

EPIDEMIOLOGICAL ASPECTS OF TENNIS AND THEIR RELATION WITH FOOTWEAR AND TENNIS COURTS

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INTRODUCTION: Epidemiological studies made in several sports and physical activities show how the location, frequency and type of injuries is highly dependent on the type of practice (Brizuela *et al.*, 1996; Caine *et al.*, 1996). However, there are different general risk factors underlying the etiology of the injuries associated with all sports, which can be basically classified as intrinsic, such as gender, age and weight (or Body Mass Index), and extrinsic, such as the weekly hours of practice, the sports equipment and gear (Mohtadi & Poole, 1996). Focusing on tennis epidemiology, the different statistical studies published show the percentage of injuries by body areas which, although they are not the same, show no important differences. Table 1 presents the results of some of the most relevant studies.

Table 1: Percentage of injuries located in the upper and lower limbs and the spine.

LOCATION OF INJURIES	NIGG & DENOTH (1980)	CHARD & LACHMAN (1987)	MGD (1989)	HUTCHINSON ET AL. (1995)
Upper limbs	33.6	35	45.7	26.2
Spine	17.7	20	11.0	24.3
Lower limbs	41.6	45	43.3	49.5

As shown in Table 1, almost half the injuries suffered during tennis practice are located in the lower limbs. However, only 15% of the publications devoted to the treatment and prevention of injuries in tennis focus on this anatomical area (Luethi *et al.*, 1986).

The purpose of the present work was to study the epidemiological characteristics of tennis in the area of Valencia, which could possibly be extrapolated to the rest of the Spanish population better than the existing studies of English origin.

MATERIALS AND METHODS: A review field study was done in which data were collected by means of structured interviews. These personal interviews were made at 5 tennis clubs in and around Valencia. About 200 interviews were made, in which the maximum sampling error was about 6.9% in the worst case (sample size of 4,000 players).

Four types of variables were collected:

- Personal: age, weight, gender and type of foot.
- Technical: years of practice, competitive level, weekly days and hours of practice, etc.
- About footwear and court surface: type of court surface, areas of wear of the sole, type of deformation of the footwear, height of the top of the footwear, number of pairs used in a year, etc.

- Epidemiological: location and type of injuries attributable to tennis practice.

The data collected in the interviews were introduced into an Access Data Base designed for this purpose and statistically processed by means of SPSS and Statgraphics Plus. Besides the descriptive analysis of the variables and the associations among them, the incidence rate of the injuries occurred during the last year of practice, according to the formula:

$$\text{Incidence rate} = \frac{n^{\circ} \text{ injuries}}{n^{\circ} \text{ hours played}}$$

RESULTS:

Characteristics of the tennis player population: The results obtained show that tennis is a sport widely practiced by players of all ages, with a clear predominance of younger players (the average age was 22.9) and 68.3% (mean \pm standard deviation) of the players were between 12 and 34 years old. 75% of the sample were male and 25% female.

Regarding the structural type of foot, the normal morphotype is the most frequent among tennis players, at 53.4%. 11.9% of the players reported having cavus feet and 8.3% had flat feet (26% did not know their type of foot).

Characteristics of the tennis courts and footwear: The type of court most often used for practice is concrete, followed by clay courts and asphalt. Other types of surface were not as widely used.

Table 2: Percentage of practice on the different surfaces.

TYPE OF COURT SURFACE	PERCENTAGE OF PRACTICE
Concrete	71.89
Clay	20.82
Asphalt	6.84
Turf	0.30
Carpet	0.15

With respect to the height of the top of the footwear, women used medium height more than men (47.9% and 33.1% respectively). A lower top is used by 56% of the players and high top by 7.2%. As to the characteristics of footwear, the players especially valued flexibility and stability, followed by transpiration and hold.

Tennis players do not wear soles homogeneously: the area corresponding to the first metatarsal head and the front-central area presented the highest wear, with about 40% of tennis players in both cases. On the other hand, the central metatarsians area and the rear-internal area showed the lowest wear, with 10% of the players in both cases. In 20% of the cases there was deformation of the upper material: the amateur men and the players with normal or flat feet presented the greatest deformation.

