The excessive intake of macronutrients: does it influence the sportive performances of young cyclists?

J. L. Sánchez-Benito* y E. Sánchez Soriano**

*Director nutricionista del equipo ciclista ENYPESA LAMBEA ELMUNDO. Departamento de Nutrición I. Universidad Complutense de Madrid UCM. **Enfermera colegiada 43380. Hospital Puerta de Hierro. Madrid. España.

Abstract

The purpose was to determine whether 34 young Spanish males belonging to a cyclist team, follows the optimal macronutrients intake based on the recommended dietary guidelines. The deficits in nutrition jeopardise the sportive performances, but what about the diets with excessive intake of macronutrients? Furthermore, is there an association between their sportive achievements and the psychological profile? Surely, but the problem is to determine which psychological variables are involved.

Method: Nutritional evaluation based on Nutrients intake questionnaire of 7 consecutive days.

Results: Cyclists consume an excessive quantity of proteins and lipids in their diets. The average consumption of proteins is 16,36% of their caloric intake (the recommended quantity is less than 10%). The average consumption of fats is 38,71% (the recommended is less than 30%).

The same tendency is found in the homologous Spanish young people of the enKID study, where the percentage of energy from fat and saturated fat is much higher than the recommended one.

The cyclists consume insufficient quantities of carbohydrates (average is 44, 94% of their caloric intake, the recommended is more than 60%), therefore the reload of their glycogen stores may not be complete on each competition stage.

No association has been found between the excessive intake of referred macronutrients and the achieved sport performances.

Conclusion: This work contributes to the knowledge of the diets of very active young cyclists. Excessive intake of proteins and fats do not jeopardise their sportive per-

Conclusión: Este trabajo ayuda a conocer los hábitos alimentarios de jóvenes muy activos físicamente. Se muestra que el consumo excesivo de proteínas y grasas no perjudica el rendimiento deportivo de estos jóvenes estudiados. Las variables psicológicas común-
Introduction

The purpose was to determine whether 34 young Spanish males belonging to a cyclist team, follows the optimal macronutrients intake based on the recommended dietary guidelines. The deficits in nutrition jeopardise the sportive performances, but what about the diets with excessive intake of macronutrients? Furthermore, is there an association between their sportive achievements and the psychological profile? Surely, but the problem is to determine which psychological variables are involved.

The hypothesis was that the excessive intake of proteins and fats do not jeopardise the sportive performance in cyclist competitions of medium duration (up to three stages) because the deficit in the glycogen stores may not be determinant for the success. Contrary in long durations (Vuelta a España or Tour of France with more than 15 stages) the balanced nutrition is essential for the success.

The appropriate psychological profile plays a fundamental role in the sportive success in any kind of competition, but the currently used psychological variables are not sufficient to predict the success of a young cyclist.

For the young people dedicated to the cycling, the success not only depends on a suitable training but, it is as well the consequence, of a correct feeding, healthful habits of life, and psychological aptitudes; that are developed by a complex emotional learning.

Specific nutritional aspects of cycling

The advances in the sport medicine, biomechanics, sport techniques like training, and nutrition, in the two last decades, have made possible to reach further sport landmarks.

Many of the factors that take part in the sport success have been identified, and one that is specially relevant, is the nutritional status and the diets of the sportsmen.

Examples to illustrate the importance of the correct diet:

- If a cyclist starts a competition with low iron reserves, he would have excessive fatigue and he will not be able to finish in time. He will need between 2 and 4 months to replenish its iron body reserves.
  - If a cyclist wastes his glycogen before finishing the competition, it would enter in a “hit the wall” state, and he would need 24 h to replenish his glycogen body stores.
  - If by dehydration a cyclist undergoes a heat blow, his performance will decrease dramatically and probably he would need medical attention to recover.

A professional cyclist spends on each competition stage (for instance in a hot and humid day, running 200 km in 5 hours), due to the physical exercise:

- About 155 grams of body fats
- About 50 grams of body amino-acids
- About 410 grams of body glucose; obtained from the muscular glycogen, hepatic glycogen and free glucose in his blood.
- Because of sweating he will lose about 6 litters of water and an important quantity of electrolytes.

