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A comparative study of development of physical fitness of volleyball players of rural and urban area from Anantnag district

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Abstract
In the present study, technique improved by 21%, while accuracy improved by 117%. The technical skill improvement following training in the present study was similar to that achieved following training in other skillbased sports (1, 22). However, the large improvement inaccuracy most likely reflected the poor accuracy in the volleyball players prior to training. While measures of skill improved following short-term training, it is unclear if these skill improvements would have been maintained following a longer period of training or if similar improvements would have been made by highly skilled volleyball players. The present results are therefore limited to talent identified junior volleyball players and may not be applicable to highly skilled, elite volleyball players. In addition, all skill tests were conducted in a controlled environment. Therefore, it is unclear if the improvements in skill would have transferred to a competitive environment, where skill is dependent on the player's cognitive knowledge of the game-specific situation, their ability to process visual and other game-specific information, and their ability to execute the skill under the pressure of competition. While skill in the isolated tasks of spiking, setting, serving, and passing improved following training, a player's ability to execute skills successfully after making a decision (e.g., during competition) is of greater importance. Future studies investigating the effect of skill-based training on skill acquisition could use a game-specific performance test to assess the decision making ability of players under conditions simulating the pressure and fatigue of competitive matches.

Keywords: volleyball players physical Fitness etc.

Introduction
Fitness is the ability to live a full and balanced life. The totally fit person has a healthy and happy outlook towards life. Fitness is the young man's absolute necessity. It breeds self-reliance and keeps man mentally alert. Physical fitness is essential for human beings to adjust well with his environment as his mind and body are in complete harmony.
It is generally agreed that physical fitness is an important part of the normal growth and development of a child, a generic definition regarding the precise nature of physical fitness has not been universally accepted. Through research and scholarly inquiry, it is clear that the multi-dimensional characteristics of physical fitness can be divided into two areas: health related physical fitness and skill related physical fitness.
General fitness implies the ability of a person to live most effectively with his and her potentials, which depend upon the physical, mental, emotional, social and spiritual components of fitness which are highly interrelated. The primary components of physical fitness identified by the president's council on physical fitness and sports were muscular strength, muscular endurance and cardio respiratory endurance. However, later on the president council also included some other motor performance components namely agility, speed, flexibility and balance in physical fitness. But keeping in view the general opinion of the majority of the researchers, the author has not included the components such as speed, agility, power and balance (which are more important for success in specified sports) as essential components of basic physical fitness. However, the author defines physical fitness by group of five components, namely muscular strength, muscular endurance and cardio respiratory endurance, flexibility and body composition.

It is important to mention here that some experts (e.g. Clarke and Clarke, 1987; AAHPERD, 1980, 1984) call such fitness tests which include the measurement of percentage body fat, as health related physical fitness tests.

The game of Volleyball has been invented in the year 1895 by William G. Morgan Hal yoke, Massachusetts as a recreational activity for the businessmen. The modern volleyball is highly specialized in almost all the major skills of Volleyball. It is a sport for young and old for men and women. The character of Volleyball game is entirely different than that of other sports discipline. Rotation system is a unique feature that differentiates Volleyball from other sports. During game the object of every player team is to sent the ball over the net in order to ground it on the opponents court and to prevent the same effort by the opponent.

Physical Fitness

Exercise scientists have identified nine elements that comprise the definition of fitness, the following list each of the nine elements and an example of how they are used:

- **Endurance** - A muscles ability to perform a maximum contracture time after time. (Continuous explosive rebounding through an entire Basketball game.)
- **Strength** – The extent to which muscles can exert force by contracting against resistance. (holding or restraining an object or person.)
- **Power** – The ability to exert maximum muscular contraction instantly in an explosive burst of movements. (Jumping, sprint/ starting.)
- **Agility** - The ability to perform a series of explosive power movements in rapid succession in opposing directions.
- **Balance** – The ability to control the body position, either stationery or while moving.
- **Flexibility** – The ability to achieve an extended range of motion without being impeded by excess tissue, i.e. fat or muscle. (Executing a leg split.)
- **Local muscle endurance** – A single muscles ability to perform sustain work.
- **Cardiovascular Endurance** – The heart ability to deliver blood to working muscle and their ability to use it.
- **Coordination**– The ability to integrate the above listed components, so that effective.

