sub groups shows higher values over 20. Probably this table is influenced by the fact that in the

youth championship the coach have available 5 and not 3 substitutions as in adults.

As regards about the speed thresholds, it is possible to note that the full match under 20 group, have a higher distance travelled at high speed thresholds DS3, DS4 and DS5, while lower values in the maximum threshold S6 and at low intensity S1 and S2. In full match sub, over 20 shows higher values in DS2, DS3 and DS4, and less values in higher speed value DS6 and in the lower speed value DS1.

In general, we can indicate that there aren't macro differences between the two groups under 20 and over 20, however, the comparison needs further analysis, carried out taking into account the internal effort parameters, or roles, in order to give greater specificity to the investigation. Overall the "under" group shows higher values on distance at high intensity and high metabolic power, these values could be expected better in a group with homogeneous age.

4. Conclusions

The purpose of the study was to investigate the physical performance indexes of amateur players under and over 20 years old, through the use of the GPS system 20Hz. The evaluation of the data was possible via the K-Fitness software. In particular, no significant differences were underlined between the two samples, as regards the Full Match, the junior group recorded higher values, in all parameters except those relating to decelerations (D_DecHI and %D_DecHI). This result can be explained in different ways, young people show higher physical data because they are a homogeneous group of the same age, but tactical position in youth categories is less important, then in the other one. Young players cover longer distances even because they don't position themselves well in the field, and because they aren't able to manage well performance commitment.

The quantitative data was higher in the over 20 Full Match Sub group, while percentage data was higher in the under 20 group. This indicates that the game intensity in junior group was higher than the seniors, even for the group of substitutes, the average quantitative values instead are lower because in the youth league they have 5 substitutions instead of 3 in senior championship.

In general, we have not found very significant differences between the two groups. In order to determine exactly performance models for these categories, further studies are needed. It will be interesting to compare athletes, dividing positions and minutes played, to determine the real performance parameters for each roles.

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