The energy spent solely by the physical exercise would be about 3,000 kcal. All the previous energy expenses are on top of the Resting metabolic energy at rest.

The cyclist has to be ready for the next stage of the competition (generally it takes place the following day), therefore that shows the importance of a correct feeding, during and after the cycling competition.

The correct diet is the one that provides the sufficient energy and the suitable nutrients (carbon hydrates, proteins, fats, vitamins, minerals and water) for the sportsman according to its age, gender, weight, and sport activity.

The group of sportsmen is one of the most motivated to follow a correct diet; but for a long time it has been one of the groups that commit the greater errors, and believe in myths with respect to which it is a correct feeding.

The deficits in nutrition jeopardise the sportive performances, but what about the diets with excessive intake of macronutrients? The recommended meals before/during/after the competition must be followed, to avoid the insufficient recharges of glycogen and to obtain the correct hydration.

The drinks should contain Carbohydrates, because they are very useful to maintain the blood glucose level.
vels by the sportsmen. Due to the limited rate of the recovery of the muscular glycogen in competitions of several daily stages, it is convenient to drink isotonic drinks with carbohydrates during the long lasting competitions\textsuperscript{10,11}.

The stress of the sportsman delays the gastric emptiness and the digestions, reason why it is fundamental to control it, and to take meals with small quantities of fats\textsuperscript{4}.

In addition to the healthy physiological effects, the exercise produces health benefits, such as preventing the appearance of chronic diseases, and also facilitating the treatment of already existing diseases\textsuperscript{12}.

Psychological aspects of cycling

Cycling puts stringent physical and psychological requirements on the sportsmen. The level of demands is quite often near to exhaustion.

When the glycogen stores diminish and the lactate level raises, your level of pain rises dramatically; and all your energy needed at that moment on your muscles goes to fight your negative thoughts.

Every evening cyclists have to fully recover physically and psychologically for next day competition stage. If you do not sleep well, next day will be worse than present day, and your state of mind enters in a cycle of negative thoughts.

The physiological and psychological stress associated to the competition is directly associated to nutritional practice, because it over-stimulates the sympathetic autonomic nervous system which makes difficult the digestion of the foods, and modifies the feeling of thirst and hungry. At the end of a strong competition you are neither hungry nor thirsty and you have to relax, to be able to eat and drink to re-hydrate and to start reloading your glycogen stores within the first two hours after the end of competition when the glycogen sintetasa enzyme is at its higher level. A good digestion is promoted by activation of the parasympathetic autonomic nervous system (antagonist of the sympathetic).

There have been several studies showing what are the important psychological factors determining the sport performances. By working on those psychological factors, the cyclist may improve his sport performances and his quality of life.

Methods

Thirty four young cyclists pertaining to the junior team (of 15 to 17 years) and to the Sub23 team (of 18 to 23 years). (http://www.echocas.com/), have participated in the nutritional study.

The cyclists have a regular program of training with technical Directors and trainers; the cyclist were trained about six days a week. Along the year they participate in about 12 competitions in the community of Madrid (Spain) and other six Spanish national competitions.

They run more than 25,000 km per year.

The nutritional and psychological evaluations are mandatory for the Juniors team; and optional for the Sub-23 team.

All cyclists have made a medical examination to participate in the cycling club. They combine their studies with practices of cycling, and their goal is to become professional cyclists.

All are healthy, without disease.

They have signed an informed voluntary consent, together with their parents or tutors, if they are under 18 years of age.

They have information on the good and safe sport practices\textsuperscript{13}.

The psychological evaluation performed used the CPRD test\textsuperscript{14} to determine the psychological profile of the cyclists.

Anthropometric data and energy requirement

The information required for the evaluation, is provided by cyclists in the “Questionnaire of nutritional habits and physical activity” such as anthropometric data, as well as the amount and intensity of the physical activity that every individual cyclist make.

The Body fat mass (FM) was assessed by bio-impedance measurements, INBODY520 body fat analyzer. Other methods, like skin folds thickness have been used but only with some of the cyclists, and the errors are of similar level\textsuperscript{15}.