Physical fitness for youth is usually defined as an outcome measured with a fitness test, most commonly the fitness gram or the president’s challenge. Therefore, a physically fit youth is defined as one who meets criteria measured by one these two tests.

Objectives of study

- To study the development of physical fitness of volleyball players of rural area from Anantnag district.
- To study the development of physical fitness of volleyball players of urban area from Anantnag district.
- To study and then compare the development of physical fitness of volley ball players from rural and urban area from Anantnag district.

Methodology

Experimental approach to the problem

The present study tracked the skill and physiological and anthropometric changes of talent-identified volleyball players over an 8-week skill-based training period. Skills sessions were designed to develop passing, setting, serving, spiking, and blocking technique and accuracy as well as game tactics and positioning skills. Coaches used a combination of technical and instructional coaching, coupled with skill-based games to facilitate learning. Subjects performed measurements of skill (passing, setting, serving, and spiking technique and accuracy), standard anthropometry (height, standing-reach height, body mass, and sum of 7 skinfolds), lower-body muscular power (vertical jump, spike jump), upper-body muscular power (overhead medicine-ball throw), speed (5- and 10-m sprint), agility (T-test), and maximal aerobic power (multistage fitness test) before and after an 8-week skill-based training program, which included 3 skill-based court sessions per week. It was hypothesized that volleyball training consisting entirely of skill-based sessions would improve spiking, passing, serving, and setting technique and accuracy, without significantly changing the physiological and anthropometric characteristics of players.

Subjects

Twenty-six junior volleyball players (mean 6 SE age, 15.5 6 0.2 years) participated in this study. All players were scholarship holders within the Queensland Academy of Sport, Talent Search volleyball program. The Queensland Academy of Sport, Talent Search volleyball program identifies young athletes deemed to have the necessary physiological and anthropometric characteristics (e.g., height, standing-reach height, muscular power, speed, agility, and maximal aerobic power) for volleyball success (15) and places those athletes in a high-performance coaching environment, where they are provided with specialized volleyball coaching. All subjects had been participating in volleyball for 3 months prior to the commencement of the study. While subjects had limited volleyball experience, they had participated in a wide range of sports (e.g., swimming, track and field, martial arts, mountain biking, tennis, netball, basketball, hockey, touch football, and rugby union) prior to being selected into the Talent Search volleyball program. Eighteen subjects (69.2%) had participated in 1 sport, while 4 subjects (15.4%) had participated in 2 or more sports. The mean 6 SE sporting experience of all subjects was 5 6 1 year (range: 0–11 year). All subjects received a clear explanation of the study, including the risks and benefits of participation, and written parental or guardian consent was obtained before players were permitted to participate.

The study adopted a cross-sectional research design. Thirty-five university athletes with mean age of 21.74 ± 2.24 years, height of 1.78 ± 0.09 meters, weight of 74.44 ± 10.53 kg, 24 males (basketball = 14, volleyball = 10) and 11 females (basketball = 10, volleyball = 1) voluntarily participated in the study.

A total of 407 Greek male volleyball players participating in all Volleyball Championships in Greece according to the Greek Volleyball Federation (Senior’s championship for athletes more than 18 years old, Junior’s championship for athletes from 15 to 18 years old and Youth’s championship for athletes from 12 to 14 years old) were observed on a weekly basis for the 2005–2006 period. This was almost 30% of the volleyball players participating in the National Championship in the A1 and A2 categories. The age groups and anthropometric characteristics of the in an orthopedic surgeon, a physiotherapist and a trainer made up the questions that were included in the interview.

In this study voluntarily participated 26male elite athletes from 3 different team sports: basketball (n=11), handball (n=7), and volleyball (n=8). Body weight (BOD POD, Life Measurement, Inc., Con- cord, CA, USA) and height (Seca – model 222, Hamburg, Germany) were assessed. These three types of ball games were assessed together once the determinant strength performance characteristics for competition are similar.

Analysis and Interpretation of Data

Result

The average heart rate over the 8-week training period was 138 6 2 beats·min21, with the majority of training time (57.4 6 3.6%) spent in very low-intensity (40–70% maximum heart rate) activities (Figure 1). The percentage of time spent in low-intensity (70–75% maximum heart rate), moderate-intensity (75–85% maximum heart rate), and high-intensity (.85% maximum heart rate) activities was 13.6 6 1.0%, 20.6 6 2.2%, and 7.8 6 1.6%, respectively. The physical, physiological and motor performance traits of the participants are shown in table 6.

