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ISAK / ISAK

H01. The international society for the advancement of kinanthropometry – History, achievements and challenges

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Anthropometry has had centuries of history in many areas such as anthropology, anatomy, health and art. In sport, however, it is only relatively recently that measures other than height and weight have been utilized to better understand the connection between morphology and performance. Though many earlier anthropometrists were very precise in the measurements they used, it was not until 1914 that comprehensive anthropometric protocols were defined, formalised and disseminated by Rudolph Martin in his *Lehrvuch der Anthropologie in systematischer darstellung*. [The latest revision of that text¹ formed the basis for Ross and Marfell-Jones' protocols² which, in turn, led to the ISAK Manual.] Once protocols were published, anthropometrists generally observed them in their own practice and in their teaching of others, but they tended to do this independently. It wasn't until the formation of ISAK in 1986, that we saw a unified international approach to anthropometry training and then, in 1996, the development and adoption of ISAK's formal Accreditation Scheme (the IAAS), with its practical examinations and Technical Error of Measurement requirements.

Eighteen years later, ISAK has trained nearly 20,000 anthropometrists worldwide; has more than 70 active Level 3 trainers and 16 Criterion Anthropometrists in 13 countries; and is in good financial health. It is still the only international organization offering and demanding formal accreditation in anthropometry. It also operates a formal course approval system and a simple, but effective, website. Nevertheless, ISAK cannot rest on its laurels. In essence, the Society is led and managed by a very small group of senior ISAK members with much of its institutional history and processes held in their heads rather than comprehensively documented for all to benefit from. This makes it potentially vulnerable in the event of an unexpected loss of the services of one or more of those individuals. To minimize the associated risk, ISAK needs to spread its various responsibilities more evenly amongst its Council members and better utilize the skills of other senior members. That way, it can look forward with confidence to its continued development and the on-going welfare of its members and the many clients they serve.

Key words: Anthropometry. ISAK. Training. Accreditation.

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Kinanthropometry and performance / Cineantropometría y rendimiento

R01. Adult anthropometric characteristics in racket sports

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Introduction: At the present time, racket sports are one of the most popular sports in the world. There are data about somatotype

and anthropometric parameters in adolescent tennis players, but not in adults. Performance parameters can be conditioned by a non-optimal body composition. The purpose of this study, therefore, was to describe the anthropometric characteristics, body composition and somatotype of adult elite male racket players.

Method: Forty-seven adult elite male racket players were evaluated on the Restricted Profile of ISAK. In addition to seventeen anthropometric values, body mass index (BMI) and somatotype components were calculated and evaluated. Players were split in two groups, tennis and paddle players, and were compared. Descriptive statistics and T tests were run using SPSS Statistics 20.0 with a significance level set a priori at $p < 0.05$.

Results: The mean somatotype of racket players was identified as meso-endomorphic. No significant differences were detected between tennis and paddle players regarding the different anthropometric parameters. Compared to studies performed in adolescents, adult tennis players presented lower muscle mass and higher fat mass percentages compared to adolescents.

Conclusions: Since body composition is a major determinant in racket sport performance, the results presented in this study can be used as a standard reference for tennis professionals, including coaches, doctors and dietitians.

Key words: Body composition. Somatotype. Racket players. Elite.

R02. The modern rugby player: are we breeding giants and what are the consequences?

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Introduction: Although physique is not the only factor determining success in sport, the modern game of rugby union has become a sport in which the physique of the players is a very important predictor of success. Furthermore the economic, political and social drivers of sporting success will act to select body types which conform more and more to an ideal morphology. In rugby, the rates of increase in height and body mass appear to have outstripped secular trends in the population from which these athletes are drawn. Therefore, the aim of this presentation is to answer the question resulting from existing anthropometric data, on whether we are busy breeding giants to play rugby and also to demonstrate the consequences this will have in future.

Methods: The anthropometric data of the two most trendsetting studies on this topic were used. The first study was done on 1420 male rugby players drawn from 21 separate reports and communications between 1905 and 1999 on elite, national and state players. The second study was done on the national team of South Africa (Springboks). Data of 1349 rugby players between 1896 and 2004 were mapped.

Results: In the study done by Olds the results suggest that the rates of increase of body mass and BMI are well above those of the general population of young males. The study by De Ridder & Meyer, suggest major shifts in the body size and shape of the rugby players, with the players as a whole becoming taller and heavier. The data also suggests

that the rates of increase of body mass and BMI in the Springboks are well above those of the general population of young males.

Conclusion: The final rankings of the rugby teams at the recent 2011 World Cup in New Zealand, demonstrate that large body size is a significant predictor of success in rugby union. Rugby has become a fast-moving and high intensity gladiator sport, featuring big tackles and giant players. This could have a great impact on the game in the future and especially the players are going to feel the effects of injuries later in life.

Key words: Rugby. Body mass. BMI.

R03. Correlation between proportional lower limb measures and vertical jump in professional basketball players

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Introduction: Currently over a million athletes belong to the International Basketball Federation (FIBA). In Chile, over 500 thousand people play basketball. Research has shown the importance of kinanthropometric and fitness assessments, as these can help achieve improved performance.

Objective: The objective, therefore, of this research was to map lower limb proportionality and vertical jump height in professional basketball players.

Methods: The study was quantitative, inferential and transversal. The lower extremities of eleven professional basketball players were evaluated using Ross and Wilson's Phantom Stratagem; and the Abalakov jump was used to determine the maximum vertical jump height.

Results: Proportional thigh and calf girth together explained 43% of the differences observed in the vertical jump, with only the proportional calf girth being significant at the 95% confidence level (0.054). No statistically-significant correlation was found between success in a vertical jump in terms of the average jump height and position of play.

Conclusion: The results obtained in this study confirmed that, contrary to our expectation of a high correlation between thigh girth and vertical jump, when values are converted from absolute to proportional the relationship can change. It is important therefore, for scientists and coaches to understand the difference between proportional and absolute values and recognise when one should be used in preference to the other.

Key words: Anthropometry. Phantom stratagem. Vertical jump. Basketball.

R04. The anthropometric profile of spanish waterpolo players based on their experience level

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Introduction: The anthropometric characteristics of the waterpolo players have been previously published; however, it has not been

determined the influence of the experience of the players on their anthropometric profile.

Method: The sample consisted of 11 water polo players of the Real Canoe Isostar team ($n=11$, age 20.5 ± 3.5 years, experience: 10.6 ± 4.3 years). It was measured weight, height, span, 5 diameters, 10 perimeters, 7 skinfolds, and length and transverse diameter of both hands as it was defined in the ISAK manual. Two experience groups were established: Over 10 years (>10) ($n=6$), and below 10 years (<10) ($n=5$). They were run for all the variables non-parametric (U de Mann-Whitney) and parametric (Student t) tests by experience groups, and paired-samples Student t test for dominant vs. non-dominant hand variables, setting the significance level in $\alpha=0.05$.

Results: The more experienced players were heavier (" >10 ": 86.0 ± 13.1 kg vs. " <10 ": 84.5 (11.0 kg), with higher perimeters and skinfolds, and the less experienced players were taller (" >10 ": 182.3 (8.2); " <10 ": 186.5 (4.8 cm), had wider span (" <10 ": 188.7 (11.7); " <10 ": 191.38 (4.78 cm) and with wider bone diameters; however all those differences were non-significant. The results for somatotype components and % of body composition by experience groups are shown in table below (also non-significant).

	General	<10	>10
ENDO	3.1(1.1)	2.7(1.1)	3.5(1.1)
MESO	5.6(1.0)	5.4(1.0)	5.8(1.1)
ECTO	2.3(1.2)	2.7(1.4)	1.8(0.9)
BMI25.0(3.1)	24.3(3.3)	25.8(2.8)	
% FAT MASS	16.7±4.6	15.3±4.4	18.6±4.7
% MUSCLE MASS	43.4±4.1	43.8±4.0	43.0±4.6
% BONE MASS	16.2±1.3	16.9±1.2	15.5±1.1

Dominant hand had a similar length (19.7 ± 0.8 cm for dominant vs. 19.7 ± 1.0 cm for non-dominant side) but a significantly greater hand transverse diameter ($p<0.05$) in dominant side (8.7 ± 0.5 cm) compared to non-dominant side (8.4 ± 0.5 cm) was found, maybe due to a functional specialization by gripping the ball.

Conclusions: The anthropometric profile does not appear to be related to the level of expertise in elite water polo players; only the transverse diameter is significantly wider in the dominant hand compared to the non-dominant hand.

Key words: Waterpolo. Anthropometry. Somatotype.

R05. Associations of skinfolds with race time in male half-marathon runners

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Introduction: Body composition changes among elite athletes may influence competitive performance. The association of skinfold variables, with race time was investigated in 32 male half-marathoners.

Methods: Thirty-two recreational male half-marathoners (M age = 41.6

yr., SD = 7.4; M body mass = 73.0 kg, SD = 7.8; M stature = 172.5 cm, SD = 6.3; M Body Mass Index = 23.6 kg/m², SD = 1.99) were recruited. Eight skinfold (SKF) thicknesses were measured twice or three times in accordance of ISAK international procedures. Sums of three, four, six, eight, sum of upper limb, trunk and lower limb and lower limb/trunk (Thigh + calf/Subscapular+ Iliac crest+ supraspinale+ Abdominal) ratio were calculated. The relationship of variables and personal best time in half marathon were performed by Pearson correlation coefficients.

Results: Abdominal, thigh and calf skinfolds were associated with total race time ($r=0.50$ to 0.56 , $P<0.05$). Also, trunk ($r=0.41$, $P<0.05$), lower limb skinfolds ($r=0.58$, $P<0.05$), sums of six ($r=0.50$, $P<0.05$) and eight SKF ($r=0.46$, $P<0.05$) were related to race time. No significant correlations was found with L/T ($r=0.17$, $P=0.43$).

Conclusions: The best association was found with lower limb SKF. Slim limbs may positively contribute to performance by having a low moment of inertia and thus requiring less muscular effort in leg swing. Fatness is only associated to half-marathon races, probably due to the fact that these runners are engaged in higher training volume and that only in this event fat metabolism prevails in training and competition. This study suggests that half-marathon run time in physically active master athletes is influenced by body fatness and distribution especially in lower limb.

Key words: Skinfolds. Runners. Half-marathon. Performance.

R06. Endomorphy is related to performance in male duathlon sprint performance

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Introduction: There is great interest in systematically studying the factors that can influence fitness development for better sporting performance. The purpose of this study was to determine how the somatotype components are predictors of duathlon sprint competitions (5 km Run - 20 km Bike - 2.5 km Run).

Method: Eight male trained duathletes - triathletes [mean (SD), age 24.8 (6.8) years, height 174.4 (6.8) cm, body mass 67.12 (8.1) kg] participate in this study. Ten anthropometric variables were measured by ISAK procedures (Norton, 1996). Somatotypes were calculated using the anthropometric technique proposed by Heath & Carter (Carter, 1975). Also were recorded variables of training load as kilometers in bike and run disciplines per week. Pearson correlation coefficients and stepwise multiple regression were performed to analyze the relationships of somatotype components as independent variables with race performance as dependent variable.

Results: The somatotype of male duathletes was 1.8-5.1-3.1. Pearson correlation coefficients were high for endomorphy ($r=0.82$ ($P<0.01$)); and non-significant for mesomorphy ($r=0.08$) and ectomorphy ($r=-0.25$) with time race. A significant model was obtained to predict performance race: Time (min) = $52.83 + 6.53$ (Endomorphy), F-ratio: 8.44, $R^2=0.67$, SEE = 1.52, $P=0.04$.

Conclusions: Lower rates in endomorphy, resulted in a significant better race performance variable. The impact of somatotype was the most distinguished on the run-bike-run discipline and had a high impact on the total race time.

Key words: Somatotype. Performance. Duathlon.

R07. Body composition and somatotype of young academy soccer players: a comparative study of south african and zimbabwean players

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Introduction: The interest in body composition, somatotype and anthropometric characteristics in competitive sports has increased over the last decades. This is because body type and body composition play a vital role in the selection of junior athletes and are related to the success of young athletes' responses to training and competition demands. This study presents a comparative profile of body composition and somatotype characteristics of South African and Zimbabwean young male academy soccer players.

Methods: 41 South African players aged 15.9 ± 0.9 years and 33 Zimbabwean players aged 16.0 ± 0.9 years were purposively sampled from sub elite soccer academies. Anthropometric variables were measured using International Society for the Advancement of Kinanthropometry (ISAK) protocols. Measurements included body mass, stretch stature, eight skinfolds, five girths and two bone breadths. Body mass index (BMI), waist-to-hip ratio (WHR), percentage body fat (%BF), fat mass (FM), fat-free mass (FFM), fat mass index (FMI) and fat-free mass index (FFMI) were calculated as body composition variables. Heath-Carter somatotype method was used in determining the somatotype of the participants. Descriptive and comparative statistics were computed using SPSS Version 16.0. Somatotype descriptions and comparisons were computed using Somatotype V. 1_2_5 software.

Results: The results of the study showed no significant difference between South African and Zimbabwean players in terms of mass $p=0.64$, height $p=0.61$ and BMI $p=0.08$. A significant difference was observed on percentage body fat ($p=0.03$), and sum of 8 skinfolds ($p=0.01$), FFM (0.004), FFMI ($p=0.001$), and the somatotype ($p=0.04$). Mean somatotype for South Africans was 2.03-3.28-3.61 (mesomorphic-ectomorph) while that for Zimbabweans was 1.61-4.38-2.91 (ectomorphic-mesomorph).

