European Journal of Sport Studies Publish Ahead of Print
DOI: 10.12863/ejssbx4x1-2016x1

EJSS - JOURNAL
Sport & Exercise Sciences

Section B

doi: 10.12863/eissbx4x1-2016x1

Aspects of the mental representation of the body in Italian male rugby players

F. Viviani[1,2] & Saggiorato A.[1]

[1]*Biomedicine Department, and,* [2]*FISPPA Department, University of Padua, Italy*

Abstract

To gain insights on body image (BI) and body satisfaction/dissatisfaction (BS) in high level rugby players, to 47 male athletes aged 23.4 ± 3.54 years, two questionnaires were administered: a figurine test for BI and a Likert-type scale for BS containing a body part statisfaction scale. Subjects were asked to report vital and curricular data, together with height and weight. Because of the wide use of their bodies, it was hypothesized that they were lesser biased than average Italians. They were subdivided into two groups A=Excellence, n=30, and B=League, n=17. This on the basis of the level of performance reached, after a thorough scrutiny of their curricula. Significant differences between the two subgroups emerged for curricular data, weight and body mass index. In both BI data are congruent with their complexion and, for BS, the degree of satisfaction with the various body parts was quite high. Comparisons carried out with data available in literature for Italians and with a cohort of speleologists, confirm the hypothesis that the wide use of the body for working or leisure purposes exerts a positive influence on BI and BS.

Key words: Body image, body satisfaction, rugby players.

Introduction

Some aspects of the so called self-referent thought, such as body image (BI) and the satisfaction/dissatisfaction of the body (BS) are complex and elusive, as the individual's mental capacity to represent her/his own body is rearranged diachronically. The picture that an individual has in mind includes the size, shape and form of her/his body, plus the feelings associated to these characteristics. They are the result of a complex past and present organization in which learning, memory and experience converge thanks to the integration of a set of sensorial, motor and affective components to form a "body unit". Sensorial representations, mainly optical and kinesthetic are also involved, together with the clues belonging to the social environment surrounding the subjects. The latter not only furnishes symbolic meanings, but also aesthetic and physical values: for example to form a coherent BI a complex physiological and psychological organization is required (Viviani et al. 1997). In sports studies the athletic BI or ABI is often considered. It is, according to Greenleaf & McGreer (2006), the internal image that a subject involved in a sporting activity has in mind regarding her/his

Corresponding Author: Franco Viviani, [1]Biomedicine Department, and, [2]FISPPA Department, University of Padua, Italy
Via Armistizio 88, 35142 Padova, Italy.
Tel.: +390498804668, Fax: +390498276600,
email: franco.viviani@unipd.it
Received: xxxxxxxxxx - Accepted xxxxxxxxxx

own body with respect of a particular athletic context. For rugby players data on BI and BS are lacking, only a study reported female BS (Russel 2004). The criteria permitting a correct evaluation of athletes usually are: age, sex and level of performance. Rugby is a group activity of contact, with different levels: amateur, semi professional and professional (Gabbett 2005). It is historically considered as being an interval or intermittent sport. In it, intensive efforts of 5 to 15 seconds duration occur, but there are less than 40 seconds recovery between each bout of high intensity activity (Maud & Schultz 1984; Morton 1978; Cahill et al. 2013; Jones et al. 2015). All the levels of performance require particular physiological and anthropometric characteristics (O'Connor 1996; Casagrande & Viviani 1993; Crewther et al 2012; Sedeaud et al 2012; Smart, Hopkins & Gill 2013). In athletes involved in rugby VO_2max levels and muscular power tend to increase with practice, while skinfolds tend to reduce. This could reverse in case of withdrawal or during a quite long period of recovery (Gabbett 2005). A wide school of thought believes that an individual requisite like a high level of anaerobic condition will permit a better performance. In effect, the varied movement patterns of rugby include hundreds of intermittent changes per session and sport-specific actions such as shots, tackles, passes. Plus high intensity runs, sprints and turns. Apparently, concurrent training (combining aerobic and anaerobic training) is effective, however, to increase VO_2max, high intensity training and continuous endurance training are required (Milanović, Sporiš & Weston 2015). This appears to be fundamental for a sustained intermittent activity, and could be also useful during recovery, in order to compensate fatigue and keeping the subsequent performance in sprint. However, to gain further clarification on physical conditioning in rugby, the Posthumus & Durandt's pdf (2009) is quite exhaustive. According to Suárez-Moreno Arrones & Nuñez (2011) more research is needed in order to gain insights on the performance of rugby players.

