

Development of a sport foods exchange list for dietetic practice in sports nutrition

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Abstract: Food exchange lists have been widely used in dietary practice in health and disease situations, but there are still no exchange lists for sports foods. The aim of this study was to develop a sports foods exchange list based on previously published statistical criteria. A cross-sectional study of the nutritional composition of sports foods, regarding macronutrients and energy, was carried out. A total of 323 sports foods from 18 companies were selected and divided into seven groups: sports drinks; sports gels; sports bars; sports confectionery; protein powders; protein bars; and liquid meals. A sports foods composition database based on portion size was created. Food exchange groups, with the definition of the amounts - in grams - of each sports foods within each group, were designed using the same methodology and statistical criteria as previously published. The nutritional composition of the portions usually consumed by athletes and/or recommended in commercial packaging was used to calculate the mean energy and macronutrient values for each group. Within each sports foods group, different subgroups were defined due to differences in the main and/or secondary macronutrient. The mean nutrient values of each exchange group and the subgroups were determined according to previously established rounding criteria. This sports foods exchange list, made up of commercial sports products, is a novel tool for dietetic practice. Its management will allow dietitians to adapt dietary plans more precisely to the training and/or competition of the athlete.

Key words: food exchange list, sports foods, dietary supplements, dietetic practice, menu planning.

1. Introduction

Sport is defined as a physical activity, whose practice implicitly requires a good physical condition of the participant and is thus related to sports nutrition. Among the indicators of the performance and health of athletes can be highlighted body composition, hydration, diet, supplements, and doping[1].

The nutritional strategies used to meet the daily nutritional requirements for sport have been discussed in recent years[2]. A number of researchers, position/consensus statements, and scientific organizations have established recommendations regarding the intake of macro and micronutrients by athletes, according to the training/competition phase, the number of training sessions, and the periodization of the training[3–5]. There are also evidence-based protocols for the use of specific sports products - dietary supplements (DS) - in specific situations in sport when the nutritional intake is insufficient or inadequate[4–6]. DS are also known as ergonutritional aids, food supplements, sports food, or sports supplements[1]. According to the International Olympic Committee, DS are defined as "A food, food component, nutrient, or non-food compound that is purposefully ingested in addition to the habitually consumed diet to achieve specific health and/or performance benefit"[6]. Since the first Olympic Games, the competing athletes have consumed a wide variety of DS, with more than 40% of athletes consuming DS, making them the main target for the industry that produces them[7–9]. Recently, Waller and colleagues found that the most widely used DS were sports drinks (70%), caffeine (48%), protein (42%), and sports bars (42%)[7].

Few of the claims regarding the ergogenic benefits of supplements are supported by sound evidence[8]. According to the Academy of Nutrition and Dietetics about Nutrition and Athletic Performance in 2016, the DS with ergogenic and physiological beneficial effects are sport foods[9] (such as sports drinks, bars, and gels or milk whey protein, which provide a source of nutrients when it is not practical to consume everyday food), medical supplements, and performance supplements[4]. These DS are placed by the Australian Institute of Sport (AIS) in its evidence group A. The AIS created a DS classification system for athletes (known as the ABCD system) in which DS are differentiated according to the existent level of scientific evidence, as well as other parameters related to security, legality, and effectiveness in improving sports performance. This system is updated constantly, the latest version being that of 2019[10]. Thus, for the DS belonging to group A there is a high level of scientific evidence for performance improvement[2,10].

The potential benefits of the use of DS include practical assistance to meet sports nutrition goals, the prevention or treatment of nutrient deficiencies, and, in some cases, a direct ergogenic effect[9].

Knowledge of the protocols of use of DS and of the evidence regarding their effects is important for the dietetic and nutritional intervention of an athlete, for both training and competition. Dietitians should base such interventions on nutritional goals, depending on the sports category, type of training/competition, intake of foods/liquids/DS, etc.[4,6]. The athletes for whom advice from a dietitian is their main source of nutritional information have better dietary habits, a better understanding of nutrient periodization, and higher consumption of DS with a high level of scientific evidence. Many of the DS used are sports foods, which are frequently included in the menu planning of training and competition days[11,12].