The anthropometric results show the average and the standard deviation of several parameters like age, weight, height, and Body Mass Index (BMI) is in table I.

BMI: body mass index, FM: body fat mass; SD: standard deviation.

Note: The quantities showed in the all Tables have been rounded to the units value, no comma and decimals were used (ie: if the means of age the cyclist teams were 20,1 years, in the table it is put 20 y).

To calculate the activity factor the DIAL program is used\textsuperscript{16}; DIAL uses an equation with the weighted daily activity duration of table II; on the basis of values of WHO\textsuperscript{17}.

In the example of the table II, the following Activity factor would result = (1 * 8 h + 1,5 * 7 h + 2.5 * 5 h + 5 * 2 h + 7 * 2 h)/24 h = 2.3.

<table>
<thead>
<tr>
<th>Age (Y)</th>
<th>Weight (kg)</th>
<th>Height (m)</th>
<th>BMI (kg/m\textsuperscript{2})</th>
<th>FM (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEANS</td>
<td>20</td>
<td>67</td>
<td>176</td>
<td>21.92</td>
</tr>
<tr>
<td>SD</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>1.53</td>
</tr>
</tbody>
</table>

The excessive intake of macronutrients: does it influence the sportive performances of young cyclists?
To calculate resting metabolic rate (RMR) for sportsmen, the Cunningham formula has been used because it is more appropriate than others:

\[ RMR = 500 + 22 \times FFM \text{ (Body Fat free mass in kg)} \]

The Energy required is calculated, based on the Resting Metabolic Rate (RMR) multiplied by the activity factor. The example of the cyclist X, whose data are given in table III is used to illustrate the method.

\[ RMR = 500 + 22 \times 57 = 1,761 \text{ kcal} \]

Total energy required = \( 2.3 \times 1,761 = 4,050 \text{ Kcal} \).

The average results of the resting metabolic energy at rest (RMR), and the daily activity factor for the cyclists of the present work, is shown in table IV.

### Table II

<table>
<thead>
<tr>
<th>Activity</th>
<th>Activity factor</th>
<th>Example</th>
<th>Activity hours per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rest (A)</td>
<td>1</td>
<td>sleep</td>
<td>8</td>
</tr>
<tr>
<td>Very light (B)</td>
<td>1.5</td>
<td>House-keeping, Study</td>
<td>7</td>
</tr>
<tr>
<td>Light (C)</td>
<td>2.5</td>
<td>Walk low speed</td>
<td>5</td>
</tr>
<tr>
<td>Moderate (D)</td>
<td>5</td>
<td>cycling &lt; 25 km/h</td>
<td>2</td>
</tr>
<tr>
<td>Intense (E)</td>
<td>7</td>
<td>Cycling &gt; 35 km/h or climbing mountain</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table III

<table>
<thead>
<tr>
<th>Cyclists × data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
</tr>
<tr>
<td>Fat (kg)</td>
</tr>
<tr>
<td>Fat free Mass (kg)</td>
</tr>
<tr>
<td>RMR (kcal/d)</td>
</tr>
<tr>
<td>Activity factor</td>
</tr>
<tr>
<td>Energy spent (kcal/d) = RMR* Activity factor. (James &amp; Schofield, 1990).</td>
</tr>
</tbody>
</table>

RMR: resting metabolic rate.

### Table IV

<table>
<thead>
<tr>
<th>MEANS</th>
<th>Activity factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMR (kcal)</td>
<td>1,761</td>
</tr>
<tr>
<td>SD</td>
<td>85</td>
</tr>
</tbody>
</table>

RMR: resting metabolic rate. SD: standard deviation.

The average results of the energy required and the calories consumed by the cyclist of the study; it appears that the Average of intake of Calories by the cyclist team are, slightly lower to the energy required by them. Certainly the body fat (MEANS ± SD) of the cyclists goes from 15% ± 2 down to about 7% along the sport season.

### Statistical method

The results are expressed in MEANS ± SD. To determine the statistical significance, independent sample \( t \) - tests were used to evaluate differences between groups of the same team. Values of \( p < 0.05 \) are considered statistically significant.

Linear correlation method has been used to analyse possible associations between nutritional variables and sport achievement variables (using Microsoft Excel).

