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Sumario / Summary

SMD
Sociedad Española de Medicina del Deporte

Presentación / Presentation

José Luis Mendoza Pérez
Presidente de la UCAM
President of the UCAM

La Universidad Católica San Antonio de Murcia tiene, entre sus señas de identidad, la de la apuesta decidida por el desarrollo de la Medicina y del Deporte.

La Universidad imparte los Grados en Medicina y en Ciencias de la Actividad Física y del Deporte y está considerada como la Universidad del Deporte por su altísima implicación y apoyo al deporte a todos sus niveles. Este año será un hito porque se prevé que la UCAM sea la universidad que más deportistas aporte a los Juegos Olímpicos de Río de Janeiro de todas las universidades del mundo.

Por ello, al escribir este artículo de la revista Archivos de Medicina del Deporte, en nombre de la institución que tengo el honor de presidir, me siento perfectamente identificado con dos pasiones personales: el Deporte y la Medicina.

La UCAM tiene un decidido interés por la promoción y el desarrollo científico, a nivel nacional e internacional. El ámbito de la investigación en la Medicina del Deporte y de sus ciencias es de primer orden, especialmente en nuestra universidad, pero también a nivel nacional e internacional en la esfera de los países iberoamericanos. Este intercambio de información científica favorece el desarrollo y colaboración de los investigadores en este campo, de la UCAM y de todos los grupos investigadores españoles, y nuestra universidad se honra al servir como instrumento de difusión científica internacional.

Por ello, el reciente acuerdo alcanzado con la Sociedad Española de Medicina del Deporte en materia de publicaciones y, concretamente, la colaboración con la revista Archivos de Medicina del Deporte para que pueda ser traducida al inglés, es una decisión especialmente importante para la UCAM.

San Antonio de Murcia Catholic University has, among its hallmarks, the firm commitment to the development of Medicine and Sport.

The university offers degrees in Medicine and in Sport and Physical Activity Sciences and it is regarded as the Sport University for its high involvement and support of sport at all levels. This year will be a milestone for it is expected that the UCAM will be the university that provides more athletes to the Olympic Games in Rio de Janeiro than any university in the world.

Therefore, when writing this article for the Journal Archives of Sports Medicine, on behalf of the institution I have the honour to chair, I feel perfectly identified with two personal passions: Sport and Medicine.

The UCAM has a strong interest in scientific promotion and development, at a national and international level. The scope of Sports Medicine research and science is first-class, especially in our university, but also nationally and internationally in the circle of Latin American countries. This exchange of scientific information promotes the development and collaboration of researchers in this field, the UCAM and all Spanish research groups, and our university is honored to serve as a resource of international scientific dissemination.

Thus, the recent agreement reached with the Spanish Society of Sports Medicine in matters of publications and, in particular, the cooperation with the journal Archives of Sports Medicine for its translation to English, is an especially important decision for the UCAM.

The university, true to its commitment to Medicine and Sport, provides its scientific and material means so that the journal achieves maximum publicity, which certainly will be easier once also offered in English.

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La Universidad, fiel a su compromiso con la Medicina y el Deporte, aporta sus medios científicos y materiales para que la revista AMD pueda alcanzar la máxima difusión, lo que sin duda se podrá conseguir con más facilidad ofreciéndose también en la lengua inglesa.

Obviamente éste es un importante paso, pero sólo uno más de los que seguiremos dando en la fructífera colaboración que la UCAM mantiene con la Sociedad Española de Medicina del Deporte.

Obviously this is an important step, but just one among all we will continue to make on the fruitful collaboration the UCAM has with the Spanish Society of Sports Medicine.

Una nueva era de la revista Archivos de Medicina del Deporte

A new era of the Archives of Sports Medicine journal

Pedro Manonelles Marqueta

Director de Archivos de Medicina del Deporte. Presidente de la Sociedad Española de Medicina del Deporte.
Director of Archives of Sports Medicine. President of the Spanish Society of Sports Medicine.

En los últimos años han sido muy escasas las editoriales que he realizado en la revista, apareciendo solamente para hablar de aspectos fundamentales de nuestra profesión y especialidad y, por lo tanto, en mi calidad de Presidente de la Sociedad Española de Medicina del Deporte. En esta ocasión, por primera, vez escribo esta editorial como Director de la revista Archivos de Medicina del Deporte que, como es sabido, es el órgano científico de expresión de la Sociedad.

Este número que podemos disfrutar en nuestras manos marca un hito en la historia de la revista que ha pasado por diferentes momentos a lo largo de su historia y hoy marca un hito nunca conseguido. Esta revista, a partir de este momento, se traduce al inglés y se presenta en dos formatos, en su versión electrónica que se puede consultar en su propia página web (http://www.archivosdemedicinadeldeporte.com/).

Sin duda, el idioma científico por excelencia es el inglés, y lo que no se expresa en este idioma, tiene un escaso recorrido, de ahí que una de las tareas que se han realizado desde la Junta de Gobierno que presido ha sido la búsqueda de una forma de poder conseguir la traducción de una forma estable y con un alto nivel de calidad.

Puedo decir, con enorme satisfacción, que esta inquietud por la difusión científica encontró su respuesta en una institución, la Universidad Católica de Murcia (UCAM), que tiene como bandera el apoyo al deporte, pero también a la Medicina y a la Medicina del Deporte.

Ambas instituciones UCAM y SEMED-FEMEDE vienen manteniendo un altísimo nivel de colaboración desde que el presidente de la Universidad, D. José Luis Mendoza Pérez, articulara los medios para la creación de la Cátedra Internacional de Medicina del Deporte de la UCAM, de la que me corresponde el honor de dirigir.

In recent years I have written very few editorials in the journal, appearing only to discuss key aspects of our profession and specialty and, therefore, in the role of President of the Spanish Society of Sports Medicine. On this occasion, for the first time, I write this editorial as director of the journal Archives of Sports Medicine which, as it is known, it is the scientific organ of the Society.

This number we can enjoy in our hands is a milestone in the magazine history, which has gone through several moments throughout its history and today marks a landmark never achieved. This journal, from this moment on, is translated to English and is available in two formats, its electronic version is available on its own website (http://www.archivosdemedicinadeldeporte.com/).

Undoubtedly, the scientific language par excellence is English, and what is not expressed in this language has little path, hence one of the tasks made by the Governing Board I lead was the search for a way to get the translation in a stable manner and with high quality.

I can say with great satisfaction that this concern about the scientific dissemination found its answer in an institution, the Catholic University of Murcia (UCAM), whose banner is the support of sport, but also of Medicine and Sports Medicine.

Both institutions, UCAM and SEMED-FEMEDE, have maintained a very high level of collaboration since the university president, José Luis Mendoza Perez, articulated the means to create the UCAM International Chair of Sports Medicine, which I have the honour to lead.

When the Chair was established less than two years ago, it was born with the will to develop various projects of Sports Medicine. Since then, progress has been made in its development and function, but what I want

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Cuando se creó la Cátedra, hace menos de dos años, nació con la voluntad de desarrollar diversos proyectos de Medicina del Deporte. Desde entonces, se ha avanzado mucho en su desarrollo y función, pero lo que quiero destacar es que, gracias a esa función, se puede asistir hoy a la lectura de esta revista en inglés.

Es muy importante destacar la ayuda que el Presidente de la UCAM nos brinda a través de un convenio de colaboración en materia de publicaciones, pero es muy satisfactorio comprobar el grado de colaboración y de desarrollo de proyectos que ya se están llevando a cabo entre las dos instituciones.

Por todo ello creo que puedo trasmitir, en nombre de toda la Sociedad y en el mío propio, el agradecimiento a D. José Luis Mendoza y felicitarnos de trabajar con una institución con la que podemos encontrar puntos de confluencia y beneficio mutuo que tan importantes son para la difusión de trabajos científicos, para el desarrollo de formación en Medicina del Deporte y para el cuidado de los deportistas, que en definitiva es el objeto principal de nuestro trabajo.

to emphasize is that, thanks to this function, today it is available the reading of this magazine in English.

It is very important to highlight the support that the President of the UCAM provides us through a cooperation agreement in the field of publications, but it is very satisfying to see the level of collaboration and project development already being carried out between the two institutions.

Therefore I think I can convey, on behalf of the whole Society and my own, our gratitude to José Luis Mendoza, and congratulate ourselves for working with an institution with which we can find common ground and mutual benefit, which are so important for the scientific studies dissemination, for the development of sports medicine training and for the care of athletes, which ultimately is the main objective of our work

Hydration practices of runners during training *vs* competition

Fabrícia Geralda Ferreira[1], Letícia Gonçalves Pereira[2], Wallisson David Rodrigues Xavier[3], Ana Paula Muniz Guttierres[4], Ângela Maria Campos Santana[5], Neuza Maria Brunoro Costa[6], João Carlos Bouzas Marins[7]

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Summary

Background: Appropriate hydration ensures that the athlete is in ideal condition during exercise. Inadequate hydration practices are still present among athletes participating in different types of sports. This could be the result of a low level of knowledge concerning the importance of hydration for athletic performance. The purpose of this study was to evaluate the level of knowledge and the hydration practices of the runners in training and competition.
Method: This study used an exploratory method involving a questionnaire containing 19 objective questions related to hydration habits and level of knowledge about hydration, as reported in prior studies, which included questions categorized into three parts: demographic characteristics, hydration habits during competition and training, and hydration knowledge. A total of 412 athletes (36.1 ± 12.9 years old) with a high experience in the sport (11.2 ± 10.9 years) were evaluated.
Results: A significant difference (p = 0.0012) was observed for reported hydration practices between training and competitions. Moreover, the data revealed that a large number of runners (41 % in competitions and 54.4% in training) had inadequate hydration habits because they did not always consume fluids. Increased consumption of fluids in the competitions was also observed. Only 35.4% of athletes consumed sports drinks, while 3.88 % had never consumed fluids during training, and 1.5% never consumed fluids in competition. Few athletes (23.2%) weighed themselves before and after exercising. Participants answered 66.6% of hydration knowledge questions correctly.
Conclusion: Runners were not able to transfer their knowledge about proper hydration during both training and competition practices.

Key words:
Sports nutrition. Hydration. Dehydration. Athletes.

Prácticas de hidratación en corredores durante el entrenamiento *vs* la competición

Resumen

Introducción: Una hidratación adecuada asegura que el atleta está en condición ideal durante el ejercicio. Se suelen presentar prácticas de hidratación inadecuadas entre los deportistas de diferentes disciplinas que podrían deberse a un bajo nivel de conocimiento sobre la importancia de una correcta hidratación para el rendimiento deportivo. El objetivo del estudio fue evaluar el nivel de conocimiento y las prácticas de hidratación en corredores durante el entrenamiento frente a la competición.
Métodos: Este estudio utilizó un método exploratorio que incluía un cuestionario con 19 preguntas objetivas relacionadas con los hábitos de hidratación y el nivel de conocimiento sobre hidratación, según lo informado en estudios previos, cuyas preguntas estaban divididas en tres partes: características demográficas; hábitos de hidratación durante el entrenamiento y competición, y conocimientos sobre hidratación. Se evaluaron 412 corredores (36,1 ± 12,9 años) con una elevada experiencia en la práctica del atletismo (11,2 ± 10,9 años).
Resultados: Hubo diferencia significativa (p = 0,0012) de las prácticas de hidratación durante los entrenamientos y la competición, con mayor consumo de líquidos durante las competiciones. Por otra parte, los datos revelaron que un gran número de corredores (41,0% en competición y 54,4 % en entrenamiento) tenían hábitos de hidratación inadecuados al no consumir siempre líquidos. Sólo el 35,4 % de los atletas declararon consumir bebidas deportivas. La ingesta de líquidos era inexistente en el 3,8% de los atletas durante el entrenamiento y el 1,5% en competiciones. Sólo el 23,2% de los encuestados controlaban el peso corporal antes y después del ejercicio. Los participantes respondieron correctamente al 66,6% de las preguntas sobre conocimiento de hidratación.
Conclusiones: Los corredores participantes no fueron capaces de trasladar sus conocimientos sobre el tema de hidratación en prácticas adecuadas tanto en entrenamiento como en competición.

Palabras clave:
Nutrición deportiva. Hidratación. Deshidratación. Deportistas.

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Introduction

Recently, the number of Brazilians who are dedicated to competitive sports has increased significantly. The last edition of the São Silvestre race in 2013 was attended by twenty-five thousand runners, and the International Marathon of São Paulo was attended by twenty thousand runners this year. However, some reports show that many of these participants are not concerned about factors that influence their performance, such as proper training, rest and nutrition, and they are either not getting regular exercise or exercising minimally.

Because running is a long-duration sporting event, it has distinctive features, as it involves supporting weight at different intensities, aerobic and anaerobic activity, a high metabolic demand and increasing water loss, the last of which can be exacerbated by weather conditions such as temperature and humidity[1]. Maintenance of fluid balance is therefore essential for athletic performance[2] and thermoregulation. Weight loss, even as little as 2 % of the total body weight, can have a negative effect on thermoregulation and exercise performance. Fluid lost through sweat during exercise must be replaced[3-5].

