Journal of Sports Science and Physical Education, Malaysia ISSN: 2232- 1926
http://jsspj.upsi.edu.my/

Review article

PHYSIOLOGICAL AND BIOMECHANICAL ANALYSIS OF BADMINTON PLAYERS: A BRIEF REVIEW

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Abstract

Journal of Sports Science and Physical Education 2(1): 9-16, 2013 – Badminton is a court based racquet games to be played either in single (one versus one) or double (two versus two) in a court. Badminton is a famous sport especially in Asia and among the excellent team in badminton includes China, Indonesia, Malaysia and South Korea. Outside of Asia, badminton is well known in England and Denmark. One of the main tasks of strength and conditioning coach or trainer is to design and implement physical conditioning program. Well developed and implemented training programs mainly dependable on how accurate the training program variables being devised and manipulated, in order to serve the need and goals of involved athletes. Appropriate manipulation of training program variables and modifications made from time to time relies a lot on the accuracy and reliability of monitoring assessment used. The main purpose of this review is to identify what has been done previously regarding physiological and biomechanical profiling of badminton players. It is also the aim of this review to discuss on the type of test previously used in previous studies, especially with regards to strength and power assessment, were close enough to movement pattern perform by a badminton players during an actual badminton match.

Keywords: badminton, physiological, biomechanical, test, training program

Introduction

One of the main tasks of strength and conditioning coach or trainer is to design and implement physical conditioning program. Well developed and implemented training programs mainly dependable on how accurate the training program variables being devised and manipulated, in order to serve the need and goals of involved athletes. Appropriate manipulation of training program variables and modifications made from time to time relies a lot on the accuracy and reliability of monitoring assessment used. So far, laboratory test although regarded as more accurate than the typical used and easier to conduct field test, seems quite problematic in term of matching the nature of actual movement pattern on court due to unspecific nature of the laboratory test used to the sport of badminton.

Thus, the main purpose of this review is to identify what has been done previously regarding physiological and biomechanical profiling of badminton players. It is also the aim of this review to discuss on the type of test previously used in previous studies, especially

with regards to strength and power assessment, were close enough to movement pattern perform by a badminton players during an actual badminton match. This is important in the sense that it will establish the foundational basis of what actually important when profiling badminton player's physical performance and, what are the best assessment should be used when assessing badminton players especially in relation to leg power capabilities. While there are many types of profiling assessment available out there, at this moment, the scope of this review will be limited to research that has done profiling on anthropometry type of assessment and specifically on leg power assessment among badminton players at all level.

For the purpose of this review, the selection criteria is based on articles that have been published as an original research articles in a peer-reviewed research journal, with main search was done using Google Scholar. Further search for full-text was done using the Sultan Idris Education University online database (for any articles without full-text access via Google Scholar, but has been identified as needed for this review).

The review will first briefly explain the historical background of badminton, followed by the discussions on the anthropometry and leg power assessment that have been used to profile badminton player and their findings, From there, the review will briefly discuss the advancement of technology in assessing accurate strength and power performance, with suggestion will be made on any gaps or areas for further research at the end.

The Game of Badminton

Badminton is a court based racquet games to be played either in single (one versus one) or double (two versus two) in court area. Previous studies that investigates the characteristics of badminton in term of its energy requirements, temporal structure, and movement pattern found that the sport's is characterised by repetitive efforts of a-lactic nature and great intensity which are continuously performed throughout the match (Cabello Manrique & Gonzalez-Badillo, 2003; Docherty, 1982; Majumdar et al., 1997) This is not surprising as pressure and attack game was the most important strategy for top level international players in producing a winning performance (Hong & Tong, 2000).

In term of speed, power and agility demand, most studies agreed that these three motor fitness component is important element in badminton, with no significant differences has been found exist between single and double badminton games (Alcock & Cable, 2009). In order to move efficiently within the court area, lunge movement is the most common way to move around, evidently shown by video-analysis that frequency of lunge movement is about 15% of all movement perform in court (Cronin, McNair, & Marshall, 2003; Kuntze, Mansfield, & Sellers) . Due to this, lower limb injuries is the most common in badminton players, with rapid changes in eccentric and concentric work of the quadriceps cited as one of the reason most of the injuries occur (Shariff, George, & Ramlan, 2009).