One of the methods used by dietitians for menu planning is the food exchange list system, a user-friendly tool that was developed to help individuals to adopt healthy eating habits and/or follow a specific diet plan[13].

Food exchange lists have been used for the last 70 years. The first edition was published in 1950 and was developed by the American Dietetic Association, the American Diabetes Association, and the United States Public Health Service[14]. Since that time, the American exchange lists have been updated several times[15–17] and used as a reference by many countries that have worked to design their own lists, to be used in the development of meal planning for healthy individuals or those with chronic disorders such as diabetes, obesity, and cardiovascular and kidney diseases[18–21]. In Spain, researchers have developed and validated food exchange lists, arranged according to the three macronutrients and energy[22] as well as micronutrients and other nutrients of concern[23], to be used in different physiological and disease situations across the lifecycle, including vegetarians and vegans[24,25]. Currently, as far as we know, for athletes there are no food exchange lists of specific sports foods that include the DS with scientific backing[4]. Our hypothesis is that it is possible to design a sports foods exchange list, using nutritional data of products of well-known brand names in different countries and our own, previously published statistical methodology[22,23]. The objective of this work was to develop a unique and novel dietary tool - namely, a DS exchange list based on previously published statistical criteria - that will allow dietitians to improve the nutritional intervention and menu planning during training and/or competition.

2. Material and methods

A cross-sectional study of sports foods and sports products was carried out, regarding their nutritional composition of macronutrients and some micronutrients of interest.

Inclusion and exclusion criteria

After reviewing the studies performed in sports nutrition and evidence based dietetic practice over recent years, the following key nutrients were selected: carbohydrates, sugars, proteins, and sodium[4]. A selection of specific sports foods and sports products with nutrient contents of special relevance to sports nutrition, according to scientific evidence, was made. For inclusion, the sports products from different national and international commercial brands had to have, in their nutritional composition, nutrients of special relevance in sports nutrition, according to scientific evidence. These include those products commonly consumed by the athletes[4,5,7], taking into account nutritional prescription in sports, dietary practices, and products whose nutritional composition was sent directly to the authors by the companies. The following were excluded: supplements whose nutritional composition was not of interest for the purpose of this study or whose suppliers/manufacturers did not provide the necessary information on their nutritional composition.

Sample size

A total of 323 sports foods, from 18 different national and international companies, were selected and divided into seven groups according to the type of sports foods: (1) sports drinks; (2) sports gels; (3) sports bars; (4) sports confectionery; (5) protein powders; (6) protein bars; and (7) liquid meals (mixed macronutrient supplement). The nutrient values of each selected food portion and/or commercial container were obtained from the technical specifications of the nutritional composition of each commercial product, which were facilitated to the authors by the manufacturers. From these data, a database with the sports foods composition *per* portion size was created. It includes a description of the nutritional composition of the portions usually consumed by athletes and/or included on commercial labeling. Also, it provides a classification of foods in several groups and subgroups according to the main macronutrient, as well as identification of food groups with a high content of some nutrients that should be taken into account in certain sports. The products were classified in groups and subgroups according to their predominant macronutrient (carbohydrates, sugars, proteins and a mix of carbohydrates, and proteins and a significant amount of each of the others). In accordance with the European Regulation on nutrition-related declarations for foods[1], the criteria for the selection of the significant nutrients in a food group were as follows: a food group was considered high in sugars when sugars comprised more than 5% of the mean net weight in solid foods and more than 2.5% in liquid foods. In the same way, the protein content was considered high when it provided at least 20% of the energy value of the product. Following these criteria, the sports products were described as follows: products rich in carbohydrates (sports gels, sports confectionery, and sports bars), containing primarily carbohydrates and sugars; products rich in carbohydrates and electrolytes solutions (sports drinks), providing mainly sugars; protein-rich products (sports bars and protein powders), providing mainly proteins; and recovery products with carbohydrates and proteins (liquid foods and bars), providing mainly

carbohydrates and proteins. The general food groupings were divided into subgroups, according to the content of secondary nutrients of the foods. In this way, sports bars were divided into three subgroups, protein powders into two subgroups, protein bars into two subgroups, and mixed macronutrient supplements into two subgroups (table 1).