### Informatic tools

PC informatics tools of the Department of Nutrition and Bromatologia I of the Faculty of Pharmacy UCM, Madrid (Spain), have been used.

The DIAL program, using a Table with the composition of foods, calculates the energy consumed and the nutrients (macro nutrients, minerals and vitamins) contained in the daily food ingestion, using the foods composition Table of the Faculty of Pharmacy in Madrid. The information of the ingested food is extracted from the “Questionnaires of Record of food consumption of 7 consecutive days”.

In addition the DIAL program uses equations to calculate the energy required (total energy spent is equal to basal energy spent multiplied by the activity factor), based on the anthropometric data and the hours of physical activity. The serving sizes are based on information provided by the University of Leon, Spain.

Nevertheless for the cyclists we have used the Cunningham equation in the calculation of energy spent, because it is more appropriated for sportsmen.

The Microsoft Excel and SIGMA 2.0 programs have been used for the statistical analysis, statistical significance and linear correlation.

### Dietetic evaluation

Every cyclist participating in the study fill up several questionnaires:

- Questionnaire of nutritional habits and physical activity: where it is recorded the frequency of intake of different groups of foods, some anthropometric data, as well as the amount and intensity of the physical activity that the cyclists make.
- Questionnaire of Record of food consumption during of 7 consecutive days. This record list all the fo-
ods and drinks ingested and its quantities; including supplements, appetizers and snacks; Other useful information are as well included, such as lunch start/end time, the place where they eat, etc.

The Questionnaires data are input into the DIAL program, which after processing it outputs a Result Report detailing the Energy intake, nutrient and the Quality of the Diet, the later based on the recommendations applicable to the studied population group. The results of the cyclist nutritional evaluation are used to determine the diet unbalances; which are compared with those of the Spanish young population of the enKid study.

The recommended macronutrients intake for the cyclists have been calculated as follows:

- Proteins: 1.5 g/kg of body weight per day.
- Fats: less than 30% of energy.
- Carbohydrates: to complete the amount of energy required.

The resulting recommended average values for the cyclist teams are shown in the table V.

**Phychological evaluation**

The psychological evaluation performed at the beginning of the sport season, consisted on a CPRD test to determine the psychological profile of the cyclist. During the sport season every cyclist has to improve on his weak psychological point. At the end of the sport season, a final evaluation will show the evolution as result of the intervention.

The CPRD model contains 55 items related to 5 psychological factors involved in sport performances, which explains the 63% of the total variance. The alpha coefficient measuring the reliability of the five CPRD factors is 0.85.

The test takes into account the following five factors of the personality, which are considered important in the achievement of the success in sports, namely:

- Stress control.
- Influence of the evaluation on the performances (how the cyclist accepts critics of peers and coaches).
- Motivation to achieve sport goals.
- Mental skills known and used by sportsmen.
- Team cohesion and degree of commitment with peers.

Weak points of the juniors cyclist team are Self Control of the stress, followed by the Influence of the evaluation (by oneself, coaches and peers) of his own performances.

Strong points are Team cohesion, correct use of mental skills, and motivation.

Table VI shows the cyclists percentiles, compared with other Spanish sportsmen in the area of Madrid.

**Sport performance index (SPI)**

Sport performance index (SPI) is a relative evaluation (from 0 till 100) of the sport achievements of each cyclist.

It is done by coaches and trainers of the team, at the beginning and at the end of each sport season.

The following achievement criteria are taken into account (for each evaluated cyclist):

- Number of triumphs in National Spanish cyclist competitions (within first three winners of the competition; within the first group attaining the goal).
- Number of triumphs in Local cyclist competitions (within first three winners of the competition; within the first group attaining the goal).
- Achievements during the Training (climbing, speed, order of arrival)

Those criteria are internal to the team, because cyclists are pre-professionals and are not in official ranking lists.

The first evaluation is done by the couches at the beginning of the sportive campaign (the one presented in this paper has been done in the beginning of 2006).

Next evaluation will be done by the couches at the ending of the sportive campaign (the next one will be done in the end of 2006) to show the team performance evolution.