For further readings on design and implementation of specific strength training program for badminton, readers are directed to a review article by (Sturgess & Newton, 2008). The review might provide a better understanding on why specific assessment will also be needed for strength training program monitoring.

Research on Badminton Players: Physiological Profiling

Almost all research that related to badminton players were done by assessing their physiological characteristics and profiles. This subtopic will briefly discuss the studies and their findings.

The first study reviewed had performed physiological profiling assessment on males elite and male sub elite of Malaysian badminton players (Ooi et al., 2009). Data collected consist of body mass, height, arm span, body mass index, body fat, and lean body mass and estimated VO2 max. The reliability of skinfold measurement is guided by International Society of Kinanthropometry assessment manual (ISAK 2001) meanwhile estimated VO^2Max was assessed using 20m multistage shuttle run test. Their findings indicated that the estimated VO^2Max of sub elite players is much better than the elite team, partly due to the age factor differences.

Another study assessed estimated VO2 max for males elite juniors and female elite junior badminton players (Faude et al., 2007). Based on their findings they concluded that badminton players for both gender must have a better aerobic capacity to sustain the energy expenditure during training and game. At the same time, results of their study showed quite a big gap between estimated VO2 max of both gender, indicating higher level of competitiveness in the male badminton. Similar study and finding's that made gender comparisons includes a study by(Campos, Daros, Mastrascusa, Dourado, & Stanganelli, 2009), with other measurement they included were skinfold assessment and 20m sprint speed. They found that female badminton playrs have higher percentage of fat based on skinfold assessment. .

In a more wider combination of age group and gender comparisons, (Heller, 2010) compared male elite senior, male elite junior, female elite senior and female elite junior, differences in VO2 max profile. The study found that, male elite junior and female elite junior have higher VO2 max capabilities compared to the more highly experienced and with better rank. This might indicates that while the juniors were more fitter, but lack of experiences and skills put their playing performance at a ,lower level than the elite group.

Other studies that assessed physiological prodiles of badminton players were , (Majumdar et al., 1997) and (Wonisch, Hofmann, Schwaberger, von Duvillard, & Klein, 2003). However, the study by (Wonisch et al., 2003) only used heart rate measurement as indicator for cardiovascular fitness performance, with no other VO2 max assessment done. Table 1 provide the summary for all above cited studies.

Table 1: Research that have quantified physiological profiles of badminton players

Author (Date)	**Athletes Number, Gender, Level, Age**	**Assessments**	**Normative Data**
(Ooi et al., 2009)	Males Elites (12) National, 24.6 yrs	Body mass (kg) Height Arm span Body mass index Body fat	73.2 ± 7.6 1.76 ± 0.07 177.6 ± 7.7 23.5 ± 2.0 12.5 ± 4.8

		Lean body mass Estimated VO2 max	63.6 ± 5.8 56.9 ± 3.7
	Male Sub-elites (12) National, 20.5 yrs	Body mass (kg) Height Arm span Body mass index Body fat Lean body mass Estimated VO2 max	62.7 ± 4.2 1.71 ± 0.05 1.73 ± 6.5 21.6 ± 1.4 9.5 ± 3.4 56.3 ± 4.1 59.5 ± 5.2
(Faude et al., 2007)	Men Elite (4) National,21 yr	Age Height Weight VO² peak World Ranking	21.3 ± 1.7 177 ± 2 70.3 ± 5.5 61.8 ± 5.9 87 ± 29
	Female Elite (8) National, 21 yr	Age Height Weight VO² peak World Ranking	21.8 ± 2.1 166 ± 5 59.8 ± 6.8 50.3 ± 4.1 122 ± 35
(Heller, 2010)	Male Elite (25) Senior, 21.3 yr	Age (n =) VO² Max	21.3 ± 2.2 25 63.2 ± 3.7
	Male Elite (29) Junior, 17.2 yr	Age (n =) VO² Max	17.2 ± 1.2 29 64.6 ± 4.3
	Female Elite (25) Senior, 24.5 yr	Age (n =) VO² Max	24.5 ± 2.5 10 55.2 ± 2.6
	Female Elite (25) Junior, 17.6 yr	Age (n =) VO² Max	17.6 ± 0.8 16 54.9 ± 2.5
(Campos et al., 2009)	Males Elites (10) Junior, 17.24 yrs	Age Body mass (kg) Height Skin fold Estimated VO2 max 20 m speed	17.24 ± 1.18 68.0 ± 7.8 172.4 ± 0.5 83.21 ± 22.02 49.68 ± 2.48 3.12 ± 0.08