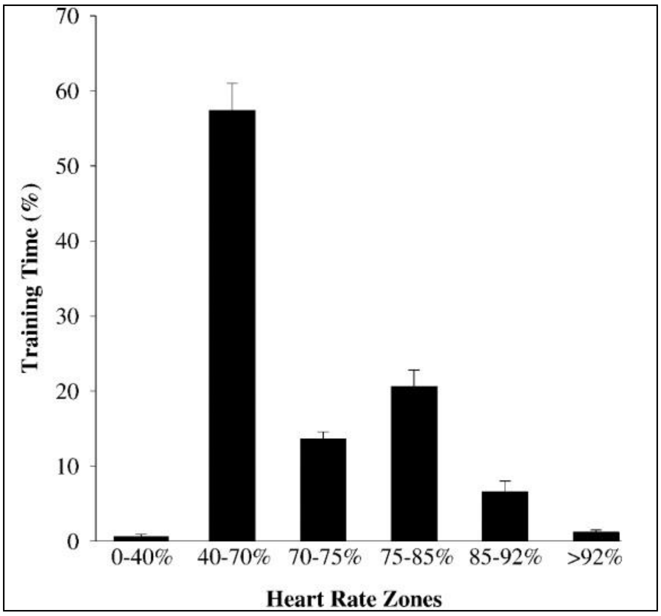

Fig 1: Percentage of total training time spent in different heart-rate training zones during skill-based training in talent-identified volleyball players.

Skill

Accuracy. The changes in spiking, serving, setting, and passing accuracy are shown in Table 2. Training induced significant (p, 0.05) improvements in spiking (176%), setting (1335%), and passing (140%) accuracy. While there was a trend for serving accuracy to improve with training (115%), there were no significant differences (p. 0.05) between pretraining and posttraining. Technique. The changes in spiking, serving, setting, and passing technique are shown in Table 3. Training induced significant (p, 0.05) improvements in spiking (124%) and passing (129%) technique. While there was a trend for serving (117%) and setting (114%) technique to improve with training, there were no significant differences (p . 0.05) between pretraining and posttraining

Table 1: Criteria used by coaches to assess technical skill of volleyball players

Skill	Criteria
Spiking	Identify height, speed, and location of set
	Angle approach to maximize hitting zone
	Build speed and increase momentum of approach
	Contact ball high in front of hitting shoulder
	Fast arm swing, which follows through past the contact point
Setting	Feet, hips, and shoulders facing target
	Hips forward and an upright body position
	Ball set from forehead and above
	Follow through to target (arms and legs)
Serving	A disciplined and consistent routine prior to each serve
	Controlled toss in front of the hitting shoulder
	Solid contact in the center of the ball (without spinning)
	Low trajectory
Passing	Feet slightly wider than shoulder width
	Knees and back slightly bent
	Arms away from the body
	Elbows locked and shoulders rotated forward
	Arms tilted toward the target

Table 2: Spiking, setting, serving, and passing accuracy of talent-identified volleyball players before and after 8 weeks of training

	Pretraining	Posttraining
Spiking accuracy	5.9 ± 0.9	10.4 ± 0.9†
Serving accuracy	3.3 ± 0.4	3.8 ± 0.3
Setting accuracy	2.0 ± 0.5	8.7 ± 0.7†
Passing accuracy	9.4 ± 0.8	13.2 ± 0.6†

* Data are reported as means ± *SE*.
† Significantly different ($p < 0.05$) for pretraining.

Table 3: Spiking, setting, serving, and passing technique of talent-identified volleyball players before and after 8 weeks of training

	Pretraining	Posttraining
Spiking technique	2.9 ± 0.3	3.6 ± 0.2†
Serving technique	3.0 ± 0.2	3.5 ± 0.2
Setting technique	2.9 ± 0.2	3.3 ± 0.2
Passing technique	2.8 ± 0.2	3.6 ± 0.2†

* Data are reported as means ± *SE*.
† Significantly different ($p < 0.05$) from pretraining.

