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EPIDEMIOLOGY OF PELOTA VALENCIANA

ESTUDIO EPIDEMIOLÓGICO EN PELOTA VALENCIANA

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ABSTRACT

The aim of this paper is to show an epidimiological study of valencian ball in order to analyse the players' needs and to improve the sporting life of the players. For this purpose, 92 players, 51 of them professionals, participated in this survey. Epidemiological and personal data were gathered. The results show that 96.7% of the players suffer injuries and the higher injury rate is in hands (66.0%), shoulders (61.5%) and ankles (39.6%). It was also checked that professional players have significantly more injuries in dominant ankle, shoulder, elbow and hand than amateur players have ($p<0.05$). To reduce the

high injury incidence, could be helpful a better hand protection and the analysis of new sports surfaces and specific footwear focused on biomechanical studies.

KEY WORDS: Epidemiology, valencian ball, sport gear, health and biomechanics.

RESUMEN

El propósito de este trabajo es presentar un estudio epidemiológico de pelota valenciana para conocer sus necesidades y contribuir a mejorar la vida deportiva de los jugadores. Para tal fin, se realizó una encuesta a 92 jugadores, 51 profesionales, en la cual se recogían datos generales y aspectos epidemiológicos. Los resultados del estudio revelan que un 96.7% de jugadores sufren lesiones, siendo las manos (66.0%), los hombros (61.5%) y los tobillos (39.6%) las zonas corporales que éstos se lesionan con mayor frecuencia. También se comprobó que los jugadores profesionales tienen significativamente más lesiones en tobillo, hombro, codo y mano dominantes que los aficionados ($p<0.05$). Una buena protección para las manos, la realización de estudios biomecánicos, el análisis de nuevos pavimentos de juego y de calzado específico, podrían reducir la elevada incidencia de lesiones, preservando así la salud de estos deportistas.

PALABRAS CLAVE: Epidemiología, pelota valenciana, equipamiento deportivo, salud y biomecánica.

INTRODUCTION

Pelota valenciana is a traditional and autochthonous sport which has been played since the fourteenth century (Conca, García, Gimeno, Llopis, Naya, & Pérez, 2003; Conca & Perez, 1999). The two main modalities are *escala i corda* and *raspall,* which are played in a game court known as *trinquete* (Llopis, 1999; Millo, 1976; Moreno, 1992; Olaso, 1994; Soldado, 1999). It is played by two teams normally comprising three players in these positions: *resto*, *mitger* and *punter*. During the game, the players strike a 42 gram spherical ball with their hands and try to send it to their opponents' ground. Players protect their hands with a number of materials, and so their handmade protections may combine low-cost materials like sheets, cards, thimbles, Tesamoll® (a material similar to EVA) or other (Conca *et al.* 2003). This hand protective equipment is based on tradition and personal experience and it does not exist commercially. However, despite the long history and tradition of this sport, technological evolution is practically inexistent and no epidemiological studies have been found in the scientific literature about *pelota valenciana*.

As a result, the references come from sports with a similar game structure, such as *pelota vasca* and racket sports. Pelota valenciana players make similar movements, gestures and strikes to those of the aforementioned sports.

Subsequently, injury data from these sports could provide good indications to undertake an epidemiological study in *pelota valenciana*.

For *pelota vasca*, Gámez, Montaner, Astorgano and Alcántara (2004) reported a high incidence of injuries in the hands (84%). Other authors studied specific hand injuries in Basque ball like Raynaud's syndrome (circulatory disease) (Letamendia, 1993), swelling (Letamendia, 1995) or haematomas (Baudet and Laporte, 1994; Laporte, 1996). Gámez et al. (2004) reported that another high incidence injury area in *pelota vasca* is the back, more specifically the lumbar (24%) and dorsal zones (20%) (Figure 1).

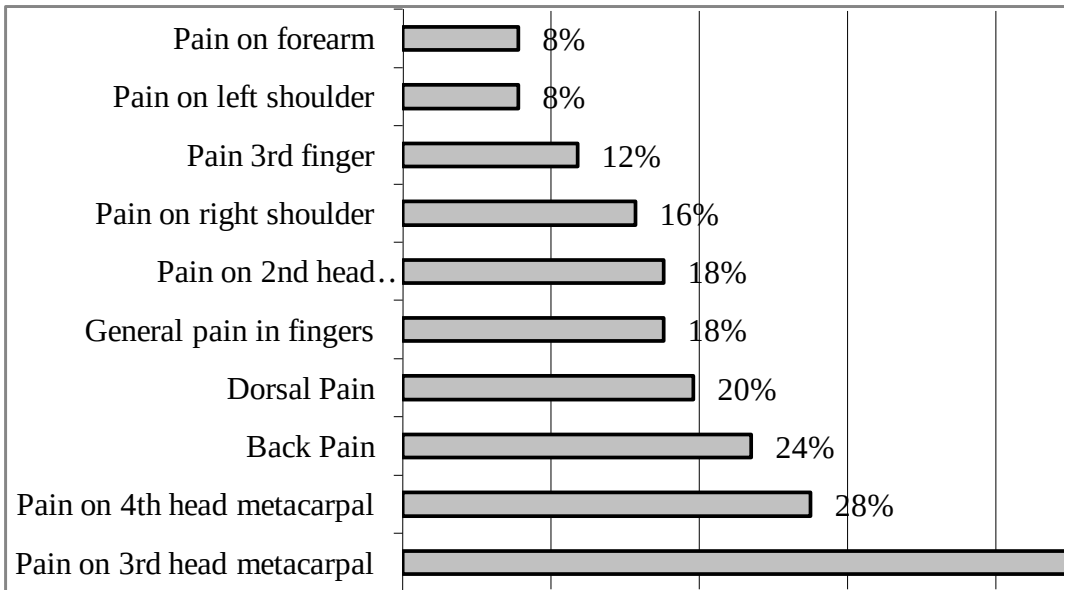

Figure 1. Injuries in *pelota vasca* players (Gámez et al. 2004).