The present investigation is part of a wider collection of data on subjects widely using their bodies for professional and/or leisure purposes. Data are collected in the idea that their BI and BS score better than those found inside the average population.

Materials and methods

In order to collect insights on some aspects of the self-referent thought such as BI and BS in Italian male rugby players, to 47 male athletes aged 23.4 ± 3.54 years (min 17, max 35) a questionnaire was administered. It contained a set of vital statistics questions plus others regarding the athletic curriculum, in order to permit the inclusion of each athlete inside one of the two groups: A and B. The first included those inside the international tournament Pro 12 or belonging to the category Excellence (n=30); while in the second those professionals belonging to lower categories, such as A and C Leagues (n=17). As most of the questionnaires were collected on-line, it was not possible to measure some anthropometric characteristics of our athletes. Therefore the Body Mass Index (BMI or body mass/square of stature, in Kg/m^2) was calculated asking the subjects to report their weight and height. This procedure can be conducive of errors (as respondents can minimize weight and maximize height), however it is useful to identify relationships (Spencer 2002). Interesting to note that this index has been recently associated by Baccouche et al. (2014) to cognitive performance, as they found in a sample of Tunisian rugby players, a reduction in visual and verbal memory in the athletes with higher BMI. Then the Italian version of the Fallon & Rozin's Test (Fallon & Rozin 1985; Rozin & Fallon 1988), using a version modified by Casagrande, Viviani & Grassivaro Gallo (1997) on the basis of the suggestions furnished by Stunkart, Sørensen &

Schlusinger (1980) was added. The test was chosen because, despite the variations in the test-retest reliability found in different studies, the results were fairly consistent (Cohane & Pope 2001). Then the Body Part Satisfaction Scale (BPSS-Berscheid, Walster & Bohrnstedt 1973), whose validity appears to be high (Petrie et al. 2002) was inserted inside the questionnaire. The first test was a figurine test, containing seven line drawings of male and female bodies, ranging from very slender to obese. Each figurine had a numeric value, from 10 (very thin) to 70, very heavy. Participants were asked to select the number below the figurine which best corresponded to different questions, such as: 1) How do you currently look (CUR)? 2) Which figurine better represents how you feel the majority of times (TIME)? 3) How would you like to look (LIKE)? 4) Which figure better represents how the others see your physique (OTHERS)? 5) Which figure of the other sex is more attractive for you (AT-OT)? 6) Which figure of the same sex is more valid for the practice of rugby (RU-SA)? 7) Which figurine of the other sex is more valid for the practice of rugby (RU-OTH)? The BPSS, subsequently administered, is a 21-item questionnaire asking the degree of satisfaction/dissatisfaction of the different parts of the body using a 6-levels Likert type scale. For each of the items we also asked if the athletes considered that body part to be important or not.

Results

On the basis of the characteristics emerged in the vital and curricular data found in the questionnaire, the athletes were included inside one of the two groups, A and B. Between the two groups (Excellence=Group A, and League=Group B) a number of significant differences emerged. For example: age, that on average was 23.4±3.5 years (min=17, max=35). Group B was younger: 21.7±3.9 years old vs 24.4±3.0 years ($t=2.7$, $df=47$, $p<.01$). Significant differences were found also for the previous experiences the athletes had: Group A declared to have performed for 3.0±2.0 seasons, while Group B for 1.8±1.1 seasons ($t=2.2$, $df=45$, $p<.05$). In the whole sample the number of admission in team was 13.6±6.6 (min=0, max=28), while the matches played as first-string were 10.2±6.7 (min=0, max=23). 46.8% of the athletes (n=22) were summoned at or participated in national level matches, while 55.3% of them participated in international official competitions. Group A dedicated on average 755.0±363.6 minutes to training activities for 4.4±0.6 days a week, while the group B devoted 478.2±192.8 minutes for 3.7±0.9 days a week to the same aspect: significant differences emerged both for the commitment in minutes ($t=2.9$, $df=45$, $p<.01$) and days per week ($t=3.4$, $df=45$, $p<.01$). Differences emerged also for minutes and days spent working out in gym. Group A worked 261±133.3 minutes for 3.2±1.1 days a week vs Group B that was involved for 164.1±119.1 minutes, 2.2±1.8 days a week. Regarding this issue significant differences were found only for the minutes spent in the gym ($t=2.3$, $df=45$, $p<.05$). 72% of the athletes have claimed rugby-related injuries, with no significant differences between the two groups.