Variable	South Africa	Zimbabwe	p-value
Mass (kg)	58.3 ± 10.26	61.9 ± 4.95	0.64
Height (cm)	169.4 ± 6.54	170.1 ± 5.05	0.61
BMI kg·m ⁻²	20.5 ± 2.51	21.4 ± 1.39	0.08
%BF	10.5 ± 3.61	9.0 ± 1.6	0.03
SSKF (mm)	61.4 ± 22.11	47.1 ± 7.18	0.01
FFM (kg)	51.9 ± 7.69	56.3 ± 4.17	0.004
FFMI	1.8 ± 2.14	1.9 ± 1.19	0.001
Somatotype	2.03-3.28-3.61	1.61-4.38-2.91	0.04

Conclusion: Zimbabwean players are taller and heavier compared to South Africans. The difference in sum of skinfolds, waist hip ratio and %BF could be attributed to the differences in age, nutritional status of

the teams as well as the training status and level of competition. The percentage body fat for the two groups reflect that Zimbabweans are leaner compared to South Africans.

Key words: Somatotype. Body composition. Anthropometry. Endomorph. Mesomorph. Ectomorph.

R08. Anthropometric profile and physical performance of professional female volleyballers in relation to playing position

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Introduction: To optimize performance in volleyball each player will adapt to the specific demands necessary to elicit peak performance. Since there are varying positions in a match, specific adaptations may vary among players.

Objective: The aims of this study were 1) to analyse anthropometric measures and physical performance of elite female volleyball players; 2) to determine any differences in these measures between various playing positions and 3) to examine any correlation between anthropometric measures and subsequent physical performance.

Methods: This study assessed 42 female professional female volleyball players (Age: 27.2 ± 5.4 years). Players were categorized according to playing position: middle blockers (n=12), opposite hitters (n=6), outside hitters (n=12), setters (n=8), and liberos (n=4). Anthropometric measurements assessed were: height, weight, 5 skinfolds, and 5 corrected girths. Additionally, the physical performance parameters examined were: jump test (vertical-jump, spike-jump), speed, agility, crunches test and overhead medicine ball throw were assessed.

Results: Results revealed significant differences in some variables of body composition, anthropometric measures and physical performance among individual playing positions. We found a good correlation between some body composition and anthropometric measures such as skinfold and corrected girth with power jump, speed, ability and strength. Height offered a performance advantage for middle blockers, whereas lower body mass, especially a lower fat mass, was identified as advantageous for setters and liberos. High musculoskeletal mass together with an appropriate fat mass appeared to offer advantages for opposite and outside hitters.

Conclusion: It can be concluded from our study that, in the sample tested, certain playing positions benefitted from differing physical attributes. Before offering these findings as any sort of benchmark for female volleyballers, however, we recommend their confirmation in a much wider sample.

Key words: Anthropometry. Body composition. Female. Volleyball.

R09. Anthropometric study for the detection of potential sports talents in Ecuador

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Introduction: High performance sports require athletes to have specific characteristics from the morpho-funcional point of view, as well as other aspects such as socio-cultural aspects. Talent is a stressed aptitude; the early ages are ideal for its detection. Considering the development of sports skills as an aspect of social responsibility, it is important to know the physical and anthropometric qualities of children and adolescents in a particular country in order to obtain national parameters from real data that characterize future programs to promote athletes, in a broad social spectrum of opportunities.

Objective: The purpose of this study, therefore was to determine the physical fitness level and body composition of Ecuadorian children and adolescents between 5 to 18 years to detect sport talents.

Methods: The ISAK protocol was applied, to a representative sample of 12,000 Ecuadorians, between 5-18 years living in urban and rural sectors. Results: National anthropometric and physical fitness tables were created related to cross-sectional socio-demographic aspects. The tables were presented by sex and age range (5-6, 7-8, 9-10, 11-12, 13-14, 15-16, 17-18 years) based on average, standard deviation, medians, maxima and minima, with the 5, 15, 25, 50, 75, 85 and 95 percentiles identified and with a reliability index of 0.05.

Conclusions: The national tables created, which characterize morphological, physical fitness and socio-cultural aspects of Ecuadorian children, will enable Ecuador to rapidly assess individual children in comparison to both national and international norms for the detection and selection of sports talents.

Key words: Anthropometry. Sports talents. Detection.

R10. Somatotype variation in world championships speed skaters

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Introduction: The anthropometric characteristics of individuals are part of their talent for reaching success in competitive sports. Anthropometric norms provide specific standards established for different sports specialties and can be used by coaches as technical reference for the effective control of morphological optimization. The somatotype is one of those reference variables. Therefore, the objective of the present study was to provide robust information for the evaluation of the sport form of skaters in their development towards excellence.

Method: 362 male skaters and 279 female, from 22 countries who participated in five World Championships held in Chile, Colombia and Venezuela, were evaluated using the procedures established by Ross and Marfell-Jones. The somatotype was calculated according to Carter and Heat. The anthropometric measurements were performed by experienced certified anthropometrists using calibrated equipment. For

practical purposes, the sample was divided into 10 subgroups according to sex and year of measurement. The statistical analysis was performed using SPSS17 along with BORIS software.

Results: The average somatotype per year of evaluation were as follows: Males: 1997 (1,94-4,43-2,84), 1999 (2,06-4,77-2,65), 2000 (2,17-4,64-2,39), 2003 (2,18-4,46-2,90) and 2007 (2,10-4,74-2,46). Comparisons between groups provide significant statistical differences between pairs: 1997-1999 ($t=1.933; p<0.05$), 1997-2000 ($t=2.385; p<0.02$), 1997-2007 ($t=2.248; p<0.02$); 2000-2003 ($t=2.193; p<0.05$) and 2003-2007 ($t=2.136; p<0.05$). Females: 1997 (3,27-3,73-2,18), 1999 (3,12-3,61-2,62), 2000 (3,57-3,87-2,06), 2003 (3,81-3,89-2,08) and 2007 (3,50-3,81-2,34). Comparisons between groups provided significant statistical differences between pairs: 1997-1999 ($t=1,949; p<0.05$), 1997-2003 ($t=2,076; p<0.01$), 1999-2000 ($t=2,746; p<0.01$) and 1999-2003 ($t=1,342; p<0.01$). Comparison between groups of different sex and same year of evaluation, showed statistical differences only in years 1999 ($p<0.001$), 2000 ($p<0.05$) and 2007 ($p<0.001$).

Conclusions: The establishment of historic somatotype data should prove helpful assistance for coaches in terms of future skater evaluation and talent selection.

Key words: Somatotype skaters. Anthropometrists dotes. Morphological optimization.

R11. Morphological characteristics of female basketball players of different qualification

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Introduction: Sports anthropology is studying among other things, morphological characteristics of athletes specializing in different kinds of sports and their variations depending on qualification of the athletes. The aim of the present paper was to compare morphological characteristics of female basketball players from several sports teams which include players of different qualification.

Method: In 2012-2013 three groups of the basketball players were examined: players of the national team – 1 ($n=21$), players of the students' team of the Russian University of Physical Education – 2 ($n=9$), players of the national team of hearing-impaired athletes – 3 ($n=12$). As a control group - 4, students of Moscow State University (MSU), non-athletes ($n=52$) were measured. The program consisted of 40 anthropometric and anthroposcopic characteristics. Statistical analysis included descriptive statistics, one-way ANOVA and discriminant canonical analysis, performed with Statistica 10.

Results: The analysis demonstrates that the players of three teams and MSU students differ in many characteristics. Females from the team 1 were the tallest (186.9 cm), with the players of two other teams being significantly shorter: 176.6 (2), 170.3 cm (3), and the MSU students - the shortest (165.2 cm). Maximal weight and BMI values were typical for the players of the team 2. For measurements in length (leg, arm, etc.) variations were the same as for height. In body diameters the females

of team 1 were also ahead of the other players and students. There were significant differences between basketball players and non-players (4) in elbow, wrist and ankle breadths, which may reflect specific adaptation to this sports activity. The calculated fat mass was minimal in players of team 1 and maximal in the MSU students, though the values of circumferences in this group (4) were minimal. The opposite is true for the fat-free mass.

Conclusions: It was shown that the level of specific training influences the athletes' morphological status. The role of selection in sports is also confirmed by variations in morphological characteristics of athletes with different qualification.

Key words: Sports anthropology. Female basketball. Morphological characteristics. Sports selection.

R12. Evolution of the anthropometric profile in professional football players during the season

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Introduction: Nowadays the measurement of body composition presents several problems due to the different values obtained when different methodologies are used. For that reason different standards have been established. In high performance athletes the accurate measurement of the body composition supposes a great advance, because in this way an individual training and nutritional program could be introduced to meet the individual requirements of the athlete and to follow the changes during the season. The aim of the study was to determine the changes in the anthropometric variables during the season in male football professional players.

Method: A descriptive study was performed to determine the evolution of several anthropometric measurements within the season. Twenty players belonging to a professional team with a mean age ($\pm SD$) of 25.8 ± 3.9 years participated in the study. Two anthropometries were performed. The anthropometries were carried out by a level I anthropometrist following the ISAK criteria. Measurements performed were: weigh, height, eight skinfolds, five girths and three breadths. Fat (Whiters *et al.* 1987) and lean mass (Lee *et al.* 2000) percentages as well as the somatotype were also determined. A student t test for paired data was used to determine the significance of the differences between values ($p < 0.05$).

Results: Results obtained in the anthropometric assessments performed in July 2011 and March 2012 are represented in the following table.

	Weight (kg)	Fat mass (%)	Lean mass (%)	Somatotype
July 2011	79.5 ± 3.94	11.89 ± 3.47	43.99 ± 1.31	MESOMORPH
March 2012	79.4 ± 4.27	10.26 ± 2.13 *	44.80 ± 1.64 *	MESOMORPH

*indicates significant differences between anthropometric measurements

Both weight and somatotype were maintained along the study. However, we emphasize that the percentage of body fat mass decreased significantly (1.63%) and the percentage of lean mass increased significantly at the end of the study.

Conclusions: An improvement of the anthropometric variables measures is produced with the continuous training sessions and matches the professional football season involves, with a decrease in the body fat mass while the weight is maintained.

Key words: Football players. Fat mass. Somatotype.

R13. Somatotype of female elite team of spanish premier league

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Introduction: Unlike the male football players, women has less support economically and followers. This difference is also visible in scientific terms as they are few published studies showing the somatotype characteristics of elite female football players (FFP). In addition, female soccer players in Spain, although playing in the top flight, are not considered as professionals.

Objective: The aim of this study is to assess the characteristics of somatotype of elite FFP.

Method: 19 FFP team first division club Sporting of Huelva were evaluated during the month of February 2014. Anthropometric measurements were taken as described in the reference manual, following the International Society of Advancement of Kinanthropometry (ISAK). A International Certified Anthropometrist (ISAK, level 2) took the 10 variables necessary to calculate the somatotype: a) height, b) weight, c) skinfolds (subscapular, triceps, supraspinale and medial calf), d) girths (arm flexed and tensed, and calf) and e) diameters (humerus and femur). To calculate the somatotype was determined, the three somatotype components separately (endomorphy, mesomorphy, ectomorphy), by the method of Heath-Carter. All FFP signed informed consent.

Results: Then the average somatotype of FFP is shown.

Endomorph	Mesomorphy	Ectomorphy
3.38 ± 0.93	3.67 ± 1.16	2.25 ± 1.17

Conclusions: In the FFP of Sporting Club de Huelva there is a predominance of the mesomorph component, followed by endomorph and ectomorph. This not happens in other Major League players surveyed in 2009. Although, there are a somatotype reference to the Female Spanish first division players, it is necessary to further study this type of athletes to know their ideal somatotype according to playing position and nutritional intervention.

Key words: Anthropometry. Somatotype. Female. Football.

R14. Anthropometric and body composition characteristics in elite female football players

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Introduction: Unlike the male football players, women has less support economically and followers. This difference is also visible in scientific terms as they are few published studies showing the anthropometric characteristics and body composition of elite female football players (FFP).

Objective: The aim of this study is to assess the anthropometric characteristics and body composition of elite FFP.

Method: 19 FFP team first division club Sporting of Huelva were evaluated during the month of February 2014. Anthropometric measurements were taken as described in the reference manual, following the International Society of Advancement of Kinanthropometry (ISAK) with restricted profile protocol. They were always taken by the same internationally certified anthropometrist (ISAK, level 2). The technical of error in the measurement of skinfolds was inferior to 5% and for 1% in the rest of the measurements. By the anthropometry equations given in the "compendio de cineantropometría", the body composition (body fat and active body mass) was calculated. All FFP signed informed consent.

Results: In tables 1 and 2 show the anthropometric profile and body composition of the FFP:

Age	20,05±9,86
Weight	62,55±8,24
Height	1,67±0,08
Fat mass	6,73±3,25
% body fat (Withers, 1987)	10,55±4,27
Active body mass (ABM)	55,82±6,78

Expressed in data±deviation; Fat mass and ABM in kg; Height in meters; ABM: Weight – fat mass.

Skinfolds	
Subscapular	8,34±2,48
Triceps	14,61±4,23
Biceps	4,55±1,22
Iliac Crest	14,71±3,19
Supraspinale	9,71±3,31
Abdominal	16,66±5,23
Front thigh	20,53±4,58
Medial Calf	10,95±4,89
Girths	
Arm (relaxed)	26,15±2,25
Arm (flexed and tensed)	27,55±2,31
Calf (máximo)	35,96±2,63
Breadths	
Humerus	6,15±0,29
Bi-Styloid	5,06±0,45
Femur	8,67±0,47
Σ8 skinfolds	
	100,05±23,24

Σ8skinfolds: subscapular + triceps + biceps + Iliac Crest + supraspinale + abdominal + front thigh + medial calf

Conclusions: By anthropometric method we know the body composition of FFP to change their values with a balanced diet. However, it still must be made more descriptive studies of anthropometric profile and body composition for athletes such as it is a determinant of their performance in the field.

Key words: Anthropometry. Body composition. Female. Football.

R15. Anthropometric characteristics in elite basque ball players

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Introduction: There is hardly any reference to the anthropometric characteristics, body composition and somatotype of elite "basque ball players" (BBP) in scientific literature.

Objective: The aim of this study was to describe the body composition, anthropometric and somatotype features of elite BBP.