Epidemiological aspects: The highest percentage of injuries is located in the lower limbs, followed by the upper limbs (30%) and spine (about 12%). Table 3 presents the incidence rate of the most common injuries.

Table 3: Incidence rate and hours of practice per injury.

INCIDENCE RATE	HOURS PER INJURY	ANATOMICAL AREAS
0.075	13.5	Ankle
0.054	18.5	Wrist
0.041	24.4	Elbow
0.037	30.3	Knee
0.033	30.5	Shoulder
0.016	62.5	Rear thigh, ankle, lumbar spine
0.012	83.3	Groin, rear thigh, rear leg
0.0083	120.5	Hip, foot, fingers, hand, arm
0.0041	244	Toes, dorsal spine, shoulder-blade, front leg

The risk factors detected are as follows:

- Gender ($p = 0.043$) and structural type of foot ($p = 0.045$) for ankle injuries.
- Hours of practice for elbow ($p = 0.024$), shoulder ($p = 0.019$) and ankle ($p = 0.043$) injuries.
- Years of practice ($p < 0.001$) for elbow injuries.
- Type of surface for spine injuries ($p < 0.001$).

DISCUSSION: The percentages of injuries in body areas show the same tendency as those published in the literature reviewed (Nigg *et al.*, 1981; Chard & Lachmann, 1987; MGD, 1989). The most frequently injured area is the ankle joint, estimating that for every 13.5 hours of practice there is an injury to this joint.

Extrinsic risk factors detected were similar to those in the literature (Mohtadi & Poole, 1996), more injuries occurring with more weekly hours of practice and when playing on poorly shock-absorbing surfaces and ones with a high friction coefficient, such as concrete. Therefore, it can be assumed that footwear has an influence similar to court surface, since both determine the mechanical requirements experienced by the musculo-skeletal systems of tennis players. However, a clear dependency between footwear and epidemiology has not been found. Nevertheless, we must emphasize that it is difficult to detect such relationships in this type of study, since the variables analyzed are mainly descriptive.

Intrinsic risk factors were the type of foot, with most injuries reported by players with normal or flat feet, and female gender in the case of ankle injuries. The fact that women report more ankle injuries than men can justify, at least partially, that women use footwear with medium-height top more often than men. On the other hand, the results show distinguishing criteria in practice routines of men and women. Therefore, women should pay more attention to the exercises to strengthen the muscles in the subastragalar-ankle complex.

REFERENCES:

- Brizuela, G., Llana, S., Ferrandis, R. (1995). Aspectos epidemiológicos del balonmano y su relación con el calzado. *Archivos de Medicina del Deporte* **54**, 267-274.
- Caine, C. G., Caine, D. J., Lindner, K. J. (1996). The Epidemiologic Approach to Sports Injuries. In C. G. Caine, D. J. Caine, K. J. Lindner (Eds.), *Epidemiology of Sports Injuries*. Champaign, Ill.: Human Kinetics.

Chard, M. D., Lachman, S. M. (1987). Racquet Sports-Patterns of Injury Presenting to a Sports Injury Clinic. *Brit. J. Sports Med.* **21**(4), 150-153.

Hutchinson, M. R., LaPrade, R. F., Burnett, Q.M., Moss, R., Terpstra, J. (1995). Injury Surveillance at the USTA Boys' Tennis Championships: A 6 Year Study. *Med. Sci. Sports Exerc.* **27**(6), 826-830.

Luethi, M., Frederick, E. C., Hawes, M. R., Nigg, B. M. (1986). Influence of Shoe Construction on Lower Extremity Kinematics and Load during Lateral Movements in Tennis. *Int. J. Sports Biomech.* **2**, 166-174.

Mohtadi, N., Poole, A. (1996). Racquet Sports. In C. G. Caine, D. J. Caine, K. J. Lindner (Eds.), *Epidemiology of Sports Injuries*. Champaign, Ill.: Human Kinetics.

MGD (Mutua General Deportiva Española) (1989). Estadística de la Mutua General Deportiva en relación a las lesiones de tenis.

Nigg, B. M., Denoth, J. (1980). *Playing Surfaces*. Zürich: Juris Verlag.

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