Regarding the anthropometric aspects, ponderousness data are interesting, as in the whole sample weight ranged from 63 to 130 Kg (average=98.3±16.1). Between A (weight=103.5±15.3 Kg) and B (89.3±13.6 Kg) groups differences emerged ($t=3.2$, $df=47$, $p<.01$). This did not happen for stature. Even if in the whole sample the average stature was 183.9±5.7 cm. (min=171, max=194), the A group showed to be 184.5±5.3 cm. tall, while group B 182.9±6.4 cm., with no significant differences between them. When BMI was calculated, group A showed values of overweight/slight obesity (30.4±4.5), while group B revealed to be slightly overweight (26.6±3.0), with significant differences ($t=3.1$, $df=47$, $p<.01$).

Extremely interesting appears to be the genetics-based paper of Heffernan et al. (2017), whose sample of 530 elite rugby players had on average a stature equal to 185.5±0.07 cm., very close to that of our samples. The weight shown by group A is close to that of the elite athletes reported there (101±14 Kg.), but this does not happen for Group B. The same is valid for BMI, that in that group was equal to 29.4±3.7. By the way, the above-mentioned paper is extremely interesting, as it shows the role of genetics in athletic success.

Regarding the figurine test, the main results for the whole sample are depicted in table 1.

	CUR	TIME	LIKE	OTHERS	AT-OT	RU-SA	RU-OTH
Mean	44.85	44.36	43.00	45.60	34.45	46.39	45.43
St. Dev.	9.29	9.97	6.32	10.79	5.05	5.21	6.87
Min.	20	20	20	20	20	30	30
Max	60	70	50	70	45	60	70

Table 1 – Scores collected in the whole sample for the figurine test.

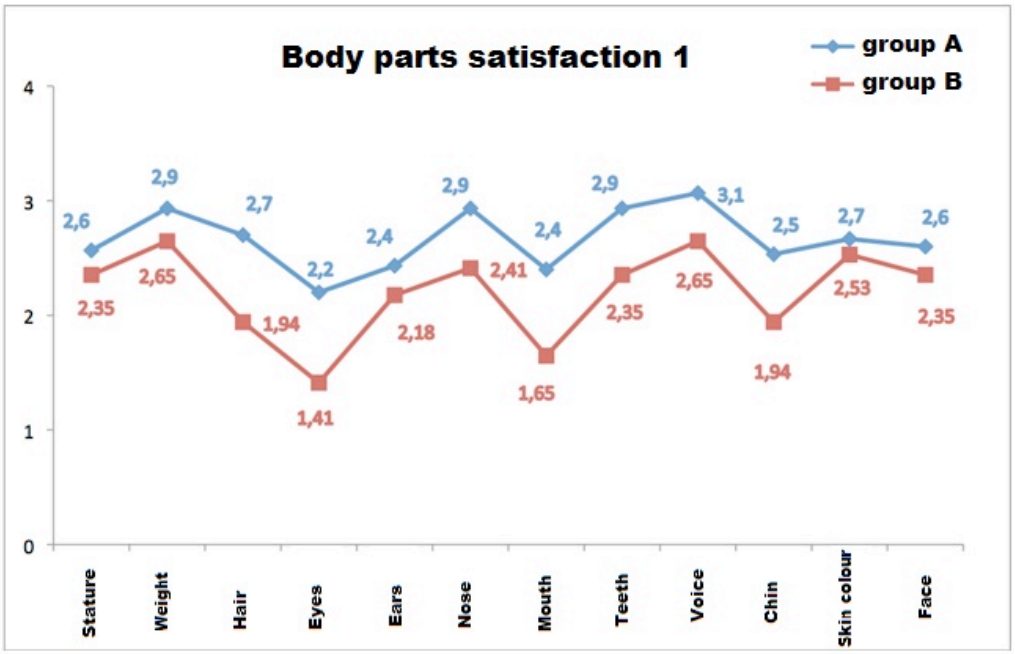
They are interesting as they reflect the anthropometric status of the players: the main values emerged from the average scores in all the questions range between 43 and 46.5, with the exception of AT-OT, whose main score was lower (34.45), and well below the average of the score for males. When the two groups were compared, significant differences emerged for CUR ($t=2.5$, $df=45$, $p<.05$) TIME ($t=2.6$, $df=45$, $p<.05$) and AT-OT ($t=2.4$, $df=45$, $p<.05$). In both cases the scores of the A group were higher, a result that is congruent with their complexion, stouter than that of their counterpart. No differences were found for the physique suitable for rugby practice, both in males (RU-SA) and females (RU-OTH). Table 2 represents the main values found in the whole sample for the BPSS questionnaire.