Methods: We examined a group of 18 elite BBP (aged 24.1±4.7, height 179.95±7.1 cm, weight body mass 82.7±8.2 kg). Anthropometric measurements were taken as described in the reference manual, following the International Society of Advancement of Kinanthropometry (ISAK) with restricted profile protocol. They were always taken by the same internationally certified anthropometrist (ISAK, level 2), and a note taker (ISAK, level 2). The technical of error in the measurement of skinfolds was inferior to 5% and for 1% in the rest of the measurements.

Results: In this descriptive study we compare the features of amateur (ABBp), under-23, and the elite professional basque ball players (EBBP) not only to create an anthropometric profile of this sport, but also to compare these features with the features of other sports. EBBP have significantly lower fat mass (FM), higher muscle mass (MM)($p=0.015$), and a less endomorphic ($p<0.001$) and more ectomorphic somatotype ($p<0.001$), because they are higher. They have a greater amount of body water and a larger bustyloid diameter ($p=0.014$), which is a very important feature that enables players to hit the ball harder. Regarding other sports, the anthropometric features and somatotype of BBP are similar to handball players.

Conclusion: Basque ball players is morphotype characterized by a low fat percentage (8-9%) and medium muscle mass (47%). This allows players to hit the ball with great stability (strength in the legs and waist) and great power and speed in the upper body.

Key words: Elite basque ball players. Anthropometric. Body composition. Somatotype.

R16. Effect of a matwork pilates exercise on somatotype

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Introduction: Some researches have demonstrated a relationship between systematic physical exercise and positive changes in somatotype. Somatotype has been proposed as a method to estimate body composition and body shape. However, previous studies with Pilates practitioners have not focused on the analysis of this parameter. Therefore, the aim of this study was to analyze the influence of matwork Pilates exercise on the somatotype of adult women.

Method: Twenty-eight women (mean \pm SD, age: 40.21 ± 8.12 years) with an experience of one or more years in matwork Pilates participated in this study. They participated in a matwork Pilates program of one hour, twice a week, for 16 weeks. A Level ISAK 2 anthropometrist measured all anthropometric variables in accordance with standard ISAK guidelines. Participants completed baseline measures across a period of one week prior to starting the exercise program. Post-test measures were taken over one week after finishing it. Instruments were calibrated in advance to avoid measurement errors. The temperature of the laboratory in which the measurements were made was standardized at 24°C . The equations of Carter and Heath were used to calculate anthropometric somatotypes.

Results: Significant differences were found in endomorphy between pre-test (4.96 ± 1.17) and post-test (4.54 ± 0.99) ($t=3.29$; $p=0.003$). No significant differences were found in mesomorphy (4.11 ± 1.10 and 4.18 ± 1.19 , respectively) and ectomorphy (1.82 ± 1.12 and 1.82 ± 1.09 , respectively). In general, women showed meso-endomorph and mesomorph-endomorph in the pre- and post-test, respectively. Thirteen women changed in their classification of the somatotype between the pre- and the post-test (46.42%).

Conclusion: The present study demonstrated that mat Pilates exercise may influence endomorphy and thus change the somatotype in active adult women.

Key words: Somatotype. Pilates. Exercise. Female. Kinanthropometry.

R17. Effect of a mat pilates exercise on muscle and fat mass

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Introduction: Some researches have demonstrated a relationship between systematic physical exercise and positive changes in body composition. A few studies have showed that using a mat Pilates method modifies both muscle and fat mass. To date no studies have investigated mat Pilates in adult women with previous mat Pilates experience. The-

fore, the aim of this study was to analyze the influence of mat Pilates exercise on muscle and fat mass in adult women.

Method: Twenty-one women (mean \pm SD, age: 42.95 ± 6.84 years) with an experience of between one and three years in mat Pilates participated in this study. They participated in a mat Pilates program of one hour, twice a week, for 16 weeks. A Level 2 ISAK anthropometrist measured all anthropometric variables in accordance with the standard ISAK guidelines. Participants completed baseline measures over a two-week period before starting the exercise program. Post-test measurements were taken over two weeks after finishing it. Instruments were calibrated in advance to avoid measurement errors. The temperature of the laboratory in which the measurements were performed was standardized at 24°C . To determinate body composition five components strategy by Kerr was used.

Results: Significant differences were found in fat mass between pre-test (20.90 ± 3.66 kg) and post-test (19.81 ± 3.40 kg) ($t=3.06$; $p=0.006$). Also, significant differences were found in muscle mass ($t=-3.16$; $p=0.005$) between both measures (22.48 ± 4.46 and 23.48 ± 4.59 in the pre- and post-test, respectively).

Conclusion: It was concluded that mat Pilates exercise was beneficial in reducing fat mass and increasing muscle mass in active adult women.

Key words: Body composition. Pilates. Exercise. Female. Kinanthropometry.

R18. Relationship between muscle mass, strength (power and speed) and electromyography during the squat

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Introduction: The aim of the present study was to analyse the muscular mass, obtained by skinfold thickness, and the strength, power and speed results during a squat.

Method: Twelve female (23.2 ± 1.4 years) recreational athletes took part in the study. Following a period of familiarization, participants performed a one-repetition maximum strength test in a Smith machine. This effort consisted of a 5-intensities incremental test (20, 40, 60, and 100% of 1RM). In addition, the electromyographic (EMG) signal was registered during the strength evaluation, by using a Bagnoli™ Desktop EMG Systems, with Rectus Femoris, Vastus Lateralis, Vastus Medialis and Gluteus Maximus muscles. An anthropometric evaluation was performed in every participant, according to the ISAK recommendations, with height, weight, skinfold, girth and breadth measures. The Shapiro Wilk statistic was used to check the normality of distribution. Correlations between the muscular mass and the squat results were analyzed by Pearson or Spearman coefficients.

Results: Our results showed statistically significant correlations between leg muscle area and average speed ($r=0.725$, $p=0.008$), propulsive speed ($r=0.732$, $p=0.007$), and power in the propulsive phase ($r=0.630$, $p=0.028$). However, the one-repetition maximum value and electromyography results were not statistically correlated.

Conclusions: Higher leg muscle mass is related to better results on one-maximum repetition squats in young females. Nevertheless, higher muscle mass did not impact on the total maximum repetition kg. The effect of muscle mass in other parameters such as speed or power during the strength test can be useful for sport professionals during fitness programs with young females at recreational levels.

Key words: Muscle mass. Strength. Electromyography. Squat.

R19. Does paddling side influence somatotype in elite junior sprint canoeists?

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Introduction: When lateral dominance is not a consideration, the standard ISAK protocol, measures the right side of the body. Where dominance is a consideration, however, the dominant side is measured, which raises the question of whether a change of measured side impacts on an athlete's somatotype. Sprint canoeing is clearly an asymmetric sport with canoeists paddling in a high kneeling position (up on one knee) and using a single-blade always on the same side of the canoe. The aim of this study, therefore, was to compare the somatotype determined with measures of the paddling and non-paddling sides in elite junior sprint canoeists.

Method: Eleven junior elite male sprint canoeists (age 17.2 ± 0.6 years old) were measured using a complete battery of 39 anthropometric dimensions following the ISAK guidelines. They were selected by the Royal Spanish Canoeing Federation as the best in their categories to participate in 2010 National Development Camp. The equations of Carter and Heath were used to calculate the anthropometric somatotypes using the measures from the paddling side and non-paddling side. An independent t-test was conducted to examine differences in somatotype components based on the side of paddling.

Results: No significant differences were found between the results of the somatotype using the data of the paddling or non-paddling sides. The mean somatotypes were $2.8 - 5.2 - 2.4$ and $2.8 - 5.0 - 2.4$ using the measures from the paddling or non-paddling sides, respectively. Only mesomorphy increased its value by 0.2 points as a result of a larger flexed and tensed arm girth on the paddling side in all the participants. In both cases, the canoeists were best described as balanced mesomorphs.

Conclusion: If considering overall somatotype it does not matter which side is measured in sprint canoeists. However, if specifically interested in the mesomorphy component of the somatotype, it may be preferable to measure the dominant side in order to recognize any increase in muscularity therein due to the paddling action.

Key words: Somatotype. Asymmetric sports. Canoeing.

R20. Anthropometric differences relating to maturity status in young canoeists

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Introduction: Relative age and maturity status have an important implication in physical performance and anthropometry in young athletes. However, sport governing bodies continue promoting competitions where a competing group covers two years of chronological age that might be even more in terms of biological age. Therefore, the aim of this study was to compare the anthropometric characteristics relating to maturity status in young elite canoeists.

Method: Twenty young elite sprint male canoeists (age: 15.7 ± 0.7 years-old) participated in this study. They were selected by the Royal Spanish Canoeing Federation as the best in their categories to participate in 2010 National Development Camp. They were measured using a complete battery of 41 anthropometric dimensions following the ISAK guidelines. Time to/from Age Peak Height Velocity (APHV) was estimated as an indicator of somatic maturity during adolescence, according to the Mirwald *et al.* procedures. The equations of Carter and Heath were used to calculate anthropometric somatotypes. Body fat percentage was calculated using Slaughter's equation. The sample was divided into two groups with regards to maturity status: less (group 1) and more than 2 years (group 2) from APHV. An independent paired t-test was conducted to examine differences between both groups for all anthropometric variables, somatotype and body fat percentage.

Results: Group 2 had significant higher values than group 1 in: age (15.9 ± 0.5 Vs. 15.4 ± 0.5 years), APHV (2.4 ± 0.3 vs. 1.5 ± 0.2 years), basic measures, trunk and limbs girths and biacromial, transverse and A-P chest breadths. No significant differences were found in the somatotype ($2.7 \pm 0.8 - 5.2 \pm 0.8 - 2.0 \pm 0.9$ Vs. $2.7 \pm 0.6 - 4.8 \pm 0.4 - 2.6 \pm 0.5$) and the body fat percentage (15.5 ± 3.4 Vs. $13.6 \pm 3.4\%$).

Conclusion: Maturation has an important influence on absolute size in canoeists that compete in the same category, so it is necessary to take it into account in talent identification and development actions in sport as an important variable that influence over the anthropometric characteristics and probably over the sport performance in young athletes.

Key words: Anthropometry. Maturation. Canoeing.

R21. Effects of 8 weeks of high-resistance circuit training (HRC) in female and male basketball players

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Introduction: The ability to generate maximal strength levels in a short time (mechanical power) has been considered determinant in optimizing high performance in basketball, so maximal strength training is essential to optimize power levels in basketball players. Circuit weight training (CWT) could be a good tool for strength training to improve strength and power and minimize training time. A recent study of CWT showed higher levels of force production in men compared to women. Because there are different adaptations depending of the gender and HRC training has found positive results (in body composition and maximal strength) in men, the aim of present study was to compare if the adaptations produced in men were different to those found in women.

Methods: Fourteen basketball players (20.5 ± 4.9 years) participated in this study. They were divided in 2 groups ($G1=7$ males; $G2=7$ females) and completed an 8-wk training period (1-3 sets: 2 blocks x 3 exercises (upper and lower body) at 6 repetition maximum (RM), twice weekly). The rest time between exercises was 40 s and the interval was 3 min. Percentage of fat mass (%FM), maximal strength (MS) in bench press and half squat (1RM) and fatigue index (FI), in modified repeated sprint ability (RSA 20m) were evaluated in pre- and post-test sessions.

Results: No significant differences were observed between pre and post-test in %FM ($G1=-1.58 \pm 2.92\%$; $G2=-0.61 \pm 1.89\%$) and in FI ($G1=-2.19 \pm 3.53\%$; $G2=-5.48 \pm 5.46\%$). 1-RM improved significantly ($p<0.05$) in bench press in females only ($G1=2.9 \pm 4.4$ kg), while no significant differences in $\frac{1}{2}$ squat in any of the groups ($G1=3.7 \pm 5.5$ kg; $G2=4.6 \pm 5.5$ kg) were found. No significant differences were observed inter-groups.

Conclusions: No significant differences were observed between groups so the adaptations were similar in both groups except in bench press in women. Is necessary more studies with a higher sample, and a longer training period may improve strength and power performance.

Key words: Resistance training. Circuit training. High load. Basketball players.

R22. Effects of modified high-resistance circuit training HRCM (continuous block) on training time in basketball players

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Introduction: Basketball is a sport that requires high physiological demands, physical fitness being a fundamental characteristic in basketball players. Specially, the mechanical power has been considered determinant in optimizing high performance in basketball. High-resistance circuit (HRC) training has been used to obtain positive changes in body composition and maximal strength when compared to a traditional strength training. Due to limited time to train, we believe that a modified HRC (HRC_M) could be a good way of reducing in 44% the total time of training in comparison with the HRC. Therefore, the aim of this study was to compare the effects of a HRC_M (continuous block) vs. HRC as a proxy for reducing basketball training time.

Method: 14 basketball players (19.9 ± 6.4 years) were divided in 2 groups: HRC methodology ($G1=7$), and modified HRC (HRC_M) ($G2=7$). HRC was

completed in 2 blocks of 3 exercises each, while HRC_M was performed in 1 block of 6 exercises (upper and lower body training). The training was performed twice weekly, during 8-wk with a non-lineal periodization (1-3 sets). The intensity was of 6RM (repetition maximum). Inter-exercise rest was 35 s in both protocols, while local rest was 3 min in HRC and 5 min 12 s in HRC_M. Maximal strength in bench press (RM), percentage of fat mass (%FM) and fatigue index (FI) in a modified repeated sprint ability (RSA 20m) were evaluated in pre and post-test sessions.

Results: Percentage of FM decreased statistically significant ($p \leq 0.05$) between pre- and post-test for G1 ($-1.6 \pm 2.9\%$) and a trend to significance ($p \leq 0.1$) in G2 ($1.6 \pm 2.2\%$) was observed. No significant differences were found in FI during RSA ($G1=4.7 \pm 8.1\%$; $G2=3.0 \pm 2.6\%$). Neither significant changes were found to RM in bench press ($G1=1.2 \pm 2.2$; $G2=6.2 \pm 7.9$ kg). Interestingly, HRC_M reduced the training time in a 44% in comparison to HRC.

Conclusions: HRC_M training can be considered as an alternative of HRC, obtaining similar results than HRC in terms of maximum strength, body composition and fatigue index in the repeated sprint with a reduced training time (44% less).