Statistical analysis of the data and quality control of the nutritional data in each food exchange list

The quality control of the nutritional data in each food exchange list was carried out using our previously published statistical methods for the design of food exchange lists[22,23], described below. Once the preliminary groups had been defined, the macronutrient compositions of the portions were compared to match them with the appropriate groups. This was done by calculating the mean, standard deviation (SD), coefficient of variation (CV), and Z score values for energy and macronutrients (protein, carbohydrates including sugars, and fat). To validate the allocation of foods to an exchange list, the recommended values of SD used by Wheeler and colleagues[17] in exchange lists for energy and macronutrients (energy: 20 kcal, carbohydrates: 5 g, fat: 2 g, and protein: 3 g) were considered. If the SD values exceeded the limits, the amounts of foods were modified or a food was removed from the list and placed in another list where its macronutrient content would be appropriate. The foods and sport products that satisfied the SD statistical criterion for all the macronutrients were incorporated into the exchange lists. After this, the CV was also analyzed, aiming for values of less than 30% for energy and at least the main macronutrient. For groups with higher values of the CV, the Z value for each food was calculated: Z values between -2 and +2 were established as a criterion to exclude foods with high variations. The criteria proposed for the inclusion of sports foods in the exchange lists are shown in **figure 1**.

Figure 1. Statistical criteria proposed for the definition of the sports foods exchanges in each group

Nutritional composition			
- Main ingredient			
- Main macronutrient			
- Adequacy with respect to dietetic-nutritional recommendations in sports			
Commercial units/container weight in sports foods			
Macronutrient	Standard deviation (SD) for each group⁶	Coefficient of variation for each group (CV)	Z values for each food
Energy	± 20 kcal	30%	± 2
Carbohydrate	± 5 g		
Fat	± 2 g		
Protein	± 3 g		

The sodium content was also included so that the contribution of each group and subgroup to the resulting menu could be monitored, due to differences in the sodium content among sports foods of the same food exchange group.

The determination of the energy and macronutrient values assigned to each food exchange group and the subgroups was performed according to the established rounding criteria previously published by the authors[22]. Values were rounded down for decimals less than 0.49 and rounded up for decimals higher than or equal to 0.50, as long as the Z value of the exchange group value against the mean group value was between ± 1 . If the Z value was outside the limits, a new rounding was performed so that the established criteria were met. The energy value of each exchange group was calculated by multiplying the mean contents of proteins, fats, and carbohydrates assigned to each exchange list by the respective Atwater factors.

In all cases, the amounts in grams tested were based on common culinary measures and the recommendations on commercial containers of the sports products intended to facilitate dietetic practices (e.g., 2 teaspoons), or on the usual portion sizes (e.g., sports drinks: 1 serving of 500 mL), or on commercial containers/portions (e.g., 1 small bar of 30 g or an energy gel, 1 dose/serving of 20 g).

3. Results

The definitive food groups and subgroups and a summary of the mean values proposed for the most representative foods of each one are presented in table 1. The food exchange groups were defined in grams and household/commercial measures. From the calibration of the food portions, the mean energy and macronutrient values for each group were obtained. These mean values together with the statistical parameters studied (CV, SD, and range for energy and macronutrients) are shown in table 2. Within each sports foods group, different subgroups were defined due to differences in the main and/or secondary macronutrient. In this sense, to be able to apply the statistical criteria, and at the same time to improve the nutritional precision in dietary prescription in sports, different subgroups had to be formed.

