

Neuromuscular Fatigue in Racquet Sports

Olivier Girard, PhD^{a,*}, Grégoire P. Millet, PhD^b

KEY WORDS

- Fatigue • Muscular fatigue • Tennis • Racquetball
- Table tennis • Squash

This article describes the physiologic and neural mechanisms that cause neuromuscular fatigue in racquet sports; table tennis, tennis, squash and badminton. In these intermittent and dual activities, performance may be limited as a match progresses because of a reduced central activation, linked to changes in neurotransmitters concentration or in response to afferent sensory feedback. Alternatively, modulation of spinal loop properties may occur because of changes in metabolic or mechanical properties within the muscle. Finally, increased fatigue manifested by mistimed strokes, lower speed, and altered on-court movements may be caused by ionic disturbances and impairments in excitation-contraction coupling properties. These alterations in neuromuscular function contribute to decrease in racquet sports performance observed under fatigue.

TECHNICAL CHARACTERISTICS AND PHYSIOLOGIC DEMANDS OF RACQUET SPORTS

Badminton, squash, and table tennis are among the most popular racquet sports, even if tennis is probably the most widely practiced. Before discussing the potential mechanisms that limit performance, the technical characteristics of these sports and the physiologic strain imposed on the players have to be described. In racquet sports, the activity pattern is intermittent; that is, characterized by repetitions of fast starts and stops and alternating brief periods of exercise at maximal or near maximal intensity, and longer periods of lower intensity.^{1,2} Performance arises from complex interaction between technical, tactical, physiologic, and psychologic skills that often have to be sustained in hostile environmental conditions. To successfully endure tournament competition, racquet sports players must accelerate, decelerate, change direction, move quickly, maintain balance, and repeatedly generate optimum stroke production. This physiologic strain is influenced by hydration and nutritional status.¹⁻⁴ The duration of competition in racquet sports can vary from 30 to 60 minutes

This article originally appeared in *Neurologic Clinics*, Volume 26, Issue 1.

^a EA 2991—Motor Efficiency and Deficiency Lab, Faculty of Sport Sciences, University of Montpellier 1, 700, avenue du Pic St Loup, Montpellier 34090, France

^b ASPIRE—Academy for Sports Excellence, P.O. Box 22287, Doha, Qatar

* Corresponding author.

E-mail address: oliv.girard@gmail.com (O. Girard).

Phys Med Rehabil Clin N Am 20 (2009) 161–173

doi:10.1016/j.pmr.2008.10.008

1047-9651/08/\$ – see front matter © 2009 Elsevier Inc. All rights reserved.

pmr.theclinics.com

in squash and badminton to more than 5 hours in tennis, but average durations of 30 to 90 minutes are common in all racquet sports.² In most high-level matches, the rallies last on average between 2 and 15 seconds and the work-to-rest ratio varies between 1.1 and 1.5. Nevertheless, match activity varies widely across racquet sports. In tennis, the mean durations of rally and resting periods are approximately 4 to 8 seconds and 15 to 20 seconds, respectively.¹ The average effective playing time ranges usually between 10% and 30% of the game duration. In squash, the point duration is longer (10–20 seconds) and the resting period is shorter (7–8 seconds); so the effective playing time is 50% to 70% of game duration.^{5,6} A summary of the results of several notational analyses of racquet sports is presented in **Table 1**.^{1,2,5–7}

Research on the physiologic demands of racquet sports indicate that these sports place considerable demands on both aerobic and anaerobic pathways, but their relative contributions are controversial.^{1,2,5} Estimates of exercise intensity (oxygen uptake, heart rate, or blood lactate concentrations) are described in **Table 2**.^{1,2,5–7} In racquet sports, the physiologic demand may vary to a large extent, and is influenced by a multitude of factors such as the style of the player, gender, the level and style of the opponent, the surface, the equipment (ie, missile and racquet characteristics), and environmental factors (ie, temperature and humidity).^{1,2}

Cardiorespiratory fitness has been traditionally measured by maximal oxygen uptake. Racquet sports players possess moderate (table tennis: $\sim 50 \text{ mL}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$; tennis: $\sim 50\text{--}55 \text{ mL}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$) to high (badminton: $\sim 55 \text{ mL}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$; squash: $>60 \text{ mL}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$) aerobic capabilities, similar to those of team-sports players but obviously lower than those of endurance athletes.² However, an elevated cardiovascular endurance is a prerequisite attribute to compete at the elite level (ie, fast recovery between points) in all racquet sports but table tennis. Flexibility, muscular endurance, strength, and power, as well as more specific factors such as acceleration, agility, balance, and response time have also been described as important physical factors in racquet sports. At the elite level, effective stroke production requires rapid on-court movements, explosive force, and the capacity to generate explosive bursts of power. As a consequence, success in the decisive rallies at the end of a long and demanding match can be determined by the ability to repeatedly perform sprints and generate effective powerful strokes. Therefore an important issue is to describe and understand how fatigue limits performance in racquet sports.

MANIFESTATION OF FATIGUE

A close inspection of the literature reveals that the effects of fatigue on performance in squash, badminton, or table tennis players have received little documentation.² During the last decades, several studies have provided scientific evidence to support the

Activity	PD (s)	RD (s)	W:R ratio	EPT (%)	References
Table tennis	3–4	8	1:3	35	²
Tennis	5–12	15–20	1:4	20–30	^{1–3}
Badminton	4–8	10–16	1:2	40–50	^{2,7}
Squash	15–20	8–10	1:1	50–70	^{2,5,6}

Abbreviations: EPT, Effective playing time; PD, point duration; RD, recovery duration; W:R ratio, work-to-rest ratio.

Download English Version:

<https://daneshyari.com/en/article/4084551>

Download Persian Version:

<https://daneshyari.com/article/4084551>

[Daneshyari.com](https://daneshyari.com)