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Physical fitness factors of school badminton players in Kandy district

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ABSTRACT

The aims of the study was to measure physical fitness parameters of school badminton players in the Kandy district and determine the factors contributing to improve the physical fitness. Height, weight, handgrip was measured and sit and reach test, shoulder flexibility test, standing long jump test, 20m sprint speed test, agility T-test and 20m multistage shuttle run test were performed on 183 school badminton players. Linear regression and correlation tests were performed using body mass index, practiced duration, age category, level of performance, additional sports involvement as independent variables and upper body power, flexibility of lower back and hamstrings, flexibility of shoulders, upper body strength and endurance, explosive power of lower limbs, speed, agility and aerobic endurance as dependent variables. The present study showed that the upper body power, upper body strength and endurance and speed depended on body mass index both in male and female school badminton players. Speed, agility, flexibility of shoulders, upper body strength and endurance and aerobic endurance depended on the duration of practiced. Furthermore, involvement in additional sports other than badminton did not enhance the performance of badminton players. But it decreased player's performance by decreasing agility and speed. Age had an effect on the upper body power, explosive power of lower limb, agility and speed in both males and females. The performance of badminton players could be enhanced by maintaining a proper body mass index. Badminton specific skills could be improved by increasing the duration of practiced. Involvement in other sports does not give an added advantage to badminton players to improve their performance.

Key words: Body Mass Index. Badminton players, Practiced duration, Additional sports, Age.

INTRODUCTION

Badminton is one of the fastest games with its long history spanning more than three thousand years. Badminton refers to a sport that is played with racket in which a shuttlecock is volleyed across a net. World federation defines any person playing badminton as a badminton player. The game involves most of the body muscles with the energy acquired from both aerobic and anaerobic processes. Regular badminton training enhances physical fitness, especially speed, strength and aerobic fitness. Badminton also requires a constant analysis of continuously changing situation on the court, focusing the player to racket precisely and quickly, improving his or her assessment and anticipating the next move.

In Sri Lanka, many schools use badminton as one of the games at school level. Such schools regularly train their students under a coach and maintain a badminton team for this purpose.

Badminton is one of the popular games among the schools in the Kandy district. It builds fundamental physical skills in children, gives an excellent aerobic workout and is highly physically demanding at the elite level [1].

Badminton is a sport that is strength-related, rather than strength-limited in that the performance of a player is influenced by strength, not limited by it [2]. There is a direct effect on certain muscle groups associated with wrist, elbow, shoulders, neck, chest, abdomen, back, thigh, knees and ankles during this game.

Muscle power or explosive strength is one such element and the ability to generate great amount of power is recognized as a primary factor in athletic success [3].

Badminton players need excellent court speed, and agility with a good background of endurance to be successful in the game. This fitness training for badminton should focus on speed, agility, endurance, strength and flexibility. Running speed and agility are also important to the badminton player due to the need for speed variation, height, and angle of approach to the shuttle. The ability to cover short distances quickly will also be one of advantages to the badminton player [4].

The badminton players use their flexibility to reach, dive and turn to cover all parts of the court. It is an advantage to have an above-average flexibility level of the trunk and shoulder region for sports [5]. The greater flexibility of the stork arms undoubtedly an important factor, as well as hip and hamstring flexibility. Therefore, in badminton, above average flexibility of the shoulder, trunk and hip is expected of players, as flexibility also allows players to perform various strokes efficiently as much retrieval are made with the spine and shoulder joint in hyperextension and with the hips fully flexed by hamstrings when lunge jumps are made at the net. This flexibility allows for more fluent stroking when forced to stretch [6] and facilitates agility on the court [7].

Endurance is a very important component of fitness for badminton. Badminton players cover a lot of ground during a match with little rest. Not only is aerobic fitness important for court play, but also the players need to remain fit for long technical training sessions and to recover well between games during extended tournaments.

There is a lack of descriptive data on physical fitness of school badminton players in Sri Lanka. If a player intends to achieve a reasonable success in international badminton competitions, improvement in physical fitness needs to be emphasised in addition to skills training. New data is necessary to identify prevailing undetected issues among badminton players in Sri Lanka and such data would be useful in introducing changes to the current sports training protocols in the country.