Meanwhile, in racket sports like tennis, 45% of injuries affect the trunk (Caine, Caine and Linder, 1996), junior players frequently having pain in the lower back (Hjelm, Werner and Renstrom, 2010). On the other hand, upper limb injuries are present in 35% of players, the shoulder and the elbow being the most damaged areas (Caine et al., 1996). In this sense, a study carried out with former professional players showed that they have more degenerative injuries in the main shoulder if compared to a sedentary control group (Maquirriain Ghisi and Amato, 2006). Finally, injuries in the lower limbs account for 20% of the total injuries (Caine *et al.*, 1996; Llana, 1998). And it must be noted that 65% of the first injuries in junior players occur in the ankle and knee joint, these being the most common injuries (Hjelm *et al.,* 2010).

The epidemiological results obtained for badminton show differences with regard to *pelota vasca* and tennis. According to Caine et al. (1996) the lower limb has the highest injury incidence (82.9%). A study carried out with badminton players in Malaysia shows that 91.5% of the recorded injuries were classified as mild overload injuries, most of them in the knee (Shariff, George and Ramlan, 2009). The same researchers found out that the upper limb bears 11.1% of the injuries,37% of them affecting the shoulder joint. The head and

neck have 4.1 of the injuries, while the back only accounts for 1.8% of the total (Caine et. al., 1996).

Similarly, squash shows a higher injury percentage in the lower limb (48.1%), the injury rate for the upper limb being lower (23%) and the percentage for head and neck considerable (18.8%) (Caine et al., 1996).

On the other hand, as underlined by Caine et al., (1996), injuries can be classified according to the functional and anatomical affected structure. In this sense, most injuries found in several racket sports like tennis, badminton and squash are mainly joint/ligament injuries, followed by muscle and tendon injuries (Table 1).

Table 1. Injury incidence according to the affected functional and anatomical structure (modified, Caine et al., 1996).

FUNCTIONAL AND ANATOMICAL STRUCTURE	TENNIS	BADMINTON	SQUASH
JOINT/ LIGAMENT	64%	58.50%	20.30%
MUSCLE	10%	19.80%	18.80%
TENDON	18%	8.80%	7.20%
BONE		5%	2.90%
INFLAMMATION			14.50%
OTHER	8%	7.9%	36.2%

OBJECTIVES

Considering the foregoing, the aim of this research is to present an epidemiological study of *pelota valenciana* in order to identify the most frequent injuries, pain or diseases, and to identify the body areas with a higher injury risk. This study is essential to improving players´ performance and to correctly fulfil players´ needs. The results will contribute to the evolution of this sport.

MATERIAL AND METHODS

Participants

The sample was comprised of 92 *pelota valenciana* players. All of them were selected based on their competitive level and two categories were established: amateur (44.6%) and professional (55.4%). Professional players were defined by their affiliation with the *Pilota Valenciana* Federation (the sample included 82.2% of registered players). The amateur players had an amateur licence, were 16 years old and had at least four years of experience.

Table 2 shows the data related to experience. Overall, the sample was fairly experienced, with more than 14 years of practice on average. Moreover, the players competed an average of 6.6. hours per week, 4.1 of them in official

games and 2.5 hours in informal games with other playmates. Concerning training, the average level was 4.5 hours a week although 19 players of the total (20.2%) did not follow any fitness programme (6 of them were professional players).

Table 2. Sample description: experience and dedication.

	N	Average	Minimum	Maximum	Standard deviation
Years of practice	92	14.15	4	44	6.84
Hours/week competing	92	6.60	2	21	2.84
Hours/week training	92	4.57	0	14	3.49
Games/week	92	2.98	1	5	0.80
Minutes/game	92	82.14	45	120	19.78

Next, Table 3 shows the current player position of the sample. The two main positions of the game, *mitger* and *resto* have a similar percentage (Table 3).

Table 3. Sample description: player position.

POSITION	Frequency	Percentage
Resto	43	46.74%
Mitger	34	36.95%
Punter	7	7.60%
Mitger/Resto	4	4.34%
Mitger/Punter	4	4.34%
Total	92	100%

The next table shows the different modalities of the sample players. The majority are *escala i corda* players. This is because there are more federated players in this modality, as it has been the most popular modality in recent years (Table 4).

Table 4. Sample description: modalities of *pelota valenciana* players.

MODALITY	Frequency	Percentage
Escala i Corda	32	34.78%
***Escala i Corda* y Otros**	26	28.26%
Raspall	16	17.39%
***Raspall* y Otros**	10	10.87%
Galotxa	4	4.34%
Escala i Corda* y *Raspall	3	3.26%
Llargues	1	1.08%
Total	92	100%

Instruments

The epidemiological study was carried out using a survey focused on the general and epidemiological data of the players. The questionnaire model included closed and yes/no questions, multiple-choice questions and four point Likert-type questions (Likert, 1932) (annex 1).

Procedure

The first task was the production of a database of Valencian Community players. For this purpose, contact was made directly with the players in the *trinquetes*, where they were explained the study and invited to participate in it. Contact was also established via the Federation of *Pilota Valenciana*. Finally, in order to extend the database, the players participating in the study gave the details of other players. It must be noted that the study was conducted with the players' written consent and in compliance with the Data Protection Act (LOPD, 1999).

