APPLIED PHYSIOLOGY AND FITNESS TRAINING FOR ALL SQUASH PLAYERS

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*This article is primarily a follow up of the recently published ASMF brochure, "**Squash as a Safe Sport: Guidelines**" and specifically attempts to address the fitness requirements for **all** squash players.*

A major guideline for all squash players recently published in the Australian Sports Medicine Federation (ASMF) brochure, "**Squash as a Safe Sport: Guidelines**" (1994), stated:

"Ensure you are fit to play and not playing to get fit. If in doubt about your physical condition have a fitness test before you take up playing and undertake a regular exercise program which will improve your aerobic fitness."

In response to this general guideline, **the primary purpose of this article is to provide specific information on the fitness requirements to play squash for all squash players.**

Squash for any level of player is physically a moderate to high intensity sport (Montpetit, 1990) and generally demands a high level of "fitness". One should "get fit" to play squash rather than play squash to get fit.

A closer examination of the overall "fitness" demands of squash provides the basis upon which appropriate training programs can be designed to protect against injury and enhance performance.

"Fitness" is an all-encompassing term that is often referred to, in a restricted sense, as being either the aerobic or endurance capacity of an individual. Nevertheless "fitness" globally refers to components that include cardiovascular endurance, local muscular endurance, strength, flexibility, speed, speed endurance, power, agility, balance and co-ordination.

Cardiovascular, strength and flexibility are the most important qualities for squash players since they are the foundation for the development of all others.

Cardiovascular endurance, local muscular endurance, speed and speed endurance are collectively referred to as the energy system demands so critical to a sport such as Squash.

1) Energy System Demands

Numerous studies have consistently reported average heart rates (HR's) ranging between 70-86% of the age-adjusted maximum maintained over a match for recreational and non-elite competitive players (Beaudin et al., 1978; Docherty and Howe, 1978; Mercier et al., 1987; Noakes et al., 1982; Northcote et al., 1983).

More recently, comparative results for elite players revealed that relatively steady-state HR responses were elicited with HR's predominantly above lactate thresholds or 85% HR_{MAX} (Gillam et al., 1988). In fact, mean $\%HR_{MAX}$ results recorded over the last 3 minutes of games were extremely high at 91% and 96% for males and females respectively. These HR responses combined with evidence of low blood lactates (2-4 mmol/L) across many studies, support the high "aerobic" nature of squash at all levels.

The more precise energy system demands of playing squash for all players depend on two major variables:

a) the relative aerobic and anaerobic "fitness" levels of both players;

b) the relative "skill" level of both players.

"Skill", as with "fitness", is also an all-encompassing term that incorporates technical (racket technique), tactical, psychological (e.g. concentration, arousal control), and anticipatory abilities. At any "fitness" or "skill" level, there will correspondingly be varying degrees of energy demands placed on both the aerobic (with oxygen) and anaerobic (without oxygen) systems.

If aerobic and anaerobic energy system fitness are insufficient to meet the imposed demands then, with the onset of fatigue, there will invariably be corresponding reductions in:

i) physical work rates;

ii) consistency of technical skill production;

iii) efficiency of tactical and anticipatory thought processes;

iv) effectiveness of psychological skills (e.g. concentration).

Since adequate aerobic and anaerobic fitness levels have a serious impact on <u>all</u> squash skills, it is therefore desirable to elevate fitness levels as much as possible to enhance overall performance and reduce the risk of injury.

Elite Vs Recreational

Squash at the elite national level has been reported as being predominantly aerobic with a major speed (alactic anaerobic) component and a small but variable lactic acid (anaerobic) component (Gillam et al., 1988).

The high aerobic nature of squash for recreational and non-

elite players has been well documented as addressed above. It is recommended that for elite, national standard squash players that maximum oxygen uptake ($MaxVO_2$) levels exceed 60 and 55 ml/kg/min for males and females respectively (Gillam et al., 1988).

In fact, for international standard players it has been reported that $MaxVO_2$ levels should be at least 65 ml/kg/min based on laboratory tests (Sharp, 1987). It was further stated that these international players tended to have $MaxVO_2$ values ranging from 58-82 ml/kg/min for males and 50-74 ml/kg/min for females (Sharp, 1987). This equates with aerobic capacities of elite class distance runners and cross-country skiers.

The higher the aerobic capacity, the less demands placed on the lactic acid anaerobic system. Consequently, for recreational and non-elite players, while it may not be necessary to achieve the highest aerobic capacities as indicated above, it makes good sense to work towards achieving as high a level as possible.