MATERIALS AND METHODS

OBJECTIVES

General objective

To measure physical fitness parameters of school badminton players in the Kandy district and determine the factors contributing to improve the physical fitness.

Specific objectives

1. To measure the physical fitness parameters of school badminton players.
2. To determine whether there is a relationship between BMI of players and their physical fitness.
3. To determine whether there is a correlation between practiced duration and physical fitness.
4. To determine whether there is a relationship between the physical fitness parameters and the level at which they play, such as school level, zonal /provincial/ national level.
5. To investigate whether involvement in other sports activities improves physical fitness of badminton players.
6. To determine whether there is a relationship between age of players and their physical fitness.

METHODOLOGY

Research design

A descriptive study was conducted to determine the physical fitness parameters of school badminton players in Kandy district. Ethical clearance was obtained from Ethical committee of the faculty of Allied Health Sciences. The permission was obtained from the provincial and zonal educational directors. Information regarding the schools in Kandy district that participate in provincial badminton tournaments was collected. According to the list of schools, six boys' schools and five girls schools were included. Some schools were excluded due to inevitable reasons. A preliminary study was done in one school that was selected randomly to validate the questionnaire.

Permission was granted from the principles of the schools and the teacher-in-charge of badminton prior to the commencement of the study. Children between 9 to 15 years were included in the study if their parents/guardian gave a written informed consent.

Data was collected from one school at a time. On the day of data collection first the questionnaires were filled by the investigators by interviewing the players. Then, the relevant tests were performed by adhering to Australian national junior programme fitness testing protocol (National Junior programme fitness testing protocols, 2008).

Measured parameters

1. Height
2. Weight
3. Upper body power
4. Flexibility of lower back and hamstring
5. Flexibility of shoulders
6. Explosive power of the lower limbs
7. Agility
8. Speed
9. Aerobic Endurance

study area

The study was carried out in 11 schools in the Kandy district who participated in provincial badminton tournaments.

Study population and sample

The study population consisted of badminton players age between 9 to15 years who had continuously played badminton as a sport for more than 3 months in a school in the Kandy district that participates in provincial badminton tournaments.

The sample size was 183 consisting of 110 male badminton players and 73 female badminton players.

Selection Criteria

Inclusion Criteria

Badminton players aged between 9 to15 years who had continuously played badminton as a sport for more than 3 months in a school in the Kandy district that participates in provincial badminton tournaments and whose parents/guardian consented for the study.

Exclusion Criteria

1. Badminton players who have a history of exercise induced asthma.
2. Badminton players with other medical problems such as heart or lung diseases.
3. Badminton players who have musculoskeletal deformities.
4. Badminton players who had sustained injuries 3 months prior to the study.

Data collection

Table 1: Parameters and Tests

Parameter	Measurement/test
BMI	Height (m) and weight (kg)
Upper body power	Hand Grip Strength Test (kg)
Flexibility of lower back and hamstring	Sit and Reach Test (cm)
Flexibility of shoulders	Shoulder Flexibility Test (cm)
Upper body strength and endurance	Push up Test (Number of repetition)
Explosive power of the lower limbs	Standing Long Jump Test (cm)
Speed	20m Sprint speed test
Agility	T Test (seconds)
Aerobic endurance	20 m Shuttle run Test (Number of levels and shuttles)

Method

An appropriate training was given to the investigating team on the operation of equipment and the use of standardized test protocols (Australian National Junior Programme Protocol) to ensure that the tests are conducted in a valid and reliable manner.

Planned visits were made according to the dates agreed by the school authorities with the least disturbance to the students. Consent letters were collected and the procedure, purpose of the study was explained to the teacher in-charged, coach and the participant students.

The questionnaires were filled by the investigators while interviewing the players. Height, weight, hand grip strength, sit and reach test, shoulder flexibility test, push up test, and standing long jump test were performed in-doors. T-test, sprint speed test, 20 shuttle run test were performed in out-doors (at the play ground) with dry, non slippery and safe surface while wearing shoes. Warm-up and stretching exercises were done 15 min before starting the test procedures.