Body part	X	Standard deviation	Min.	Max.
Stature	2.49	0.98	1	5
Weight	2.83	0.76	1	4
Hair	2.43	1.17	1	6
Eyes	1.92	0.97	1	4
Ears	2.34	1.03	1	5
Nose	2.75	0.82	1	4
Mouth	2.13	0.90	1	3
Teeth	2.72	0.93	1	5
Voice	2.92	0.97	1	5
Chin	2.32	1.00	1	6
Skin colour	2.62	1.23	1	6
Face	2.51	0.78	1	4
Shoulders	2.49	0.91	1	4
Thorax/chest	2.51	0.86	1	4
Arms	2.62	0.82	1	4
Hands	2.57	0.97	1	5
Abdomen	3.36	1.05	1	6
Buttocks	2.45	1.10	1	6
Hips	2.75	1.07	1	6
Legs	2.36	0.90	1	4
Ankles	2.57	1.02	1	5
Muscular tone	2.70	0.72	1	4
Complexion	2.53	0.58	1	3

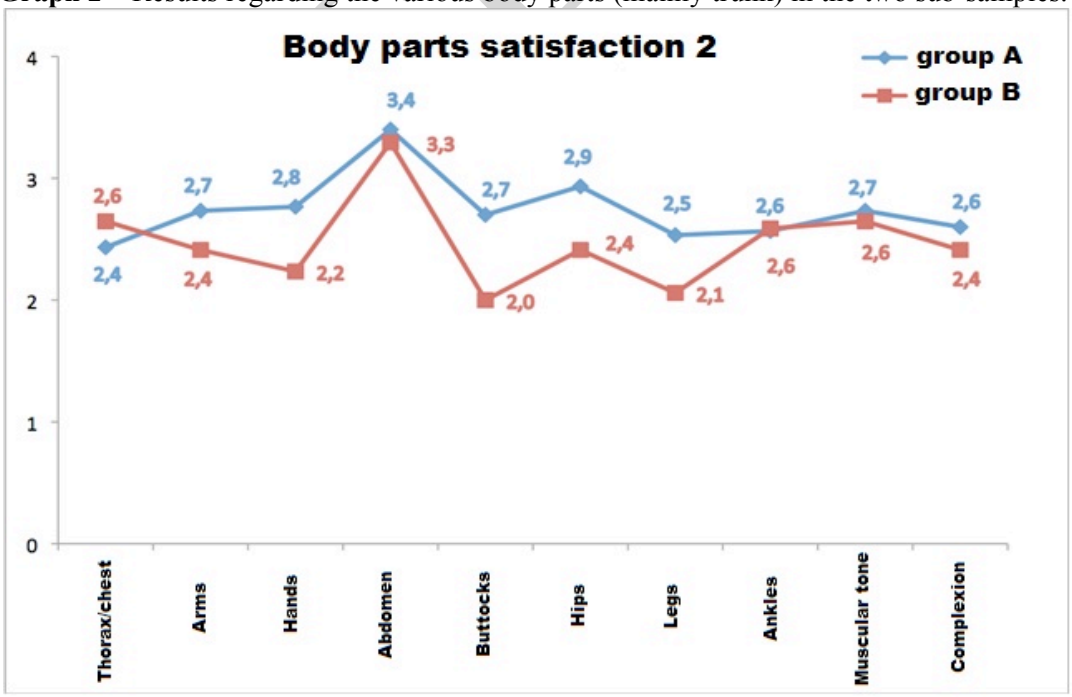
Table 2 – Average scores found in the whole sample for the different body.