Studies that have monitored water loss during long races, such as marathons and ultramarathons, observed significant fluid loss[6,7]. These studies demonstrated that these losses can reach high levels. Indeed, a runner at The Los Angeles Marathon in 1984 lost 3.7 liters of water per hour[8]. These studies illustrate the importance of hydration. A dehydrated runner may have decreased performance, altered cardiovascular parameters and an altered electrolyte balance, which can trigger anything from minimal inconvenience to cramps and even more serious conditions, such as convulsions or fainting[3]. Appropriate hydration ensures that the athlete is in ideal condition during exercise.

Many researchers to date have demonstrated that inadequate hydration practices are still present among athletes participating in different types of sports[9-16]. This could be the result of a low level of knowledge concerning the importance of hydration for athletic performance. This lack of knowledge can lead to inappropriate behavior, such as drinking water during long bouts of exercise instead of drinking the recommended sports drinks during endurance competitions[17-19]. Therefore, long distance runners must have knowledge about hydration habits and practices for adequate planning of fluid replacement during training and competitions.

Thus, our hypothesis is that runners do not have and appropriate knowledge about hydration during training and competition. Therefore, the aim of this study was to investigate the level of knowledge about hydration and the hydration practices during training and competition in Brazilian runners.

Material and methods

Participants

The sample consisted of 412 volunteer male runners who were willing to participate in the study by answering the questionnaire. All of them were previously informed about the objectives of the research and evaluation procedures. Those who agreed to participate signed their consent to participate in the survey. So, the sample had a characterization of probabilistic type.

Data were collected at major road races held in the cities of Belo Horizonte, Juiz de Fora, Mariana, Contagem and Viçosa, all in the State of Minas Gerais, Brazil. Contact with runners was at random after the competition is held. All questionnaires were administered by trained evaluators, allowing uniformity in procedures and data collected. The average time to complete the questionnaire was 15 minutes for each runner.

The research project was approved by The Federal University of Viçosa Ethics Committee of Human Research (approval no. 035/2006).

Procedure

This study used an exploratory method involving a questionnaire containing 19 objective questions related to hydration habits and level of knowledge about hydration, as reported in prior studies[9-12,14]. Before starting the study, the questionnaires were pilot tested on a group of ten runners who were not included in the sample described in this study.

The questionnaire was divided into three parts. Part 1 included questions on demographic information such as gender, hometown, age and years of sport practice. Part 2 referred to hydration practices and included questions related to the frequency of hydration; time at which hydration occurred; type, taste and temperature of fluid used; weight control; symptoms caused by inadequate hydration practices; and clothing worn during exercise. Part 3 consisted of six questions that investigated the level of knowledge about hydration. Each correct answer was awarded 1 point, with a possible maximum score of 6. No points were awarded for an incorrect answer. For questions seven and nine, the answers were considered correct if anything other than "nothing" was selected. For question 18, the correct answer was "have already obtained guidance about the best method of rehydration". The athletes were encouraged to ask for clarification regarding any questions they did not understand.

The questionnaire was previously evaluated by three professional sports nutritionists, and was previously used in earlier studies with Spanish runners[9], fighters[10], undergraduate athletes[11] and young soccer players[14].

Data analysis

All statistical analyses were conducted using Epi–info 2002 software. Descriptive statistics were used to calculate the mean and standard deviation for age and years of sport practice. A frequency analysis was calculated for each question, discarding unanswered questions. The chi-square test was used to compare the differences between hydration habits during training and competition situations. Significance was set at $p<0.05$.

To compare hydration habits (never, rarely, sometimes and always) during training and competition using the chi-square test, "always" was considered the appropriate response for each habit, and all other options were considered inappropriate and were grouped together.

Results

Sample characteristics

Among the 412 street runners who answered the questionnaire, 83% were from Minas Gerais and lived in 39 different cities in the state, with a mean age of 36.1 ± 12.9 years and an average of 11.2 ± 10.9 years of practice in the sport. All individuals were of Brazilian nationality.

Hydration practices

Figure 1 shows the percentage of responses (from never to always) related to the hydration practices of athletes in training and competition.

There was a statistically significant difference ($\chi^2 = 14.78$; $p = 0.0012$) between the athletes' behavior in training and competition situations. Fluid intake was greater in competitions. Moreover, the data revealed that a large number of runners—41% in competitions and 54.4% in training—have inadequate hydration habits because they do not always consume fluids.

When athletes were asked about when they hydrated (Figure 2), a low percentage (36.9%) reported that they hydrated during training, indicating that athlete behavior during competition is not always the same as that during training.

As shown in Figure 2, a high percentage of athletes reported ingesting fluids after physical activity, demonstrating that there is a need to restore the fluid homeostasis lost during exercise.

In terms of the type of fluid ingested, 72.7% of athletes reported that they were concerned about what to use for hydration. However, when asked about what type of fluid they drink, the respondents reported that they consumed water the most before (77%), during (86.2%) and after exercise (64.6%), showing that, in practice, few athletes hydrate with sports drinks.

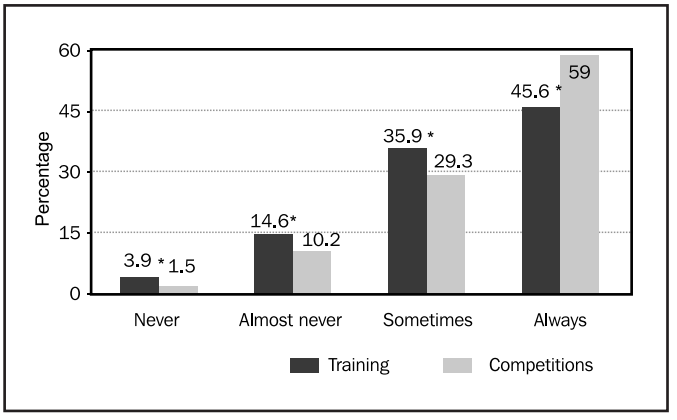
In addition to water and sports drinks, other possible fluids that could be consumed for hydration during sports events were also investigated. Water was the most fluid consumed by 95.6% of the athletes. Apart from water, other fluids consumed by the athletes included fruit juices (48 %), sport drinks (35.4%) and fruit soft drinks (18%).

Among the athletes who consumed sports drinks, 67.5% of them took the same brand among available in Brazil. Another relevant finding is related to the flavor of drinks that athletes prefer, as flavor contributes significantly to increased consumption when compared with water[1,20]. The favorite flavors among the runners were orange (34.5%), tangerine (21.4%), citrus (14.6%) and lemon (13.1%).

The largest percentage of athletes (62.8%) were concerned about hydration regardless of season, while 34.7% of the athletes reported that they were more concerned with hydration in the summer, and 2.6% said they do not to worry about hydration. The data revealed that only 23.2% of the athletes regularly weighed themselves before and after exercise. In contrast, 76.8% of the athletes weighed themselves occasionally, almost never or never.

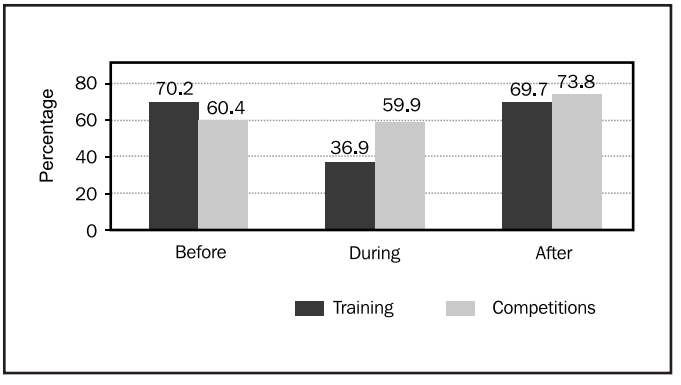
Whereas dehydration is associated with a series of physiological impairments, athletes were asked to indicate which symptoms they had experienced in their careers. Table 1 shows the frequency of symptoms that could be related to dehydration.

Figure 1. Fluid intake of runners in training and competition.



*Statistically significant difference between the athletes' behavior in training and competition situations.

Figure 2. Timing of hydration among runners in training and competition.



Among the athletes, 94.5% said they worry about the type of clothing they use, and the biggest concern was related to the type of fabric (80.9%). Only 31.7% of the athletes said they were concerned about the color or the amount of fabric they use.

In this study, athletes were asked to provide the preferred temperature of the fluid they used to hydrate. Fifty-one percent of the athletes preferred to hydrate with fluid at room temperature, while 47.2% preferred moderately cold fluid and only 1% preferred extremely cold fluid.

Level of hydration knowledge

The sample mean was 4 out of a maximum score of 6 points, meaning that the sample answered 66.6% of the questions correctly. Table 2 shows the percentage of correct answers for each question.

Thirst was identified as an indicator to start hydrating by 22.8% runners. In this study, the correct option was to consume fluids before feeling thirsty. The athletes' answers indicated that 89.8% were familiar with a brand of sports drink and 83% were familiar with a brand of energy drink. The best known sports drink was reported by 82% of the

Table 1. Physiologic manifestations that occur in training and/or competition.

Signs of Dehydration	Frequency
Intense thirst	24.8 %
Feelings of loss of strength	20.4 %
Cramps	19.4 %
Generalized fatigue	13.6 %
Headache	10.2 %
Concentration difficulties	9.2 %
Difficulty performing a technical movement easily performed under normal conditions	6.8 %
Tiredness	5.8 %
Paleness	4.9 %
Deep eyes	3.9 %
Alterations in vision	3.9 %
Lack of sensation in the hands	2.9 %
Interruption of sweat production	1.9 %
Interruption in planning an activity	1.9 %
Momentary loss of consciousness	1.5 %
Convulsion	1.0 %

Table 2. Percentage of athletes who correctly answered each question.

Question	Frequency of correct answer
Liquids must be consumed before thirst is felt	75.7 %
Familiar with a brand of hydro-electrolytic replacement	89.8 %
Familiar with a brand of energy drink	82.5 %
Consumption of liquid must be 250 mL per 15 minutes	45.5 %
Has acquired information on the best hydration habits	64.0 %
The function of an isotonic solution is to hydrate, replace electrolytes and provide energy	41.8 %

athletes, while the second most cited brand obtained 26.7%. Among the energy drinks, there was a balance between the different brands, as 33 % of the athletes were familiar with two brands.

These data show that few athletes regularly ingest sports or energy drinks. This is due in part to lack of knowledge about the drinks, as 17.5% said they did not know any sports drink brands, and 10.2 % did not know any energy drink brands.

The questionnaire also asked about the volume and frequency of hydration that athletes considered appropriate. Only 45.5% of athletes who reported always hydrating during competitions were found to hydrate adequately during training.

As shown in Table 2, 64% of the athletes had already received information about the best method of hydration. Guidance was most often provided by coaches (43.7%), doctors (35.5%) and magazines (31.8%). The nutritionist was responsible for providing information to only 17.5% of athletes. It was noted that only 41.75% of the athletes understand the correct function of the sports drinks, even though a majority reported that they had already received information about hydration.

Discussion

The large number of runners that have inadequate hydration habits indicates that the group needs educational intervention because dehydration can compromise not only performance but also health[1,3,5].

Despite being relatively small, a percentage of the athletes said they never consume fluid in training or competitions. This finding is alarming because the weekly training load of street runners can range from 50 to 200 km depending on the stage of training or competition, which can place a large burden on the body.

Inadequate hydration habits were also described by Duarte *et al*[6], in a study with Brazilian ultramarathon runners and by Marins *et al*[9], in a study with runners in Europe, which demonstrated that these athletes are susceptible to the deleterious effects of dehydration.

The athletes in this study prioritized hydration in competitive situations. However, if the competitive situation is not reproduced in training, the athlete may not be adapted to the increased hydration and may experience stomach discomfort at the time of competition. Furthermore, it is important to emphasize that attention should be devoted to hydration especially in training because this is part of the everyday life of an athlete. If water levels are inadequate, the quality of training will be reduced and the possibility of damage to the athlete's health will be increased.

Studies on the timing of hydration were also undertaken with athletes of other sports, such as triathlon and cycling[9], judo[10], karate[12] and various college sports[11]. The authors reported that in those types of sports, there is no balance between the timing of hydration or between two different exercise situations (training and competition).

Hydrating prior to beginning exercise by the majority of athletes in both training and competitions is a preventative action intended to avoid low water levels or dehydration, which could contribute significantly to a reduction in performance[1,3].

Ingesting fluids after exercise can be stimulated by thirst and can be caused by the difference between the rate of gastric emptying and sweating rate[21] or by the adoption of inadequate hydration strategies during exercise.

The low consumption of sports drinks found before, during and after exercise is concerning because in the majority of street races, the distances range from 10 km to a marathon length (42,195 meters). This habit increases the chances of experiencing hypoglycemia in individuals who participate in events lasting more than one hour[22].