In order to obtain the epidemiological information a questionnaire was designed, which was reviewed by the *Users Oriented Design* (UOD) of the Institute of Biomechanics of Valencia, a unit made up of specialized staff in users assessment and statistical processing experts.

Before filling in the questionnaire, the participants were informed of the study aims and ensured the confidentiality of their data. Experience in the sport and in the practice of the two main modalities played at the *trinquete* (*escala i corda* and/or *raspall*) were the two criteria used to select the sample.

The epidemiological variables of the study provided information about different aspects. First, on the percentage of players who had been injured or had had pain whilst practising; second, on the most affected body parts and the period of

convalescence; and finally, injuries were classified based on the affected functional and anatomical element.

Once the information was collected from the questionnaires, data were statistically processed and analysed. To that end, variables were codified with the software ACCES 2010, and the computer programme SPSS 18.0 was used for the subsequent statistical study (Statistical Package for the Social Science, 2010). The first step was the descriptive analysis of the injuries using frequencies, means, maximum and minimum values, standard deviation and percentages. The second one consisted of a non-parametric variance analysis (Kruskal Wallis) to determine whether statistically significant differences existed in the injuries of the different *pelotari* groups. The grouping variables used were playing position, modality, and sports level. Significance was set at $p < 0.05$.

RESULTS

The epidemiological data collected for *pelota valenciana* reveal that more than 96% of players have some type of complaint, which points to the high injury incidence among those who practise this sport (Table 5).

Table 5. Percentage of players with an injury.

INJURY FREQUENCY	Frequency	Percentage
Injured	89	96.73%
Not injured	3	3.26%
Total	92	100%

Figure 2 shows a map of the human body with the areas with the highest injury rate in *pelota valenciana* players, and the percentage of interviewees who have had an injury in those areas. Apart from the hand (66.0%) and the shoulder (61.5%) –the areas with the highest rate– lesions are also common on the ankle (39.6%), the elbow (34.1%), the lower back (22.0%), the knee (16.5%) and the abductors (12.0%).

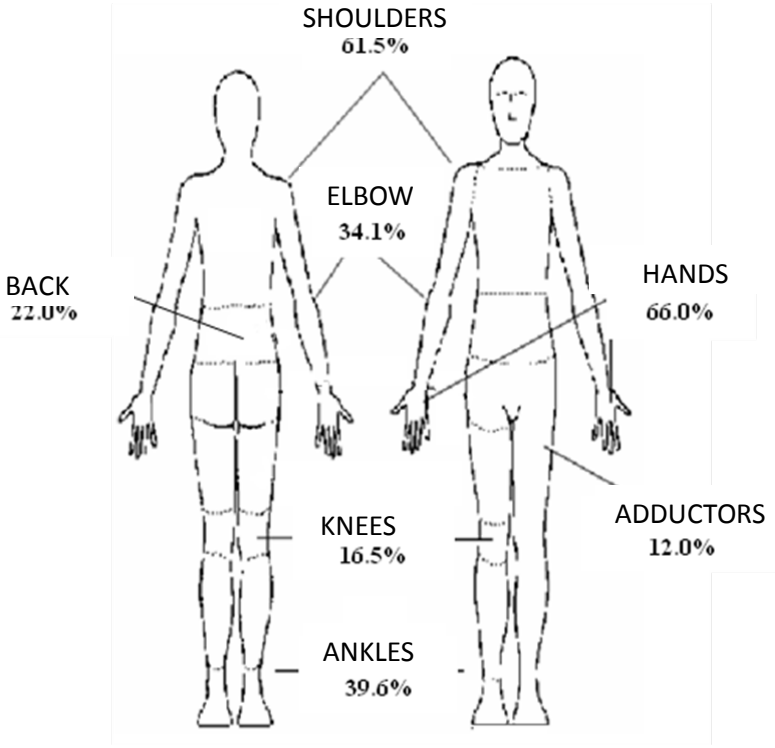

Figure 2. Map of the human body and most frequent injuries.

Next is a table that shows the high injury incidence in the lower limbs. 56.5% of the sample has had some type of lesion on the lower limbs (Table 6).

Table 6. Percentage of players with lower limb injuries.

	Frequency	**Percentage**
Injured	52	56.52%
Not injured	40	43.48%
Total	92	100%

One of the parameters that determine injury severity is the existence of a convalescence period, that is, when the injury prevents the player from practising for at least one week. Figure 3 shows the percentage of *pelotaris* who had to suspend their practice as a result of an injury.