<table>
<thead>
<tr>
<th>Table VI</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Psychological factors evaluated in the Junior Team (n = 17). It shows the cyclists percentiles, compared with other Spanish sportsmen of the area of Madrid</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Junior team</th>
<th>Stress control</th>
<th>Influence of the evaluation on the performances</th>
<th>Motivation</th>
<th>Mental skills</th>
<th>Team cohesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEANS (percentiles)</td>
<td>42</td>
<td>60</td>
<td>61</td>
<td>61</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>33</td>
<td>30</td>
<td>25</td>
<td>24</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

SD: standard deviation.

The excessive intake of macronutrients: does it influence the sportive performances of young cyclists?
Results of the nutritional evaluation

The energy balance show that the Average of intake of Calories by the cyclist team (n = 34) is as average, slightly inferior to the energy required by them. The table VII presents the average data of the studied group.

Since the factor of activity is greater in the time of competitions from February to October, a reduction of the weight of the cyclists takes place, but it returns to normal weight because there is a diminished factor of activity from November to January.

In the Spanish young people community (as average, more sedentary than the studied cyclists), the mean daily energy consumption is 2,189 kcal among males, and 1,781 kcal among females25. The rate between the cyclist caloric intake and the male young people caloric intake, is 1.55 times.

Evaluation of ingested macronutrients

Regarding the average consumption of macronutrients the results, of cycling young people, shows important unbalances in the caloric profile.

The macronutrients and energy intake of cyclists participating in the present study; as well as the ones of the homologous Spanish young people of the eN-KID study25, are shown in table VIII.

We found the same eating pattern in both groups of Spanish young people participating, namely excessive intake of proteins and fats. By contrary the intake of carbohydrates is noticeable not sufficient.

Cyclists consume an excessive amount of Proteins (= 16.36% of the energy) and Fats (= 38.71% of the energy); while the recommended profile would be less than 10% of the energy form proteins and less than 30% of the energy from fats.

The same tendency is found in the Spanish young people, where the mean daily energy consumption shows that the percentage of energy from fat and saturated fat was 38.65% and 13.4%, respectively, without any differences by gender. We consider only the intake of males, the fat and saturated fat was 40.1% and 12.7%, respectively25.

Instead the Carbohydrates ingestion (= 44.94% of the energy) is inferior to the recommended value (more than 60% of the energy). The consumption of cereals seems to be adequate, but the intake of fruits and vegetables is insufficient. The means of carbohydrates intake was less than the recommended 7-10 g/kg BM per day6.

In this food group of Carbohydrates, the intake of the sugar is 16.59%; this consumption is higher than the recommended quantity (less than 10%) for the Spanish population, but in general that does not give us any concern, if it is consumed during and after the exercise; to maintain glycaemia and to make faster the reload of the glycogen reserves, by taking foods with high glycaemic index.

It is advisable to perform series of snacks during the early recovery phase, but during longer recovery periods (24 h) the athlete should organize the pattern and timing of carbohydrate-rich meals and snacks according to what is practical and comfortable for their individual situation6.

Evaluation of the index of quality of the diet (ICD)

The index of quality of the Diet (12), allows to classify the Diets as, poor diet (< 50 points), diet which needs to be improved (51-80 points), and excellent diet (80-100 points)29.

The ICD is calculated analysing the variety and quantity of groups of food consumed by comparison with the recommendations (CRD). The CRD are determined taking into account the anthropometric data and the energy requirements of the cyclist24.

Ten criteria are evaluated corresponding to groups of food in the food pyramid. Each criteria may have from 0 till 10 points. The ICD evaluation therefore has a range from 0 till 100 points.