In general, the degree of satisfaction with the body parts was quite high. Greater satisfaction was reported for some head parts, such as eyes, ears, mouth and chin, and legs. Lesser satisfactory appeared to be weight, abdomen and voice.

Graph 1 – Results regarding the various body parts (mainly head-referred) in the two sub.



Graph 2 – Results regarding the various body parts (mainly trunk) in the two sub-samples.



The comparison between A and B groups highlighted significant differences for hair ($t=2.2$, $df=45$, $p<.05$), eyes ($t=2.9$, $df=45$, $p<.01$), nose ($t=2.2$, $df=45$, $p<.05$), mouth ($t=3.0$, $df=45$, $p<.01$), teeth ($t=2.1$, $df=45$, $p<.05$), shoulders ($t=2.2$, $df=45$, $p<.05$) and buttocks ($t=2.2$, $df=45$, $p<.05$). For both groups abdomen was the body part source of greater dissatisfaction.

The answers regarding the importance that rugby players assigned to the various body parts in a dichotomic way (yes/no) are lesser interesting, as they follow the trend found for the above reported questions. Table 3 and 4 depict the percentages found in both group.

Group	Stature	Weight	Hair	Eyes	Ears	Nose	Mouth	Teeth	Voice	Chin	Skin color	Face
Group A (%)	90.0	80.0	66.7	70.0	23.3	63.3	56.7	86.7	76.7	20.0	46.7	90.0
Group B (%)	94.1	88.2	76.5	82.4	29.4	64.7	70.6	82.4	94.1	64.7	53.9	100

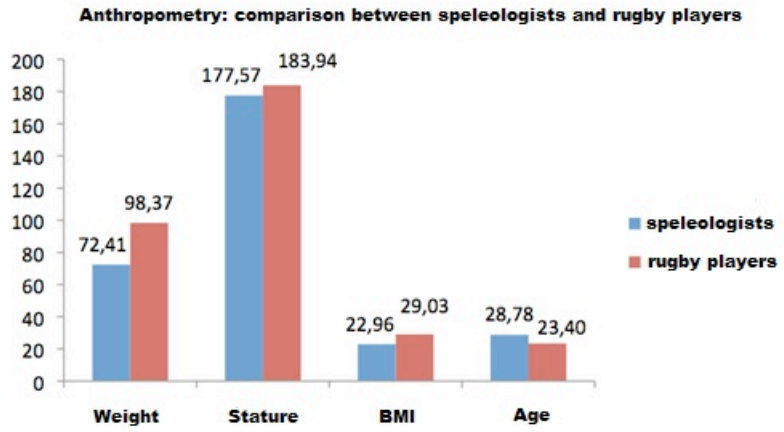
Table 3 - Percentages of athletes of both groups assigning importance to the different body parts.

Group	Shoulders	Thor.	Arms	Hands	Abdomen	Buttocks	Hips	Legs	Ankles	Muscolar tone	Complexion
Group A (%)	76.7	70.0	76.7	66.7	83.3	56.7	46.7	90.0	33.3	83.3	90.0
Group B (%)	82.4	76.5	70.6	64.7	64.7	82.4	35.3	76.5	35.3	100	94.1

Table 4 - Percentages of athletes of both groups assigning importance to the different body parts.