Key words: Resistance training. Circuit training. High load. Players. Basketball.

R23. Evolution of anthropometric variables and body composition of polarized training model vs threshold training distribution

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Introduction: Half Ironman distance (1.9 km swim, 90 km bike, 21.1 km run), is currently very popular for recreational experienced triathletes. In spite of the amount of training proposals, there is a lack of training intensity distribution scientific guidelines for this particular event. A predominantly easy training approach is considered to be most logical way to train that distance but many coaches suggest that 'faster is better' in reference to a concept of 'junk miles' related to easy training. The objective was to compare the evolution of anthropometric variables and body composition of 2 groups of triathletes [polarized training model (POL) and threshold training distribution (THR)] after 13 weeks of training.

Method: 18 triathletes were divided into POL ($n=9$ 29.1 ± 6.7 years) and THR ($n=9$ 30.1 ± 6.9 years). All measurements were done in the same laboratory to ambient temperature of ($22 \pm 1^\circ\text{C}$) and by the same investigator (ISAK level 3) anthropometric measurements followed protocols of Heath-Carter anthropometric protocol.

Results: THR showed significant differences in muscular mass (0.9% more; $p < 0.05$) and in the $\Sigma 8$ skinfold (75.8 ± 31.6 vs 71.1 ± 27.5 ; $p < 0.05$) respectively to previous measures. POL showed significant differences in the $\Sigma 8$ skinfold (83.8 ± 28 vs 77.8 ± 21.8 ; $p < 0.05$) and differences in muscular mass (0.3% more) respectively to previous measures. Between groups, showed significant differences in the $\Sigma 8$ skinfold and muscular mass (1.7% and 2.3%) pre and post-measures ($p < 0.05$).

The mean results for the three somatotype components was in THR mesomorphy (1.9 ± 1.5 vs 1.8 ± 1.4), ectomorphy (2.1 ± 0.5 vs 2.3 ± 0.4) and

endomorphy (3.7 ± 0.9 vs 3.5 ± 0.9). Meanwhile in POL was mesomorphy (2.2 ± 2.1 vs 2 ± 2.3), endomorphy (4.1 ± 1 vs 3.8 ± 0.7) and ectomorphy (2.1 ± 0.7 vs 2.2 ± 0.6). Significant differences are not shown.

Conclusions: Both training programs got a significant reduction of fat mass. THR Group increase their muscle mass despite the fact that both groups followed the same program of strength training, which can be due to longer training in area between thresholds.

Key words: Performance. Body composition. Training. Triathlon. Kinanthropometry.

R24. Evolution of body composition with "live high-train low" in normobaric vs hypobaric hipoxia

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Introduction: Slight physiological differences between acute exposures in normobaric (NH) vs. Hypobaric (HH) hipoxia have been reported recently. However, the clinical significance of these differences is still questioned. For example, it is unknown if the performance decrement, when compared to normoxia, is similar in NH or HH. Nowadays, no study has investigated the adaptations and performance gains following NH and HH altitude training camps. The aim of the present study was to assess in well-trained athletes the body composition changes to LHTL training camps in NH vs HH.

Method: Twenty-seven highly trained athletes living at or near sea level (27 males, age 23 ± 4 years, height 179 ± 5 cm, body weight 71 ± 7 kg and $\text{VO}_{\text{2max}} 66.9 \pm 8.4 \text{ ml.kg}^{-1}.\text{min}^{-1}$) participated in this study. The experimental design consisted of a lead-in period of three weeks, where the training loads were quantified controlled with ECOs model. The two groups followed the same recommendations for nutrition and supplementation. Day 1 and day 21 of the camp were anthropometric measures. All measurements were done in the same laboratory to ambient temperature of ($22 \pm 1^\circ\text{C}$) and by the same investigator (ISAK level 3) anthropometric measurements followed protocols of Heath-Carter anthropometric protocol.

Results: Results found significant differences between the Σ 8 skinfold between groups (pre NH 73.5 ± 30 vs HH 64.1 ± 19.3 mm; post NH 68.2 ± 20.7 vs HH 58.2 ± 11.9 mm) and pre-training and post-training camp. Fat mass between groups and Pre and post on NH (pre NH 10.3 ± 4.1 vs HH $9.3 \pm 2.2\%$; post NH 10 ± 3 vs HH $8.6 \pm 1.6\%$). And the values of ectomorfia between groups and between pre and post (pre NH 2.4 ± 1 vs HH 3.2 ± 0.8 ; post NH 2.8 ± 1.1 vs HH 3.5 ± 0.7).

Conclusions: The decrease in total body weight has been described as a consequence of the training in hypoxia, in our groups we found similar results. However the decrease in the value of the Σ skinfold thickness indicates a decrease in fat mass that may be due to the effect of training and that has occurred in both groups equally. Either there has been a decrease in muscle mass, and this fact is also confirmed by the significant increase in both groups the value of ectomorfia. Not found significant differences in body composition between the HH and NH training group, therefore the effect of the training in this aspect has been the same, not producing differences different stimulation of hipoxia in the anthropometric variables of athletes.

Key words: Performance. Body composition. Training. Hipoxia.

Kinanthropometry and nutrition / Cineantropometría y nutrición

N01. Nutritional characteristics and somatotype of capital district athletes

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Introduction: Nutrients are essential to life and are required for each sport by age, sex, duration and type of practice. Body composition describes the characteristics of the human physique and is directly related to food intake and physical type affects the athlete and also related to athletic success. Somatotype study is used as a system designed to classify the body or physical type.

Objective: The purpose of our study, therefore, was to evaluate the relationship between food intake and somatotype in athletes drawn from the capital district of Caracas.

Method: The sample consisted of 118 athletes (56 females and 62 males). We used a questionnaire that included a number of key data for nutritional assessment and dietary habits and annotation record for collecting the necessary anthropometric data to calculate somatotype.

Results: There was a similar consumption pattern in both sexes - a high percentage intake of cheeses, fruits, vegetables, arepas, poultry with skin, oils and sugar. We found increased food consumption with increasing age from 12 to 22 years and decreased after this age, with the exception of cheese and oil consumption which was progressive from adolescence to adulthood in females. The mean somatotype for

females was meso-endomorphic, while the male group reported as endo-mesomorphic. The body components were related to the dietary intake of athletes.

Conclusions: Given the dietary patterns observed and the tendency to endomorphy in the men as well as the women, it was concluded that the dietary habits of the athletes in the sample were not optimal and thus warrant a positive nutritional education campaign.

Key words: Food intake. Sports. Nutrition. Somatotype.

N02. Dehydration and voluntary intake of water in mountain runners

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Introduction: Fluid losses in recreational activities and competitions is prevalent in Spain due to the high temperature and relative humidity at certain times of the year. The mountain race competitions are regulated by the Spanish Federation of Mountaineering and Climbing (FEDME) and require a minimum distance of Half Marathon (21 km); a minimum accumulated climb altitude of 1000 meters and have a maximum of 15% of total travel on asphalt, cement, or any pavement type. According to Jeukendrup (2011), in this type of race, the lack of carbohydrates and dehydration are the principal factors that contribute to the fatigue. The characteristics of this sport combined with the Spanish climate, therefore, predispose mountain runners to suffer from pathologies by dehydration. Water intake by a runner during an event, however, is voluntary

Objective: The aim of this study, therefore, was to investigate the level of dehydration of these types of athletes and to find out the extent of voluntary intake of water during a race.

Method: The sample was composed of 9 male athletes between the age of 25 and 35 years. Anthropometry was measured by an ISAK Level 2 anthropometrist using ISAK protocols and percentage fat mass (%MG) was calculated using the weight fatty equation of Carter. All participants completed a race according the FEDME rules, their race water intake was monitored during the race and their weight re-checked immediately post-race.

Results: The average pre-race (standard deviation) Body Weight (BW) of the group was 74.52 (10.2). The corresponding values for fat mass (%MG) were 10.53 (2.72). Race Time averages in minutes (RT) were 160.1 (23.54).

Percentage of Body Weight Lost (%BWL) was 2,967 (0,969). The Race Water Intake in litres (WI) was 0.524 (0.265). There was no correlation between the 3 variables. When weight loss exceeds 2% in sports, the subject is deemed to be dehydrated, so the majority of our athletes finished the race in a dehydrated state.

Conclusions: Given the results of our study, we concluded that mountain running athletes and coaches in Spain need to be very aware of the importance of hydration in their event, both for performance and to prevent health problems.

Key words: Dehydration. Mountain runners. Water intake.

N03. Sport drinks in mountain running

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Introduction: Physical activity reduces the risk of premature death as well as cardiovascular disease, hypertension, type 2 diabetes and even certain types of cancer. This is one possible reason why mountain races in Spain are booming. The characteristics of approved mountain races are defined by the Spanish Federation of Mountaineering and Climbing (FEDME). These characteristics plus Spain's climate predispose mountain runners to the occurrence of pathological fluid loss due to the high temperature and relative humidity.

Objective: Given the risks of hydration, it was hypothesised that the use of sport drinks during a mountain race might ameliorate the extent of dehydration suffered. The purpose of this study, therefore, was to evaluate the level of dehydration when sport drinks are used and to see whether there were variances between the percentage of fat mass before and after the run.

Method: The sample consisted of 9 male athletes aged 25 to 35 years. Anthropometry was measured by an ISAK Level 2 using ISAK protocols and percentage fat mass (%MG) was calculated using the equation of Carter. All participants completed a race according the FEDME rules, their sport drink intake was monitored during the race and their weight re-checked immediately post-race.

Results: The average (standard deviation) %MG was 10.344 (2.906). Body Weight (BW) was 74.52 (10.2). The average Race Time minutes (RT) was 152.667 (29.84). Percentage of Body Weight Lost (%BWL) was 2,883 (0,730). Sports Drink Intake (SDI, in litres) were 0,508 (0,233). The % MG after the race was 10,348 (3,018). The difference between the %MG before and after the race was non-significant. Based on the literature, most of our athletes suffered dehydration during the race.

Conclusions: Given the dehydration identified, we concluded that the amount of sport drink consumed by the athletes in the sample was insufficient to offset dehydration. We think this was because by the time the thirst reflex manifested itself dehydration had already occurred. We believe, therefore, that, to prevent dehydration and heat pathologies in this type of sport, protocols should be employed which initiate fluid intake prior to the onset of the thirst reflex.

Key words: Sport drinks. Mountain runners.

N04. Effect of diet or free diet on body composition in judo

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Introduction: Several studies in judo positively correlate excess body fat content with low sport results, technical skills and yield in energy supply. Fat can be mobilized, but this takes time and is more efficient if the individual performs aerobic training routines, which are not usual

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in judo training sessions close to contests. The usual strategy consists of competing within the maximal weight allowed in a specific category. Thus, in the present study, we investigated the effect of dietary intervention on anthropometric characteristics in judo players.

Method: Men and women judo players were evaluated through the ISAK Restricted Profile before and after following a free diet or specific dietetic program. Diets were adapted accordingly to each particular subject and a P value of less than 0.05 was considered statistically significant.

Results: When judo players followed a designed diet, they decreased

body weight, fat mass and their endomorphic component, yet increased muscle mass and their ectomorphic component. Despite the weight loss, their mesomorphic component was unchanged.

Conclusions: We concluded that correct diet planning in judo players can keep fat mass lower without compromising muscle mass. It is recommended, therefore, that all serious judo players make the effort to follow a well-designed diet if they wish to maximize their performance potential.

Key words: Muscle mass. Fat mass. Somatotype. Judo. Diet.

Kinanthropometry and health / Cineantropometría y salud

S01. Effects of physical activity on some anthropometric characteristics in children with emotional and behavioral problems

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Introduction: Intervention programs for people with disabilities or mental problems normally lack on Physical Activity (PA) contents. The aim of this study was to investigate the effects of PA on some anthropometric characteristics of children with emotional and behavioral disturbances.

Methods: Sample consisted of 19 children from the child and adolescent psychiatry Unit of the Ege University Medical School. They participate in a twelve-week educative program including controlled PA (2 days a week, 60 min a day).

Anthropometric data were collected before and after enrolling in the educative program by an accredited ISAK Level II anthropometrist following the ISAK manual. Relaxed Arm (RAG), Contracted Arm (CAG), Waist (WG), Gluteal (GG) and Calf (CG) Girths, Triceps (Tsk), Subscapular (Sbsk), Biceps (Bsk), Iliac (Isk), Supraspinale (Ssk), Abdominal (Ask), Thigh (Tsk) and Calf (Csk) skinfolds, Humeral (HB) and Femoral (FB) breadths, body weight (W), stature (St), sitting height (Sh) and arm span (AS) (Restricted Profile) were measured and used to determine the sum of 8 skinfolds (S8), BMI and percentage of body fat (%BF).

Children were divided into two mixed groups according to the age and gender. Student T-test was run for comparing pre- and post- results and Wilcoxon Signed-Rank Tests were used for identify differences by gender and age groups setting always statistical significances at $\alpha=0.05$.

Results: When general pre- and post- test data were compared, significant differences in W, St, Sh, AS, GG and CG were observed ($p<0.05$). Considering only the boys' data, differences ($p<0.05$) were found for W, St, Sh, AS, Tsk and GG results, but in girls only for St, Sbsk, and CG. Finally, children under-10 significantly changed their W, St, Sh, AS, and CG measurements and children over-10 changed their St, Sh, AS, and GG.

Conclusion: Physical activity programs can lead to significant changes in some anthropometric characteristics of children with emotional and behavioral problems. Educative programs with PA contents can support the correct growth and development of those children.

Key words: Physical activity. Anthropometric measurements. Emotional and behavioral problems. Children.

S02. Effects of strength training and creatine in preventing sarcopenia in older people

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Introduction: Sarcopenia is a syndrome characterized by a gradual and widespread loss of skeletal muscle mass and strength with risk of adverse outcomes such as physical disability, poor quality of life and mortality.

Purpose: To determine whether strength training reduces sarcopenia in older persons and whether taking creatine impacts on strength gain.