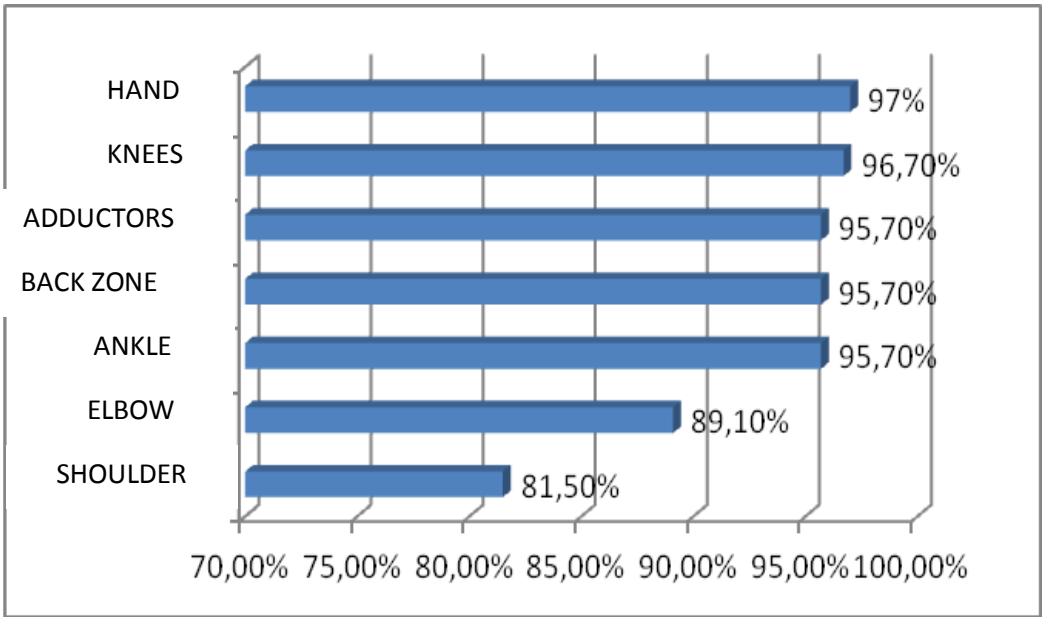

Figure 3. Percentage of *pelotaris* who suspended their practice as a result of an injury.

Data (Figure 2 and Figure 3) can be used to produce a frequency-importance chart to identify the most frequent injuries (X axis) and determine the percentage of *pelotaris* who have to stop training as a result of their injury (Y axis) (Figure 4).

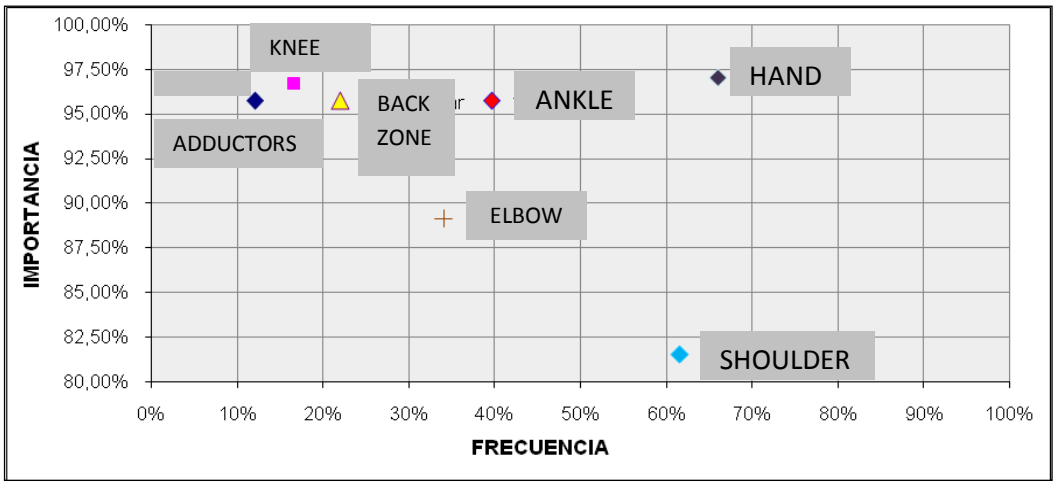

Figure 4. Frequency-importance chart for the injuries of the *pelotaris.*

Sport lesions can be classified on the basis of a number of factors. Next is a classification of injuries based on the affected functional and anatomical element and their influence on *pelota valenciana* (Table 7).

Table 7. Type of injury according to functional and anatomical elements.

	PELOTA VALENCIANA
JOINT/ LIGAMENT	27.02%
TENDON	24.99%
OTHER (DERMIS)	17.90%
MUSCLE	17.56%
BONE	12.83%

An injury rate analysis taking into account the athlete's playing position shows that, for the two main positions, *mitgers* are more likely to have an injury in the hand or the ankle. On the other hand, *restos* have more shoulder injuries. As for the ball modality, *raspall* seems to have a lower injury incidence than *escala i corda*. Thus, elbow and shoulder lesions in *raspall* are less frequent than in *escala i corda*, while ankle, hand and lower back injuries are the same. However, the results of the non-parametric variance analysis (Kruskal Wallis) do not show any statistically significant differences when injuries are compared according to these two grouping variables (Table 8).

Table 8. Injury areas based on player position and ball modality.

INJURY AREA	PLAYER POSITION			BALL MODALITY		
	Mitger	***Resto***	**P**	***Escala i corda***	***Raspall***	**P**
Shoulder	55,8 %	65.1%	0.574	64.8%	53.7%	0.057
Elbow	35.3%	30.2%	0,640	41.4%	17.5%	0.291
Lower back	26.4%	20.9%	0.571	21.7%	21.2%	0.230
Ankle	47.1 %	32.5 %	0.456	65.1%	66.2%	0.278
Hand	73.5%	65.1%	0.251	65.5%	65.4%	0.820

The following table compares injuries on the basis of the players' sports level. As can be seen, professional players have a higher injury rate in all anatomical areas when compared to amateur players. Similarly, the differential analysis (Kruskall Wallis) shows that professional players have significantly more lesions on the dominant shoulder, elbow, ankle and hand than aficionado players ($p < 0.05$) (Table 9).

Table 9. Injury areas based on sports level.