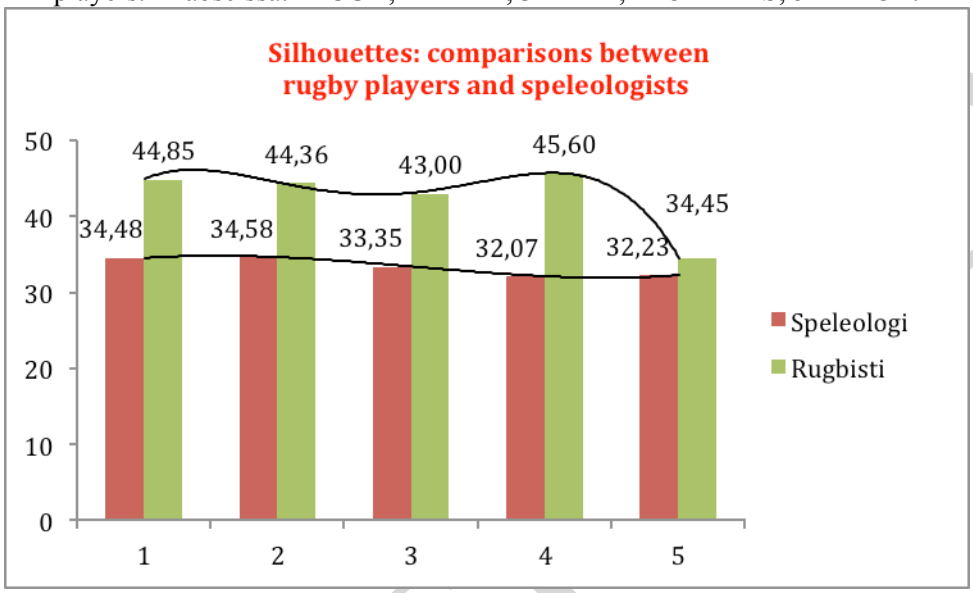
In fact, these athletes assigned great importance to stature, legs, muscular tone, complexion, voice and facial traits. Lesser important resulted to be ears, chin and ankles. As this investigation is part of a wider research project aiming to collect data on some aspects of the self-referent thought in subjects widely using their bodies because of their professional activity, we compared this sample with a cohort of male speleologists aged 18-35 years, after having expunged the other age-classes of their wide sample (Viviani & De Vivo 2017). Clearly, given the differences in physique existing between the two groups of professionals, the anthropometric data were not considered for comparisons. In fact, the average weight for speleologists was 72.4±7.6 Kg., 26.0 Kg. lower than that of rugby players and the stature 177.6 ± 7.2 cm., 6.3 cm. shorter. This resulted in a BMI=23.0 for speleologists, clearly more fit for their activity. The main anthropometric differences are shown in Fig. 1.

Figure 1 – Mainly anthropometric characteristics of the two cohorts of speleologists and rugby players.



Interesting are the differences emerged for the figurine test, depicted in figure2.

Figure 2 - Comparisons carried out between a cohort of speleologists and the whole sample of rugby players. In abscissa: 1=CUR, 2=TIME, 3=LIKE, 4=OTHERS, 5=AT-OT.



Between speleologists and our athletes, similar values were found for the BPSS scale. Significant differences emerged for ears ($t=2.79$, $df=110$, $p<.01$), hands ($t=3.59$, $df=110$, $p<01$), ankles ($t=2.89$, $df=110$, $p<01$), as the speleologists were more satisfied.

Discussion and conclusions

As expected, the few anthropometric data reported here show that these athletes differ from the average Italian population (Blackwell et al. 2002); but that the self-reported values are, on average congruent with Heffernan et al. (2017) values valid for top rugby players. The finding of overweight and first grade of obesity values in our cohorts of athletes, evaluated through BMI, could create misclassifications and misinterpretations. BMI, in fact, as an index of obesity has limitations, because it does not consider the composition of an individual body weight (Heyward & Wagner 2004). The percentage of body fat and BMI is connected to several factors (age, body build, frame size, ethnicity), and it tends to forget visceral fat (Janssen et al. 2002), therefore, as the most appropriate cut off value for designate obesity is controversial, the universal cut off value used to define overweight and obesity maybe not appropriate for rugby players. Athletic-specific cut off values based on the percentage of body fat in relation to BMI are needed. Interesting appears to be the introduction of a lean mass index (LMI) valid for top performers, introduced by Duthie et al. (2006). The comparisons carried out between the two cohorts of players show that group A reached excellence for different reasons: higher age (influencing experience), weight and BMI. The latter parameters are important, as they follow the trend shown worldwide, where the teams which performed better included the tallest backs and the heaviest forwards. Sedeaud et al. (2013) intersected

various factors explaining the trend: not only the secular trend permitting the reaching of higher statures, but also a wider and thorough knowledge of training, conditioning and the time devoted to training and in recovery, with addictive effects. In our sample other factors appear to diversify the different levels reached by the athletes: the higher number of seasons and tournaments played, even at international level. Last but not least the time spent for training, both in minutes and days and the activities performed in gym sessions appear to play a role.