After performing in-door tests, a 10 minute rest period was given before embarking on a new test. T-test, speed sprint test and 20 m shuttle run test were performed in that order with a 10 minute rest period in-between. The same order was followed throughout the study.

The players were not allowed to have a preliminary trail. Accuracy was maintained by the same tester conducting the same test in all schools included in the study.

a) Height
Instrument used: Stadiometer
Players were instructed to stand with shoes off, feet together and arms by the sides, heels, buttocks and upper back in contact with wall. Height measurement was taken maximum distance from the floor to the highest point on the head.

b) Weight
Instrument used: Calibrated scale
The players were instructed to stand with minimal movement with hands by their side with shoes off. Weight reading was taken.

c) Sit and Reach Test
Instrument used: Sit and reach box
The players were instructed to sit on the floor with legs out stretched forward. Feet (shoe off) were placed with the soles flat against the box, shoulder width apart. Both knees were held flat against the floor by the investigator.

Then, the players were instructed to place their hands on top of each other with palms facing down while reaching forward along the measuring line as far as possible. After three attempts of reach the 4th reach was held for at least 2 seconds and the distance was recorded to the nearest centimetre.

(d) Shoulder Flexibility Test
Instruments used: The steel ruler and stick
Players were instructed to lay prone on the floor mat with the arms fully extended, wrist in neutral position and nose on the ground while holding the stick. They were asked to raise their hands holding the stick as high as possible. Then, vertical distance was measured to the nearest centimetre from the floor to the stick. Test was repeated 3 times and best distance was recorded. finger tips remain level and legs flat without any jerky movement.

e) Push up Test
Instruments used: Floor mat
Players were asked to lay prone with the hands and toes touching the floor. The body and legs were in straight line, feet slightly apart, and the arms at shoulder width apart, extended at right angles to the body. Keeping the back and knees straight, the body was lowered until there was a 90 degree angle at the elbow with the upper arm parallel to the floor. Hands were held at the point of 90 degree by the examiner so that the players could go down only till their shoulders touched the examiner`s hand. Then backed up.

The total number of correctly completed push ups with a rhythm was recorded.

Modifications of this test were introduced to make it easier for female allowing the knees to touch the ground.

(f) Standing Long Jump Test
Instrument use: Measuring tape
The take off line was marked clearly on a non slippery surface. Players were instructed to stand behind the line marked on the floor with feet slightly apart. They were asked to take both feet off the ground and jump as long as possible with swinging of the arms and bending of the knees to provide forward drive and to land with one or both feet.

The measurement was taken from the take off line to the nearest point of contact on the landing which is usually the back of the heel

(g) Sprint Speed Test
Instruments used: Measuring tape and stopwatch
The players were instructed to run a single maximum sprint over 20 m distance. They were asked to start from stationary position with a foot behind the starting line with no rocking movement and encouraged to continue running as fast as possible to the finishing line. Time spent was recorded.

h) T-Test
Instruments used: Marking cones, measuring tape and stopwatch
The four cones were set out as illustrated in the diagram below.

Test was started at cone A. Players were instructed to sprint to cone B and touch its base with their right hand. Then, shuffle side ways to cone C and touch its base with their left hand. Next, shuffle side ways to cone D, touch the base with the right hand and shuffle back to cone B touch it with left hand. Finally, run back to cone A, the starting point.

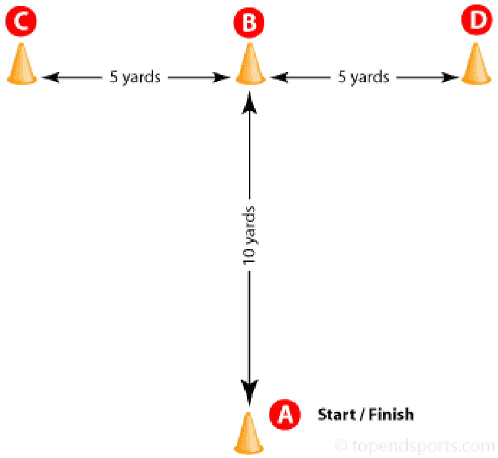

Figure : Placement of cones for T test

The stopwatch was stopped as they passed cone A. Time duration was recorded to the nearest 0.1 second. Test was not counted if the player crossed one foot in front of the other while shuffling, failed to touch the base of the cones or failed to face forward throughout the test. If so test was repeated after a 10 minute rest period.

i) Multistage 20 m Shuttle Run Test
used: Flat, marking cones, 20m measuring tape, shuttle run CD, CD player and recording sheets.Instruments non-slip surface.

