



## Differences in Pulmonary Function among Croatian Premier League Soccer and Futsal Players

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### ABSTRACT

*The purpose of this study was to compare pulmonary function of Croatian premier league soccer and futsal players. 52 soccer players and 56 futsal players performed forced expiratory manoeuvres into a portable spirometer. Measurements included forced vital capacity (FVC), forced expiratory flows at 50%FVC (FEF50) and 25%FVC (FEF25), forced expiratory volume within the first second (FEV1), Tiffeneau index (FEV1/%FVC) and maximum voluntary ventilation (MVV). The analysis of spirometry indicators differences between Croatian futsal and soccer players indicated that the soccer players had statistically significantly higher values in the FVC, FEV1, FEF50 and MVV variables, in relation to the futsal players. The differences of training and competition process in Croatian soccer and futsal players most likely caused the obtained differences of lung functions.*

**Keywords : spirometry, athletes, physical activity**

### INTRODUCTION

Although most of the movement structures in futsal and soccer are very similar, the rules of the two sports (court dimensions, match duration, number of players on the court and their substitutes etc.) are significantly different. Among other, the rules differences influence the performance frequency of certain intensity individual movement structures (Rodrigues et al., 2011; Castagna et al., 2009; Barbero Álvarez et al., 2008; Bloomfield, Polman, and O'Donoghue, 2007), the differences in total distance covered during the match (Dogramaci, Watford and Murphy, 2011; Carling et al., 2008; Di Salvo et al., 2007), and therefore the differences in the functional abilities necessary for a successful competition performance (Stolen et al., 2005; Castagna and Barbero Alvarez, 2010; Gorostiaga et al., 2009; Wislof et al., 2004). To sum up, the shorter match duration and the unlimited number of players substitutions means that futsal players in average spend less time playing than the soccer players, with shorter distance covered, but on the other hand, they spend more time sprinting and performing high intensity activities.

The spirometry tests are mostly used in the respiratory status evaluation, and they have become a basic part of the routine health checks in occupational medicine, sports medicine, public health status monitoring and clinical practice (American Thoracic Society, 1994).

Although lung function is genetically regulated, and its function is among other influenced by the environmental and alimentary factors, previous research show that it can be improved by bodily exercise (Suryawanshi, Shinde and Patil, 2012), as well as the fact that it is influenced by the type of the sport (Doherty and Dimitriou, 1997; Mehrotra et al., 1998).

Although both soccer and futsal are very popular in Croatia, pulmonary function of soccer, and especially futsal players, is insufficiently investigated. The previously listed similarities, but also the evident differences between the sports, indicate the need of lung function comparison in soccer and futsal players.

It is therefore important to ascertain the differences in spirometry parameters between soccer and futsal players. They represent an indirect indicator of the aerobic abilities, which are an important factor in realising the individual and team achievement in those sports.

### METHODS

The main aim of this study was to compare pulmonary function of premier league Croatian futsal and soccer players. The research was conducted on a sample of 108 examinees. Fifty-two examinees were premier league soccer players, members of second and fourth ranking teams competing in First Croatian soccer league. Fifty-six examinees were first league futsal players, playing in four Croatian futsal league clubs, while one of the clubs was a national champion. Several players from both subsamples were members of national selections. Height, body mass, body mass index (BMI), chronological age and training experience of the examinees are shown in table 1.

The dynamic spirometry research was conducted in concordance with the recommendations of American Thoracic Society – ATS (1994), by using a portable spirometer - micro-Quark PC Based Spirometer (Cosmed, Rome, Italy). The examinees sat with their nose plugged, performing three forced expiratory manoeuvres, as recommended by ATS. The best of three repeated forced expiratory measures was used in the analysis. Pulmonary measures included:

- forced vital capacity (FVC), measuring the largest amount of air that can be maximally expired after a maximum inspiration;
- forced expiratory volume within the first second (FEV1), representing a volume of air expired by a maximum expiration after a maximum inspiration. It is usually measured during the first second (FEV1), because the initial part of the curve depends on the effort and the cooperation of an examinee, while the end part expresses the changes of capacity
- Tiffeneau index (FEV1/FVC);

- Forced expiratory flows at 50 %FVC (FEF50) and 25%FVC (FEF25) measured by the flow-volume curve;
- maximum voluntary ventilation, measured while the examinee, after a period of calm breathing, tries to ventilate his lungs as much as possible during 10-15 sec;

All values are expressed as percentages of reference (predicted) values for European adults (Quanjer et al., 1993; Miller et al., 2005).

Statistical comparisons between soccer and futsal players were accomplished using an independent t-test. A criterion alpha level of  $p \leq 0.01$  was used to determine statistical significance. A statistical program Statistica for Windows, ver. 10.0 was used in entering and processing the data.

## RESULTS AND DISCUSSION

Table 1 shows basic anthropometric characteristics and training experience of soccer and futsal players.