Methods: Total population ($n = 80$) between the ages of 65-79 years. Division of groups: 1) Strength training ($n = 34$) with intake of isotonic drink (7oz), 2) Strength training with creatine (2.5gr) intake ($n = 20$) 3) Creatine intake (2.5gr) without strength training (26). Strength was pre- and post-tested by 1 Repetition Maximum bench press and bioelectrical impedance was used to estimate muscle mass

Results: Combined treatment of creatine with strength training reduced severe sarcopenia in women by $1.0\% \text{ kg/m}^2$ ($p < 0.050$) and in men by $3.0\% \text{ kg/m}^2$ ($p < 0.001$). Moderate sarcopenia in both genders was reduced by $2.0\% \text{ kg/m}^2$ ($p < 0.001$). The normal muscle increase in women was $+4.0\% \text{ kg/m}^2$ ($p < 0.001$) and in men was $+6.0\% \text{ kg/m}^2$ ($p < 0.0001$).

Conclusion: Strength training was able to improve the adverse effects caused by the loss of strength and muscle mass known as sarcopenia. Combining creatine supplementation with strength training can increase the benefits in improving sarcopenia.

Key words: Sarcopenia. Creatine supplementation. Strength training.

S03. Effect of anthropometry, body composition and maturity on lower limb pain in young football athletes

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Introduction: Participation in football at competitive levels during infancy and adolescence may increase the exposure to risk situations which can be related to musculoskeletal health decline. The purpose of this study, therefore, was to identify the extent to which maturity, anthropometry and body composition contribute to lower limb pain (LLP), during a competitive season in young football players.

Method: A longitudinal study was conducted involving 43 football athletes-FA (11.9 ± 1.2 years) and 32 non-athletes-NA (11.3 ± 0.97 years), evaluated in two occasions (beginning and end of the season for FA, and one year apart at the beginning of the school year for NA). Anthropometric variables were taken according to ISAK, body composition was calculated by Frisancho equations, maturity was measured by Mirwald equations, and the lower limb pain was evaluated with a pain VAS (0-10).

Results: There were no statistically significant differences for LLP between FA and NA participants at the baseline. However, in the second moment the FA showed a greater level of LLP ($p=0.025$). The differences between FA and NA participants were statistically significant, on both measurement occasions, for relative trochanterion height, relative sitting height, calf skinfold, sum of lower limb skinfolds and sum of total skinfolds relative to height. Higher differences between sitting height related to stature corresponded to an increase in lower limb pain in the FA group ($OR=2.59$; 95%CI 1.09-6.14).

Conclusions: Although the higher relative sitting height values observed in the FA group could indicate a structural factor in the increased risk of lower limb pain, it is also possible that the differences were due, to a greater or lesser extent, to the stresses and strains of actually playing. It is recommended, therefore, that further study concentrates on this latter aspect.

Key words: Anthropometry. Maturity. Lower limb pain. Young football athletes.

S04. Anthropometric and somatotype characteristics of type 2 female diabetic patients from different religious communities

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Introduction: Lifestyle, food habits, activity levels and beliefs of some of the religious groups are detrimental to keeping good health among women. The main factors contributing to lifestyle diseases include bad food habits, physical inactivity and disturbed biological clocks. Rates of diabetes in India have increased over the last 50 years in parallel with increased obesity. The increase in the incidence of Type 2 diabetes among middle-aged women in India is alarming.

Objective: It was the purpose of the study, therefore, to analyze the anthropometric and somatotype characteristics of Type 2 diabetic patients of women from different religious communities.

Method: Subjects selected for the study were 150 Type 2 diabetic women patients of three different communities (Hindu-50, Christian-50 and Muslim-50) from Trivandrum, India. Data was collected on the 17 anthropometric measurements of the ISAK Restricted profile, along with neck girth, and the three somatotype components were calculated along with Body Mass Index and Waist-to-Hip ratio. A Standard anthropometric kit (GM Company Switzerland) and Electronic weighing machine were used to collect data. Analysis of variance was calculated using SPSS.

Results: No significant difference was observed in body mass and stretch stature among the three different religious groups. 14 out of 17 ISAK restricted profile measurements of the Muslim group showed significantly higher mean scores when compared with Christian and Hindu groups. Mean scores on Neck girth were significantly higher in the Hindu group compared with Christian group. All three groups were mesomorphic endomorphs. Significantly higher values on mean scores of Somatotype components, larger girths and skinfold measurements were observed in the Muslim group when compared with the other two groups.

Conclusions: We concluded that as Type 2 diabetic patients of the Muslim community at Trivandrum city were more vulnerable to lifestyle disease than Christian or Hindu women, this group needed to closely examine whether any aspects of its religion were contributing to this increased vulnerability.

Key words: Anthropometric measurements. Somatotype. Body mass index.

S05. Correlation between body mass index and body adiposity index with the body composition

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Introduction: Body mass index (BMI) is an interesting method for the diagnosis of the obesity. Other method to estimate the adiposity is the body adiposity index (BAI). Both, BMI and BAI, establish parameters of obesity in relationship to adiposity tissue. On the other hand, BAI determines a relationship between perimeter hip, height and a constant.

Purpose: Determine the relationship between the BMI and BAI with percentage and kilograms of adiposity tissue (AT) and muscular mass (MM) in university students.

Methods: Was applied ISAK protocol to determine anthropometrics index and body composition using the method for fractionation of five compartmental protocol to a sample ($n = 54$ men, $19,35 \pm 1,3$ years). The variables was analyzed using Pearson Correlation's, alpha error $p < 0,05$ to determine significance. Software utilized was GraphPad Prism.

Results: The BMI exhibit a positive correlation with the muscle mass and adiposity tissue ($r = 0,73$; $r^2 = 0,534$; $p < 0,001$; and $r = 0,704$; $r^2 = 0,495$; $p < 0,001$, respectively). However, the correlation between BMI with percentage of muscle mass and adiposity tissue showed a weak

positive correlation, no statistical significance ($r = 0,018$; $r^2 = 0,0003$; $p = 0,442$; and $r = 0,279$; $r^2 = 0,078$; $p = 0,012$; respectively). The IAC showed a positive correlation with the adiposity tissue ($r = 0,655$; $r^2 = 0,42$; $p < 0,001$), but with the muscle mass was a weak positive correlation ($r = 0,372$; $r^2 = 0,138$; $p < 0,001$). The correlation between IAC with percentage of adiposity tissue showed positive correlation ($r = 0,468$; $r^2 = 0,219$; $p < 0,001$).

Conclusions: We suggest that the IAC could be a better predictor of health risk, since correlate better with the adiposity tissue. The BMI could be increases both muscle mass and adiposity tissue.

Key words: Anthropometry. Body mass index. Body adiposity index.

S06. Is there a correlation between anthropometry, quality of life and physical activity?

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Introduction: Physical aspect is important at aesthetic level but moreover, recent studies relate it closely with our health.

Objective: Our objective is to prove whether physical aspect, as evaluated by anthropometry, influences our quality of life and if it is related to our physical activity.

Method: Anthropometry in 114 patients - 49 men and 65 women from 30 to 65 of age - in primary health centres following the protocol established by ISAK and GREC (Grupo Español de Cineantropometría), with subsequent somatochart. We estimated their quality of life and physical activity by means of questionnaires: 1) of quality of life Euroqol -5D; 2) visual analogue scale (VAS) to self-evaluate one's health; 3) Physical activity questionnaire (LTPA- Minnesota Leisure Time Physical Questionnaire).

Results: Men had higher alcoholic habits and overweight (49%) and obesity type I (30.6%). Men get closer to the mesomorphic axis (endomesomorphic area), while women get closer to the endomorphic axis (meso-endomorphic area). Lower values of BMI are related to better quality of life, objectively measured by calculating the social rate. The VAS reached an average value of 72.5 and is related to a higher ectomorphy and a lower value in the 'X' axis of the somatochart. Mild physical activity is associated to a lower ectomorphy while intense physical activity is associated to a higher ectomorphy.

Conclusions: There is, and can be proved, a relation between the anthropometry of an individual, his quality of life and his physical activity.

Key words: Anthropometry. Quality of life. Physical activity.

S07. Body mass relationship with left ventricular hypertrophy in hypertensive patients from Boyacá, Colombia

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Introduction: It has been documented left ventricular hypertrophy as one of the early signs of cardiac affection in hypertensive disease.

Objective: To assess the prevalence of left ventricular hypertrophy and relationship with body mass Index in hypertensive patients attending control programs in health institutions at Boyacá, Colombia.

Method: By sequential random sampling, it was assembled a sample of 1275 patients who underwent measurement of Body Mass Index and blood pressure and take an electrocardiogram. Cornell, Romhilt-ES Test and Rodriguez-Padial criteria were evaluated, to assess the presence of left ventricular hypertrophy.

Results: There was found overall prevalence of LVH in 17.9% of patients analyzed, with marked differences in each municipality. LVH was found to be associated with age over 65 years ((OR=1,36 p=0,028), female gender (OR=1,41 p= 0,018), increased body mass index >25 (OR=1,31 p=0,027) and high blood pressure systolic and diastolic.

Conclusions: These results suggest the need of physical activity programs for older people and continued control of blood pressure and LVH by electrocardiogram of routine. The body mass index and EKG in older womens is one priority in public health.

Key words: Body mass index. Ventricular hypertrophy. Electrocardiogram.

S08. Impact of vigorous exercise on levels of L-Carnitine in prisoners in Colombia

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Introduction: Overweight and obesity are conditions that have gradually been increasing in the world. By 2008 it was estimated that there were in the world around one billion people living who were overweight and/or obese. In the provinces of Boyacá, Colombia, this situation has become a public health problem, especially in rural areas where average body mass indexes) above 25 exist, especially among women. Simultaneously, technological development has led to the gradual reduction of the amount of physical activity that people do and an increase in the consumption of processed foods without fiber. The objective of this study, therefore, was to assess the effect of a program of vigorous physical exercise on the serum concentration of L-Carnitine free and total, in prisoners in Boyacá, Colombia.

Method: An experimental, prospective cohort study. 44 prisoners with overweight and/or obesity, from a jail at Boyacá, Colombia were randomly assigned into two groups – experimental and control. Intervention consisted of the practice of a vigorous exercise program for twelve weeks. Anthropometric measures and levels of L-Carnitine free ad total were taken four-weekly.

Results: There were significant increases in serum levels of free and total L-Carnitine in the intervention group compared with the control group.

Concurrently, in this group there was a reduction in body mass index (BMI), while in the control group there were no changes. Regarding the average BMI values, in the control group there was no significant variation from week 0 to 12 (27,7 vs 27,5; p=0,79), while in the experimental group there was a marked reduction from 28,6 to 25,7 (p=0,0011).

Conclusions: In the presence of overweight/obesity, the routine practice of vigorous exercise offers significant benefits in reducing body fat volumes by mechanisms of energetic consumption of long chain fatty acids.

Key words: Obesity. Physical exercise. L-Carnitine. Fat acids metabolism.

S09. Kinanthropometric study of heli-transported forest firefighters during summer

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Introduction: A heli-transported forest firefighter prepares for his work at his base, pending emergency calls, which require being in the air within 10 minutes of receiving them. Physical activity and energy expenditure are heavily affected by the number of callouts attended during the campaign and physical training is influenced by both the danger of the professional activity, and the limitations at base training, with age also being a significant factor. In order to optimize and individualize brigade training, we proceeded to the study the morphology and physical condition of forest firefighters by age groups during a forest campaign.

Method: 67 helicopter firefighters from 6 different bases, divided into 8 age groups, were interviewed and underwent anthropometric measurement (ISAK Restricted Proforma) at the beginning, middle and end of a firefighting campaign, and conditioning tests were performed in 5 sessions from April to September 2013. All measurements were made at base. Absolute and derived values (e.g. Waist/Hip ratio, sum of eight skinfolds) plus conditional tests and a questionnaire on nutritional habits were treated with the SPSS 18.0 software.

Results: The results showed no significant differences in food habits in 6 bases studied, nor by age group. However, the differences between brigades were significant in all registered anthropometric data (RCC, Sum of folds and waist circumference), the Rufier-Dickson test (cardiac adaptation to stress) and the Burpee test (aerobic capacity). There were no significant differences between age groups in terms of sums of folds, although differences did exist between other anthropometric data recorded throughout the campaign and in the Lian test (cardiac recovery capacity), Pack Test (test to assess contextualized aerobic capacity of forest brigade) and the Course Navette test (as a method of indirect assessment of VO_{2max}).

Conclusions: The significant differences found in functional capacity between age groups highlights the importance of continued strenuous physical training at all ages for active firefighters in order to adequately prepare them to cope with the major physical challenges of heli-transported firefighting.

Key words: Firefighters. Kinanthropometrie.

S10. Physical inactivity and its social determinants in people from Boyacá, Colombia

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Introduction: The World Health Organization has identified sedentary lifestyle as one of the main risk factors for the occurrence of cardiovascular disease and socioeconomic status has long been considered as a contributory factor to such lifestyles. We therefore wished to investigate the extent to which this global phenomenon applied in Colombia by investigating the prevalence of physical inactivity and its relation to socioeconomic factors in inhabitants of the department of Boyacá, Colombia.

Method: This was an observational, cross-sectional, analytic study. We administered the International Physical Activity Questionnaire (IPAQ) a questionnaire to identify cardiovascular risk assessment to 6736 residents aged 15 to 69 years in 34 municipalities. The collected data was evaluated using multivariate analysis.

Results: Physical inactivity was prevalent in 63.72% of the people, with inactivity occurring more in women and young people. Inactivity increased with the level of education and the negative perception of health. Higher rates of inactivity occurred in people with incomes above the minimum (p <0.01).

Conclusions: The results demonstrate the need to implement strategies for educational intervention that can change dietary patterns and encourage communities and individuals into common and effective practice of physical activity as a measure of health protection.

Key words: Physical inactivity. Cardiovascular disease. Risk factor.