The intake of different groups of foods by the cyclist team is shown in the table IX.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Energy (kcal/day)</th>
<th>Proteins (g/day)</th>
<th>Carbohydrates (g/day)</th>
<th>Fats (g/day)</th>
<th>% energy of proteins</th>
<th>% energy of carbohydrates</th>
<th>% energy of fats</th>
</tr>
</thead>
<tbody>
<tr>
<td>CYCLISTS (n = 34) MEANS</td>
<td>3,842</td>
<td>162</td>
<td>443</td>
<td>149</td>
<td>16.36</td>
<td>44.94</td>
<td>38.71</td>
</tr>
<tr>
<td>Spaniards 18-24 years (serra-majem l, et al., 2001) (n = 436) MEANS</td>
<td>2,482</td>
<td>107</td>
<td>264</td>
<td>107</td>
<td>18.0</td>
<td>41.5</td>
<td>40.1</td>
</tr>
<tr>
<td>Ratio Cyclists/Spaniards</td>
<td>1.6</td>
<td>1.5</td>
<td>1.7</td>
<td>1.4</td>
<td>0.9</td>
<td>1.1</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Table VII

Energy requirements and intake of calories by Junior and Sub23 teams (n = 34)

<table>
<thead>
<tr>
<th>Energy balance (kcal/day)</th>
<th>Energy requirements</th>
<th>Intake of calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEANS</td>
<td>4,121</td>
<td>3,842</td>
</tr>
<tr>
<td>SD</td>
<td>413</td>
<td>615</td>
</tr>
</tbody>
</table>

SD: standard deviation.

Table VIII

Ingested Macronutrients and caloric profile, in cyclists and Spanish young people

[The table contains detailed nutritional information about cyclists and Spanish young people.]

[The table is not included in the text, but it would typically contain columns for each macronutrient and row entries for cyclists and Spaniards, with subcategories for males and females where applicable.]
The resulting index of quality of the diet of the cyclists teams (as calculated by the DIAL program), expressed as MEANS ± SD; is ICD = 67 ± 11 points, which means as average it is a good diet, but has to be improved.

The cyclist of the present study consumes excessive quantities of meat, eggs, cholesterol and sodium. At the same time they consume less quantities of vegetables and fruits than the recommended ones, The intake of cereals and legumes is slightly under the recommended quantities.

As part of the nutritional intervention, individual diets have recommended to the cyclist to correct those unbalances. Those fat and sodium unbalances may jeopardise their health as they are considered risk factors for obesity, heart and kidneys in the long term30 and excess of proteins with excretion of calcium in the urine may be a risk of osteoporosis31.

**Comparison of carbohydrates intake by Junior and by the Sub-23 teams**

The carbohydrates intake of the Juniors and Sub-23 teams are shown in table X.

The mean intake of carbohydrates was significantly greater in Sub-23 than in Juniors team. One reason is, may be, because sub-23 cyclists (18-23 years old) have learned the importance of eating sufficient amounts of carbohydrates, while Junior cyclists (15-17 years old) are still in the process of learning good nutritional habits.

**Association between nutritional intake and the achievements of the cyclists**

In the present study we have analysed the possible correlation between the nutritional intakes defined as the quality of the diet (ICD) and the sport achievements index (SPI) obtained by the cyclists:

- SPI average of both teams (n = 34), means ± sd = 49 ± 16.
- ICD average of both teams (n = 34), means ± sd = 67 ± 11.

The correlation factor is 0.17, therefore we have found a weak association between the studied nutritional variables and the sport achievements obtained at this point in time by the cyclists. See figure 1.

Possible reasons are that for those young cyclist, the physiological capabilities are the main determinants of their sportive achievements; given that all are in rather good nutritional state, and given that the cyclist competitions for young people have a relative short duration: they last one, two or maximum three consecutive days. That relatively short duration makes not significant differences in the management of their glycogen stores.

The unbalances encountered in their evaluation are excessive intake of proteins and fats, that may present excessive intake of macronutrients: does it influence the sportive performances of young cyclists?