The low level of intake of energy fluids during physical activity found in this study demonstrates the need to prepare campaigns to guide athletes. Water intake alone can only keep hydration levels close to normal, while the ingestion of an energy source in fluid form can restore the water supply and maintain glucose levels within the normal range, minimizing the occurrence of hypoglycemia[22]. In this way, it is possible to improve the athlete's cognitive performance and reduce muscle fatigue[23].

It is necessary to increase the consumption of drinks containing carbohydrates before and after long bouts of exercise. Before exercise,

this practice allows the athlete to start with maximal reserves of liver and muscle glycogen and keep blood glucose at the appropriate levels. After exercise, however, the purpose is to promote the restoration of muscle and liver glycogen and accelerate the recovery process[24].

The low consumption of sports drinks among runners was previously described[6,17], and according to Duarte *et al*[6], only 24.5% of ultramarathon runners drink some type of beverage containing carbohydrates during long training periods.

Unlike studies that applied the same questionnaire in other sports[9,11,12] the use frequencies of drinks such as Coca-Cola®, coffee and beer were lower in this study (5.34%, 6.31% and 4.85%, respectively). This represents a positive habit compared to that observed in athletes of other sports, given that these drinks are not appropriate for effective hydration[21].

The favorite flavors among the runners in this study were similar to the flavors most cited by judokas[10] and college athletes[11], although the percentages differed compared with those in this study.

Few athletes evaluated in this study regularly weighed themselves before and after exercise. Marins and Ferreira[11] investigated college athletes and found that 41% of them do not weigh themselves.

Rockwell *et al*[25], investigated the effective use of weight monitoring by coaches and athletes. Their study showed that 39% of college coaches considered weight monitoring to be important, which is less than the percentage described by Corley *et al*[26], who found that 60% of coaches monitored weight to control body mass changes in their athletes.

The importance of weighing oneself is related to establishing the amount of fluid that must be replaced after exercise[27]. Given the effect that dehydration and improper rehydration has on performance, any method capable of monitoring these changes would be invaluable. Pre- and post-exercise body mass changes are reliable and simple to measure, providing accurate and timely information related to fluid loss and rehydration[28].

Maughan and Shirrefs[29] reported that the required amount of fluid ingestion after exercise is equal to one and a half times the amount lost. In other words, 150% of the amount lost should be consumed within 6 hours after the end of the exercise. The amount proposed by these authors is justified by the continuity of water loss in urine and sweat after the end of the exercise. The American College of Sports Medicine[1] agree with these authors, also recommending the consumption of 1.5 times what was lost, stating that this amount allows the restoration of water levels even if elimination through the kidneys occurs.

Evaluating that recommendation in a practical way, we can establish that when weight loss is less than or equal to 3 kg, the guidance above is relevant. However, when there is a marked loss (4 kg or more), it will become difficult to implement this recommendation because of the large amount of fluid that would be necessary for replacement. In this case, it is suggested that athletes consume the amount of fluid lost during the activity.

Symptoms commonly caused by dehydration could be minimized if the proper hydration strategy with appropriate quantity, frequency and type of fluid is adopted. The occurrence of cramps may or may not be related to dehydration, as demonstrated by Sulzer *et al*[30]. If dehydration is associated with cramps in these athletes, adequate hydration using fluids containing carbohydrates and electrolytes could ameliorate these cramps. Symptoms such as thirst, loss of strength and cramps were also the most prevalent among the college athletes evaluated by Marins and Ferreira[11].

Runners also experienced more serious symptoms such as visual disturbances, interruption of sweat production, loss of consciousness and seizures. Although this study found that a small number of athletes that reported these symptoms, it is important to monitor and plan hydration adequately. Except for the interruption of sweat production, which is related to a high degree of dehydration and can even lead to hyperthermia, all other symptoms may be related to dehydration in less than 5% of cases[19]. Alternatively, the symptoms may be related to hypoglycemia, indicating that athletes should drink fluids that provide approximately 30 to 60 g of carbohydrates per hour. Consuming only water is not sufficient to prevent or minimize the occurrence of these symptoms[1,20].

Symptoms such as cramps may also be related to hyper-hydration, highlighting the need for monitoring not only regular hydration but also the type, amount and frequency of fluid consumption[4,31].

Individual sweat rates vary and depend on factors such as ambient temperature, humidity, air movement, exercise intensity, body size and clothing[32]. This study investigated athletes' concerns regarding features such as color, type and amount of fabric used when exercising. Few athletes reported being concerned about the color and the amount of fabric they use. This lack of worry can lead to damage to the athlete because dark-colored clothing will promote greater thermal stress because it absorbs more heat. Likewise, exercising on hot days or while wearing more fabric will cause greater difficulty in dissipating heat by sweating, which may lead to hyperthermia[33].

Brouns[33] showed that the temperature of the liquid has little influence on the rate of gastric emptying; therefore, the best temperature is that which is preferred by the athlete. Pinto *et al*[34], used water at three different temperatures (10 ºC, 24ºC and 38 ºC) and found that water temperature did not interfere with body temperature or performance when submaximal exercise was performed in a thermoneutral environment.

According to Greenleaf[35], beginning hydration after feeling thirst is not effective because a person is approximately 2% dehydrated when they start feeling thirsty. On the other hand, some studies have demonstrated that encouraging athletes to drink fluids before the sensation of thirst may lead to hyper-hydration, resulting in reduction of plasma electrolytes[31]. However, it should be noted that this condition typically occurs in only cold-weather climates. In Brazil, with a typically tropical climate, the weather conditions associated with heat are more frequent and thus impose a more continuous heat stress, minimizing the risk of hyper-hydration.

Machado-Moreira *et al*[36], claimed that fluid intake according to thirst is sufficient and appropriate because the central nervous system can correctly indicate the volume of fluid that should be taken in by providing information on the demands of the body.

As there is no consensus in the literature related to the amount of fluid that must be ingested before or after the sensation of thirst, the discussion is ongoing. Common sense is required by athletes and coaches as to the amount of fluid consumed during their sports practice.

Marins and Ferreira[11] reported that 21.5% of Brazilian college athletes said that they should hydrate after they feel thirst. The result was

similar in the current study, in which 17.3% of athletes indicated they should consume fluid after thirst and 6.9% said they should consume fluid after feeling really thirsty. Rosenbloom *et al*[37], also found that among the Americans who were evaluated, only 79% of men and 73% of women know that thirst is not a good indicator of the need for fluid. Marins *et al*[9], found that different percentages of runners, triathletes and cyclists consumed fluids after the sensation of thirst (25%, 8.4% and 14 %, respectively).

These studies show that although most athletes understand when they should initiate fluid intake, it is still necessary to extend this level of knowledge and always encourage them to ingest fluids in pre-determined quantities and frequencies, regardless of the feeling of thirst. This action may allow a balance of fluid intake with the loss due to sweating, which is especially important in exercises performed under extreme temperatures.

Proper hydration implies a balance between the amount of fluid intake and the interval of ingestion. Less than half of the runners in this study were properly hydrated. This behavior limits the benefits that could be attained from their training because large quantities of fluids, as well as insufficient quantities, may limit performance.

Guidance about hydration was provided mainly by coaches. Information provided by coaches is very important and needs to be expanded because they exert a direct influence on the athletes. However, some studies show that coaches do not have enough knowledge about nutrition, particularly about hydration[27,38] therefore, coaches could give inadequate information.

The quality of information provided to athletes should be investigated to avoid the transmission of erroneous information. Soper *et al*[39], reported that 55% of the dance instructors surveyed said that thirst was a good signal to start fluid replacement.

Nutritionists less frequently served as professionals responsible for giving information to athletes about hydration, which may be due to the small number of athletes who have access to nutritionists. Bianco *et al*[40], showed that nutritionists participated infrequently in dietary recommendations for athletes. Instead, coaches were chosen as the best consulting source.

Journals were common sources of information for athletes. Thus, journal editors should devote special attention to articles on hydration because if the journal does not have expertise in this area, it cannot be used as a reliable source and could lead to the creation of myths.

Other studies that investigated the source of nutrition information for athletes showed that coaches, parents, doctors and family members were the main sources[41]. However, Cupisti *et al*[42] reported that the most information came from parents, the media and teammates.

Although hydration knowledge is important for improving the athletes' practices, it has been observed that knowledge on the subject does not always result in the best practice, as has been shown in studies that found no correlation between the level of knowledge and the level of hydration[16].

Conclusions

Knowledge about the role and benefits of sports drinks can lead to an increase in their consumption. In this study, 64 % of the runners reported having received information about the best method of hydration, and more than 80% were familiar with one or more brands of sports drinks. It was expected, therefore, that the athletes were properly informed about the functions of a sports drink, but this was not observed. This shows the need to devote more attention to the quality of information provided.

The high percentage of athletes who do not understand the function of sports drinks may be an important cause for the low consumption of this drink among athletes.

Brazilian street runners hydrate most frequently during competitions; however, in training, fluid intake was not regular. Moreover, consumption of sports drinks among athletes was low, and some reported never hydrating in training or competitions.

The runners demonstrated a failure to translate hydration knowledge into proper hydration strategies. Knowledge alone is not enough; therefore, continued efforts must be made by coaches, athletes and others involved with racing to develop and implement more effective hydration strategies.

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Somatotype comparative study between spanish and brazilian young females dancers

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Summary

Not much is known about the influence of dance in the morphological and anthropometrical development of young dancers. Therefore, the purpose of this study was to obtain and compare the somatotype of two groups: one group of classical ballet dancers, from Porto Alegre, Brazil, and the other group including spanish dancers and classical ballet dancers, from Cordoba, Spain, trying to draw a parallel between these two groups, comparing and relating the data. We evaluated 110 young female dancers: 60 from Cordoba Conservatory of Dance, Cordoba, Spain, and 50 from private dance schools in Porto Alegre, Brazil. Trying to reach the objectives of the study, data collection was developed by a cross-sectional study. In addition to the individual identification variables, age variable and nationality, this study measured anthropometric variables, based on the ISAK protocol, and calculated the somatotype according to the Heath-Carter method. Descriptive statistical methodology and the "Student t test" was used to analyze and compare the data. The two groups present the dominance of the mesomorphic component, determining the prevalence of muscle mass. Regarding the somatotype no significant statistical differences were found between spanish and brazilian young female dancers.

Key words:
Somatotype. Dance. Child.

Estudio comparativo del somatotipo de niñas-bailarinas cordobesas y porto-alegregrenses

Resumen

Casi no se conoce la influencia de la danza sobre el desarrollo morfológico y antropométrico de niñas que la practican. Así, el objetivo de este estudio es obtener y realizar comparaciones entre el somatotipo de niñas-bailarinas pertenecientes a la ciudad de Porto Alegre (RS), Brasil, y de la ciudad de Córdoba (CO), España, practicantes de ballet clásico y danza española, intentando establecer un paralelismo entre estas dos poblaciones, comparando y relacionando los datos obtenidos. Fueron evaluadas 110 niñas-bailarinas: 60 cordobesas, estudiantes del Conservatorio de Danza de Córdoba, España, y 50 porto-alegrenses, estudiantes de academias de ballet clásico de la ciudad de Porto Alegre, Brasil. Intentando atender a los objetivos del estudio, la recogida de datos fue desarrollada por abordaje transversal. Además de las variables de identificación del individuo, de las variables edad cronológica y nacionalidad, el presente estudio comprende las informaciones antropométricas referentes al somatotipo, mediante la medida de varios bloques de parámetros antropométricos, siguiendo las indicaciones del protocolo de la ISAK. El somatotipo fue calculado según el método de Heath-Carter. Para el tratamiento estadístico de los datos se utilizó la estadística descriptiva y el Test t de Student ($p<0.05$). Los resultados sugieren el predominio del componente mesomórfico en el somatotipo de los dos grupos estudiados, determinando el predominio de la masa muscular. Todavía, no hubo diferencias significativas entre las niñas-bailarinas cordobesas y las porto-alegrenses en el somatotipo.

Palabras clave:
Somatotipo. Danza. Niñas.

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Introduction

Classical ballet has long been considered a highly developed art form involving specific corporal aesthetics and technical archetypes. Through trial and error, and advice from highly experienced teachers, these standards have been developed and passed on for many centuries, from the very outset right up to today[1]. Professional dancing demands an ever-increasing degree of rigour and better results. Only recently, the scientific community has recognised that classical ballet is just as physically active and requires an equal amount of physical preparation as high-level sporting activities[2].

Dance can be very beneficial for the girls that practice it. It develops rhythm, coordination and flexibility, among other physical qualities, as well as being very educational in many aspects. However, if it is not well regulated it may cause numerous physical injuries[3,4], postural problems[5], illnesses such as anorexia[6], and amenorrhea problems[7-11].

The influence of dance on the morphological and anthropometrical development of girls that practice it – young female dancers - is still widely unexplored. The range of literature available in this field is practically inexistent; it is very difficult to find studies carried out on this particular demography. Upon researching databases, only one study performed on girls practicing classical ballet was found, and none were found for girls practicing Spanish dance.