Physiological and Anthropometric Characteristics

Anthropometric Characteristics: The changes in height, standing-reach height, body mass, and skinfold thickness are shown in Table 4. There were no significant differences (p. 0.05) between pretraining and posttraining for height, standing-reach height, body mass, and sum of 7 skinfolds.

Table 4: Body mass, height, standing-reach height, and sum of 7 skinfolds of talent identified volleyball players before and after 8 weeks of training

	Pretraining	Posttraining
Body mass (kg)	72.3 ± 2.5	72.3 ± 2.3
Height (cm)	182.2 ± 1.5	182.6 ± 1.2
Standing-reach height (cm)	241.7 ± 2.0	240.7 ± 2.1
Sum of skinfolds (mm)	88.7 ± 5.7	86.8 ± 5.7

* Data are reported as means ± *SE*.

Physiological Characteristics: Compared with pretraining, there was a significant (p, 0.05) improvement in 5- and 10-m speed and agility. There were no significant differences

(p. 0.05) between pretraining and post-training for lower-body muscular power (vertical-jump height and spike-jump height), upper-body muscular power (overhead medicine-ball throw), and V˙O2max (Table 5).

Table 5: Upper- and lower-body muscular power, speed, agility, and maximal aerobic power of talent-identified volleyball players before and after 8 weeks of training

	Pretraining	Posttraining
Vertical jump (cm)	45.7 ± 2.3	45.7 ± 2.4
Spike jump (cm)	50.0 ± 2.5	51.2 ± 2.9
Overhead medicine-ball throw (m)	6.7 ± 0.3	6.8 ± 0.3
5-m sprint (s)	1.12 ± 0.02	1.06 ± 0.01†
10-m sprint (s)	1.95 ± 0.03	1.87 ± 0.02†
Agility (s)	11.12 ± 0.16	10.54 ± 0.18†
$V̇O_2$max (ml·kg^{-1}·min^{-1})	40.8 ± 1.1	43.2 ± 1.1

* Data are reported as means ± *SE*.
† Significantly different ($p < 0.05$) from pretraining.

Table 6: Summary of participant's Physical, Physiological and motor performance Traits

Traits		Mean±SD
Physical	Age (yr)	21.74±2.24
	Height (m)	1.78±.09
	Weight (kg)	74.44±10.53
	BMI (kg/m^2)	23.36±2.92
	WC (cm)	72.14±14.02
	HC (cm)	92.61±18.06
	WHR (%)	0.77±0.05
Physiological	RHR (bpm)	59.85±9.38
	SBP (mmHg)	123.00±12.63
	DBP (mmHg)	72.62±9.28
Motor Performance	SME(rep.)	26.48±11.87
	AME(rep.)	34.90±7.81
	LMS(kg)	53.95±26.90
	RMS(kg)	47.67±21.01
	Speed(sec.)	0.51±0.16
	Reaction time (cm)	8.96±3.26
	Power (Watt)	518.11±84.10
	Agility (sec.)	11.55±7.02

Keys: *BMI- Body Mass Index, WC- Waist Circumference, HC- Hip Circumference, WHR- Waist-hip Ratio, RHR- Resting Heart Rate, SBP - Systolic Blood Pressure, DBP- Diastolic Blood Pressure, SME-Shoulder Muscular Endurance, AME-Abdominal Muscular Endurance, LMS- Left-hand Muscular Strength, RMS- Right-hand Muscular Strength*

Conclusion

The present study investigated the effect of a skill-based training program on measurements of skill and physical fitness in talent-identified volleyball players. Training induced significant improvements in spiking, setting, and passing accuracy and spiking and passing technique. Significant improvements in speed and agility were also observed. However, there were no significant differences between pretraining and posttraining for body mass, skinfold thickness, lower-body muscular power, upper-body muscular power, and V ˙O2max.

These findings demonstrate that skill-based volleyball training improves spiking, setting, and passing accuracy and spiking and passing technique, but has little effect on the physiological and anthropometric characteristics of players.