Regarding BI, the general trend shown by our athletes is clear: both groups appear to be aware of their bodies, given the congruence found between CUR and TIME for the figurine test and their body parameters. For BS on the average the subjects show a quite high degree of satisfaction with respect to their bodies. The comparisons carried out between the groups reveal similar trends: the most unsatisfactory body part, in fact, appears to be the abdomen in both groups. The similarities found with the cohort of speleologists, whose body's representations and the degree of satisfaction/dissatisfaction with the body appeared to be influenced by the activity chosen, are high. In this case as well their BI appeared to be positive and BS enhanced with respect to average Italians (Viviani & Locati 2013).

Once again, individuals performing structural activities requiring training and constant application show better BI and BS, confirming the hypothesis.

This study has limitations. Apart the relative paucity of the sample (a bigger sample could permit to distinguish between forwards and backs, whose weight is always lower, for example), the administered BI and BS tests appear to be outdated: they were chosen in order to permit comparisons with previous data. The figurine test, for example, according to Swami & Tovée (2007), shows poor ecological validity, even if it proved a good reliability in many studies. The main problem with this test regards respondents that sometimes are not able to discern if the increase in body dimensions is due to muscularity or fatness, and this is important in rugby practice. Then, to appropriately verify the relationships existing between BI and anthropometry, different measures should be considered, for example skinfolds or those permitting to calculate the athletes' somatotype

References

- Viviani, F., Bortoli, L., Robazza, C. & Grassivaro Gallo, P., 1997, 'Body Image in Adolescent Subjects', in M.F. Coetsee & H.J. Van Heerden (eds), *Nutrition and Physical Activity*, University of Zululand, Department of Human Movement Science, KwaDlangezwa, pp. 130-134.
- Greenleaf, C., & McGreer, R., 2006, 'Disordered Eating Attitudes and Self-Objectification Among Physically Active and Sedentary Female College Students', *The Journal of Psychology: Interdisciplinary and Applied,* 140, 3: 187-198.
- Russel, K.M., 2004, 'On Versus Off the Pitch: The Transiency of Body Satisfaction Among Female Rugby Players, Cricketers, and Netballers', *Sex Roles,* 51(9):561-574.
- Gabbett, T. J., 2005, 'Science of rugby League football: A review', *Journal of Sports Sciences,* 23(9): 961-976.
- Maud, P.J., & Schultz, B.B., 1984, 'The US national rugby team: a physiological and anthropometric assessment', *Physician Sportsmedicine*, 12: 86–99.
- Morton, A. 1978, 'Applying physiological principles to rugby training', *British Journal of Sports Medicine*, 17: 4–9.
- Cahill, N., Lamb, K., Worsfold, P.,Headey R. & Murray S., 2013, 'The movement characteristics of English Premiership rugby union players', *Journal of Sports Sciences*, 31(3):229–237.
- Jones, M.R., West, D.J., Crewther, B.T., Cook, C.J. & Kilduff, L.P., 2015, 'Quantifying positional and temporal movement patterns in professional rugby union using global positioning system', *European Journal of Sport Sciences*, 15(6):488–496.
- O'Connor, D., 1996, 'Physiological characteristics of professional rugby league players', *Strength and Conditioning Coach*, 4: 21-26.
- Casagrande, G. & Viviani, F., 1993, 'Somatotype of Italian rugby players', *Journal of Sports Medicine and Physical Fitness*, 33:65-69.
- Crewther, B. et al., 2012, 'Scaling strength and power for body mass differences in rugby union players. *Journal of Sports Medicine and Physical Fitness*, 52(1):27–32.
- Sedeaud, A., Marc, A., Schipman, J., Tafflet, M., Hager, J-P. & Toussaint, J-F., 2012, 'How they won Rugby World Cup through height, mass and collective experience', *British Journal of Sports Medicine*, 46:580–4.
- Smart, D.J., Hopkins, W.G. & Gill, N.D., 2012, 'Differences and changes in the physical characteristics of professional and amateur rugby union players'. *Journal of Strength and Conditional Research*, 27(11):3033–44.
- Milanović, Z., Sporiš, G. & Weston, M., 2015, 'Effectiveness of High-Intensity Interval Training (HIT) and Continuous Endurance Training for VO_2max Improvements: A Systematic Review and Meta-Analysis of Controlled Trials', *Sports Medicine,* 45(10):1469-1481.
- Posthumus, M. & Durandt, J., 2009, 'Physical Conditioning for Rugby', http://www.sarugby.co.za/boksmart/pdf/BokSmart%20-%20Physical%20conditioning%20for%20rugby.pdf
- Suárez-Moreno Arrones, L.J. & Nuñez, F.J., 2011, 'Physiological and antropometric characteristics of elite rugby players in Spain and relative power out as predictor of performance in sprint and