Table 1. Criteria to select the net weight of the portions tested to define the sports foods exchange.

Sports foods	Criteria	Sports foods and companies included
Sports drinks	Weight range: 35-55 g (one, two, or three servings in 400-500 ml). Sodium range: <250 mg and >250 mg.	Crown Sport Nutrition, Geo Nutrición, Infisport, Recuperat-Ión, Enervit, Nutrixxion, 226ERS, Victory Endurance, Weider, Etixx, Coca-Cola, Keepgoing, Nutrinovex
Sports gels	Weight range: 25-60 g (one or two servings). Sodium range: <100 mg, 100-200 mg, and >200 mg.	Biofrutal Sport, Enervit, Victory Endurance, Maurten, Nutrixxion, GlucoUp!, Myprotein, Crown Sport Nutrition, 226ERS, Infisport, Recuperat-Ion, Etixx, Keepgoing, Nutrinovex
Sports bars	Weight range: 25-60 g (one or two servings). Subgroup 1. <25 g carbohydrate Subgroup 2. >30 g carbohydrate, 2 g of fat, and 2 g of protein. Subgroup 3. >30 g carbohydrate, 6 g of fat, and 5 g of protein.	Nutrinovex, Infisport, Geo, Etixx, Keepgoing, 226ERS, Nutrixxion, Victory endurance, Crown Sport Nutrition, Enervit
Sports confectionery	Weight range: 4-8 g (one, two, or four servings)	GlucoUp!, 226ERS, Victory endurance
Protein powders	Weight range: 25-40 g (one, two, or three servings) Subgroup 1. Between 20 and <25 g protein. Subgroup 2. Between ≥25 and 30 g protein	Weider, Myprotein, Crown Sport Nutrition, 226ERS, Enervit, Victory endurance, Keepgoing, Etixx, Infisport, Nutrixxion.
Protein bars	Weight range: 30-80 g (one or two servings) Protein content >20%. Subgroup 1. <15 g protein per serving. Subgroup 2. >20 g protein per serving.	Victory Endurance, Weider, 226ERS, Nutrixxion, Enervit, Infisport, Myprothin, Keepgoing, Etixx, Paleobull,
Liquid meals	Weight range: 30-60 g (one, two, three, or four servings) Subgroup 1. Ratio of 1 Carbohydrate/1 protein. Subgroup 2. Ratio of 2-4 Carbohydrate/1 protein.	Infisport, 226ERS, Etixx, Crown Sport Nutrition, Geo, My protein, Weider, Keepgoing, Enervit, Recuperat-Ion

Table 2. Mean macronutrients values (by rounding mean values of group) and energy values (by applying Atwater factors) of the sports foods groups proposed in the exchange list.

Sports food exchange groups	N	Energy kcal (SD)	CV (%)	Protein g (SD)	CV (%)	Fats g (SD)	CV (%)	Carbohydrate g (SD)	CV (%)
Sports drinks									
Sports drinks	46	137.25 (19.94)	14.53	1.32 (1.91)	144.96	0.03 (0.16)	481.04	32.95 (3.75)	11.38
Sports gels									
Sports gels	72	101.28 (17.35)	17.14	0.16 (0.28)	175.73	0.02 (0.05)	249.30	25.12 (4.25)	16.93
Sports bars									
Sports bars. Subgroup 1	17	117 (21.06)	18	1.27 (1.13)	89.12	1.86 (1.81)	97.21	23.8 (3.68)	15.45
Sports bars. Subgroup 2	24	167.5 (33.3)	19.9	2.2 (1.4)	64.7	2.2(1.7)	76.3	34.6 (4.5)	13
Sports bars. Subgroup 3	17	203.9 (21.4)	10.5	4.6 (2.3)	49	6.0 (1.5)	24.8	33.0 (4.4)	13.4
Sports confectionery									
Sports confectionery	9	19.86 (5.75)	28.95	0.07 (0.12)	165.30	0.11 (0.16)	142.26	4.64 (1.29)	27.88
Protein powders									
Protein powders. Subgroup 1	50	108.72 (9.74)	8.95	22.64 (1.16)	5.11	1.11 (0.67)	60.34	2.1 (0.94)	45.03
Protein powders. Subgroup 2	20	116.01 (10.58)	9.12	25.82 (1.0)	3.86	0.7 (0.76)	109.29	1.62 (1.05)	65.19
Protein bars									
Protein bars. Subgroup 1	27	158.42 (25.60)	16.16	10.86 (1.57)	14.5	4.81 (1.76)	36.55	17.93 (4.38)	24.42
Protein bars. Subgroup 2	16	191.76 (57.69)	0	22.68 (30.8)	13.59	5.19 (1.23)	23.63	16.59 (3.88)	28.57
Mixed macronutrient supplements									
Liquid meals. Subgroup 1	8	176.02 (14.5)	8.24	20.67 (1.3)	6.3	2.25 (0.59)	26.31	18.28 (1.47)	8.04
Liquid meals. Subgroup 2	17	154.58 (18.09)	11.7	9.74 (1.74)	17.83	0.35 (0.39)	111.56	28.11 (3.85)	13.71