TEE and EI were measured in 10 female Canadian Inter-university Sport varsity volleyball players over a 1-week period during in-season play. On average, participants reported consuming 3,435 kcal/day. Self-reported EI is higher than what others have reported among volleyball players (Ahmadi *et al.*, 2010; Anderson, 2010; Beals, 2002; Hassapidou & Manstrantoni, 2001; Papadopoulou *et al.*, 2002). The observed values in this investigation may be more true to actual intakes than in other investigations (that often allude to underreporting), as we removed 16 daily food records based on implausible data before any data analyses. Furthermore, all participants were very familiar with food diaries due to their 50 experience and comfort with their sport nutrition coach (i.e., having done multiple food diaries in the preceding 2 years). While food journaling may lose resolution after 3 or 4 days, many others have used this 7-day recording methodology (e.g., Kopp-Woodroffe *et al.*, 1999; Laughlin & Yen, 1996; Thong *et al.*, 2000; Wilmore *et al.*, 1992). Participants were motivated to complete the study for the benefit of their own performance as athletes, and informal check-ins with all participants occurred two or three times during the data-collection period to ensure accurate and continued recording. There were large ranges for daily EI within each participant over the 7 days. While one might expect daily variability of EI, participants were able to stabilize their EI to TEE over the course of the week. The large variability may have been due to busy academic and training schedules (e.g., not enough time to eat), living arrangements (e.g., on own vs. living at home), or differing appetites (not measured in the current study).

On average, participants expended 3,479 kcal/day and spent 5 hr and 16 min/day above 3 METs. Based on the training schedule, participants were scheduled in volleyball-related physical activities 2 hr on practice days and 4.5 hr for game days, suggesting that they were also active outside of regularly scheduled volleyball activity. TEE is much higher than in the average population (Johannsen *et al.*, 2010), due to the strenuous nature of their sport, and is much higher than what has previously been estimated for elite volleyball players. For example, Hassapidou and Manstrantoni (2001) estimated TEE at 2,211 kcal/day and 2,396 kcal/day during training and competition, respectively, using 3-day physical activity diaries. We believe that this was the first time that TEE has been objectively and continuously monitored among elite female volleyball players. Although the preferred method to measure TEE is through either indirect calorimetry or doubly labeled water, the practical nature of those methodologies limits measurement in the field (Koehler *et al.*, 2011). The armband has been shown to be valid for activities of daily living (Johannsen *et al.*, 2010) and low- to moderate-intensity exercise (Fruin & Rankin, 2004; King *et al.*, 2004). However, it reportedly underestimates TEE at higher intensities (Drenowatz & Eisenmann, 2011; Koehler *et al.*, 2011), and it has been suggested (Drenowatz & Eisenmann, 2011) that the threshold for accurate measurements seems to be around 10 METs.

The highest observed MET value of any participant in the current study was 6.4 (during a game warm-up session), suggesting that armband was capable of measuring the intensity of the sport of volleyball, likely due to the anaerobic nature of the sport (e.g., repeated high-intensity bursts). Regardless, the use of an objective validated measurement tool is superior to self-report physical activity diaries with estimated energy costs. On average, participants were mainly in a state of energy balance, as evidenced by no statistical differences in body weight, fat mass, or percent body fat over the 7-day testing period. Although some small differences were observed within each participant, the differences were well within the normal error associated with the Bod Pod. There are limited data for test–retest reliability using the Bod Pod, 51 especially in female athletes. Among 15 Division IA male college football players, the correlation coefficient for test–retest reliability was .994 with a technical error rate of

0.448% (Collins *et al.*, 1999), while others have reported correlation coefficients of .992 (Vescovi *et al.*, 2001) and .982 (Sardinha, Lohman, Teixeira, Guedes, & Going, 1998) among adult populations. Furthermore, the small differences observed in the current study could have been due to differences in size and time of last meal (even though 2 hr is thought to be sufficient for testing, we did not standardize the last meal before testing) or bowel or bladder fullness. Furthermore, while none of the participants were actively trying to lose or gain weight, the small individual differences in body weight (nonsignificant), fat mass (p = .036), fat-free mass (nonsignificant), and percent body fat (nonsignificant) observed in the current study are well within the normal daily weight fluctuations, self-reported EI error, and errors associated with entering the exact foods consumed into Food Processor (ESHA Research, Salem, OR). For example, error may have been introduced when entering the food items into the nutrient analysis software, because some brand names were missing and, therefore, a generic brand was used instead; some food items were missing completely; and some cooking methods were absent (e.g., breaded chicken strips had to be substituted for homemade breaded chicken because this food item was not present in the software). While we believe that the participants were comfortable reporting all food consumed due to the preexisting nature between themselves and their sport nutrition coach, it is possible that some social desirability of food reporting could have occurred, which is why the 16 daily food records were eliminated before analysis. Finally, although we did not provide the participants with prepared food and beverages (similar to Horton *et al.*, 1994), they were encouraged to consume typical food and beverages, even though it would limit the researchers' control.