**Table IX**

<table>
<thead>
<tr>
<th>Food group</th>
<th>cereals &amp; legumes (servings/d)</th>
<th>vegetables (servings/d)</th>
<th>fruits (servings/d)</th>
<th>dairy (servings/d)</th>
<th>meat, fish, eggs (servings/d)</th>
<th>% E from fat</th>
<th>% E from saturated fats</th>
<th>cholesterol (mg/d)</th>
<th>sodium (mg/d)</th>
<th>variety of food types</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEANS</td>
<td>11.1</td>
<td>6.3</td>
<td>2.7</td>
<td>3.3</td>
<td>7.3</td>
<td>41.0</td>
<td>13.4</td>
<td>669.5</td>
<td>5,758</td>
<td>18</td>
</tr>
<tr>
<td>SD</td>
<td>4.3</td>
<td>2.7</td>
<td>1.2</td>
<td>1.2</td>
<td>2.6</td>
<td>3.5</td>
<td>2.0</td>
<td>210.0</td>
<td>3,763</td>
<td>4.4</td>
</tr>
<tr>
<td>CDR</td>
<td>12</td>
<td>6</td>
<td>4.4</td>
<td>4</td>
<td>3</td>
<td>&lt; 30</td>
<td>&lt; 10</td>
<td>&lt; 300</td>
<td>&lt; 4,800</td>
<td>&gt; 16</td>
</tr>
</tbody>
</table>

Note: The quantities showed in this Table have been rounded to one decimal value.
Note: the serving sizes are based on information provided by the University of Leon, Spain22.

**Table X**

<table>
<thead>
<tr>
<th>Intake</th>
<th>Carbo-hidrates (g/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>junior team (n = 16)</td>
<td>398 ± 87*</td>
</tr>
<tr>
<td>sub-23 team (n = 18)</td>
<td>488 ± 88*</td>
</tr>
</tbody>
</table>

* statistically significant difference between groups, p < 0.01; SD: standard deviation.

**Fig. 1.**—NO Association found between Sport Achievements (SPI) and Diet Quality (ICD).
a health risk in the long term, but they do not jeopardise their sport performances in the short term.

**Comparison of quality of diet among the cyclists**

When we classify the cyclists into two groups W and L, according to their score index of quality of their Diet (ICD), we have the results shown in table XI.

There is statistically significant difference between both groups in the quality of their diets (group W have better diet than group L); but there is not statistical difference in sport achievements between group W and L.

The correlation factor between SPI and ICD for group L is $= 0.07$; there is a no association between achievements in sport and the quality of the diet. Figure 2 shows the ICD and SPI scores of the 16 cyclists with poorer diet quality (bellow the average of the team).

The correlation factor between SPI and ICD for group W is $= 0.29$; there is a weak association between achievements in sport and the quality of the diet. Figure 3 shows the ICD and SPI scores of the 18 cyclists with better diet quality (above the average of the team).

**Comparison of sports achievements among the cyclists**

When we classify the cyclists into two groups G and B, according to their index of quality of sports achievements (SPI), we have the results shown in table XII.

There is statistically significant difference between both groups in sport achievements (group G have better achievements than group B); but there is not statistical difference between group G and B, in the quality of their diets.

The correlation factor between SPI and ICD for group G is $= 0.46$; there was an association was found between achievements in sport and the quality of their diet (for the better performing group G). Figure 4 shows the SPI and ICD scores of the 20 cyclists better performing (above the average of the team).

The correlation factor between SPI and ICD for group B is $= -0.42$; there is an _inverse association_ (within the poorer performing GROUP) between sport achievements and the quality of their diets. Figure 5 shows the SPI and ICD scores of the 18 cyclists worse performing (below the average of the team).

---

**Table XI**

<table>
<thead>
<tr>
<th>Association of quality of diet index (ICD), with sport achievement Index (SPI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correlation factor</strong></td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Group W (n = 18)</td>
</tr>
<tr>
<td>means ± sd</td>
</tr>
<tr>
<td>Group L (n = 16)</td>
</tr>
<tr>
<td>means ± sd</td>
</tr>
</tbody>
</table>

Group W has Index Diet Quality (ICD) > 67 points (more than the average of total collective). Group L has ICD $\leq 67$ points (less than the average of total collective).

* statistically significant difference between groups, $p < 0.001$; SD: standard deviation.

**Fig. 2.**—No association was found between Quality of diet (ICD) and sport performances (SPI); (poorer quality $N = 16$).

---

**Table XII**

<table>
<thead>
<tr>
<th>Association of sport achievement Index (SPI) with quality of diet index (ICD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Correlation factor SPI vs ICD</strong></td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Group G (n = 20)</td>
</tr>
<tr>
<td>means ± sd</td>
</tr>
<tr>
<td>Group B (n = 14)</td>
</tr>
<tr>
<td>means ± sd</td>
</tr>
</tbody>
</table>

Group G has Sport performance Index (SPI) > 49 points (more than the average of total collective). Group B has SPI $\leq 49$ points (less than the average of total collective).