Therefore, monitoring the morphological development of girls studying dance is extremely important, in order to quantify, classify and thus achieve better results. It should also be recognised that the modifications that occur in the bodies of young female dancers are further conditioned by physical, social and cultural factors, and others such as diet and the physical constitution of each individual (genetic make-up)[12,13].

The objective of this study is to obtain and carry out comparisons between the somatotype of young female dancers from the city of Porto Alegre (RS), Brazil, and dancers of classical ballet and Spanish dance from the city of Cordoba (CO), Spain, with the aim of drawing a parallel between the two demographics, comparing and linking the data obtained between the two groups and the different ages.

Material and method

Subjects

The research was carried out at the Cordoba Conservatory of Dance, Spain, where data was taken regarding the somatotype of 60 young female dancers from Cordoba, aged between 10 and 13, average age 11.50±0.94, height 145.51±8.63 cm, weight 37.98±6.98 kg, practicing classical ballet for an average of 5 hours a week and Spanish dance for 3 hours a week. After this, data was collected from 50 young female classical ballet dancers from Porto Alegre, of the same age as the previous group, average age 11.12±1.00, height 147.87±9.26 cm, weight 38.78±8.03 kg, practicing classical ballet for an average of 4 hours a week in the main ballet academies in Porto Alegre, RS, Brazil. The Cordoba group of young female dancers corresponded to 43% of the total population of the Cordoba Conservatory of Dance, and the Porto Alegre dancers corresponded to 8% of the total academies in Porto Alegre, the sample total being 110 subjects.

The age range of between 10 and 13 years was chosen due to the great importance of studying girls that practice dance at these early ages. There are very few large-scale comparative studies available in this field, and those available have a much more restrictive measurement protocol. We believe that a carefully studied sample may act as a reference group, sometimes considered as a prototype sample.

We chose the Cordoba Conservatory of Dance for its standing as an official school that follows a unique methodology and trains both teachers and dancers based on Organic Laws established by the Ministry of Education and Science *(MEC)* governing the General Education System in Spain *(LOGSE),* making it the most homogeneous and best monitored sample group. With regards to the selection of ballet schools in Porto Alegre, two schools were chosen for this study: one medium-sized and one small, both with high acclaim and well-reputed both in Porto Alegre and within the State of Rio Grande do Sul.

To proceed with the data collection, authorisation was requested from the Head of the Cordoba Conservatory of Dance and the owners of the Dance Academies in Porto Alegre to allow the study to be performed. The Centres that participated in the study were also asked to send a letter to the students' parents explaining the type of assessment concerned as well as an authorisation request allowing their daughters to be assessed, by means of a consent form in accordance with the ethical codes applied to research on people, under the 1975 Helsinki Declaration principles. We performed the study on the girls whose parents signed the consent form allowing them to participate in the study. The girls whose parents did not give their permission were not allowed to participate in the study.

Collecting data

A cross-cutting approach was developed regarding data collection. The technical team went to the Dance Schools, where they proceeded to set up all the materials and resources needed for measurement, in a room. The room temperature was controlled with heating or ventilation, ensuring that it was comfortable so that the girls would be relaxed.

The girls were assessed either before or after class; they were called to come half an hour before class started, or to stay a while after class given that many of the teachers did not give the girls permission to leave while their classes were underway.

During the assessment, first of all their identification details were taken. Next, the anatomical reference points were marked using a dermographic pencil, with the girls adopting the anatomical position (standing with the palms of their hands facing forwards) and finally came the assessment with measurements taken of the study variables.

As well as the identification variables of the individuals, of the chronological age and nationality variables, this study included anthropometric data regarding the somatotype, by measuring various blocks of anthropometric parameters, such as: body weight (kg), height (cm), skin folds (mm), muscular perimeters (cm), and bone diameter (cm). The subjects were always measured on the right-hand side of their bodies, following the instructions of the ISAK *(International Society of the Advancement of Kinanthropometry)*.

Materials and instruments

The materials and instruments used to take the data were:

- File-form (Proforma) designed based on the file created by the *Kinanthropometric Research Associates* from the *Simon Fraser University,* for the Montreal Olympic Games.
- Dermographic pencil to mark the anatomical reference points on the subject.
- Sesimax 130 weighing scale with 100gr precision.
- Aluminium Broca's Plane.
- Box or bench for anthropometry, 50x40x30 centimetres.
- Wall-mounted height-rod with 1mm precision.
- Slimguide model skin-fold calliper with 0.5mm precision.
- 1cm thick retractable metal sesmometer, with a mm scale.
- Flexible metal anthropometric tape.
- "Berfer" compass with an error of 0.5 cm, with two round-ended rods and the lower section displays the measurement in cm. It is used to substitute the anthropometer when measuring large diameters.
- "Berfer" pachymeter used for measuring small bone diameters. It has two curved rods ending in two flat surfaces allowing for a firm application on bone points. Given that the scale is displayed in mm, it has a magnifying glass to enhance the reading. The measurement is given in cm and the precision in millimetres.

Analysis of the Somatotype

One of the ways of studying the form and composition of the body is the somatotype, which gives us a more general overview of an individual's morphological characteristics. Although each of the components may be studied separately, the somatotype must be analysed as a whole so as to keep the information in context[14]. The somatotype or biotype is the current configuration of the individual that may change over the course of their life for different reasons or factors. It is always expressed numerically, and in this order: Endomorphic, Mesomorphic, and Ectomorphic[15]. Endomorphic is the term that comes from Endoderm, corresponding to Kretschmer's *Pyknic* body types, dominated by fat and the digestive tract (the morphological type of Sancho Panza). Mesomorphic comes from the term Mesoblast, corresponding to Kretschmer's Athletic type, dominated by the muscular-skeleton component. Ectomorphic comes from the term Ectoblast, corresponding to Kretschmer's Leptosomic type, typically longilinear and weak (morphological type of Quijote). This type predominantly conveys relative linearity (prevalence of height over weight).

The somatotype was determined by the Heath-Carter Anthropometric Method or Somatotypic Cineanthropometry. The numeric values of the three somatotype components were calculated using the Heath-Carter method (1990)[15].

Statistical analysis

For the statistical handling of the data, SPSS for Windows version 6.0 was used. The descriptive statistic was used (calculation of the average and standard deviation) and a comparative study was also carried out among the two groups of young female dancers (from Cordoba and Porto Alegre), using the Student T Test ($p<0.05$) to detect the presence of statistical differences between the girls and also between age groups.

Results

Table 1 displays the results of the average, standard deviation and p value of the somatotype values of the Young Cordoba Female Dancers (YCFD) and the Young Porto Alegre Female Dancers (YPAFD).

Table 2 displays the results of the average, standard deviation and p value of the somatotype values of the Young Cordoba Female Dancers (YCFD) and the Young Porto Alegre Female Dancers (YPAFD) by age.

Upon analysing the values of the somatotypes for the various ages and nationalities, it can be observed that the total number of young female dancers studied present a balanced mesomorphic somatotype (3-4-3), as with the Cordoba and Porto Alegre dancers combined (Table 1) and just the group of 13-year old Cordoba dancers (Table 2). The groups of 10-year olds from Cordoba and Porto Alegre revealed an endo-mesomorphic somatotype (Table 2). The Cordoba dancers aged 11 and 12 years presented an ecto-mesomorphic somatotype, as did the 11-year old dancers from Porto Alegre (Table 2). The 12-year old Porto

Table 1. Average, standard deviation (SD) and "p" value of the somatotype components of the young Cordoba and Porto Alegre female dancers.

	YCFD (n=60) Average±SD	YPAFD (n=50) Average±SD	Total (n=110) Average±SD	p
Endomorphy	3.29 ±1.03	3.59 ±1.01	3.43±1.03	0.13
Mesomorphy	4.32± 0.87	4.14 ±0.82	4.24±0.85	0.28
Ectomorphy	3.25±1.14	3.57±1.08	3.40±1.12	0.14

Table 2. Descriptive study of the somatotype components of the young Cordoba and Porto Alegre female dancers by age.

	YCFD 10 years Average ± SD	YPAFD 10 years Average ± SD	P	YCFD 11 years Average ± SD	YPAFD 11 years Average ± SD	P	YCFD 12 years Average ± SD	YPAFD 12 years Average ± SD	P	YCFD 13 years Average ± SD	YPAFD 13 years Average ± SD	P
Endomorphy	3.71±1.25	3.74±0.88	0.94	3.15±0.96	3.39±0.11	0.44	3.07±0.74	3.46±0.80	0.34	3.26±1.04	4.06±1.61	0.29
Mesomorphy	4.79±0.60	4.49±0.71	0.22	4.21±0.92	4.09±0.80	0.68	4.12±0.72	3.90 ±0.76	0.56	4.03±1.00	3.75±1.12	0.64
Ectomorphy	2.87±1.02	3.23±0.82	0.28	3.39±1.17	3.71±1.29	0.40	3.56±1.38	3.87±1.08	0.60	3.18±1.05	3.50±1.15	0.61

Figure 1. Somato-chart of the Young Cordoba Female Dancers.

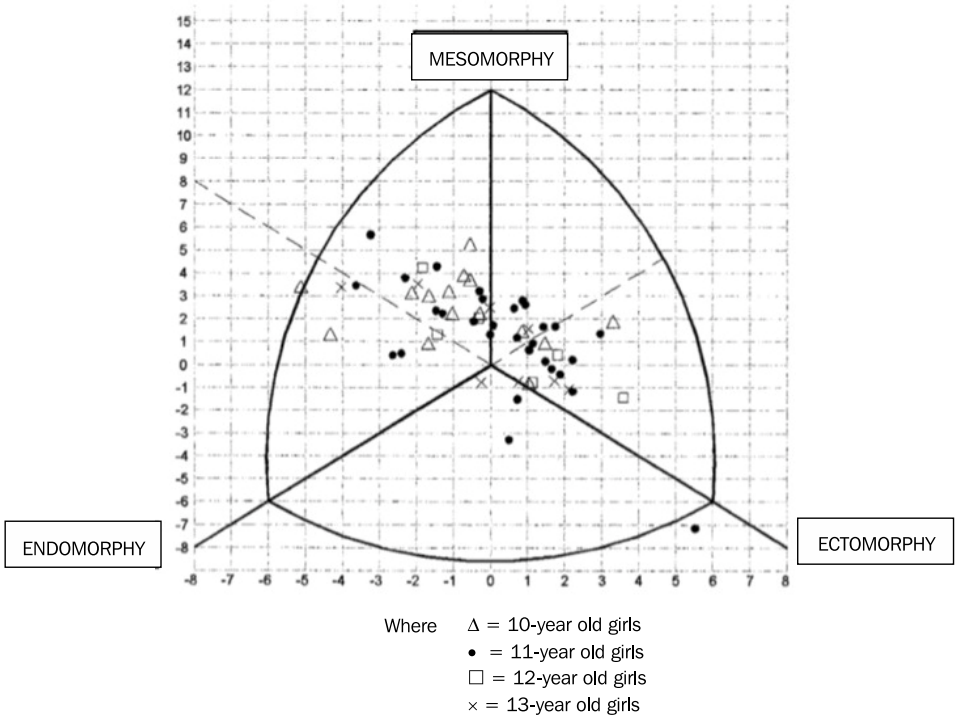
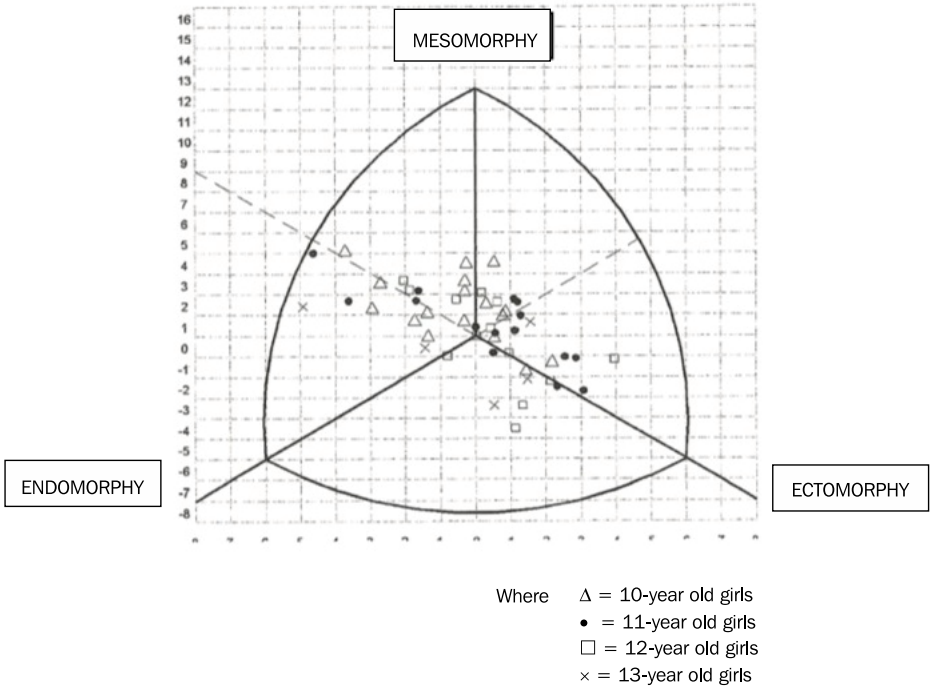


Figure 2. Somato-chart of the Young Porto Alegre Female Dancers.