To determine whether the participants were meeting their ExEE needs, EA was estimated to be 42.5 kcal· kg FFM–1 · day–1 across all 7 days. Two participants fell below the 30-kcal · kg FFM–1 · day–1 threshold over the course of 7 days, which is concerning. However, on further investigation, Participant 3 (i.e., lowest mean EA observed was 19.9 kcal · kg FFM–1 · day–1) had 4 days of EI removed from further analysis due to suspected underreporting, leaving only 2 game days and 1 rest day. Participant 2 had a mean EA of 26.9 kcal · kg FFM–1 · day–1, with an exceptionally low 5.2 kcal · kg FFM–1 · day–1 on one of the game days (thus lowering heroverall mean). This participant, in particular, has difficulties with consuming food in general (e.g., difficulties with textures, food allergies, and food aversions), which is constantly a concern for her athletic performance. On the other end of the spectrum, Participant 9, who had a mean EA of 79.2 kcal · kg FFM–1 · day–1, with 3 days of EAs greater than 80 kcal · kg FFM–1 · day–1, was cautioned about weight gain if this were to continue for a prolonged period of time. EA studies to date have mainly used endurance-type athletes (e.g., runners, cyclists, and triathletes) and reported EAs ranging from 19 to 59 kcal · kg FFM–1 · day–1 (Kopp-Woodroffe *et al.*, 1999; Laughlin & Yen, 1996; Thong *et al.*, 2000; Wilmore *et al.*, 1992). For example, EAs among 39 52

amenorrheic, elite, and recreational athletes in Ontario, Canada, were 16, 30, and 33 kcal · kg FFM–1 · day–1, respectively (Thong *et al.*, 2000). While endurance athletes typically have high ExEE, it is suggested that EA be studied in other high-performance athletes.

None of the participants were experiencing menstrual dysfunction during the time of the study, and only 1 had mentioned irregular menses in the past (not one of those identified with a low EA). Failure to clearly assess menstrual history and where participants were in their cycle during data collection was a limitation of the current study, as menstrual function may have influ-enced body-weight changes (e.g., water retention). The current data show that the participants increased FFM (i.e., + 0.7 kg) over the course of 1 week; however, we are unable to distinguish between an increase in muscle mass and water weight. Future research needs to include menstrual status to better understand and standardize the results. However, menstruation status should not be the only sign or symptom used to determine female athletes' health. For instance, although the current study was of relatively short duration, Ihle and Loucks (2004) reported that bone mineralization declined significantly after only 5 days of decreased EA among eumenorrheic women. With prolonged duration, irreversible reductions in bone mineral density could occur, and future research should also include biomarkers of bone health or more regular assessments of EA to prevent lasting harmful effects or behaviors.

Finally, we believe that this is the first time that ExEE has been objectively measured during practices, game warm-ups, and games. On average, participants (N = 10) expended 511 (± 216), 402 (± 50), and 848 (± 155) kcal during practices, game warm-ups, and games, respectively. Female volleyball players need to account for this high level of ExEE with adequate nutrition before activity to be able to maintain a high performance output. Similarly, athletes should be encouraged to consume energy during practices and games, given their long duration (e.g., 2–2.5 hr), for maximal sport performance.

In conclusion, EA is a critical component to investigate for athletes expending high amounts of energy who may be at risk for low EIs relative to ExEE. Athletes need to be encouraged to consume enough energy to cover the cost of repeatedly elevated ExEE. Our data suggest that while most previously published articles report that female elite volleyball players are in a state of negative energy balance, the new and more sophisticated technology and the inclusion of the EA analysis in this study have shown that this may not necessarily be the case. Although expending a high level of energy throughout their sport, particularly on game days, athletes need to consume adequate energy. Optimal levels of athletic performance, as well as a decreased risk of menstrual dysfunction and bone pathologies, tend to be achieved with an EA above 30 kcal · kg FFM–1 · day–1. Future research should examine body-composition changes, as well as the diet composition of each athlete, more often over the season and include metabolic markers of bone and menstrual health.

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