Table 1: *Guidelines for training methods corresponding to fitness level of player (training status) to develop the aerobic energy system in isolation (continuous) or combined with anaerobic benefits (Anaerobic Threshold & $MaxVO_2$ training).*

Training Status	*Years of Regular Training*	**Training Method*	**Intensity ($\%HR_{MAX}$)*	**Duration (Mins) x No. of Reps.*	**Frequency (Times per Week)*
Beginner	0 - 1	Continuous	[a]50/60 - 75	15/20 - 30	2 - 3
*Advanced	1 - 3	*Continuous *Anaer Thres *$MaxVO_2$	[a]70 - 85[b] 85[b] 85[b]- 95	30 - 60 x 1 5 - 10 x 2 - 3 1 - 3 x 6 - 16	3 - 4 1 - 2 1 - 2
*Elite	3+	*Continuous *Anaer Thres *$MaxVO_2$	[a]70 - 85[b] 85[b] 85[b]- 95	40 - 60+ x 1 10 - 15 x 2 - 3 1 - 3 x 8 - 20+	3/4 - 5 1/2 - 3 2 - 3

[a] *Assumption that 50/60% or 70% of HR_{MAX} is equivalent to "aerobic threshold".*
[b] *Assumption that 85% of HR_{MAX} is equivalent to "anaerobic threshold".*
* *Further details including phases of training are provided in Wollstein, 1994a.*

The relative contribution of the lactic acid anaerobic system at the elite level is primarily dependent on three variables:

i) the player's aerobic fitness level;

ii) mean duration of rallies;

iii) the level of competition (Gillam et al., 1988).

It is therefore desirable to acquire as high an aerobic capacity as possible, particularly considering the limited supply of anaerobic energy sources relative to the aerobic. This equally applies to recreational and non-elite players. Aerobic endurance demands created by the average duration of matches ranging between 30 minutes to in excess of two hours for some elite level matches, also need to be met depending on the level of competition.

2) Strength & Flexibility Demands

The precise demands of strength and flexibility have not been well researched and documented. Detailed discussion however is provided by Wollstein (1993b,c).

Strength is extremely important due to the stop-start and twisting-turning dynamic nature of the game where deceleration, lunging and acceleration are ever constant.

An increase in strength levels, particularly in the lower limbs, not only enhances speed development but also accelerates the development potential of the aerobic system as well as anaerobic capacities. Strength training also tends to significantly overcome bi-lateral (right-side to left-side) and agonist/antagonist muscle group (e.g., hamstrings/quads; chest/upper back) strength imbalances induced by squash playing alone.

Flexibility demands are ever present due to the rapid stretching into the corners and from side-to-side, often necessary to retrieve the ball.

Greater flexibility in the lower limbs facilitates greater court movement efficiency and a greater stride length which consequently allows a more rapid approach to and recovery from each shot. Greater flexibility in the upper body allows for an unrestricted range of motion about the shoulder joint necessary for the effective and efficient execution of squash swing technique.

Greater sports science research evidence is recommended to establish the precise nature of flexibility demands.

3) Fitness Training: Recreational Vs Elite

Irrespective of the standard of play, squash demands a well developed aerobic energy system.

The practical methods by which aerobic fitness can be developed are summarised in Table 1 while methods that develop anaerobic qualities are reported elsewhere (Refer Davie et al., 1989; Watson & Champion, 1987; Wollstein, 1994a).

Properly structured periodised training programs allow for an optimal rate of development relative to training status while avoiding overtraining. Actual daily and weekly training loads (i.e., volume & intensity) for any one individual ultimately depends on their recovery rate which is a highly individualised response.

Consultation with a qualified strength and conditioning specialist is strongly recommended for players of any fitness level.

4) Injury Prevention Measures

A summary of related injury prevention measures is provided as follows:

1) Development and/or maintenance of adequate aerobic & anaerobic capacities, strength and flexibility (Refer Wollstein, 1994a,b,c);
2) Utilisation of adequate Warm-up and Cool-down procedures (Refer Wollstein, 1988; 1994c);
3) Development and/or maintenance of adequate strength and flexibility in stabiliser muscle groups (Refer Fitzgerald, 1992).

In relation to long term injury prevention, strengthening and stretching "stabiliser muscles" of the pelvic and lower back regions is crucial for junior and senior players alike (Fitzgerald, 1992).

These muscle groups primarily include the hamstrings, quadriceps over the hip (rectus femoris), gluteus medius and oblique abdominals.

The insidious degeneration of lumbar region, sacro-iliac and hip joints resulting in arthritic and inflammatory conditions of

the mid-section can be significantly reduced through the development and/or maintenance of adequate strength and flexibility in stabiliser muscle groups.

Consultation with a sports medicine doctor, physiotherapist or exercise scientist who specialises in this area of knowledge is strongly recommended.

The practical application of "stabiliser" muscle group strengthening and stretching programs on an individualised basis for athletes attending the AIS Squash Unit over the past 3 years has proven successful in rehabilitative terms. Scientific research is needed to determine the extent to which these "stabiliser" muscle group programs protect players from long term injury and enhance squash performance.

Finally, medical screening for cardiovascular risks is strongly recommended prior to engaging in squash playing in accordance with the guidelines published in the ASMF brochure, "Squash as a Safe Sport: Guidelines" (1994).

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