S11. Comparative study of functional autonomy in athlete and sedentary old men at moderate altitude

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Introduction: The systematic practice of physical activity contributes to improving the living conditions and health and slows the aging process of the elderly.

Objective: To identify differences in functional autonomy in men aged 60 to 70 years, living in Tunja, at moderate height.

Methods: A comparative cross sectional, analytic study. Participants were 22 elderly male - 11 sedentary and 11 practitioners of mountain biking, aged 60 and 70 years (mean 63.03 ± 4.32 years). Previously, participants signed an informed consent. Then, subjects underwent a testing battery of the Senior Fitness Test (SFT) of Rikli, R and Jones (1999), the Astrand Submaximal Test (1954) and right- and left-hand dynamometer tests.

Results: The groups were found to be comparable in age, weight, height and body mass index (p> 0.05). Statistically significant differences

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were recorded for the group of mountain bikers, the mean percentage of body fat, bone density, muscle mass, whereas neither BMI nor the percentage of body water showed significant differences. In the SFT, test statistically-significant differences in waist mobility ($p<0.001$) were found. In the submaximal test, statistically-significant differences were found in the stress test in Watts ($p = 0.021$). In the left-hand dynamometry tests, statistically significant differences were found.

Conclusion: Older adults who routinely practice physical activities such as mountain biking, show superior indicators of health such as reduced fat, increased muscle, greater, waist flexibility, higher, aerobic capacity and better motor skills.

Key words: Physical activities. Aged. Personal autonomy (DeCS).

S12. Planter pressure distribution in children and adolescents with different somatotypes

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Introduction: The plantar pressure (PP) distribution allows us to characterize the function and the geometry of the foot, as well as monitor pathologies of the foot over time in order to understand the evolution and effects of a clinical intervention. Since it is demonstrated that the PP distribution alters according to BMI and different stages of growth, the objective of this study was to understand whether there are changes in the PP distribution according to different somatotypes.

Method: A total of 63 students of both sex were included in the study (age=11.68±1.11 years, BMI=18.89±3.17 kg/m²). The peak pressure was evaluated when they walked barefoot across an emed-a pressure platform at a self-selected speed. The peak pressure of 10 regions was obtained (hell-lateral and medial; mid foot-lateral and medial; 1st, 2nd, and other metatarsals; Hallux; 2nd and other toes). Anthropometric variables were taken according to ISAK and the somatype was calculated with the Carter and Heath equations.

Results: There were no statistically significant differences for plantar pressure distribution between groups of somatype; neither there were differences of peak plantar pressure in different regions of the foot within the same somatype. However, we can see that there is a tendency for a predominantly endomorph somatype to apply higher pressure levels under the hallux by comparison with other somatypes.

Conclusion: The morphological type does not influence the distribution of plantar pressure in children and adolescents.

Key words: Somatype. Plantar pressure distribution. Children. Adolescents.

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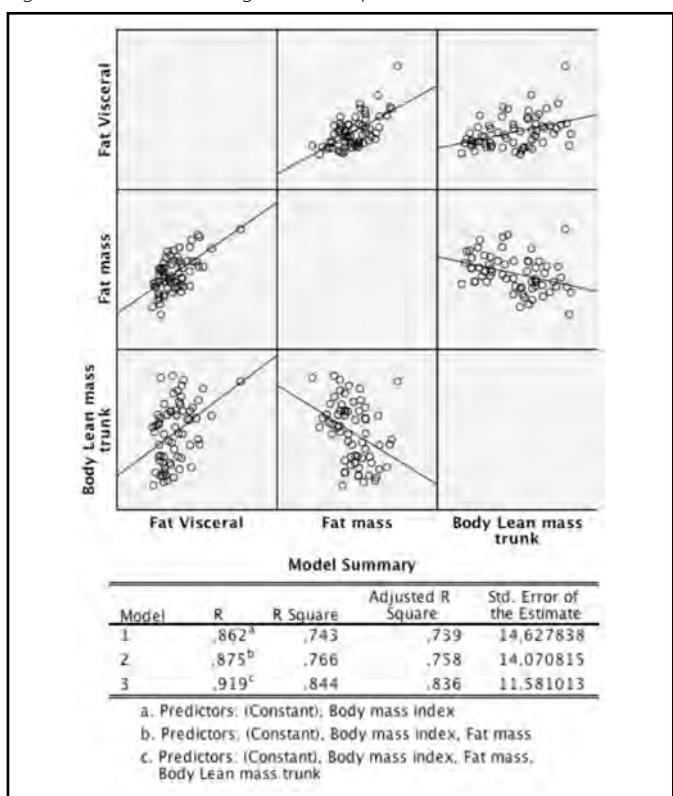
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Introduction: Excessive visceral fat produces inflammatory cytokines that increases skeletal muscle insulin resistance. Obesity is defined as the excessive accumulation of visceral fat and it is associated with an increase in cardiovascular disease risk. The purpose of this study was to analyze the correlation between visceral fat and body mass index (BMI) and total and segmental body fat and lean body mass, obtained by electrical bioimpedance (BIA) in a group of healthy weight adults.

Methods: Seventy-four healthy weight adults that performing light physical activity (23.48±5.1 years-old) participated voluntarily in this study. Data collection for the evaluation was performed on two different days: on the first day, the participants signed the informed consent documents and they were informed about manufacturer's guidelines of BIA (Inbody 720, Biospace, Seoul, Korea) on the second day, anthropometric and bioimpedance data were collected. Body mass index (kg/m²), fat mass (%), lean body mass (kg) and segmental lean body mass (kg) (right and left arm, trunk, right and left leg) were analyzed (bioimpedance-based proprietary algorithm). Statistical analysis: standard descriptive statistics were performed (mean and standard deviations). Besides, Shapiro-Wilk test was used to determining variables normality. Finally, Pearson correlation test and linear regression (stepwise) were applied.

Results: Significant correlation between visceral fat area and BMI ($r = 0.862$, $p = 0.0001$) and total body fat ($r = 0.845$, $p = 0.0001$) were found.

Figure 1. Results linear regression (stepwise)



S13. What is a better predictor of visceral fat area in healthy weight adults?

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On the other hand, no correlation between visceral fat and other body composition variables were observed. Three regression models (Figure 1) with the variables BMI, body fat and lean mass of the trunk were found.

Conclusions: The best predictor variable for visceral fat area in healthy weight adults that performing light physical activity was body mass index.

Key words: BIA. BMI. Obesity. Visceral fat.

S14. Osteogenic effects of different sports on growing female players

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Introduction: It is known that sport practice may have a beneficial effect on bone mass throughout life. However, it is not well established which sport is more beneficial to increase bone mineral density (BMD) in growing girls. Therefore, the objective of this study was to analyze if there are differences in bone mass in girls playing different sports.

Method: Two hundred girls (10.6±1.5 years old, Tanner stages I-III) participated in the study and were divided into five groups: 40 swim-

mers, 40 soccer players, 40 basketball players, 40 handball players and 40 controls. BMD at whole body, hip and lumbar spine was measured using dual-energy X-ray absorptiometry (DXA). The degree of sexual development was determined using the Tanner scale and physical activity habits were recorded by questionnaire. Bone mass differences between sports were assessed by analysis of covariance with height and fat-free mass as covariates. Analyses were performed separately in two groups depending on the tanner stage (prepubertal and pubertal).

Results: In the prepubertal group, BMD at intertrochanter was significantly higher in the handball players and soccer players compared to the control group ($p<0.05$). On the other hand, in the pubertal group, BMD at whole body, mean arms, pelvis, femoral neck, intertrochanter and Ward's triangle was significantly higher in the soccer players and handball players compared to the control group ($p<0.05$) and the swimmers showed significantly higher values ($p<0.01$) in the mean arms BMD compared to control group.

Conclusions: Our data suggest that sport practice during puberty, especially in activities that support the body weight, may be an important factor in achieving a high peak bone mass and reducing osteoporosis risk in girls.

Key words: Body composition. Bone mass. DXA. Female players. Physical activity.

Kinanthropometry, growth and development / Cineantropometría, crecimiento y desarrollo

C01. Automated estimation of growth and nutrition of children from pre-school institutions in Lara State, Venezuela

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Introduction: In Venezuela, child anthropometric assessment, with emphasis on prevalence of growth and nutritional problems, allowing identification of those children without problems, with probability of suffering them and those who already are carriers of them has gained interest. The purpose of the present research is to find better ways of dealing with anthropometric data related to growth and nutrition. To make such process easier, an intelligent software was developed and tested to analyze data, issue reports and consolidate databases for further analysis.

Method: The anthropometric procedures proposed by the World Health Organization were used. Measurements were performed by well-trained anthropometrists. Prevalence of problems related to growth and nutrition were established according to the cut-points recommended by the WHO. The sample of 319 boys and 290 girls between 2 and 6 years was

divided into 10 groups according to sex and age range. The software APTOKIDS along with SPSS17 were used for data analysis.

Results: Growth indicators were analyzed taking as reference the categories of presumptive diagnosis recommended in Venezuela. Occurrences were only obtained in 14 categories. The number of subjects with very high, high and normal size for age, accounted for 303 male 94.98% and 277 female 95.52%, percentages highly significant $p<0.001$. On the other hand, 14 male 4.39% and 12 female 4.14% reflected chronic malnutrition. Similarly 2 male 0.63% and 1 female 0.34% suffered from severe chronic malnutrition. The number of subjects with normal weight was 241 male 75.55% and 234 female 80.69%, highly significant $p<0.001$. With risk of overweight 44 male 13.79% and 41 female 14.14%. In the same way 18 overweight male 5.64% and 8 girls 2.76% and finally, 11 obese male 3.45% and 5 female 1.72%.

Conclusions: The analysis of data based on software APTOKIDS for identifying those with growth and nutritional problems, generates information similar to that obtained by using software Anthro 3.2.2. According to the obtained data, it can be concluded that the sample of children presents a good state of growth and nutrition, with higher prevalence of overweight compared to underweight among both sex.

Key words: Growth indicators. Presumptive diagnosis. Obese. Overweight. Pre-school.

C02. Relationships between maturity and performance in young swimmers: effects of anthropometric variables

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Introduction: Adolescents mature at different rates such that individuals competing in the same competition may differ in physical and biological maturity despite being of similar chronological age. Morphology, physical fitness and biological maturity status are determinants of performance. Adjustment for body mass, height, maturation and performance is important for talent development and training schedules. It was therefore the goal of this cross-sectional study to examine the relationships of maturity and performance in young swimmers.

Methods: Twenty-five young swimmers (13 male and 12 female) were recruited. Maturity was assessed on years from/to age of predicted peak height velocity (APHV) and determined from anthropometric measurements (Mirwald, 2002). A dependent variable was considered the best time in 100, 200 and 400 m freestyle events in the previous three months and an independent variable was APHV with weight and height as a co-variables. Partial correlations were performed and multiple linear regression analyses were done as statistical analyses.

Results: Performance of swimmers showed a greater dependency on body mass than velocity-related variables. Age was correlated with performance ($r=0,33, P<0,04$), but when controlled by HPV this correlation was non-significant (partial $r=0,26, P=0,12$). Also, age explained only 11% of performance.

Conclusions: Improvement in performance with maturation is due only partly to increases in body mass and height. Such increases, along with appropriate adjustment for body mass, need to be taken into account when comparing performance of maturing athletes.

Key words: Maturity. Performance. Swimmers.

C03. Body composition variations during menstrual cycle among hockey players

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Introduction: Hormonal changes during the course of a woman's menstrual cycle may affect the physiological and psychological potential of her sports performance. Women of all ages have been participating in sports, at both recreational and competitive levels. It was hypothesized that like non-athletic women with regular menstrual cycle, hockey players also would have body compositional changes during different phases of their menstrual cycle.

Method: The data were collected from 12 players between the age of 17-23 years who represented State teams in senior National Championships and also reported a regular menstrual cycle. All the subjects were tested at four phases of their menstrual cycle i.e. menses phase,

follicular phase, ovulation and luteal phases. The variables selected for the study were: stretch stature, body mass, body mass index, resting metabolic rate, fat free mass, fat mass, total body water, extra cellular water, intracellular water, protein mass, mineral mass, muscle mass, total body potassium, total body calcium and glycogen. Bioscan 920-2, anthropometric kit and electronic weighing machines were used to collect the data.

Results: Analysis of variance showed no significant variation on any of the selected body composition variables at the four phases of the menstrual cycle in hockey players, even though a rise in the mean score of body weight and total body water at follicular and luteal phases was observed.

Conclusions: Given the observed absence of significant compositional variation throughout the menstrual cycle in these athletes, it was concluded that their regular exercise programs and participation in competitions might have had an effect in stabilizing the period with minimum discomfort and disturbances. Slight variations showed in mean scores of body mass and total body water at the follicular and luteal phases of the menstrual cycle may be due to hormonal imbalance at different phases of the cycle.

Key words: Menses phase. Follicular phase. Ovulation phase. Luteal phase.

C04. Reference values of total and regional skeletal muscle mass in children and adolescents

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Introduction: The acquisition of skeletal muscle mass (SMM) during childhood and adolescence must be a main concern to ensure healthy growth and improved motor development. Moreover, peak SMM increment must happen during youth, which would determine adulthood health and performance. Although some indicators of SMM have been using for assessment of nutrition status since the seventies like upper arm circumference or arm areas there is insufficient SMM data throughout childhood and adolescence to establish references norms. The first aim of this study, therefore, was to analyze trends of fat free mass (FFM) and regional and total SMM. The second objective was to compare trends between SMM and FFM by age and gender.

Method: Cross-sectional data of 1103 healthy volunteers were analyzed (13.3 ± 2.5 yrs, $BMI=20.1 \pm 3.4 \text{ kg/m}^2$; 323 girls and 780 boys). They were recruited from local primary schools, high-schools and local sport clubs. Anthropometry in accordance with ISAK guidelines was used to measure: triceps, thigh and calf skinfolds, and arm, thigh and calf circumferences were assessed by a caliper and tape respectively. Regional muscle areas were calculated from the corrected limb circumferences. FFM was estimated by anthropometric-derived equation. Validated age-specific models were applied to obtain SMM based on anthropometric variables (Poortmans' (<16 years) and Lee's models). Subjects were grouped annually from 8 until 18. A Kruskal-Wallis test was carried out to compare differences between age groups. A P value <0.05 for all tests was accepted.