INJURY AREA	PROFESSIONAL PLAYERS	AMATEUR PLAYERS	P
Dominant shoulder*	72,5 %	46.2 %	0.005*
Dominant elbow*	47.1 %	17.5 %	0.004*
Lower back	23.5%	20.5%	0.734

Dominant ankle*	15.7 %	12.5 %	0.002*
Dominant hand**	76.5 %	55.0 %	0.047**

*P < 0.01 and ** P< 0.05

DISCUSSION

The results of the epidemiological study show that a very high number of players (96.7%) have some type of complaint or injury. Since data are not available in the literature to corroborate such results, several possible explanations could be formulated. First, an imbalance has been noticed between training load and competition load, as the participants devote more time to competing (6.6 hours/week) than to training (4.6 hours/week). As pointed out by sports training specialists (Balmaseda, 2010; Bompa and Haff, 2009; Matveev, 2001; Platonov, 2002; Thiess, Tschiene and Nickel, 2004), this type of imbalance does not allow performance to be optimised, and considerably increases the risk of being injured. Second, most players do not implement adequate injury-prevention methodology and hygiene, e.g. suitable stretching routines, which increases the risk of injury and discomfort. Third, the non-specific nature of protective materials must be born in mind. This aspect hinders their effectiveness. Fourth, the striking technique itself and the high level of strike repetition –as is the case with other ball sports (Basque ball, tennis, *frontón*, etc.)– exerts considerable stress to the musculoskeletal system. Lastly, reference must be made to the idiosyncrasy of the game: it can hardly be understood without the betting. This practice hampers the continuity of the game and establishes an intermittent dynamics with continuous stops, particularly at the beginning of each game, which causes the players to cool down.

Concerning the convalesce period caused by the injuries, more than 80% of players do not feel well and must stop playing to get better, which prevents both training and competition from continuing.

For all the above reasons, it is only logical to think that the parents of the youngest players may end up rejecting the sport, as for them playing *pelota* is synonymous with being injured. Besides, these health effects can lead to poor performance and lack of enjoyment, this in turn deterring new participants.

As for the most frequently injured body parts, all of them seem to be involved in the kinematic chain of the striking movement. The hand (66.0%) and the shoulder (61.5%) are the most commonly hit. Yet, the percentage of hand injuries is somewhat lower than that found in the literature for similar sports like Basque ball, where 82.4% of players had hand injuries (Gaméz *et al.,* 2004). The elbow ranks next, with a slightly lower percentage (34.1%). These results are similar to those found for tennis, though in tennis the elbow and the shoulder are the areas most frequently injured whereas in *pelota valenciana* it is usually the hand and the shoulder (Caine *et al*., 1996). To minimise these injuries, biomechanical analyses of the striking technique could be carried out,

to try to establish the most effective and safest technical models (inexistent to date). Personalised recommendations could be made to the *pelotaris* on that basis.

The data collected relative to injuries in the lower limbs are comparable to those obtained for squash, with a 48.1% injury rate (Caine *et al*., 1996). Knee injuries stand out for their severity (16.5%) and ankle ones for their high incidence (39.6%). The possible causes of the lesions can be grouped into three factors. First, the playing surface is considered to be one of the extrinsic risk factors (Twizere, 2004) that determine the epidemiology of the sport, as expressed by a number of authors (Andreasson and Olofsson, 1983; Cavanagh and Lafortune, 1980; Denoth y Nigg, 1981; Durá, Alcántara, Rosa, Gámez and González, 2006; Kibler y Safran, 2005; McMahon and Greene, 1979; Nigg, Denoth, Kerr, Luethi, Smith and Stacoff, 1984; Nigg and Yeadon, 1987; Pasanen, Parkkari, Rossi and Kannus, 2008; Stiles and Dixon, 2006). It must be noted that the paving (Monóvar slabs) provides very poor cushioning. Besides, some courts are in really bad condition. Another possible cause is the footwear. In fact, there is not a specific footwear type for playing ball, and so athletes use shoes developed for other sports. Studies have been published in recent decades on the relationship between sport practice and footwear (Cavanagh *et. al.,* 1980; McMahon *et. al.,* 1979; Nigg *et al.,* 1984; Newton *et. al.*, 2002). A possible line of action to overcome this issue is to research on specific footwear for *pelota* sports. Finally, lower limb injuries could be related to ball-specific gestures, as many striking movements involve turns, stops and direction changes. Some studies support this statement, since many knee and ankle ligament injuries happen in actions that include this type of gesture (Andreasson, Lindenberger, Redstrom, and Peterson, 1986; Junge, Chomiak and Dvorak, 2000; McGrath and Ozanne, 1997; Twizere, 2004). In line with what was said about the paving, links have been made with knee injuries after a twist with high friction (Olsen, Myklebust, Engebresten, Holme y Bahr, 2003; Pasanen *et al.,* 2008). However, it must also be underlined that too low friction levels can lead to falls and impaired performance (Cham and Redfern, 2002; Li, Yu and Han, 2007). Therefore, and according to some authors (Cohen and Compton, 1982; Durá, Gil, Ramiro and Vera 1996; Redfern and Bkoswick, 1997), the surface should be designed considering two friction-related aspects:

- it should be above a minimum level so as to prevent falls and imbalance caused by slipping, and
- not too high so as to allow controlled sliding, and prevent falls caused by sliding resistance between footwear and floor, fatigue, joint deterioration and general discomfort.

Concerning the typology of injuries in Valencian pelota, joint and ligament lesions are predominant (27.0%), particularly sprained knees and ankles possibly caused by poor paving and the use of unsuitable footwear, as mentioned earlier. Tendon lesions rank next on the list (25.0%), particularly shoulder and elbow ones, probably as a result of poor technique, injury relapse, and/or the absence of preventive measures. These data are in line with those found for other ball sports with similar structures, movements and strikes, such

as tennis and badminton, where most injuries can be grouped into these three functional and anatomical units (Caine *et. al*., 1996, Hjelm et *al.*, 2010). Muscle-related discomfort (17.6%) is noteworthy too. It generally consists of fibrillar ruptures originated in inadequate warm-up routines and the playing dynamics, i.e. activity/stop, at the beginning of the games, which causes players to get cold, this increasing the likelihood of acute conditions. Finally, injuries affecting the hands (17.9%) must also be mentioned. They are likely to be caused by unsuitable, unspecific protections. To avoid this, research must focus on the study of the most protective and safest protection systems, as has been the case with Basque Ball (Gámez, 2008).