**Table 1 Physical characteristics of soccer and futsal players**

	Soccer players (N = 52)		Futsal players (N = 56)	
	Mean	SD	Mean	SD
Stature (cm)	184.81	5.89	183.38	5.62
Body mass (kg)	78.62	6.60	79.41	8.72
Body mass index	22.99	1.15	23.62	2.39
Age (years)	22.79	4.39	25.50	5.22
Experience (years)	12.90	4.29	6.66	4.25

### Mean-arithmetic mea; SD-standard deviation

The comparison of results shown in Table 1 and the previous research lead to a conclusion that Croatian premier league soccer players are somewhat taller and heavier than the Brazilian (Casajus, 2001; Silva de Araujo et al., 2012) and German soccer players (Hoppe et al., 2013), and that their stature and body mass are approximately equal to those of Norwegian soccer players of the same rank of competition (Wislof et al., 2004; Haugen, Tonnessen and Seiler, 2013).

Croatian futsal players are taller and heavier compared to the Spanish (Gorostiaga et al., 2009; García-Jiménez et al., 2011), Brazilian (Rodrigues et al., 2011; Hartman Nunes et al., 2012) and English futsal players (Berdejo-del-Fresno, 2012).

Regarding the body posture, Croatian futsal players are more similar to soccer players than premier league futsal players from other countries. This can be explained by the fact that in Croatia there are still no adequate futsal schools, and the earliest participation in futsal is around year 16. Most futsal players had previous experience in soccer, meaning the shorter training status of futsal players in comparison to soccer players, as well as very similar values of Croatian soccer and futsal players body stature and mass (table 1).

**Table 2 Comparison of pulmonary function test of soccer and futsal players**

	Soccer players (N = 52)		Futsal players (N = 56)	
	Mean	SD	Mean	SD
FVC (%)	100.21	9.51	92.78	11.45*
FEV1 (%)	103.57	9.92	95.88	11.97*
FEV1/FVC (%)	103.51	6.06	103.52	7.44
FEF50 (%)	104.78	17.82	94.49	19.19*
FEF25 (%)	109.23	29.47	104.21	32.38
MVV (%)	110.74	9.81	96.76	14.28*

Statistically significant difference (t-test for independent samples, \*  $p < 0.01$ )

Accepting the  $\pm 20\%$  of the predicted value as an acceptable level of normal respiratory parameters value, we can conclude that both soccer and futsal players in average had regular spirometry findings (table 2).

Spirometry parameters of Croatian soccer players participating in this research had somewhat higher values than soccer players from Hong Kong (Chin et al., 1992), Japan (Tahara et al., 2006), Iran (Ehteshami-Afshar, Asadian and Zahmatkesh, 2002) and Nepal (Mahotra and Shrestha, 2013), and somewhat lower values in relation to obtained spirometry parameters of premier league junior Croatian soccer players (Erceg, Jelaska and Maleš, 2011).

The values of certain spirometry parameters of futsal players participating in this study were similar to those of the Brazilian futsal players of a regional quality level (Mozella Munhoz et al., 2012).

The spirometry indicators difference analysis between Croatian futsal and soccer players showed that soccer players had statistically significantly higher values of the FVC, FEV1, FEF50 and MVV variables in relation to futsal players.

Mahotra and Shrestha (2013) ascertained that the athletes who had most strenuous respiratory muscle exercise like swimming and weight lifting had better pulmonary function compared to other athletes such as sprinters, who have less strenuous muscle exercise. It is therefore possible to partially explain the obtained differences in lung function between the analysed subsamples of this research by the difference between soccer and futsal competition. Futsal match is shorter, with unlimited number of allowed substitutions (Dogramci et al., 2011), while soccer is extremely strenuous and energetically demanding, and the coach has only 3 substitutions during the 90 minutes match. Because of this, soccer players spend more time in the game than the futsal players, and run more kilometers during the match. It is generally accepted that people with higher levels of physical activity tend to have higher levels of fitness and that physical activity can improve cardiorespiratory fitness (U.S. Department of Health and Human Services). Regular exercise produces a positive effect on the lung by increasing the pulmonary capacities. By the participation in sport training during a longer time period, the oxygen transport and usage system becomes significantly improved, and since soccer players in average have 6 years more of training process, the obtained results are expected. It can be assumed that this is the reason why soccer and futsal players trainings are different, and that the exercises developing the analysed lung functions are more common in Croatian premier league soccer training.

## CONCLUSION

Based on the findings of this study, the following conclusions have been drawn:

- Croatian premier league soccer and futsal players have similar body stature and mass.
- Futsal players are somewhat older, but have less training experience in relation to soccer players.
- Soccer players have significantly higher values compared to futsal players in FVC, FEV1, FEF50 and MVV pulmonary function tests.
- The obtained results indicate the fact that the training and competition differences between soccer and futsal players most probably influence the obtained pulmonary function differences.

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