Results: All total and regional variables showed a significantly different rank within groups of age. Total SMM showed a chi-squared value of 641.6 ($P>0.000$) while FFM showed 688.7 ($P>0.000$). Sex interaction was found.

Conclusions: Our findings show that there is a difference between boys and girls in the relationship between total SMM and age. Regional muscle areas from the upper limbs don't develop in linear fashion with age in contrast to development in the lower extremity areas. These results suggest that upper and lower muscle areas growth is different in terms of timing. Longitudinal studies are required to confirm these results.

Key words: Skeletal muscle mass. Children. Adolescents. Reference values.

C05. Evaluation of the age peak height velocity from anthropometric measurements in adolescent female dancers

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Introduction: Some researches have proposed gender-specific equations to predict age from peak height velocity (a measure of maturity offset) by using four anthropometric variables. The aim of the study was to compare the APHV in a longitudinal study in female dancers.

Method: One hundred seven female dancers between 10 and 14 years-old (mean age: 12.30 ± 1.06 years-old) were recruited for this study. All participants had between 3 and 6 years of experience in the Dance Conservatory. Body mass, stretch stature and sitting height were measured, in accordance with the ISAK guidelines standard techniques. Variables were measured twice, with 1.0 ± 0.5 years between the two measurements. The equation of Mirwald *et al.* were used to calculate the APHV of both measures (APHV_1 and APHV_2). APHV₁ plus the time between both measurements in years were calculated (APHV_{1Y}). A paired t-test was used to identify the differences between the APHV_{1Y} and the APHV_2 .

Results: The values of the APHV_1 , APHV_{1Y} and the APHV_2 were 0.20 ± 1.01 , 1.24 ± 1.06 and 1.06 ± 0.91 , respectively. The mean years between both measures were 1.04 ± 0.17 years. Significant differences between APHV_{1Y} and APHV_2 were found ($t=-7.25$; $p<0.001$). The value of APHV_{1Y} was significantly higher than the value of APHV_2 .

Conclusion: The equation to predict age from APHV (a measure of maturity offset) by using four anthropometric variables (chronological age, stature, sitting height, and body mass) did not show a good concordance in a longitudinal study in adolescent female dancers. Future studies on the current topic are therefore recommended.

Key words: Peak height velocity. Maturity. Dance. Dancers. Adolescence.

C06. Energy balance, growth and maturity

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Introduction: The type and level of nutrition as well as the amount of physical activity (PA) are important factors in growth and maturation. Nevertheless, the association between nutrition, physical activity, morphology and maturity has rarely been studied.

Objective: This research was conducted, therefore, in order to better understand the influence of energy balance on maturation.

Methods: A total of 930 Portuguese children and adolescents were studied, (decimal age (DA) 13.6 ± 1.9 years; stature 158.1 ± 11.1 cm; body mass 50.7 ± 13.1 kg). Bone age (BA) was obtained through the TW3 method, anthropometric data were collected according to ISAK protocols and fat mass (FM) percentage was calculated according to Slaughter *et al.* Energy intake (EI) was assessed from a food frequency questionnaire (SQportfoodFQ), physical activity level (PA) was obtained from a questionnaire (RAPIL2) using PA intensity levels proposed by Ainsword *et al.*, energy expenditure (EE) was calculated by multiplying the basal metabolic rate (BMR) by PAL and by the growth factor 1.01, and the energy balance (EB) was calculated using the EI and the EE. Subjects were divided into 3 maturation categories (delayed, normal and advanced) using the maturity rate tertiles (BA - DA). The influence of maturation on EE and EB was evaluated with ANOVA and ANCOVA using the DA and PAL as covariant ($p<0.05$).

Results: BA was not associated with PAL in both sexes. Late-maturing boys and early-maturing girls spent more energy in PA. However, EB was not significantly different among maturity groups. Boys' EE significant difference among maturity groups disappeared after adjusting for DA (ANCOVA). Contrarily, girls' differences between maturity groups become more pronounced after controlling for DA. These results show that, although FFM and FM (used to estimate RMR) were the variables that most differentiated EE, in both sexes, PA has to be considered in girls. Boys' EB significant differences between the 3 maturity subgroups only appeared after adjusting for PAL, underlining that the observed differences in EE between maturity groups were due to the RMR which seem to increase with BA.

Conclusions: 1) At these ages seems to depend essentially on growth and development; 2) contrary to what had previously been described, our late maturing boys' and advanced maturing girls' spent more energy on PA. Given this apparent contradiction, we recommend that further investigation of this topic be conducted similar data collected by accelerometry.

Key words: Maturity. Body fat mass. Energy intake. Physical activity level. Energy balance.

Kinanthropometry and ergonomics / Cineantropometría y ergonomía

E01. The role of morphology on shoulder mechanical load in high-risk tasks in the automobile industry

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Introduction: There is evidence of causal relationships between mechanical exposures and disorders of the upper limbs. Although epidemiological studies provide insights to understanding the causes of work-related disorders, they are sometimes criticized for their inability to measure accurately how workers respond to specific risk factors. This study, therefore, aimed to identify the influence of morphological characteristics on mechanical load in high risk tasks in automobile industry.

Method: This study involved 22 workers of both genders from an automobile industry plant, with mean age of (33.14±8.13yr). Anthropometric variables were taken according to ISAK. The quantification of the mechanical load was obtained in the field (*in situ*) by EMG from upper trapezius and anterior deltoid. The Amplitude Probability distribution

Function (APDF) method was used for data processing, allowing the measurement of muscular load level (expressed by 10th, 50th and 90th, corresponding to static, median and peak load, respectively). Data analysis was performed using multivariate linear regression; significant level was set for $p<0.05$.

Results: The results obtained showed that high static and peak loads (2-5%MVC and <50%MVC, respectively) of Anterior Deltoid were both associated with stature ($\beta=-0.77$; $\beta=1.87$), and interacted with elbow height ($\beta=-1.21$) for peak load. The explained variance of both mechanical loads was ~60%. This means that the workers with higher stature presented lower static load levels and simultaneously higher peak levels; superior elbow height was only associated with lower static load levels. Regarding the Upper Trapezius, a statistically-significant association was identified between stature and static load ($r^2\sim40\%$), where workers with higher height presented lower static load levels ($\beta=-0.61$).

Conclusions: The results strengthen the need to custom design assembly lines, considering anthropometric reference values, in order to avoid the mismatch of the physical work conditions and workers' anthropometric characteristics, which are responsible for the increase of mechanical load, especially in physically demanding and repetitive tasks.

Key words: Mechanical load. Anthropometry. Automobile industry.

Kinanthropometry and measurement techniques / Cineantropometría y técnicas de medición

T01. Agreement between two methods of assessing fat, muscle and bone mass during a lifestyle intervention

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Introduction: Accurate assessment methods that track changes in body composition during health behaviour interventions have the potential to reinforce positive health habits. Expensive and time-consuming criterion methods like magnetic resonance imaging (MRI) cannot be used routinely; dual-energy X-ray absorptiometry (DXA) is rapid, but is also not routinely available; whilst bioelectrical impedance analysis (BIA) is inexpensive, portable, and easily available. The purpose of this study therefore was to examine whether BIA is able to accurately track changes in fat, muscle and bone mass over a 12-week lifestyle intervention, using DXA as the criterion.

Method: A sample of 136 volunteers aged 18-66 years underwent an "Exercise for Life" intervention to enhance physical activity and muscle mass, and reduce fat mass. BIA (Tanita BC545) and DXA (Hologic Explorer) measures of whole body composition were taken at baseline and at the end of the intervention.

Results: After an average of 74 days of intervention, the criterion DXA showed significant changes in 2 of 3 outcome variables: reduction in fat mass of -802g ($p<.001$), increase in muscle mass of +478g ($p<.001$); minor increase of +7g of bone mass ($p=.052$). The respective changes in BIA measures were a significant reduction of -486g fat ($p<.001$), but non-significant increases of +84g muscle ($p=.425$), and +14g bone ($p=0.074$). Significant, but moderate, correlations were seen between absolute mass changes between DXA and BIA of 0.511 (fat), 0.362 (muscle), and 0.172 (bone).

Conclusions: Changes in whole body fat following a lifestyle intervention can be tracked moderately well by simple BIA scales, but relatively poorly for muscle mass. BIA significantly underestimated the magnitude of changes in both body fat and muscle mass compared to DXA.

Key words: Fat mass. Muscle mass. Agreement. Intervention.

T02. Existing anthropometric equations significantly underestimate body fat in young Chinese adults

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Introduction: The current worldwide obesity epidemic is placing considerable stress on public health resources. Being able to assess body fat in a simple, rapid and valid manner provides health professionals with a valuable surveillance tool. However, most anthropometric equations have been derived from Western samples that may not be appropriate in Asian countries. The purpose of this study was therefore to (a) determine the accuracy of existing predictive body fat equations on a young adult Asian sample, (b) derive improved predictive equations using dual energy x-ray absorptiometry (DXA) as the criterion measure, (c) cross-validate our predictive equations.

Method: A sample of 57 male and 51 female young Chinese adults living in Hong Kong had their Level-1 ISAK anthropometric profile measured by trained anthropometrists, and percentage body fat determined using a Hologic Explorer DXA. A cross-validation of the new predictive equations generated was undertaken on a further 12 males and 11 females.

Results: All of the existing 9 male and 14 female equations significantly under-predicted body fat%: ~3-11% absolute (~11-55% relative) error. Stepwise regression methods provided localized predictive equations for males ($R^2=0.85$, Standard Error of Estimate SEE=1.6%, requiring Medial Calf, Iliac Crest and Triceps skinfolds) and females ($R^2=0.78$, SEE=2.3%, requiring Triceps, Biceps and Supraspinale skinfolds). Cross-validations showed low bias, with small percent errors, coefficient of variations, and effect sizes.

Conclusions: All the traditionally used anthropometric equations for predicting body fat% in Western adults were shown to be unacceptably biased when applied to young Hong Kong Chinese (effect sizes typically >1.0). The stepwise regression provided new predictions that more accurately predicted the body fat% for young adult Chinese using only three skinfold variables. Additional research on older and more heterogeneous samples is needed to provide more generalizable predictive equations for the Chinese population.

Key words: Percent body fat. Anthropometry. Dual-energy X-Ray absorptiometry. Comparison.

T03. Reliability of the body fat measured by skinfolds, bioimpedance and dual-energy X-ray absorptiometry in adults

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Introduction: The consistency of the results of physical assessment is related to the reproducibility of measurements over multiple occasions. Simple, accessible and less-invasive tests have been applied in practice for assessing body composition. For a correct analysis of the results the reliability of each method needs to be identified. This was investigated in the present study in healthy young adults.

Method: Nineteen Caucasian subjects (age 22.6 ± 4 ; body mass index $23.3 \pm 2.4 \text{ kg/m}^2$), non-smoking and active participated in the study (Physical Activity Students). Anthropometric measurements included height (H), body mass (BM), skinfolds (SK), circumferences and diameters.

The measurements were performed according to the restricted profile proposed by International Society for the Advancement of Kinanthropometry (ISAK). The body composition parameters were analyzed from bioelectrical impedance analysis (BIA) by OMRON BF 306W analyzer (Omron Healthcare Co., Ltd, Ukyo-ku, Kyoto, Japan), and from dual-energy X-ray absorptiometry (DXA) by GE Lunar Prodigy apparatus (GE Healthcare, Madison, Wisconsin, USA). Two non-consecutive randomized measures were taken for each method. Reliability was assessed from Pearson coefficient (r) and intra-class correlation coefficient (ICC), with confidence intervals (CI) set at 95%.

Results: Pearson coefficient indicated high correlation between first and second measurements from all methods for fat percentage (SK: $r = 0.996$; BIA: $r = 0.995$ and DXA: $r = 0.995$; $p < 0.01$) and FM (SK: $r = 0.995$; BIA: $r = 0.996$ and DXA: $r = 0.997$; $p < 0.01$). Reproducibility was ensured by ICC values (>0.90)² in the two measurements for the three methods. The ICC values and confidence intervals were similar among SK, BIA and DXA in fat percentage (ICC = 0.998, CI: 0.994–0.999). For FM, the ICC was of 0.993 (CI: 0.993–0.999) to the SK, and 0.998 (CI: 0.995–0.999) to the BIA and DXA.

Conclusions: SK, BIA and DXA of body fat assessment have no difference in the reliability of measurements for healthy young adults.

Key words: Physical assessment. Body composition. Reproducibility.

T04. Estimation of internal abdominal fat from anthropometry measurements in children

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Introduction: Internal abdominal fat (IAF) measured by dual energy X-ray absorptiometry (DXA) has been proposed as surrogate of visceral adipose tissue, which is a cornerstone measurement for screening of metabolic syndrome. However, measuring IAF is time-consuming, expensive and impractical for field studies with children. Since 1990, anthropometric models have been developed to estimate IAF in adults, but no models exist for children. Because of the high prevalence of childhood obesity, the assessment of IAF is a major factor in the evaluation metabolic risk. Therefore, the aim of this study was to develop an anthropometry-based model to estimate IAF in children.

Methods: Forty-one (n=24 boys, n=17 girls) healthy Caucasian children (age 11.4 ± 0.6 years, BMI $20.1 \pm 3.9 \text{ Kg/m}^2$) were volunteers. Anthropometric measurements (waist and hip circumferences, abdominal sagittal diameter and skinfolds) were taken in accordance with ISAK guidelines. Total body and IAF (dependent variable) body composition were measured by DXA. Stepwise regression analysis was carried out to obtain the fittest variables and beta coefficients in order to develop the equation that predicts IAF with a high squared R and a low standard error of estimation.