Alegre group presented a mesomorphic-ectomorphic somatotype, as the mesomorphic and ectomorphic were the same and endomorphic was less; and the 13-year olds presented a meso-endomorphic somatotype (Table 2).

The p values indicate that no statistical differences were found between the young Cordoba and Porto Alegre female dancers in any of the somatotype components (Tables 1 and 2).

Figures 1 and 2 present the somato-charts of all the young Cordoba and Porto Alegre female dancers. The majority of the young female dancers from the two groups are positioned in the endo-mesomorphic, balanced mesomorphic and ecto-mesomorphic areas, predominantly featuring mesomorphic components.

Discussion

Upon performing a comparative study of the somatotypes of the two study groups, no significant statistical differences were found. Probably, the fact there are no differences is due to the rigorous training schedules and diets followed by the young female dancers, both in Cordoba and Porto Alegre, as well as the selection process they undergo to be accepted in the Cordoba Dance Conservatory. In the case of the Porto Alegre Academies, there is no entry selection process, as they are private academies. However, as the majority of girls enter at a very young age (between 3 and 5 years old), by the age of 10 a selection process has already been performed, as the girls that are still dancing are those that have resisted the rigorous training and demands put on them by their teachers in terms of keeping a very thin body type required to be a dancer[8].

Overall, the young Cordoba and Porto Alegre female dancers presented a balanced mesomorphic somatotype (Table 1). The prevalence of the mesomorphic component determines the domination of muscle mass in the majority of the groups, with the exception of the Porto Alegre 12-year old group, where there is a balance between the mesomorphic and ectomorphic components, and the Porto Alegre 13-year old group in which there is a prevalence of the endomorphic component (Table 2).

In the bibliography consulted there are very few studies that determine values for the somatotype of girls practicing classical ballet. Only the Claessens *et al.* (1987)[16] study was found, which determined the somatotype of North American classical female ballet dancers, of a similar age to those in this study (between 11.8 and 13.5 years old), undergoing 13 hours of training a week, also using the Heath-Carter Method.

Vásquez Cabrera *et al*. (2007)[17] also carried out a cross-cutting study of the somatotype of 38 professional Chilean dancers (16 men and 22 women), using the Heath-Carter Method, in which they established that the predominant somatotype of the female dancers was ectomorphic. These results are similar to the finding of the Claessens *et al.*[6] study, but they differ from the majority of the data taken from the female dancers in this study.

Betancourt *et al.* (2008)[18] also studied the somatotype of professional dancers using the Heath-Carter Method, using subjects from the *Ballet Nacional, Danza Nacional* and *Folclórico Nacional* companies in Cuba, with ages between 18 and 40 years. The somatotype of the ballet dancers was on average ecto-mesomorphic, and the most strongly represented somatotypical categories were balanced ectomorphic (50%), and ecto-mesomorphic (40%). These results are similar to those found among the Cordoba female dancers aged 11 and 12 years, and the 11-year old Porto Alegre dancers (Table 2), in which the average displayed is also an ecto-mesomorphical somatotype.

Twitchett *et al.* (2008)[19] studied the somatotype of 42 classical ballet students (31 women and 11 men) using the Heath-Carter Method, with the aim of establishing possible associations between the somatotype, the percentage of body fat and the nature of injuries. The study revealed a balanced mesomorphical somatotype, just as with the young female dancers studied (Table 1) and the group of 13-year old Cordoba dancers (Table 2).

Liiv *et al.*[20] compared the anthropometric, somatotypical and aerobic capacity variables of three groups of dancers (classical, contemporary and sporting dance). The results of the study indicate that there is a statistical difference between dance styles in endomorphy and mesomorphy, given that contemporary dancers have a greater muscle mass than classical ballet dancers, whilst sporting dancers are heavier and bigger. The authors conclude that the dancers of these three dance styles differ in somatotype, but they were not able to confirm that this was due to the type of training and/or selection. These results do not meet those found in this study, given that despite the different practices of the two dance styles (classical and Spanish dance), the young female dancers studied present a similar somatotype, and therefore there were no significant differences.

The doctoral thesis by Sanchiz Minguez (1989)[21] was the only work found in the literature encountered containing data regarding adult Spanish dancers. In this study the female dance group studied was formed of 12 dancers, in different modalities and with high technical levels, between 27.6 years ± 59.6 years of age. The average somatotypical values found, calculated using the Heath-Carter Method, were similar to those encountered in the young Cordoba and Porto Alegre female dancer groups that presented a predominantly mesomorphical component (Table 2).

Just as there is no homogeneity in the results of the cited studies, in general they establish a somatotype with a prevalent mesomorphic or ectomorphic component, determining a prevalence of the muscular-skeleton component (mesomorphic) and linearity (ectomorphic) in the dancers. This physical type is ideal for classical ballet, as the ballerina must be thin and longilinear to be able to express lightness and agility when executing the movements of this dance. In this respect, classical ballet attracts girls with specific body structures and features, requiring exceptional thinness[17, 22].

We would like to highlight that the data collected in this study may be used by dance teachers so they can deal with physical morphology aspects of young female dancers, with the objective of suggesting a suitable calorific intake for their students, so that they can maintain a high-level of performance and health, whilst remaining able to preserve the conventional figure of a talented dancer. The tables presented for each age and nationality may also be useful as references for future studies and for clinical applications.

Another noteworthy fact is that when comparing the results of the young female dancers studied with groups of young sedentary fema-

les, we came across a study carried out by Guedes & Guedes (1999)[23], performed upon 1,180 children and teenagers from the municipal of Londrina, Paraná, Brazil. In general, the somatotype of young Cordoba and Porto Alegre female dancers overall is different to the school-aged girls studied by Guedes & Guedes (1999)[23], because among the young female dancers from this study there was a predominantly mesomorphic component, with lesser and equal values for the endomorphic and ectomorphic components. This may be due to the training regime to which the young Cordoba and Porto Alegre dancers are subjected, which leads to the appearance of a more developed muscle mass, something that does not occur among the school-aged girls studied by Guedes & Guedes (1999)[23].

It is also important to highlight that this is the first time young Cordoba and Porto Alegre female dancers have been studied, achieving the quantification of somatotypical components, given that in scientific literature there are no studies featuring these characteristics.

Conclusions

After analysing the results obtained, comparing and discussing them, we can conclude that there were no significant differences in the somatotype of the two groups of young Cordoba and Porto Alegre female dancers studied, or in the age groups.

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Young women soccer players. Anthropometric and physiological characteristics. Evolution in a Sports season

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Summary

Background: Female's football has had a great improvement and in the number of players over the last decades. Our goal is to analyse both anthropometrical characteristics and physical capacity of young women football players, comparing our results with current literature and assess the evolution during a season.
Methods: 21 women football players were examined. All between 12-15 years old and used to train twice a week during 90 minutes each session; playing a match at the weekend as well. Players positions were not discriminated. They all passed a sports physical exam at the beginning and at the end of the study. This check-up included a thorough medical history, a physical exam, blood pressure, rest-electrocardiogram, anthropometry (weight, height, 6 skin-fold thickness) and the Astrand step test. Descriptive statistical analysis and paired means comparison were performed.
Results: We observed a weight gain, a growth in height and a rise in body fat percentage throughout the season. The average weight increased from 48.83 (8.17) to 52.82 (7.69) kg. Height augmentation was from 158.5 (6.19) to 160.7 (5.33) cm, and body fat percentage moved up from 14.7 (3.84) to 16.9 (3.98) %. Maximal oxygen uptake incremented from 42.95 (6.13) to 44.58 (9.37) ml/kg/min. The body fat percentage results are slightly lower than reference values in senior elite women football players (17.5-28.3%) while maximal oxygen uptake is lower than reference range for European women elite football players (47-57 ml/kg/min).
Discussion and conclusions: The results concerning weight (p<0.0001), height (p<0.0001), body fat percentage (p=0.002) and absolute values of maximal oxygen uptake (p=0.009) are statistically significant. Given the age of the players, it is difficult to attribute which part of these results is due to growth itself and which one is due to training.

Key words:
Football. Anthropometry. Maximal oxygen uptake (VO_2 max).

Fútbol femenino categorías inferiores. Características antropométricas y fisiológicas. Evolución a lo largo de una temporada

Resumen

Introducción: El fútbol femenino ha experimentado un importante aumento de practicantes en las últimas décadas. Se aportan datos antropométricos y de condición física de jugadoras de fútbol en formación valorando su evolución a lo largo de una temporada y comparándolos con los existentes en la literatura.
Material y métodos: Se estudiaron 21 jugadoras de edades comprendidas entre 12 y 15 años, que entrenaban 2 días/semana, 90 minutos/sesión, más el partido del fin de semana. No se diferenció por posiciones en el terreno deportivo. Todas ellas realizaron un examen médico-deportivo al inicio y al final del estudio, que incluyó: anamnesis, exploración física, tensión arterial, ECG de reposo, antropometría (peso, talla, 6 pliegues) y Test de Banco de Astrand. Se realizó estudio estadístico descriptivo y comparación de medias para datos apareados.
Resultados: A lo largo del año se observa un aumento del peso: media de 48,83 (8,17) a 52,82 (7,69) Kg, de la talla: media de 158,5 (6,19) a 160,7 (5,33) cm , del % de grasa: media de 14,7 (3,84) % a 16,9 (3,98) % y un aumento del VO_2max: media de 42,95 (6,13) a 44,58 (9,37) ml/Kg/min. Los valores del % de grasa son algo inferiores a los descritos en jugadoras de categoría senior de equipos de elite (rango de 17,5-28,3%), mientras que el VO_2max se sitúa por debajo del rango de referencia para jugadoras europeas de elite (47-57 ml/kg/min).
Discusión y conclusiones: Las diferencias halladas entre los dos controles son estadísticamente significativas en el peso (p<0,0001), talla (p<0,0001), % graso (p=0,002) y VO_2max en valores absolutos (p=0,009) y no en valores referidos al peso. En las edades objeto de estudio es difícil atribuir en qué proporción estas variaciones se deben al crecimiento y desarrollo y que parte al entrenamiento físico.

Palabras clave:
Fútbol femenino. Antropometría. VO_2 máx.

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Introduction

The practice of women's football has increased significantly over the past decade, both on a national and international scale. The number of licences in 2003-4 was 13,582, and in 2012-13 this figure reached 28,129, spelling a 52% increase in licences in 10 seasons[1].

Football is an acyclic sport with a high number of non-linear actions and interactions, resulting from the execution of technical-tactical variables of speed, space and time. It is an intermittent sport, in which efforts are made employing varying degrees of intensity with unpredictable recovery times, encompassing situations in which the player is stopped, walking, jogging or sprinting[2,3].

As a result of the interest emerging from the increase in very young female football players, studies and research projects have been undertaken with the aim of bringing us closer to the before now unexplored reality of the morphological and functional characteristics of these sportswomen.

According to Ekblom[4], weight, height and fat percentage elements are not essential for playing football well. This is due to the lack of specific features among footballers, given that the range of values observed is very wide.

Despite the majority of research carried out till now being based on describing the anthropometric and physiological characteristics of players[5-8], studies have begun to emerge regarding the development and requirements of competition[9].

Studies of the anthropometric and functional profile of female Spanish football players are scarce, making it difficult to find reference values to these effects, though this does not occur on an international level. Along with the scarcity of bibliographic references, it should also be noted that one of the distinguishing features of football is the existence of diverse types of players, with vastly different performance shown by footballers with a similar typology[10].

Our aim is to discover the state of physical fitness of the players at the Reus Deportiu Football School, and to evaluate their possible modification and evolution throughout a season as a result of the training process as well as growth and maturity, and to compare the results with existing literature.

Material and methods

Sample

The sample studied is made up of 21 female field players aged between 12 and 15 years (average 13.48 in the first control and 14.03 in the second control), belonging to the Reus Deportiu Football School. The players trained over 10 months, 2 days a week for 90 minutes each day, as well as competing in weekly matches and competing in the Catalonian Women's First Division for their age-group.