Although the Z value for each food is not indicated, it is important to note that some foods had a Z value outside the limits (table 3). These sports foods should not be interchanged very frequently because that would modify the dietary intakes of athletes. These sports foods should be taken into account by professionals in menu planning in order to avoid high nutritional deviations from the mean values. If none of the foods listed in a group with a high CV showed Z values outside the limits, the variability of the group was disregarded.

Table 3. Foods with Z values outside the limits (± 2) for the main macronutrients of the sports foods groups.

Sports food exchange groups	Macronutrient	Sports foods with Z <-2	Sports foods with Z >2
Sports drinks			
Sports drinks	Carbohydrate	Energy carbo charge - chocolate (Keepgoing)	Powerade® Ice Storm (Cocacola), Powerade® Blood Orange (Cocacola)
Sports gels			
Sports gels	Carbohydrate	-	Longovit Gel - strawberry and banana (Nutrinovex)
Sports bars			
Sports bars. Group 1	Carbohydrate	-	-
Sports bars. Group 2	Carbohydrate	Enervit power sport competition – orange (Enervit)	-
Sports bars. Group 3	Carbohydrate	-	Protein bars – chocolate (Enervit)
Sports confectionery			
Sports confectionery	Carbohydrate	-	-
Protein powders			
Protein powders. Subgroup 1	Protein	Day & night casein chocolate (Weider), Isolate protein drink – chocolate (226ERS), Sequential Protein - chocolate (Cronw Sport Nutrition), Impact Whey protein (My Protein), The whey + (My Protein).	-
Protein powders. Subgroup 2	Protein	-	sequential protein - chocolate (Infisport), K-weeks immune – chocolate (226ERS)
Protein bars			
Protein bars. Subgroup 1	Protein	-	Vegan protein bar - berries (Victory Endurance), Enervit power sport – crunchy cookie (Enervit)
Protein bar. Subgroup 2	Protein	-	-
Mixed macronutrient supplements			
Liquid meals. Subgroup 1	Carbohydrate and protein	Top 50/50 recovery 1:1 leucina+ - chocolate (Infisport)	-
Liquid meals. Subgroup 2	Carbohydrate and protein	-	Recovery shake chocolate (Etixx)

The macronutrient values assigned to each sports foods exchange list after subjecting them to the rounding criterion and the energy value calculated by the Atwater system are shown in table 4. There is a mean rounded value assigned to each subgroup. In sports foods rich in carbohydrates - such as sports drinks, gels, and bars - the carbohydrates per portion ranged from 24 to 35 grams. These products have very low amounts of protein and fat (0 to 2 grams per serving), except for subgroup 3 of the bars - which had 5 grams of protein and 6 grams of fat per serving and whose intake could be useful at a given time depending on the sporting activity of the athlete. The sports confectionery is also high in carbohydrates, providing 5 grams per serving and 0 grams of fat and protein.