Results: The best-correlated variables with IAF were BMI, waist circumference, calf and subscapular skinfolds ($r=0.900$; $r=0.946$; $r=0.901$; $r=0.900$; respectively, all $P < 0.001$). The best model for estimating the

IAF included waist circumference and subscapular skinfold ($R^2=0.93$ SEE=115.43; $P<0.001$). The estimated model was IAF (g) = -1332.89 + (18.515*WC) + (773.39*SubSKF).

Conclusion: We developed a model, which accurately predict IAF in children, affording a practical tool to quantify this variable without expensive techniques such as DXA. However, external cross-validation must be performed in order to confirm the model validity. Additionally, construct validity should be carried out to determine the applicability of this measurement in children.

Key words: Childhood. DXA. Anthropometry. IAF. Abdominal fat.

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T05. Somatotyping sports in alicante according to gender

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Introduction: The objective of this study i was to determine the average of somatotype values in sports in the province of Alicante and to establish any gender differences.

Method: Anthropometric variables (ISAK procedures, Norton, 1996) were measured on 3988 members of the Alicante sporting public with their anonymous participation and not using their names individually; only in an aggregate way (no ethical concerns are involved) over a period of six years and somatotypes (using the anthropometric technique of Heath & Carter, 1975) were calculated for all individuals. Gender differences in somatotype and sport were identified using SPSS statistic package with descriptive statistics.

Results: The representative sample had an average age of 21.52 ± 7.14 . The medium value of the endomorphic component was 3.23 ± 5.12 , the mesomorphic was 4.83 ± 1.67 and the ectomorphic: 2.05 ± 0.98 . The sample contained 1255 women and 2733 men. The average value of the en-domorphic component was 2.87 ± 6.04 for men and 4.03 ± 1.51 for women; the mesomorphic component was 5.12 ± 1.74 for men and 4.17 ± 1.28 for women and the ectomorphic was 2.06 ± 1.02 for men and 2.03 ± 0.9 for women. These values highlight that the somatotype for men is endo-mesomorphic and for women is mesomorph endomorph. **Conclusions:** Due that the study reveals that men are endo-mesomorphic and women mesomorph endomorph we can conclude that high level sport men highlights the mesomorphic component comparing with women.

Key words: Somatotype. Sports. Gender.

T06. Corporal fat measurement by ultrasound

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Introduction: Both in the field of medicine as in sports, there are different methods of assessing body composition. Some are complex, high cost and require fixed equipment. Others are more simple, inexpensive, safe and practical, facilitating their mobility and use anywhere. Although, all require time to develop measurement. However, the measurement of subcutaneous fat using ultrasound can be a quick alternative to obtain the percentage of body fat (% BF), fat mass in kilograms (kg MG).

Objective: This study aim was to: Get a set of equations that allow the identification of the body composition of healthy young adults in a quick, simple and safe way using the ultrasound technique.

Material and Methods: Controlled, cross-sectional analytical study. It was developed with 221 healthy adult subjects (132 men and 89 women) with an age range of 15-80 years (mean age = 33.44 ± 14.48 years). To obtain the formulas for assessing the MG (%) and kg) with a scanner, a stepwise regression (with a probability of F to enter, ≤ 0.050 , and probability of F to exit, ≥ 0.100). The accuracy of the prediction equations was assessed with a validation test (by studying the absolute deviation between anthropometric and ultrasonographic formulas).

Results: There was a statistically significant (at the 0.01 level bilateral) correlation between MG (%) obtained by anthropometric measurements and equations of simple and multiple regression equation developed in this study (ECO).

Conclusion: The new regression equations will allow the use of ultrasound as a method of assessing body composition in all individuals, regardless of their body mass index or level of physical activity.

Key words: Fat mass percentage. Fat mass kilograms. Skinfolds. Ultrasound.

T07. An anthropometric model to estimate appendicular lean muscle in children

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Introduction: Skeletal muscle mass (SMM) is a cornerstone for children development since it is related to basic motor skills acquisition, motor performance and health. However, there is a lack of anthropometric mathematical models aimed to estimate appendicular skeletal muscle mass on children in order to allow assesses SMM in a field context. Appendicular lean soft tissue (ALST) has been recently suggested as a surrogate of SMM in adolescents, and it can be measured easily by dual X-ray absorptiometry (DXA). The aim of this study was to develop an anthropometric equation to calculate ALST in healthy children.

Methods: Forty-one (n=24 boys, n=17 girls) healthy children (age 11.4 ± 0.6 years, BMI 20.1 ± 3.9 Kg/m²) were volunteers. Height, weight, limb skinfolds and perimeters were assessed by anthropometric measurements in accordance with ISAK guidelines; and corrected perimeters were calculated. ALST was measured by DXA (Hologic, Explorer) following the procedures indicated by the manufacturer. A stepwise

regression was carried out to obtain the anthropometric variables that best estimated ALST.

Results: Weight, calf skinfold, waist circumference and calf circumference were the variables included in the final best model for estimating the ALST ($R^2 = 0.917$ SEE = 1.016 kg, $P < 0.001$).

Conclusion: The main finding of this study was that for first time a model to estimate ALST has been derived from a sample of children younger than twelve years old. In accordance with other studies, our analysis showed that anthropometry is a useful method to estimate ALST in children too. The model developed need to be validated in a larger, independent sample, which would allow the establishment of more accurate associations between performance, development, physical training and ALST at these ages.

Key words: Childhood. DXA. Anthropometry. Skinfolds.

T08. Proposed design of a anthropometric box assembly

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Introduction: Dietetics & Nutrition (DN) has within its portfolio, conducting anthropometric measurements. Office furniture and equipment, and specialized equipment are important tools for the analysis of the specific needs of individuals. The anthropometric box is a useful and inexpensive such tool.

Method: The anthropometric equipment must be easy to use, perform precise measurements and have homologated norms.

The material used for the design of the three boxes is wood. The box measurements for adults are 40 cm high, 50 cm wide and 30 cm deep. The thickness of the wood should be 1.6 cm. You must have a cut out at the bottom of one side so that the subject can put their feet under it to facilitate anthropometric positioning for taking measurements. The bottom needs to be open. It is essential that the box can take a minimum weight of 180 kg.

The anthropometric measurements for the children's box should be 60 cm high, 54 cm wide and 30 cm deep. The thickness of the wood should be 1.6 cm. There should be no bottom on the child's box so that it can be inserted into the adult box. There should be no cut outs at the bottom of the sides.

The platform must be complete on all four sides. The measurements are 20 cm high, 40 cm deep and 45.5 cm wide.

Our proposal is that the anthropometric children's box, adults' box and the platform that is used with a photoscopic screen can be assembled as one unit.

Results: The three boxes are inexpensive and simple in construction and can be assembled easily.

Conclusions: The three pieces that make up the assembly of the anthropometric boxes are offered as useful tools for measuring children and adults, and for use in photoscropy.

Key words: Kinanthropometry. Dietitian. Nutritionist. Anthropometric box.

T09. Validation of a screen for anthropometric photoscopic valuation

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Introduction: The anthropometric screen is an instrument used for assessing body shape and composition. There are some methodologies already available but few professionals know about them. These methodologies are difficult to apply in many Nutrition & Dietetics consultations.

Method: I designed new materials and simplified the photoscopic methodology for use in a Nutrition & Dietetics consultation. I chose 10 subjects with different characteristics (children and adults) to validate the methodology. I took 30 photographs in 3 planes (frontal, sagittal and posterior). I used a professional laser and a Smartphone as a camera. I designed a screen of 2,20 m by 2,20 m, divided into 4 parts. The screen was adhered to the wall with Velcro. The minimum distance was 2 metres and maximum distance was 2.6 metres. The validation was performed by three dietitian/nutritionists with an International Society for Advancement of Kinanthropometry (ISAK) Level 1 or Level 2 certification. We did the photographic processing with the Kappa correlation.

Results: The dietitian/nutritionists agreed that the Kappa correlation was very good (0.8) for most photographs. The photoscopic screen methodology was rated by the dietitian/nutritionists with a good score (0.7).

Conclusions: This methodology allows the assessment and monitoring of individual subjects from images in the frontal, sagittal and posterior planes. It is simple, quick, transportable and inexpensive to install.

Key words: Kinanthropometry. Dietitian. Nutritionist. Screen. Photocopy.

T10. Comparison of methods for determining total body fat percentage in triathletes: dual X-ray absorptiometry, bioelectrical impedance and anthropometric equations

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Introduction: The aim of this study was to compare the total body fat percentage of triathletes obtained by the methods dual X-ray absorptiometry (DXA), bioelectrical impedance analysis (BIA) and anthropometric equations, with in order to analyze whether the equations used with the last two techniques produce reliable results in the study population when compared with a method to be considered "gold standard" as DXA.

Method: This study was observational, cross-sectional and quantitative with a total of 30 mexican triathletes adult (18 to 40 years) who agreed to participate. Measurements were performed in fasting, in the morning and avoiding issues that may affect the total body water. For the analysis by DXA was used a HOLOGIC equipment full body (Explorer

model) with the procedure dictated by the International Society for Clinical Densitometry. In the BIA was used a QUANTUM II (RJL), using the measurement procedure specified by the manufacturer and the Macias (2007) equation validated for mexican. To obtain anthropometric data was used a HARPENDER caliper and CESCORF equipment with the methodology proposed by the International Society for the Advancement of Kinanthropometry (ISAK). The formulas used Durnin & Womersley (1974) with Siri (1956), Faulkner (1968) and Kerr (1988). For the analysis of results was used Student t test and Pearson correlation ($p<0.5$).

Results: We evaluated 10 women and 20 men mexican triathletes adult. The results showed that the better correlation was between DXA and Kerr equation ($r=0.98$, $p<0.01$). Durnin-Siri and BIA equation were the most underestimated results when compared to the reference method. Fat mass % by DXA was not statistically different when measured with results of Kerr equation.

Conclusions: The best correlation method and that no has significant differences with DXA in the study population was the anthropometric using Kerr equation, although the BIA equation was validated in the mexican population. Therefore, this formula it is recommended for the assessment of body composition in mexican people who practice triathlon. It will be important to assess whether this equation shows similar results in people who practice other sports and with different age ranges, for example adolescents.

Key words: Fat mass percentage. DXA. BIA. anthropometry.

T11. Comparison between 2-compartment and 3-compartment bioimpedance analysis estimations of body composition in a population over 55

Marín-Puyalto J^{1,2}, Aparicio-Ugarriza R^{1,2}, Lizardo-Socorro R^{1,2}, Maroto-Sánchez B^{1,2}, Palacios G^{1,2,3}, Tur JA^{3,4}, González-Gross M^{1,2,3}.

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Introduction: Body composition assessment in the elderly is important due to age-related changes. Bioimpedance analysis (BIA) instruments perform assessments of the body composition based on a 2-compartment model (fat mass and fat-free mass) of the human body. They also provide an estimation of the muscular mass, thus including a third compartment, which could be more suitable for comparisons with other methods, like the dual-energy X-ray absorptiometry (DXA), which is considered the gold standard on body composition measurement. The aim of this study was to evaluate the accuracy of the two estimation procedures that the BIA offers, when compared with the DXA results.

Method: BIA (TANITA Corp, BC-418MA) and DXA (GE/LunarPRODIGY. GEHealthCare, Wisconsin, USA) were applied to a sub-sample of the FIS PI11/01791 study (47 men and 58 women, 55-82 years old). The variables analysed were body mass, fat mass percentage, fat-free mass percentage and muscular mass percentage.

Results: BIA fat-free mass values shows a deviation from the muscular mass percentage calculated with the DXA higher than 6 percentage points in 52.4% of the sample. If muscular mass estimation is used instead, this value decreases to 15.4%. Both estimation methods explain at least 72% of the variance in muscular mass percentage for men and 82% for women. However, paired t-tests showed significant differences for both genders between the muscular mass percentage obtained by means of DXA and fat-free mass percentage assessed with the BIA, while there are no significant differences for men when using the estimation of muscular mass provided by BIA.

Conclusions: The estimation of the muscular mass provided by BIA is adequate when evaluating men over 55. The inclusion of the 3-compartment model also reduces considerably the cases of extreme deviations on the assessment of muscular mass between both methods.

Key words: Bioimpedance. Muscular mass. Body composition.

T12. Causes of deviations on bioelectric impedance assessment versus dual X-ray absorptiometry in women over 55

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Supported by Instituto Salud Carlos III (PI11/01791). ImFINE and NUCOX are members of the EXERNET research network.

Introduction: A previous study showed that body composition assessment in women over 55 by bioelectric impedance analysis (BIA) had some significant deviations according to Dual X-ray absorptiometry (DXA) which is considered the gold standard on body composition measure. The aim of this study was to identify any factors that might cause an erroneous estimation in body fat and muscular mass assessment in women over 55 when using BIA.

Method: BIA analysis (TANITA Corp, BC-418MA) and DXA (GE/LunarPRODIGY. GEHealthCare, Wisconsin, USA) were applied to a sub-sample of the FIS PI11/01791 study (58 women, 55-82 years old). The variables analysed were body mass, fat mass percentage and muscular mass percentage. The EXERNET questionnaire was used to determine the daily time spent walking and performing sedentary activities. As covariates taken into account were age, height, body mass index, waist and hip perimeter and arm muscle strength measured with the arm curl test.

Results: There was a significant and positive correlation ($p<0.01$) between both methods for all study variables, although weight and fat mass are slightly underestimated and fat-free mass overestimated with BIA. However, differences greater than 6 percentage points were observed on 2 women (3.4% of the sample) in body mass assessment and on 11 participants (19%) in muscular mass percentage. When compared with the rest of the sample, these participants showed significant differences ($p<0.05$) in daily time spent walking and the best result on arm curl tests (which were higher than those of the rest of the sample). There were also variations in body mass, hip perimeter, time spent sitting per day and practising intense physical activity per week (> 5 MET), although these differences were not significant.

Conclusions: BIA is an adequate method for measuring body composition in the frame of our study. In order to guarantee the reliability

of the data, hip perimeter and arm muscle strength were identified as potential confounding factors.

Key words: Bioimpedance. DXA. Body mass. Fat mass. Muscular mass.

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