Procedure

The parents and players were informed about the methodology and objectives of the study, and their corresponding informed consent was required for participation. Two controls were carried out, the first for the pre-season (September) and the second during the competition season (April), which included:

- Medical-sport test: anamnesis, physical exploration using apparatus, blood pressure and resting electro-cardiogram.
- Anthropometric study following the regulations set by the International Society for the Advancement in Kineanthropometry (ISAK) and the Spanish Cineanthropometric Group (GREC), taking measurements of weight, height, six skinfolds (triceps, sub-scapular, abdominal, supra-spinal, anterior thigh, medial leg) to determine the fat % using the Yuhasz formula[11].
- Sub-maximum effort test, Astrand bench test, using a 33-cm high bench, which participants had to get on and off for five minutes at a rhythm of 22.5 times a minute to the pace of a metronome, with a constant cadence, with continuous electrocardiographic monitoring and a recorded blood pressure. This allowed for a reliable assessment of the participant's clinical condition, heart-rate response, blood pressure response to the sub-maximal effort, and their aerobic condition via the indirect calculation of oxygen consumption.

Material

- Anthropometric: Añó Sayol Weighing Scale (0-150 kg, 100 gram accuracy) and Añó Sayol height measuring rod (55-200 centimetres, 1 millimetre accuracy). Holtain Skinfold calliper (0-40 mm; 0.2 mm accuracy). Dermographic pencil. Anthropometric box.
- Astrand bench test: 33-cm high bench, EK-41 Hellige Cardiotest and Hellige Servomed Monitor, Taktell Piccolo Wittner Serie 830 Metronome, Riester Sphygmomanometer. Casio Stopwatch. Vo_{2max} estimate using the Astrand and Ryhming Normogram.

The data was handled using the Student t and the two controls were checked using the Wilcoxon test for non-parametric paired data.

Results

Table 1 displays the average values for weight (Kg), height (cm), body mass index (BMI, in Kg/m^2) and body fat percentage. We can see that over the season there was an increase in weight, height and BMI, with a statistical significance of $p < 0.0001$ and the fat percentage with a statistical significance of $p < 0.002$.

Table 2 displays the average values of the six skinfolds studied, revealing an increase in the second control when compared to the first in all skinfolds, with a statistical significance in all of $p < 0.0002$.

In the Astrand bench test, improvement was achieved over the season in the maximum VO_2 in absolute value (1/min) with a statistical significance of $p < 0.0095$, but not in values relating to weight ($p < 0.4576$). No significant differences were found in the final blood pressure and final heart-rate frequencies. Table 3.

Table 1. Anthropometric characteristics of the sample.

	Weight 1	Weight 2	Height 1	Height 2	% Fat 1	% Fat 2	BMI 1	BMI 2
Average	48.83	52.82	158.53	160.77	14.70	16.91	19.41	20.44
SD	8.17	7.691	6.21	5.33	3.84	3.98	7.53	8.17
Significance	p<0.0001		p<0.0001		p<0.002		p<0.0001	

SD: Standard deviation; Weight 1, Height 1, % Fat 1, BMI 1: Control September; Weight 2, Height 2, % Fat 2, BMI 2: Control April.

Table 2. Evolution of skinfolds.

Skinfolds	Average	SD	Significance
Triceps 1	11.66	2.98	
Triceps 2	14.33	3.89	p<0.0002
Sub-scapular 1	8.04	2.42	
Sub-scapular 2	9.51	2.56	p<0.0002
Suprailiac 1	7.75	4.32	
Suprailiac 2	9.88	4.91	p<0.0002
Abdominal 1	14.24	7.87	
Abdominal 2	16.25	7.26	p<0.0002
Anterior thigh 1	12.57	5.87	
Anterior thigh 2	14.53	6.01	p<0.0002
Leg 1	18.31	3.66	
Leg 2	21.44	5.44	p<0.0002

SD: Standard deviation; Triceps 1, Sub-scapular 1, Suprailiac 1, Abdominal 1, Thigh anterior 1, Medial leg 1: Control September; Triceps 2, Sub-scapular 2, Suprailiac 2, Abdominal 2, Thigh anterior 2, Medial leg 2: Control April.

Table 3. Evolution of the Astrand Test variables.

Astrand Test Variables	Average	SD	Significance
Systolic arterial pressure 1	130.72	12.72	
Systolic arterial pressure 2	128.8	16.73	
Diastolic arterial pressure 1	49.29	13.44	
Diastolic arterial pressure 2	56.67	10.17	
Final heart rate 1	156	12.46	
Final heart rate 2	154	15.91	
Max.VO2 (l/min) 1	2.09	0.41	
Max.VO2 (l/min) 2	2.33	0.51	P<0.0095
Max. VO2 (ml/Kg/min) 1	42.95	6.13	
Max. VO2 (ml/Kg/min) 2	44.58	9.38	P<0.4576

SD: Standard deviation; 1: Control September. 2: Control April.

Table 4. Anthropometric characteristics of female football players, Average (SD).

Authors	Country	Sample (N)	Age (years)	Height (cm)	Weight (Kg)	% Fat
Wilhers RT, *et al* (1986)	Australia	10	24.4 (4.5)	158.1 (5.7)	55.4 (6.5)	20.8 (4.7)
Davis JA, Brewer J (1992)	England	14	24.5 (3.6)	166.0 (6.1)	60.8 (5.2)	21.1 (3.6)
Rhodes Ec, *et al* (1992)	Canada	12	20.3	164.8	59.5	19.7 (4.0)
Tumilty D, Darby S (1992)	Australia	20	23.1 (3.4)	164.5 (6.1)	58.5 (5.7)	19.7 (4.0)
Jensen K, Larsson B (1993)	Denmark	10	24.7	169	62.2	20.1
Reiter L, *et al* (1996)		11	23.8 (2.9)			23.8 (4.6)
Tamer K, *et al* (1997)	Turkey	22				18.3 (1.71)
Rico-Sanz J (1998)						21
Scott D (2002)	England	26	22.2 (6.2)	163.2 (5.7)	63.3 (6.2)	24.2 (3.8)
Todd MK, *et al* (2002)	England	120	22.6 (5.9)	163.4 (5.9)	61.8 (6.7)	24.4 (3.9)
Clark M, *et al* (2003)	EEUU					16.1-16.4
Sieger, *et al* (2003)		17	16.49 (0.91)	167.42 (4.64)	61.46(9.43)	12.13 (4.66)
Polman R, *et al* (2004)	England	12	21.2 (3.1)	163 (0.65)	64.5 (6.2)	26.7 (2.87)
Can F, *et al* (2004)	Turkey	17	20.73 (2.09)	162.4 (4.64)	56.63 (5.03)	19.75 (0.69)
Garrido, *et al* (2004)	Spain			160.77		14.76
Gómez M, *et al* (2006)	Spain	52	20.73 (4.34)	163.0 (0.06)	59.1 (8.14)	16.01 (3.08)
Ramos JJ, *et al* (2007)	Spain	20				14.6 (2.4)
Sedano S, *et al* (2009)	Spain	90	19.91 (3.70)	161.39 (1.04)	61.20 (1.59)	29.35 (1.15)
Sedano S, *et al* (2009)	Spain	100	21.25 (3.71)	161.30 (0.66)	57.88 (0.81)	21.88 (0.97)
First control sample study	Spain	21	14.64 (0.75)	158.53 (6.21)	48.83 (8.17)	14.70 (3.84)
Second control sample study	Spain	21	15.06 (0.74)	160.77 (5.33)	52.82 (7.69)	16.91 (3.98)

Discussion

Table 4 displays the anthropometric values described in the bibliography. It is worth being cautious when comparing this data, given that the differences found may be due to the different measurement techniques and formulas applied to obtain them, as well as the heterogeneity of the groups studied (number, age, weight, height, and sporting level).

Table 5. Max. VO2 (ml/Kg/min) in female football players. Average (SD).

Authors	Country	Sample (N)	Age (years)	Max. V02 (ml/kg/min)
Colquhoun, *et al.* (1986)	Australia	10		47.9 (8.1)
Davis JA, Brewer J (1992)	England 1	14	24.5 (3.6)	48.4 (4.7)
Davis JA, Brewer J (1992)	England 2	14		52.2 (5.1)
Tumilty D, Darby S (1992)	Australia	20	23.1 (3.4)	48.5 (4.8)
Jensen K, Larsson B (1993)	Denmark	10	24.7	53.3-57.6
Rhodes EC, *et al.* (1992)	Canada	12		47.1 (6.4)
Evangelista M, *et al.* (1992)	Italy	12		49.76 (8.3)
Tamer K, *et al.* (1997)	Turkey	22		43.15 (4.06)
Miles A, *et al.* (1993)		10		42.5
Reiter L, *et al.* (1996)		11		42.4 (6.1)
Hoare DG, *et al.* (2000)	Australia	17		39.4 (4.3)
Tumilty D (2000)	Australia	17		50.3 (5.1)
Helgerud J, *et al.* (2002)	Norway	12		54 (3.54)
Todd MK, *et al.* (2002)	England	120		44.8 (5.8)
Polman R, *et al.* (2004)	England	12		38.6 (3.72)
Aracheta C, *et al.* (2006)	Spain	10	20.3 (3.8)	45.1 (6.3)
Scott D, *et al.* (2007)		14		53.4 (3.8)
First study sample control	Spain	21	14.64 (0.75)	42.95 (6.13)
Second study sample control	Spain	21	15.06 (0.74)	44.58 (9.38)

England 1: Pre-season; England 2: During season.

According to Ekblom[4], weight and height elements are not essential for playing football well, as the range of values observed is very wide and because no features specific to footballers have been described.

It would seem that being taller, as in other sports, can be advantageous in certain positions. This variable oscillates between 158.1 and 169 centimetres, a parameter within which the entire sample is included, though nearer the lower rather than the upper range[12].

The height registered falls below that obtained from female footballers in other countries[5,6,13-20]. Results can be found that are similar to those described among female Spanish footballers[8,21,22]. It would be interesting to analyse the height patterns of the general population in the countries where these studies were carried out, to see if there are any differences or if they are limited exclusively to the field of female footballers.

When comparing the weight of the female footballers from our sample, we encountered identical data as that found for height comparison.

The same occurred with the starting and end fat percentages, which are lower than those described in female Spanish football players[8], and female players from other countries[4,6,14-18] and similar to those referred to by Garrido *et al*.[21] and Ramos *et al*.[22] among female Spanish footballers and Clark e*t al*.[23] among female North American University footballers.

As we can see in Table 5, the maximum VO2 obtained in the two controls is within the range described in the bibliography for footballers of different ages and sporting levels: 39.4 -53.4 ml/Kg/min; the oxygen consumption described by Bangsbo[24] of 61 ml/Kg/min is not considered to be a benchmark reference, as it was an isolated case in one female player. The values are similar to those obtained by Reiter *el al.*[19], Rhodes *et al.*[20], Todd *et al*[25], Miles *et al*.[26], Tamer *et al*.[14] and Aracheta *et al.*[27], higher than those from Hoare and Warr[28], Polman *et al*.[29] and lower than those from Jensen and Larson[6], Tumilty and Darby[14], Colquhoun and Chad[30], Evangelista *et al*.[31] and Scott and Drust[32].

Conclusions

The development of female football, on the one hand requires actions aimed to promote the practice of this sport, and on the other, a specific knowledge of women as sportswomen and footballers. Some of the research carried out till now falls within the second field.

The differences found in our study between the first and second control, should not be over-valued, as they may be equally due to the process of maturity, growth and development that influences sporting performance, as well as training. Therefore, selecting sportswomen of this age for having higher oxygen consumption and/or a lower level of body fat as predictive performance factors may exclude players that mature later.

The fat percentages are difficult to compare with other studies, because the methodology used is not the same.

The maximum oxygen consumption obtained in the second control is similar to reference data from football players described in the literature.

The studies carried out with female football players, and the heterogeneity discovered regarding their characteristics, suggest that perhaps there are no features specific to female footballers.

Various publications[3,29] conclude that a combination of suitable training in volume, intensity and specificity, and balanced nutrition could lead to improvements in the physical composition and aerobic process of female football players.

Carrying out a comprehensive assessment protocol of the physical condition of the footballer at the start of the season becomes paramount if we wish to successfully plan and customise the responsibilities of the sportswomen when it comes to the competitive season.

The regular and developmental control of these female players is useful for, wherever possible, reaching reference values.

We believe that it would be interesting to study female footballers depending on their position on the pitch, in order to define the characteristics that are specific to female footballers in particular positions.

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Survey of safety requirements for swimming pools associated with accidents through the jurisprudence

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Summary

Jurisprudence has considerable interpretive value in understanding how health regulations are applied to swimming pools. As such, it is of unarguable interest to focus on the most outstanding aspects that have required legal resolution due to the impact on the health of swimming pool users. A comparative examination of 23 legal disputes has allowed us to explore the assessments of the main technical-health requirements that the courts of justice draw from when acknowledging a causal link between these and the injuries incurred at swimming pools. The typical profile of a swimming pool accident victim was identified to be a healthy adult suffering injury to the lower extremities following a slip and subsequent fall on a walkway area around the swimming pool. Injuries were also observed following thoughtless or negligent behaviour by the swimmer. In this study, various legal appraisals were investigated and we offer reliable technical criteria regarding health requirements for publically used swimming pools in Andalusia involved in the occurrence of accidents, analysing technical concepts and non-compliance with regulations put forward in the most recent jurisprudential rulings. From the court rulings examined in the context of swimming pool safety, it would appear highly advantageous to review the assessment criteria regarding the scientific-technical parameters associated with the causes of injuries, with the aim of proffering a greater degree of specification by incorporating established international rules that contribute a higher level of legal safety in protecting the rights of users.