In protein-rich products, such as protein powders and bars, the protein ranged from 11 to 26 grams per serving. The amounts of the protein powders per exchange provide very little carbohydrates (2 grams per exchange) and fat (0.5-1 gram per exchange). Protein bars (with more than 20% of the caloric value in proteins) provide low amounts of fat (5 grams per exchange) and moderate amounts of carbohydrates (14 and 18 grams in subgroups 1 and 2, respectively). Finally, the mixed group with carbohydrates and proteins (liquid meals) is divided into two subgroups, the first with a higher contribution of proteins and the second with a higher contribution of carbohydrates.

Table 4. Mean values of the exchanges and the Z value for each sports foods exchange list.

Sports food exchange groups	kcal	Z	Carbohydrate	Z	Protein	Z	Fat	Z
Sports drinks								
Sports drinks	138	0.04	33	0.01	1	-0.17	0	-0.21
Sports gels								
Sports gels	101	-0.02	25	-0.03	0	-0.57	0	-0.40
Sports bars								
Sports bars. Subgroup 1	118	0.05	24	0.01	1	-0.24	2	0.08
Sports bars. Subgroup 2	166	-0.04	35	0.08	2	-0.15	2	-0.15
Sports bars. Subgroup 3	206	0.10	33	0.0	5	0.2	6	0.0
Sports confectionery								
Sports confectionery	20	0.02	5	0.28	0	-0.6	0	-0.7
Protein powders								
Protein powders. Subgroup 1	109	0.03	2	-0.1	23	0.31	1	-0.16
Protein powders. Subgroup 2	119	0.28	2	0.36	26	0.18	0.5	-0.26
Protein bars								
Protein bars. Subgroup 1	161	0.10	18	0.02	11	0.09	5	0.11
Protein bars. Subgroup 2	192	0.0	14	0.1	23	0.10	5	-0.15
Mixed macronutrient supplements								
Liquid meals. Subgroup 1	176	0.0	18	-0.19	21	0.26	2	-0.42
Liquid meals. Subgroup 2	154.5	0.0	28	-0.03	10	0.15	0.5	0.38

4. Discussion

In this study, sports foods have been grouped mainly according to their content of macronutrients, following statistical criteria. These food exchange groups are a useful and novel tool to help dietitians and improve the nutritional precision of dietary plans for athletes. As previously mentioned, these products are considered as "sports foods", which can be defined as "specialized products used to provide a convenient source of nutrients when it is impractical to consume everyday foods"[4,10].

This tool offers, for inclusion in meal planning, a wide variety of sports foods in each group that are DS with ergogenic and physiological beneficial effects. This food exchange list for sports was developed based on typical DS available with a nutritional prescription to athletes in Spain, although most of the commercial sports products included can be used at an international level, since they are available in other countries. Within a food exchange group, one food exchange is approximately equal to another in terms of energy, carbohydrates, proteins, and fats, and it can be exchanged for any other food in the same list. The food exchange list is divided into different DS exchange categories (sports gels, bars, drinks, etc.); however, some groups are divided into subgroups based on the secondary nutrient contents (e.g., different amounts of sodium in sports drinks or protein in sports bars). In this sense, the nutrition and dietetics practitioner could opt for different subgroups according to the athlete's nutritional goals[4,5]. All the amounts of the sports foods proposed have been established according to the size of the commercial containers or the serving dosage indicated by the manufacturer. This food exchange list could be useful for professionals, since it allows estimation of the number of exchanges needed to meet the energy and macronutrients requirements of an athlete, as well as the appropriate foods in the daily menu for training sessions and competition; at the same time, it can be used to prevent medical-nutritional problems such as dehydration, hyponatremia, and gastrointestinal problems [1,4].