Testing Protocol:
Players were instructed to run between two lines that were placed 20 m apart. They were asked to reach the 20 m line and turn as an audible beep is emitted from an audible device. The time between beeps progressively shortens,

thus increasing the work load on the players. The test was started at the moderate intensity and progressively increased until the player became fatigue and could not maintain the required pace. Finished shuttles and levels were counted when he or she failed to maintain the required pace for two successive beeps.

Data analysis

Data on questionnarie was entered into the SPSS. Descriptive results were obtainned for male and female. As well as linear regression analysis was performed between independent variables and dependent variable to find out the relationship. Correlation test was performed between continuous independent variables (body mass index and practiced duration) to find out relationship strength with dependent variables.

Dependent Variables

- Upper body power
- Flexibility of lower back and hamstring
- Flexibility of shoulders
- Upper body strength and endurance
- Explosive power of lower limbs
- Speed
- Aerobic endurance

Independent Variables

- Body mass index
- Age category
- Practice duration
- Level of performance
- Additional sports

RESULTS

Descriptive data on school badminton players

Table 2: Descriptive data of male badminton players

Physical fitness parameter	Number	Range	Mean	SD
Handgrip (kg)	110	4-38	19.16	6.457
sit and reach (cm)	110	17.0-44.0	32.637	5.301
Shoulder flexibility (cm)	110	14.5-68.0	41.505	10.294
Push ups	110	1-70	22.08	12.269
Standing long jump (cm)	110	34-240	168.13	33.131
sprint speed test (sec)	110	2.950-5.090	4.021	0.466
T-test (sec)	110	10.58-19.90	14.386	1.77
VO_2 max (ml/kg/min)	65	27-48	34.18	5.84

Table 3: Descriptive data of female badminton players

Physical fitness parameter	Number	Range	Mean	SD
Handgrip(kg)	73	4-28	17.44	4.833
sit and reach(cm)	73	22.0-44.80	34.464	4.839
Shoulder flexibility(cm)	73	15.0-67.0	44.021	11.321
Push ups(rep)	73	1-90	23.03	15.242
Standing long jump(cm)	72	83-204	144.41	24.457
sprint speed test(sec)	73	3.23-5.39	4.340	0.409
T-test(sec)	73	12.47-22.39	15.158	1.659
VO_2 max(ml/kg/min)	21	27-35	29.60	2.241

There were 110 male badminton players and 73 female badminton players in the sample. Males and females had mean BMIs of 16.60 kg/m^2 (±3.293) and 18.32 kg/m^2 (±4.337), respectively. The BMI values of males and females ranged from 12.25kg/m^2 to 29.14kg/m^2 and10.54kg/m^2 to 37.05kg/m^2 in, respectively. The male players had a mean handgrip of 19.16 kg (±6.457), a mean sit and reach of 32.63 cm (±5.30), a mean shoulder flexibility of 41.51cm (±10.29), a mean push up rate of 22 repetitions (±12.26), a mean standing long jump of 168.23 cm (±33.131), a mean sprint speed of 4.02 sec (±0.466), a mean agility of 14.386 sec (± 1.77) and a mean VO_2 max of 34.18 ml O_2/kg/min (±5.849).

The female players had a mean handgrip of 17.44 kg (±4.833), a mean sit and reach of 34.46 cm (±4.839), a mean shoulder flexibility of 44.0 cm (±11.32), a mean push up rate of 23 repetitions (±15.242), a mean standing long jump of 144.41 cm (±24.45), a mean sprint speed of 4.34 sec (±0.409), a mean agility of 15.15 sec (± 1.65) and a mean VO_2 max of 29.6 ml O_2/kg/min (±2.241).