The analysis of injury incidence according to playing position did not provide any significant differences, although *mitgers* seem to be more discomfort/injury prone, particularly in the hand (73.5%). The impacts they withstand are of a higher magnitude than those of the *restos*, as they frequently receive a volleying ball, that is, they hit it before it bounces, which means it hits the hand at a greater speed. In fact, they usually wear more protection than the *restos*. The latter are more bound to have shoulder injuries (65.1%), possibly as a result of their awkward posture when striking the ball, such as the *rebot* gesture after the ball hits the wall, or the *bot de braç*, a sudden shoulder movement to hit the ball above joint level.

No significant differences were found for the areas of incidence according to sport modality. In general terms, more injuries seem to occur in *escala i corda* than in *raspall*. More particularly, elbow pain is a lot more common in *escala i corda* (41.5%), than in *raspall* (17.5%). The percentage of discomfort associated to the shoulder is also higher (64.8% and 53.7% respectively), which could be due to:

- the fact that the striking technique in this modality involves the upper-limb joints to a greater extent, and also the way it is played: in *escala i corda* the ball is struck while still in the air or after the first bounce; in *raspall* both things can be done but there is no limit on the number of bounces, which means that the speed of the ball when struck is slightly slower.

Lastly, the injury rate for dominant ankle, shoulder, elbow and hand is significantly higher ($p < 0.05$) in those playing professionally than in amateur players. This could be due to a higher playing intensity, a more frequent participation in games and, above all, a longer period of practice as professional *pelotaris*. This result is in line with those in the study by Maquirriain et al. (2006) according to which intensive, long-term practice in tennis can be a predisposing factor for slight joint degeneration in the dominant shoulder. This could indicate that the risk of being injured is higher in professional players with a longer career, which places the emphasis on the need to take measures with a focus on health preservation.

CONCLUSIONS

From the injury data collected from the *pelotaris,* we can conclude that Valencian pelota is a sport with a high injury rate for all bodily segments. This finding evidences the need to develop different lines of study aimed at overcoming this issue: first, exploring new hand protection systems; second, analysing the biomechanics of the ball technique with a view to determining effective and safe technical patterns; and finally, studying new paving surfaces and specific footwear to reduce injuries in the lower limbs.

REFERENCES

Andreasson, G. and Olofsson, B. (1983). Surface and shoe deformation in sport activity and injuries. En B.M. Nigg y B.A. Kerr, (eds.), *Biomechanical Aspects of Sport Shoes and Playing Surfaces* (pp. 51-61). Calgary: University printing.

Andreasson, G.; Lindenberger, U.; Redstrom, P. y Peterson, L. (1986). Torque developed at simulated sliding between sport shoes and an artificial turf. *American Journal of Sports Medicine* (14), N. 3.

Balmaseda, M. (2010). *Entrenamiento Deportivo. Una Disciplina Científica.* Sevilla: Wanceulen.

Baudet, J. and Laporte, G. (1994). El Clavo (Itzia) en su aspecto quirúrgico. In *I Congreso Internacional de Medicina Deportiva orientada hacia la Pelota Vasca*. San Juan de Luz.

Bompa, T. O. and Haff, G.G. (2009). *Periodization. Theory and metodology of training*. Champaign: Human Kinetics.

Caine, D.J.; Caine, C.G. and Lindner K.J. (1996). Epidemiology of Sports Injuries. Champaign: *Human Kinetics*.

Cavanagh, P.R. y Lafortune, M.A. (1980). Ground reaction forces in distance running. *Journal of Biomechanics* (13), 397-406.

Cham, R. and Redfern, M.S. (2002). Changes in gait when anticipating slippery floors. *Gait Posture* 15 (2), 159-71.

Cohen, H. and Compton, D.M. (1982). Fall accident patterns: characterization of most frequent work surface-related injuries. *Professional safety* (27), 16-35.

Conca, M. and Pérez, V. (1999). Joc popular i tradicional valencià: la Pilota Valenciana. In M. Villamón (ed.). *Formación de los maestros especialistas en E. Física* (pp. 187-215). Valencia: Generalitat Valenciana.

Conca, M.; García, G.; Gimeno, T.; Llopis, F.; Naya, J. y Pérez, V. (2003). *La Pilota Valenciana, Unitat didáctica.* Valencia: Generalitat Valenciana.

Denoth, J. y Nigg, B.M. (1981). The influence of various sport floors on the load on the lower extremities. En A. Morecki, K. Fidelus, K. Kedzior and A. Wit (eds). *Biomechanics VII* (pp 100-105). Baltimore: *University Park Press*.

Durá, J.V.; Alcántara, E.; Rosa, D.; Gámez, J. and González, J.C. (2006). Biomechanical aspects of playing surfaces and shoe-surface-interaction. *Biomedical Engineering in Exercise and Sports*.

Durá, J.V.; Gil, S.; Ramiro, J. and Vera, P. (1996). *Los pavimentos deportivos en España. Servicio de asesoramiento y ensayo*. Madrid: Consejo Superior de Deportes.

Gámez, J. (2008). *Diseño de un guante de protección para pelota vasca, atendiendo a criterios biomecánicos, mecánicos y de rendimiento deportivo*. Tesis doctoral. Valencia: Universistat de València.

Gámez, J.; Montaner, A.; Astorgano, A. and Alcántara, E. (2004). Estudio epidemiológico en pelota vasca. In J. Campos (coor.), *III Congreso de la Asociación Española de Ciencias del Deporte. Hacia la convergencia europea.* Valencia: Universitat de Valencia.