RSA', *Journal of Sport and Health Research*, 3(3):191-202.

- Spencer, E.A., Appleby, P.N., Davey, G.K. & Key, T.J., 2002. 'Validity of self-reported height and weight in 4808 EPIC-Oxford participants', *Public Health Nutrition,* 5:561–556.
- Baccouche, M.A., Arous, I., Sellami, H., & Elloumi, A., 2014, 'Association between Body Mass Index and Cognitive Performance in Rugby Players', *International Journal of Scientific and Research Publications*, 4(6):1-5.
- Fallon, AE & Rozin, P., 1985. 'Sex differences in perceptions of desirable body shape', *Journal of Abnormal Psychology*, 94:102-105.
- Rozin, P. & Fallon, A.E., 1988, 'Body Image, attitudes to weight, and misperceptions of figure preferences of the opposite sex: A comparison of men and women in two generations', *Journal of Abnormal Psychology*, 97:342-345.
- Casagrande, G., Viviani, F. & Grassivaro Gallo, P., 1997, 'A methodological approach to the assessment of the "ideal body figure" in fat, obese, and non-obese women', in *Nutrition and Physical Activity*, M.F. Coetsee & H.J. Van Heerden (eds), University of Zululand, Department of Human Movement Science, KwaDlangezwa, pp.70-75.
- Stunkart, A.J., Sørensen, T. & Schlusinger, F., 1980, 'Use of the Danish adoption register for the study of obesity and thinness', in *The Genetics of Neurological and Psychiatric Disorders*, S. Kety, R.L. Sidman & S.W. Matthysse (eds), Raven Press, New York, pp. 115-120.
- Cohane, G.H. & Pope, H.G., 2001, 'Body Image in Boys: A Review of the Literature', *International Journal of Eating Disorders*, 29: 373-379.
- Berscheid, E., Walster, E. & Bohrnstedt, A., 1973, 'Body Image', *Psychology Today*, *76*:119-131.
- Petrie, T.A., Tripp, M.M. & Harvey, P., 2002, 'Factorial and Construct Validity of the Body Parts Satisfaction Scale-revised: An Examination of Minority and Nonminority Women', *Psychology of Women Quarterly*. 26:213-221.
- Heffernan, S.M. et al., 2017, 'Fat mass and obesity associated (*FTO*) gene influences skeletal muscle phenotypes in non-resistance trained males and elite rugby playing position' *BMC GeneticsBMC series* 18:4**,** DOI: 10.1186/s12863-017-0470-1.
- Viviani, F., De Vivo, T., 2017, 'Aspects of the Self-Referent Thought in Italian Speleologists', *Antrocom Journal of Anthropology*, 13,2, in press.
- Blackwell, S., Robinette, K.M., Daanen, H.A.M., Boehmer, M., Fleming, S., Kelly, S., Brill, T., Hoeferlin, D. & Burnsides, D., 2002, '*Civilian American and European Surface Anthropometry Resource (CAESAR), Final Report. Volume II: Descriptions',* AFRL-HE-WP-TR-2002-0170, Human Effectiveness Directorate, Crew System Interface Division Warrendale, PA 15096: United States Air Force Research Laboratory.
- Heyward, V.H. & Wagner, D.R., 2004, '*Applied Body Composition Assessment*', Human Kinetics, Champaign.
- Janssen, I., Heymsfield, S.B., Allison, D.B., Kotler, D.P. & Ross, R., 2002, 'Body mass index and waist circumference indipendently contribute to the prediction of non-abdominal, abdominal subcutaneous, and visceral fat', *American Journal of Clinical Nutrition,* 75:683-688.