	Female elites (12) Junior, 15.21 yrs	Age Body mass (kg) Height Skin fold Estimated VO2 max 20 m speed	15.21 ± 2.06 61.74 ± 6.85 163.84 ± 0.3 131.58 ± 29.36 42.92 ± 2.94 3.5 ± 0.14
(Majumdar et al., 1997)	Males Elites (6) National,24.3 yrs	Age Height Weight Body Fat VO^2 Max Maximum Heart Rate	24.3 ± 4.1 175.4 ± 5.4 64.8 ± 6.9 12.1 ± 3.4 55.7 ± 4.4 183 ± 6
(Wonisch et al., 2003)	Males Elites (17) National, 26 yrs	Age Body weight Height Maximum Heart rate	26 ± 8 74 ±10 179 ±7 195 ± 6

Lower Limb Kinematics and Kinetics Profiling

Out of all physiological profiling research reviewed in this chapter, only six studies have been found to also assess lower-limb strength capabilities (kinematics and kinetics). Almost all studies that have quantify leg strength capabilities used either counter movement jump or squat jump assessment (Campos et al., 2009; Girard & Millet, 2009; Ooi et al., 2009), with only no published study have assessed horizontal strength capabilities. Summary of all findings can be found in Table 2.

Table 2: Research that have assessed leg strength capabilities among badminton players

Author (Date)	Athletes Number, Gender, Level, Age	Assessments	Normative Data
(Ooi et al., 2009)	Males Elites (12) National, 24.6 yrs	1 RM Squat SJ Height SJ Power CMJ Height CMJ Power DJ Height DJ Contact time	143.2 ± 17.3 42.7 ± 5.2 3851 ± 431 46.3 ± 5.4 3977 ± 385 34.4 ± 5.5 0.23 ±0.01
	Male Sub-elites (12) National, 20.5 yr	1 RM Squat SJ Height SJ Power CMJ Height CMJ Power DJ Height DJ Contact time	129.9 ± 14.1 41.5 ± 5.2 3306 ± 377 46.0 ± 3.7 3448 ± 304 32.6 ± 4.4 0.23 ±0.00
(Campos et al., 2009)	Males Elites (10) Junior, 17.24 yrs	CMJ Vertical Squat Jump CMJ Upper Limb contribution	36.7 ± 6.0 39.3 ± 5.7 46.0 ± 6.5
	Female elites (12) Junior, 15.21 yrs	CMJ Vertical Squat Jump CMJ Upper Limb contribution	27.2 ± 2.1 28.1 ± 2.4 33.4 ± 1.9
(Girard & Millet, 2009)	Competitive Male Teenage Tennis Player(12), 13.6 yr	CMJ DJ SJ	32.97 ± 13.10 22.10 ± 4.33 34.09 ± 7.99
Alcock.A et al. (2009)	Competitive male singles (8),22yr	10 m sprint 505 agility test Vertical jump	1.9 ± 0.1 2.5 ± 0.1 48.1 ± 4.6
	Competitive male doubles (8),30 yr	10 m sprint 505 agility test Vertical jump	1.9 ± 0.1 2.5 ± 0.1 47.3 ± 5.2

Conclusion

Thus, it can be concluded that, there are a lack or near non-existence of any assessment that measure leg strength capabilities with movement pattern mimic actual performance of badminton players in play. Moreover, measuring a kinematics and kinetics variables using a laboratory test will be much more accurate in assessing strength capabilities of elite badminton players. What can be said is that, the lack or no assessment done might be due to the non-existence of any laboratory test specifically design for badminton players. It is suggested that laboratory test to be introduced and conducted on the movement specific in badminton to improve the body of knowledge on this sport.

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