Key words:
Swimming pool. Accident. Prevention. Safety. Case reports. Jurisprudence (source: MeSH, NLM).

Examen de requisitos de seguridad de piscinas asociados con accidentes a través de la jurisprudencia

Resumen

La jurisprudencia tiene un notable valor interpretativo para comprender cómo se aplican los reglamentos sanitarios sobre piscinas. Por ello es de indudable interés fijarse en los aspectos más sobresalientes que han tenido que ser resueltos judicialmente por su impacto en la salud de los usuarios de este tipo de instalaciones acuáticas. El examen comparativo de 23 conflictos judiciales nos permitió indagar en la valoración de los principales requisitos técnico-sanitarios que sirven como fundamento a los tribunales de justicia, para admitir su nexo causal con las lesiones derivadas de accidentes ocurridos en piscinas. El perfil típico de la víctima por accidente en una piscina quedó caracterizado por un adulto sano que sufre lesiones en la extremidad inferior, después de caerse por un resbalón en una zona de tránsito en el entorno del vaso. También se observaron lesiones derivadas de un comportamiento irreflexivo o culposo del bañista.

En este trabajo se cuestionan diversas apreciaciones en sede judicial y proporcionamos criterios técnicos fiables sobre requerimientos sanitarios para piscinas de uso colectivo de Andalucía implicados en la producción de accidentes, analizando conceptos técnicos e incumplimientos normativos esgrimidos en los pronunciamientos jurisprudenciales más recientes. De las resoluciones judiciales examinadas en el contexto de la seguridad de las piscinas surge la conveniencia de revisar los criterios valorativos acerca de los parámetros científico-técnicos asociados con las causas de las lesiones, procurando dotar mayor grado de concreción con la incorporación de normas internacionales asentadas que aporten mayor seguridad jurídica en la protección de los derechos de los usuarios.

Palabras clave:
Piscina. Seguridad. Accidente. Prevención. Informe de casos. Jurisprudencia (Fuente: MeSH, NLM).

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Introduction

The radical technological development of swimming pools over recent years has led to a major revolution in the devices, equipment and techniques used with the aim of creating safe environments and preventing public health risks. The presence of danger in these environments and coexisting alongside the risks emerging from modernisation and human behaviour constitute an unavoidable phenomenon. Even so, the activities that take place at swimming pools often involve a certain degree of risk that is voluntarily accepted as "normal", though in other cases the risks are unknown, unexpected, or simply misunderstood.

This reality has given rise to the intensive monitoring of swimming pools by public administration health departments, as well as the development of an exhaustive and varied legislation, covering each environmental and health aspects separately or drawing them together with safety or constructive aspects. All this has created a complex regulatory landscape, which proves difficult for citizens, professionals, companies and legal practitioners to fathom, hindering the development of a comprehensive approach on public health safeguarding strategies.

Recently, on a state level, a swimming pool health regulation was passed[1], following over 50 years under the previous system[2], which had not been updated since 1960. Over this long period, apart from some new provisions included in the technical construction code[3], the autonomous communities had acted as legislators, which by legitimately using their competencies, established additional protective health measures, legally approved rules to regulate the technical-health conditions of collectively used swimming pools, eventually creating a preventive instrument to safeguard public health.

One of the most adverse health outcomes that arises from the use of swimming pools are accidents to swimmers[4], which with varying degrees of severity, have resulted in multiple compensatory complaints against facility owners, whether natural or legal entities, or Public Administrations, grounded on the alleged liability which they incurred. In this respect, protecting public health is bound to be conditioned by the interpretation of the rules regulating this type of leisure facility by public authorities.

The importance of the issue presented has given rise to wide-spread legal unrest that has caused a sustained jurisprudence in various jurisdictional divisions. From this point, when trying to obtain an adequate application of health regulations for swimming pools, it may be useful to look at the most recent jurisprudence to understand how the technical regulations for swimming pools have been configured.

The aim of this study was to provide some interpretive criteria from disputes that have been settled in different legal institutions, regarding the technical-health requirements of swimming pool facilities involved in the occurrence of accidents. To do so, we draw upon the characterisation and causal analysis of the accidents identified in court decisions regarding health regulations in force for public swimming pools in Andalusia[5], excluding legal analyses, which would require a specific study.

Method

Design

Observational. The *study type* consisted in a descriptive analysis. The basic investigation unit was the court ruling, defined as the ruling o jurisdictional act that *"definitively decided the litigation or grounds, in any instance or appeal, or when according to the procedural laws they should be this way"*[6], indexed in a national legal database. As source of identification for the documents, the legal database at the Centre for Judicial Documentation of the General Council of the Judicial Branch in Spain was used. Access to this database was made during March 2013, using the CENDOJ jurisprudence system search engine.

Sample studied

The analysis was chronologically limited to the period 1999-2012, both included, within the region of the Autonomous Community of Andalusia. The search strategy to capture the court rulings was fundamentally based on the "search text" field with the description (accident AND swimming pool). The search results produced 23 court rulings to be analysed.

Inclusion criteria

Only the records that identified accidents with injuries occurring at swimming pools and aquatic parks were selected, in the field of application of current swimming pool health regulations.

Main measurements

Based on the analysis of the contents and by extracting information from court rulings, a database was created to study the following variables: judicial body, procedural field, location, province, year/resource, swimming pool type, no. of victims, sex, adults/minors, physical activity (that the victim was carrying out just before the accident took place), deviation (description of the unusual occurrence that took place in order for the accident to happen), form of accident (the way the victim was injured by the physical agent that produced the injury), physical agent (element or object with which the victim had an accident), part of the body injured and description of the injuries. Essentially, the classification conforming to NTP 592 (Technical Prevention Notes) was used to codify the fields, governing document handling and the investigation into accidents of the National Occupational Health and Safety Institute[7].

Analytical procedure

Two parallel and complementary strategies were used in a causal analysis by, on the one hand, identifying the circumstances and/or behaviours that could lead to the occurrence of an accident, and on the other hand, the setting and limiting of parameters or technical requirements of the swimming pool facilities employed by the different legal bodies in their respective decisions.

Statistical handling

A quantitative analysis was carried out and different graphic presentations were produced (tables, bar charts, pie charts), using the Microsoft®Excel 2010 v.14 for Windows 7 software. To ensure data quality control, revision was carried out in pairs to correct possible errors in data entry.

Results

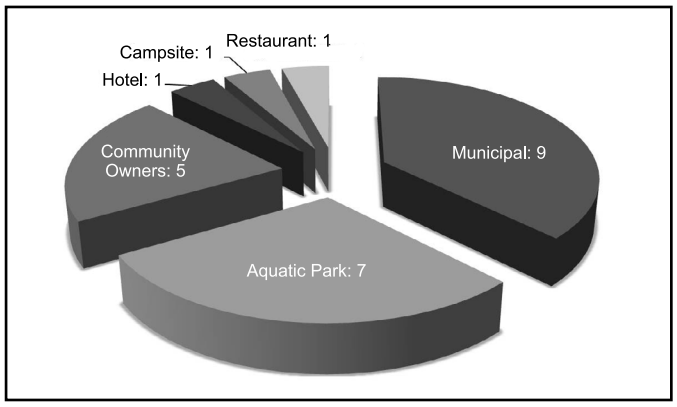
The court rulings analysed mainly corresponded to civil procedures (n=16), followed by contested administrative procedures (n=5) and two in the criminal field, issued mainly by the Provincial Court (n=18) and in 5 cases by the Superior Court of Justice in Andalusia.

Behind the cases there were 4 mortal victims, minors, with equal division in sexes. Three deaths were caused by drowning and one from a dive. In 8 cases the accidents had an aftermath. In 7 sentences no details were provided regarding injuries, however diverse injury patterns were identified. The most frequent diagnosis was bone fracture, mainly to lower extremities. In two cases the drowning mechanism was not specified (submersion-asphyxia, submersion-inhibition), and in the third, cardio-respiratory arrest was diagnosed through water on the lungs. Table 1 displays the relationship between the injuries extracted from the database, compensation acknowledged on one occasion for psychological damages occurring as a result of injuries suffered.

The majority of the swimming pools were privately owned (n=14) compared to public swimming pools (n=9). In the latter, all the accidents occurred in municipal facilities, whereas in the private pools, 7 occurred in aquatic parks (Figure 1).

The activity the victims were carrying out just before the accident (Figure 2) cannot be classified as dangerous, with the most common activity being walking near the pool (n=8) or going up the pool steps (n=2), compared with actions with an intrinsic risk, such as going down a slide (n=5). The anomalous event that is most frequently associated with accidents was slipping and falling on a level surface (n=8); three cases of drowning were identified; whilst in 3 cases the judges ruled that the impacts that occurred were incidental. In accordance with the aforementioned, the most common way an accident was produced was by coming into contact with a slippery surface (n=10), followed by an impact against a surface (n=5), with the least frequent being the inhaling of chemical substances resulting from the creation of a cloud of toxic gas due to an incompatible chemical mixture (Figure 3). The physical agent associated with the form of contact describes the facility element with which the victim incurred an injury, not implying the existence of a causal connection, the most common being even-levelled walkways, the bottom of the pool, and slippery floors (Table 2).

Figure 1. Accidents by swimming pool type.



In analysed 12 cases, deficiencies in the facilities were mentioned, but only 5 of them were related, in the judgement of the courts, to the events that led to the accident. Among the most litigated technical requirements, the slippery nature of surfaces stands out (n=12), followed by professional and organisational aspects relating to the task of surveillance by lifeguards (n=4) and/or monitors (n=2). The technical requirements breached that founded the attribution of liability, included incorrect lifeguard surveillance, inadequate anti-slip properties of floor surfaces, deficient maintenance of the facilities, and insufficient abilities of an operator. Mention was made on only 6 occasions to the drawing up of expert reports, of which 5 refer to assessing the anti-slip properties of the floor or paving where the swimmer was moving when the accident occurred.

In more recent jurisprudence, it is indicated that the causal link between the incurrence of injury and the behaviour of the agent is

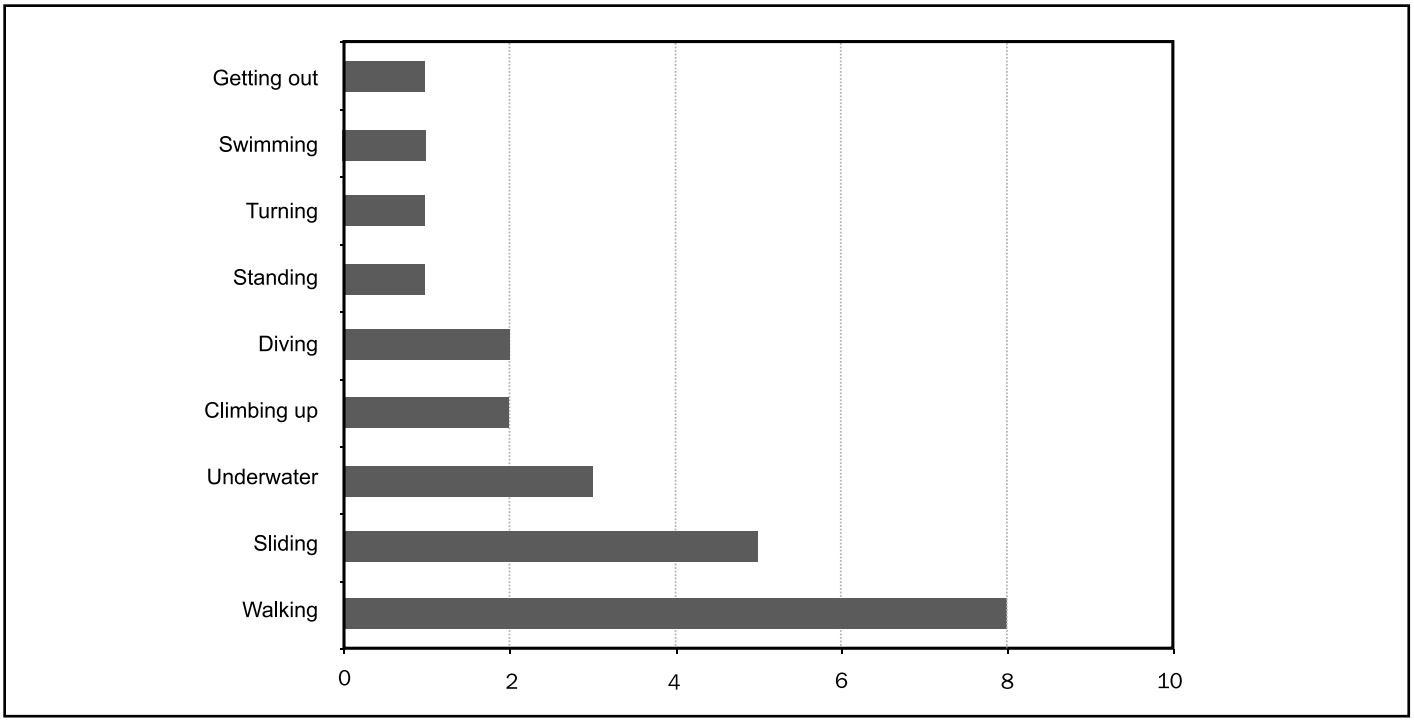
Table 1. Description of the injuries.