Hjelm, N.; Werner, S. and Renstrom, P. (2010). Injury profile in junior tennis players: a prospective two year study. *Scandinavian Journal of Medicine & Science in Sports.* Jun 18 (6), 845-850.

Junge, A.; Chomiak, J. and Dvorak, J. (2000). Incidence of Football Injuries in Youth Players. *The American Journal of Sports Medicine* (28).

Kibler, W.B. and Safran, M. (2005). Tennis injuries. *Medicine and Sport Science* (48), 120-137.

Laporte, G. (1996). La Patología de la Mano del Pelotari. In *Lesiones de la mano del deportista* (pp 85-96). Paris: Fison Roche.

Letamendía, A. (1993). *El dedo blanco del pelotari.* San Sebastián Fundación Kutxa.

Letamendía, A. (1995). *El pelotari y sus manos*. Ikastolen Elkartea.

Ley Orgánica 15/1999, de 13 de diciembre, de Protección de Datos de Carácter Personal.

Li, K.W.; Yu, R.F. and Han, X.L. (2007). Physiological and psychophysical responses in handling maximum acceptable weights under different footwear-floor friction conditions. *Applied Ergonomics*. May; 38 (3), 259-265.

Likert, R. (1932). A Technique for the Measurement of Attitudes. *Archives of Psychology* (140), 1–55.

Llana, S. (1998). Análisis del *calzado técnico de tenis atendiendo a criterios epidemiológicos de confort y biomecánicos*. PhD thesis. Valencia: Universitat de València.

Llopis, F. (1999). *El joc de Pilota Valenciana*. Valencia: Carena.

Maquirriain, J, Ghisi, J.P. and Amato, S. (2006). The incidence and distribution of stress fractures in elite tennis players. *British Journal of Sports Medicine.* May; 40(5): 454-459.

Matveev, L. (2001), *Teoría general del entrenamiento deportivo.* Barcelona: Paidotribo.

McMahon, T.A. and Greene, P.R. (1979). The influence of track compliance on running. *Journal of Biomechanics* 12 (12), 893-904.

McGrath, A. and Ozanne, J. (1997). Heading injuries out of soccer: a review of the literature. *Accident Research Centre*, 125.

Millo, Ll. (1976). *El trinquet*. Valencia: Prometeo.

Moreno, C. (1992). *Juegos y deportes tradicionales en España*. Madrid: Alianza and CSD. 178-179.

Newton, R.; Doan, B.; Meese, M.; Conroy, B.; Black, K.; Sebstianelli, W. and Kramer W. (2002). Interaction of wrestling shoe and competition surface: effects on coefficient of friction with implications for injury. *Sports biomechanics* July 1 (2), 157-166.

Nigg, B.M. and Yeadon, M.R. (1987). Biomechanical aspects of playing surfaces. *Journal of Sports Sciencies* 5 (2), 117-45.

Nigg, B.M.; Denoth, J.; Kerr, B.; Luethi, S.; Smith, D. and Stacoff, A. (1984). Load sport shoes and playing surface. Sport Shoes and Playing Surfaces. In E.C. Frederick (ed). *Human Kinetics Publishers* (pp.1-23). Champaign, Illinois.

Olaso, S. (1994). *El joc de la pilota en la Comunitat Valenciana*. PhD thesis. Barcelona: Universitat de Barcelona.

Olsen, O.E.; Myklebust, G.; Engebretsen, L.; Holme,I. and Bahr, R. (2003). Relationship between floor type and risk of ACL injury in team handball. *Scandinavian Journal of Medicine & Science in Sports*. 13 (5), 299-304.

Pasanen, K.; Parkkari, J.; Rossi, L. and Kannus, P. (2008). Artificial playing surface increases the injury risk in pivoting indoor sports: a prospective one-season follow-up study in Finnish female floorball. *British Journal of Sports Medicine.* 42 (3), 194-7.

Platonov, V. (2002). *Teoría General del Entrenamiento Deportivo Olímpico.* Barcelona: Paidotribo.

Redfern, M.S and Bkoswick, D. (1997). Slips, trips and falls. In M. Nordin, G. Andersson and M. Pope (eds.), *Muskuloskeletal Disorders in the Workplace* (pp. 152-166) St. Louis: Moseby-Year Book.

Shariff, A.H.; George, J. and Ramlan, A.A. (2009). Musculoskeletal injuries among Malaysian badminton players. *Singapore Medical Journal.* Nov; 50 (11), 1095-7.

Soldado, A. (1999). *Joc de pilota. Historia de un deporte valenciano*. Valencia: Diputació de València.

Stiles,V.H. and Dixon, S.J. (2006). The influence of different playing surfaces on the biomechanics of a tennis running forehand foot plant. *Journal of Applied Biomechanics*. Feb; 22 (1), 14-24.

Thiess, G.; Tschiene, P. and Nickel, H. (2004).*Teoría y metodología de la competición deportiva*. Barcelona: Paidotribo.

Twizere (2004). *Epidemiology of soccer injuries in Rwanda*. PhD thesis, unpublished.

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ANNEX 1. QUESTIONNAIRE USED IN THE EPIDEMIOLOGICAL STUDY OF VALENCIAN PELOTA PLAYERS

Sports Biomechanics Group **CODE no._____**

This questionnaire is strictly CONFIDENTIAL. Data shall only be used as part of a statistical analysis with a large population sample; under no circumstances reference shall be made to the information of a particular questionnaire.