* statistically significant difference between groups, $p < 0.001$; SD: standard deviation.

Note: The quantities showed in the all tables have been rounded to the units value.
shows the SPI and ICD scores of the 14 cyclists less performing (below the average of the team).

It seems that there are contradictory results:

- The group that has poor achievements, the better are the achievements, the worse is quality of their diet.
- The group that performs better, the better are the achievements, the better is quality of their diet.

Therefore the cause of sport achievements cannot be associated, for those young cyclists with the “quality of their diets” as it have been measured here; mainly because “bad diet” in this study means unbalanced diet with excessive proteins and fats and may be because the index of quality of the diet used has been indicated for normal people and not specifically for sportsmen.

It is important to practice healthy nutritional habits which are useful along all the time; because while the sportsmen make much physical activity they maintain under control their corporal fat, but they will become over-weighted, if they do not make a correct de-training program.

Discussion and conclusions

Several cyclists present unbalances in their diets (this situation is worse within the junior team than sub23 team), namely:

- The cyclists, as average, take insufficient amount of carbohydrates, reason why they do not probably recharge its reserves of glycogen to the maximum.
- Also the cyclists take an excessive amount of Proteins, that in the long term it will probably be a factor of risk for diseases of the liver and kidney. The excretion of the protein nitrogen implies the lost of increased quantities of Calcium which, in the long term, may be a factor of risk for osteoporosis.
- The cyclists, as average, take excessive amounts of saturated Fats and cholesterol, which, and long term, may be a factor of risk of cardiovascular diseases caused by atherosclerosis.

Fig. 4.—Weak association was found between sport performances (SPI) and Quality of diet (ICD) (More performing N = 20).

Fig. 5.—Association between SPI and ICD for less performant group B (N = 14).

NO association between nutritional state and the achieved sport performances, has been found in the present study, because the results are contradictory. Excessive intake of proteins and fats do not jeopardise their sportive performances. The commonly studied psychological variables are not determinant of sportive achievements of young cyclists; additional work is needed to determine the psychological profile playing a determinant role in cyclists success. The linear correlation found is weak.

• Possible reasons are that all young cyclist are in good nutritional state for the practice of the sport, in fact the unbalances are excessive intake of proteins and fats, which may present a health risk in the long term, but they do not jeopardise their sportive performances in the short term. In addition it seems that the duration of the competitions (up to three days) is not long enough to affect significantly the recovery of their glycogen reserves. The index of quality of the diet used is applicable to general people, it is not specific for sportsmen, therefore it may be not a suitable predictor of sport performances.

• The achieved performances depends, at this point in time, more on their physiological state than on the factors used to determine the quality of their diets.

• The evaluation was done at the beginning of the sport season, therefore without enough data on their sport achievements.

We have designed individual diets to correct their nutritional unbalances found during the evaluation (reducing the proteins, fats and cholesterol in their diets; while increasing the starch and carbohydrates); and we are performing nutritional campaigns to inform the cyclists, their parents and their sport couches of the suitable nutrition habits.

The weak emotional skills of the studied young cyclist are, the control of their stress and their dependency on critics and comments (received by peer’s, couches, and be themselves) related to their performance.

Strong emotional points are, their motivation and their consciousness of belonging to the same team.

We are providing psychological advice and support, to develop emotional shelf-control skills of the cyclist team.
The results of the mentioned interventions will be the subject of a future work to be published at the end of the year, when the present cyclist season has ended. It is important to continue the study, to find out efficient and reliable indicators of the quality of the diet and of the sport achievements; it is also important to define methods to improve the sport performance based on psychological and nutritional support.

Acknowledgements
We wish to thank the advice of Ascensión Marcos Sánchez, Julia Wärnberg, Instituto del Frío del CSIC; Rosa M. Ortega Anta, Cátedra de Nutrición I de la facultad de Farmacia (UCM), Eva Montero psychologyst; Eduardo Chozas (http://www.ecochozas.com/).

References