Type	n	Injured part of the body	n
Bone fracture	7	Non-specified body parts	7
Drowning and mortal submersion	3	Lower extremity	7
Open wounds	2	Head	6
Dental fracture	2	Thoracic region, including organs	4
Internal injuries	1	Back	2
Mortal cranial-encephalic trauma	1	Neck	1
Dislocations, severe sprains and twists	1	Upper extremity	1
Psychological damage	1		
Severe intoxication	1		

Table 2. Description of the accident.

Physical agent	n	Deviation	n
Surface below ground level (bottom of the pool)	5	Slip with a fall on the same level	8
Level surfaces or walking areas	5	Incidental impact	3
Slippery floor	3	Drowning	3
Water	3	Untimely movement	2
Humans	2	Dive	2
Electrical installation (spotlight)	1	Slip with a fall on a different level	2
Handrail on a different height	1	Standing on a sharp object	2
Gaseous chemical substances	1	Formation of toxic gases	1
Steps	1	Uncoordinated movement	1
Ladder	1		

Figure 2. Activity of the swimmer prior to the accident.

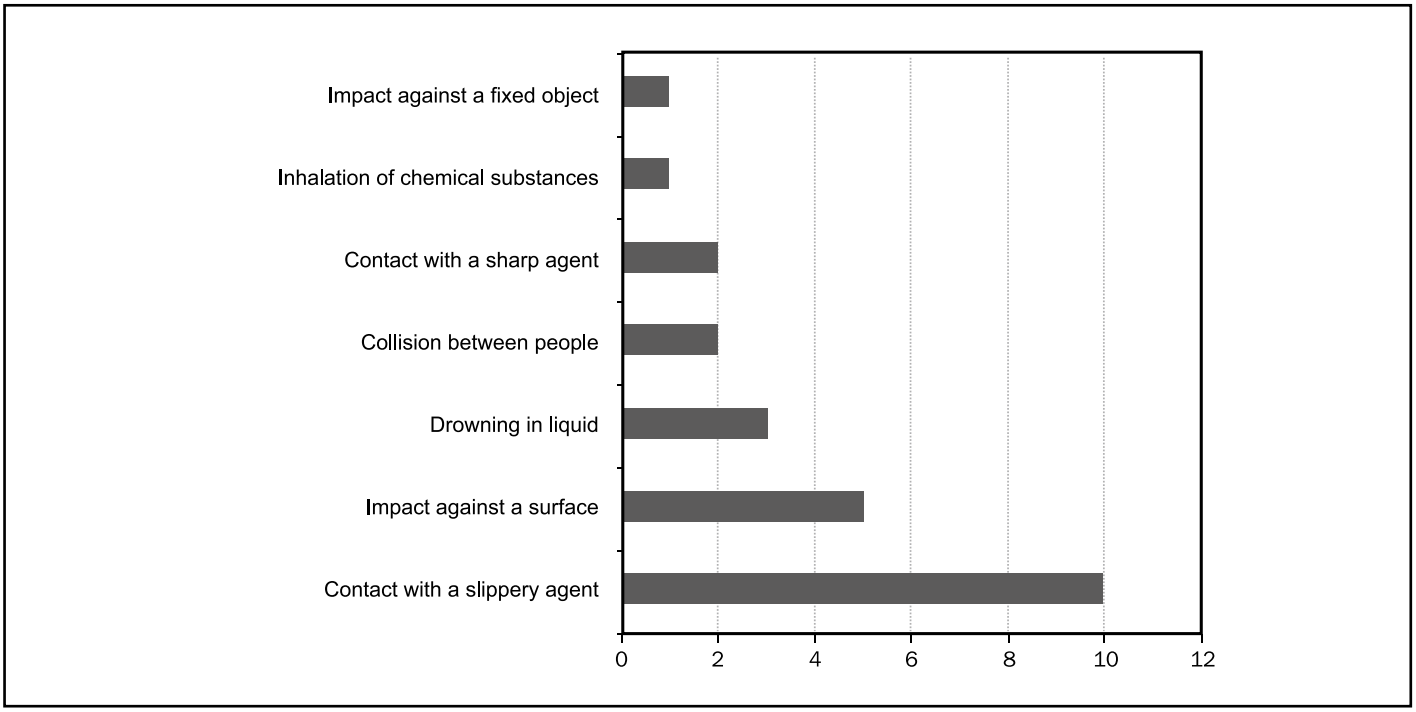


a legal matter, for example, that the service operation was normal or unusual would be considered irrelevant. In order to determine the causal link, it must be supported by some evidential certainty, which cannot be undermined by a possible application of the risk theory, the objectification of responsibility or the reversal of the burden of proof[8]. With regards to anti-slip characteristics, no causal link was found in 8 of the 12 demands for falls associated with slippery floors or surfaces. In these cases, the courts allow carefully considered individual factors that indicate that the victim may have provoked the accident by behaving in a thoughtless, distracted or reckless way.

The aetiology of the submersion is not featured in 2/3 of the drowning cases, for example, through interrupted digestion, apnoea, diving or resistance under the water; whilst in one case it was specified that the cause of death was asphyxia through breathing underwater. Of the three accidents with this motive, one was produced in the presence of a lifeguard who did not have an exclusive job title (shared job assignment as a gardener, concierge, cleaner and maintenance worker); another occurred without the presence of a contracted lifeguard, and in the third case, the sentencing court attributed part of the liability to the lifeguard for insufficient, though not negligent, surveillance of the swimmers.

In the accidents associated with the use of the slide, none of them was due to the poor state of the surfaces, joins, side edges or flaps, rather linked to the impact, whether incidental or not, between people and surfaces in the reception area.

Figure 3. Physical agent associated with the accident form.



A lack of due care or reckless behaviour of the injured swimmers was present in 10 cases (Table 3).

Table 3. Causal analysis of the accidents.

Act/Unsafe condition	n
Not paying attention	7
Slippery walkway floor surface: deficient maintenance	4
Incidental accident: chance	3
Reckless conduct	3
Sharp material: inadequate maintenance	2
Deficiency in taking on or interpreting instructions	2
No lifeguards	1
Lack of response by lifeguard	1
Insufficient lifeguard monitoring	1
Negligent conduct: collision between people	1
Human error: incompatible mixture of chemicals	1

Discussion

Injuries associated with using swimming pools still constitute a pertinent public health issue, in terms of human injury and economic losses. 24 episodes of injury-incurring accidents in swimming pools and aquatic parks have been identified, corresponding to a 12 year period of judicial rulings.

By analysing the data it was possible to describe the typical profile of a swimming pool accident victim, as a healthy adult, suffering injuries to the lower extremities following a fall caused by slipping on a walkway in the vicinity of the pool.

The victims were equally distributed in terms of sex and age (adults/minors), though they varied depending on the type of accident. All drowning cases occurred in the paediatric age group, indicating that the infant population is a particularly vulnerable group to this type of process[9]. Accidents associated with slipping on slides predominantly occurred with males, which indicates behavioural risk factors and health consequences may differ by sex[10-12].

Falls caused through slipping were more common among adults, representing the most frequent cause for the described injuries in people of advanced age[13,14], where factors such as a decrease in psychophysical aptitudes lead to a greater chance of accidents.

The most represented type of swimming pool was the municipal pool, where a greater level of responsibility and demand is expected regarding the protection of users, versus the provision of services, in accordance with the health authorities in the field of swimming pools assigned to Public Administrations.

Accidents in swimming pools may result in serious injuries, develop an aftermath, and constitute a major cause of morbidity. Falls were the main reason behind the injuries incurred, and slipping was the prevailing mechanism behind these falls. Tripping or losing balance due to discontinuities or irregularities in flooring (joins, unevenness, grooves, relieves, floor covers, etc.) are not mentioned. Injuries to the lower extremities and to different parts of the head were mainly associated with slips that occurred on surfaces that were wet or in contact with water.

Jurisdictional theses regarding the technical criteria required to understand how a non-slip floor affects the safety of swimmers prove to be insufficient. In the jurisdictional acts studied, no benchmark standards were found to be able to analyse compliance with non-slip conditions, a property that changes its variability over its lifespan. In fact, the deliberation of the specific requirements of non-slip surfaces and floors is particularly poor, and generally, the assessment of a "non-slip" attribute lies, quite wrongly, in the complete conception of the term, and in some cases, in characteristics such as the roughness of the surface, which does not necessarily make it less slippery[15]. International regulations state that there are no measurable parameters for determining when a surface is no longer non-slip, i.e. no discrimination can be made between safe and dangerous conditions. Instead, there are different measuring methods (dynamic slider, friction pendulum, ramp trial) that classify, without any methodological equivalences, flooring based on a level of recommended slipperiness and taking into account usage conditions[16-19]. Some authors have disputed the safety criteria based on the friction demand and the friction used, which is independent from slipping, finding very wide variations depending on the measurement method[20,21].

Despite the main risk factor of slipping is by definition poor control or little friction between foot/contact surfaces, the deliberations of judges cover a wide range of individual factors subject to the people that injured themselves incidentally, and also due to dangerous behaviour or reckless conduct.

In any case, accreditation in accordance with a standard of some minimum safety conditions on floors and paving in compliance with available scientific-technical evidence is essential in determining the non-legal nature of the injuries, given that by complying with current state-of-the-art recommendations and scientific knowledge, we would reduce the appearance of injuries and avoid heterogeneous interpretations made by professionals and Governments regarding the first-degree technical requirements, making it easier to effectively apply swimming pool health regulations, and eventually, provide guarantees in terms of the right to protect the health of swimmers.

Slipping on slides is one of the most injury-inducing activities[22]. However, here there is no clear evidence of regulations that should be complied with to avoid injury, meaning that legal analyses focus on the human factor, examining the conduct of the user and the role of the monitor. Despite the separate reception area at the slide, for exclusive usage and with sufficient depth constituting an important and common requisite[23], it was an obviate measure when collisions occurred between swimmers, with only signage requirements and the instructions of monitors being valued.

Diving is another worrying activity in terms of public health, especially given the severity of the injuries produced[24-26]. In one case, the traumatic impact of a swimmer's head against the bottom of the pool caused *ipso facto* death, whilst on another occasion it produced a spinal-cervical injury following the reckless behaviour of the swimmer. Despite this behaviour being very dangerous and difficult to control, notices prohibiting "dive-bombing" or "head-first" diving, especially in shallow water, are not mandatory in publically-used swimming pools. However, the physical factors that affect this type of injury such as the impact of colours, contrast, location, design and size used for the visualisation of depth markers and gradient changes, were barely considered in legal hearings.

A different problem emerges regarding drowning, as the public generally perceives that the main responsible individual for monitoring swimmers is the lifeguard. It should be considered that these events were described as quick and silent, and it is widely accepted that lifeguards are effective in improving safety conditions during recreational activities, but they alone are not enough to prevent all incidents of drowning and their ability to safeguard swimmers is limited[27]. It is true that the death of swimmers in pools in the presence of lifeguards is unusual, but it does happen.

As a general recommendation, promoting active prevention strategies aimed at improving risk awareness among vulnerable groups may be beneficial, including safety advice and training programmes on safe practices when swimming.

The jurisprudence studied seems to have little effect on compliance with the health rules of swimming pools, given that generally it offers solutions based on a heterogeneous regulation that covers legislation regarding consumers and users[28], the civil code[29], and administrative procedure[30]. In this respect, jurisprudence may end up perverting the standards that should be met within a facility, equipment or accessories, to comply with their function, by excessively downplaying their influence on reducing injuries incurred in swimming pools.

The main conclusion drawn from this investigation is that the observation of specific technical requirements and scientific evidence provides contrasting criteria when giving effective guarantees for the right of health protection. One beneficial line of action could be to introduce legal modifications in the regulation of swimming pools with more reliable, accurate and predictable regulatory requirements, where UNE standards regarding swimming pools could act as a driver for change and update technical criteria[31,32].

The results of this study should be interpreted within the context of its limitations. A reduced number of court rulings were obtained and the study was not designed to infer statistically; two elements that are essential for reaching more solid conclusions. Due to the very nature of the source of data, the health information was less detailed. The exploratory nature of this work determines that the results are provisional and act as a foundation for more in-depth investigations.

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