1. PERSONAL DETAILS

- NAME AND SURNAME _____

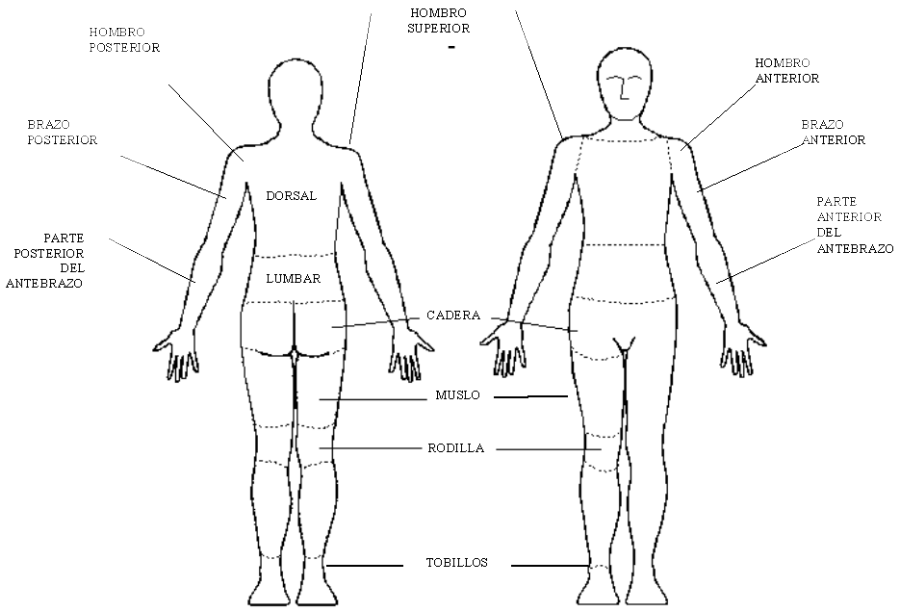
Age: _____ Weight: _____ Height: _____ Sexo:# Male # Female

- What was your sport CATEGORY last year?
  # Professional # Amateur
- How many years have you been playing *pelota valenciana*? _____
- How many official games and minutes per game approx. do you play per week?
  Official games per week ___ Minutes per game ___
- How many hours a week did you practise in non-official games last year? _____
- How many hours a week did you devote to training last year? _____
- What is your usual modality?
  # Escala i corda # Raspall # Frontó # Other:_____
- Indicate your usual playing position:
  # Resto # Mitjer # Punter

1. EPIDEMIOLOGICAL DATA

- Do you currently have pain/discomfort during training sessions or while competing? # Yeş #No

If Yes, MARK THE BODY PARTS.



On the pain that you have:

INJURY 1

- Where do you feel pain or discomfort?_____
- What pain or discomfort is it? _____
- WHEN DO YOU HAVE IT (more than one option possible)?

  # Only when I compete.
  # When I compete and when I train, throughout the season.
  # When I compete and when I train, at the beginning of the season.
  # When I compete and when I train, at the end of the season.
  # Always, even if I don't play.

- If you have pain/discomfort, HOW INTENSE IS IT?

  # Mild.
  # It bothers me but I can bear it.
  # Very intense but I play anyway.
  # Too intense, I can no longer play.

INJURY 2

- Where do you feel pain or discomfort? _____
- What pain or discomfort is it? _____
- WHEN DO YOU HAVE IT (more than one option possible)?

  # Only when I compete.
  # When I compete and when I train, throughout the season.
  # When I compete and when I train, at the beginning of the season.
  # When I compete and when I train, at the end of the season.
  # Always, even if I don't play.

- If you have pain/discomfort, HOW INTENSE IS IT?

  # Mild.
  # It bothers me but I can bear it.
  # Very intense but I play anyway.
  # Too intense, I can no longer play.

INJURY 3

- Where do you feel pain or discomfort? _____

- What pain or discomfort is it? _____

- WHEN DO YOU HAVE IT (more than one option possible)?
  - # Only when I compete.
  - # When I compete and when I train, throughout the season.
  - # When I compete and when I train, at the beginning of the season.
  - # When I compete and when I train, at the end of the season.
  - # Always, even if I don't play.

- If you have pain/discomfort, HOW INTENSE IS IT?
  - # Mild.
  - # It bothers me but I can bear it.
  - # Very intense but I play anyway.
  - # Too intense, I can no longer play.

INJURY 4

- Where do you feel pain or discomfort? _____

- What pain or discomfort is it? _____

- WHEN DO YOU HAVE IT (more than one option possible)?
  - # Only when I compete.
  - # When I compete and when I train, throughout the season.
  - # When I compete and when I train, at the beginning of the season.
  - # When I compete and when I train, at the end of the season.
  - # Always, even if I don't play.

- If you have pain/discomfort, HOW INTENSE IS IT?
  - # Mild.
  - # It bothers me but I can bear it.
  - # Very intense but I play anyway.
  - # Too intense, I can no longer play.

INJURY 5

- Where do you feel pain or discomfort? _____

- What pain or discomfort is it? _____

- WHEN DO YOU HAVE IT (more than one option possible)?
  - # Only when I compete.
  - # When I compete and when I train, throughout the season.
  - # When I compete and when I train, at the beginning of the season.
  - # When I compete and when I train, at the end of the season.
  - # Always, even if I don't play.

- If you have pain/discomfort, HOW INTENSE IS IT?

  - # Mild.
  - # It bothers me but I can bear it.
  - # Very intense but I play anyway.
  - # Too intense, I can no longer play.

- From the above injuries, WHICH ONES DO YOU HAVE NOW?

#1 #2 #3 #4 #5 #……

- TIME INJURED (without playing):

#1……. #2……. #3……. #4……. #5……. #…….

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