In different countries or regions, there are usually food composition tables that collect nutritional information per 100 g of food [26]. In the same way, there are food databases for many types of sports DS[27,28], but there are no databases that collect sports DS nutritional information according to the size of the commercial container or the serving dose. The sport food exchange list compiled here achieves this, thus facilitating the adaptation of diet plans. In this way, this list could help the transfer of nutritional recommendations for the diet plans of athletes, so aiding sports dietitians [29]. Sports dietitians have access to a lot of scientific literature about the nutritional needs of athletes, but more dietary-practice tools are necessary. As an example, the software Core Nutrition Planning - that performs nutritional planning for endurance events - has been created, but for the use of specific supplements[30]. Another example of a dietary-practice tool is the sports food exchange lists proposed in this research.

These sports foods exchange lists include more than 300 products from several companies, allowing the selection of different products with similar macronutrient characteristics.

The choice of a sports food subgroup from within a food exchange list will depend on the dietary-nutritional needs before, during, or after training and/or competition. The sports drinks, sports gels, sports bars, and sports confectionery groups can be used before or during training and/or competition, while the protein powders, protein bars, and mixed macronutrient supplement groups can be used after training and/or competition[4-6].

The current nutritional recommendations for sport events (training and competition) establish that during physical activity, whilst an event is taking place, the average hourly intake should be 500 ml of liquid, 250-350 mg of sodium (Na), and 30-90 g of carbohydrates[4,5]. The carbohydrates guideline can be broken down in the following way: the average intake of carbohydrates should be 30 g during the first hour of exercise, 60 g in the second hour, and 90 g in the third hour. The athlete's nutritional needs could be met with the intake of water, sports drinks, sports gels, sports bars, and food. In addition, the post-exercise nutritional recovery is contemplated through the intake of carbohydrates and proteins (0.8 g carbohydrate/kg body weight plus 0.2-0.4 g protein/kg body weight)[4]⁷.

The carbohydrate needs during training or competition can be achieved using the following examples of food exchange lists: 1) one exchange of sports drink provides 33 g of carbohydrates; 2) one exchange of sports drink plus one exchange of sports gel provides 58 g of carbohydrates; 3) one exchange of sports drink plus one exchange of sports gel and one exchange of sports bar (group 2) provides 93 g of carbohydrates; as well, three exchanges of sports gel diluted in 500 ml of water plus three exchanges of sports confectionery also provides 90 g of carbohydrates. In these examples, the recommended Na and liquid intakes are also met. Also, an example of a recovery option for an athlete with a body weight of 70 kg would be two exchanges of mixed macronutrient supplements.

The use of these sports foods exchange lists allows the dietitian to adjust more precisely the dietary plans developed and adapted to the training and/or competition of the athlete. This improves nutritional accuracy.

Finally, we recommend strict control of the selection of foods with z-values outside the limits and do not recommend using a fraction of the exchange amount indicated to adjust the recommendations of the menu planning.

Future research could evaluate the effectiveness of the list and the impact of the system among nutrition and dietetics practitioners and athletes.

Thus far, different food exchange lists from different countries[13,31,32] or regions[33] have been published, adapted to the general population or disease situations such as diabetes[34] or kidney disease[20,35]. Other tools for dietary planning have also been developed[36], but none incorporate supplements to be applied in sport.

The main limitation of this study is the restricted number of DS brands and products included. Also, the use of these sports lists by athletes should be tested, regarding the ease and utility of their use in: the planning of menus by the dietitian, the understanding of the diet plan by the athlete, and his/her adherence to the diet plan in different sports situations. In this first phase, this could not be carried out but it will be in the next phase.

5. Conclusions

The sports foods exchange list developed here, made up of commercial sports products, is a novel tool that could be very useful for sports dietitians in the dietary-nutritional planning for athletes before, during, or after training and/or competition.

The management of these food exchange lists could allow dietitians to adjust their dietary plans more precisely to the training and/or competition of the athlete, thus improving the precision of the nutritional prescription.

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