Furthermore, the physical fitness parameters were considered as dependent variables and BMI, practiced duration, level of performance, age and involvement in additional sports activities were considered as independent variables in order to apply linear regression tests.

Relationship between dependent variables and independent variables

a) Upper body power

Female players

The upper body power of females was significantly related to the BMI (sig. 0.000) and the age (sig. 0.000).

Table 4: Relationship between upper body power and independent variables (Female)

Independent variable	B value	Significance
Body mass index	0.432	0.000
Age category	1.307	0.000

After excluding other confounding variables, regression coefficient value of 0.432 for BMI indicated that by increasing BMI by 1, the upper body power increased by 0.432. Regression coefficient value of 1.307 for the age category indicated that by increasing age category by one, the upper body power increased by 1.307.

Male players

The upper body power was significantly related to the BMI (sig. 0.000), the age (sig. 0.000) and the level of performance (sig 0.023).

Table 5: Relationship between upper body power and independent variables (Male)

Independent variable	B value	Significance
Body mass index	0.633	0.000
Age category	2.246	0.000
Level of performance	1.922	0.023

After excluding other confounding variables, regression coefficient value of 0.633 for BMI indicated that by increasing BMI by 1, the upper body power increased by 0.633. Regression coefficient value of 2.246 for the age category indicated that by increasing age category by one level, the upper body power increased by 2.246. Regression coefficient value of 1.922 for the level of performance indicated that by increasing level of performance by one level, the upper body power increased by 1.922.

b) Flexibility of lower back and hamstrings

Female players

There was no significant relationship (sig 0.822) between the flexibility of lower back and hamstrings with any of the independent variables in females.

Male players

Flexibility of lower back and hamstrings was significantly related to BMI (sig 0.009) in males.

Table 6: Relationship between flexibility of lower back, hamstrings and independent variables (Male)

Independent variable	B value	Significance
Body mass index	-0.401	0.009

After excluding other confounding variables, regression coefficient value of -0.401 for BMI indicated that with increasing BMI by 1, flexibility of lower back and hamstrings decreased by 0.401.

c) Flexibility of shoulders
Female players
Flexibility of shoulder was significantly related to age (sig 0.011) and practice duration (sig. 0.000).

Table 7: Relationship between flexibility of shoulders and independent variables (Female)

Independent variable	B value	Significance
Age category	2.241	0.011
Practice duration	0.228	0.000

After excluding other confounding variables, regression coefficient value of 2.241 for age category indicated that with increasing age by 1, flexibility of shoulder increased by 2.241. Regression coefficient value of 0.228 for practiced duration indicated that with increasing practiced duration by 1, flexibility of shoulder increased by 0.228.

Male players
There was no relationship (sig 0.806) in flexibility of shoulders with independent variables.

d) Upper body strength and endurance
Female players
The upper body strength and endurance was significantly related to the BMI (sig. 0.006) and the level of performance (sig. 0.009).

Table 8: Relationship between upper body strength, endurance and independent variables (Female)

Independent variable	B value	significance
Level of performance	8.180	0.006
Body mass index	-1.021	0.009

After excluding other confounding variables, regression coefficient value of 8.180 for the level of performance indicated that by increasing level of performance by one level, the upper body strength and endurance increased by 8.180. Regression coefficient value of -1.021 for BMI indicated that by increasing BMI by 1, the upper body strength and endurance decreased by 1.021.

Male players
The upper body strength and endurance was significantly related to the BMI (sig. 0.000) the duration trained session (sig. 0.021) and age (sig 0.031).

Table 9: Relationship between upper body strength, endurance and independent variables (Male)

Independent variable	B value	significance
Body mass index	-1.796	0.000
Duration trained session	0.115	0.021
Age category	1.527	0.031

After excluding other confounding variables, regression coefficient value of -1.796 for BMI indicated that by increasing BMI by 1, upper body strength and endurance decreased by 1.796. Regression coefficient value of 0.115 for the duration of trained session indicated that by increasing duration of trained session by one, the upper body strength and endurance increased by 0.115. Regression coefficient value of 1.527 for the age category indicated that by increasing age category by one, upper body strength and endurance increased by 1.527.

e) Explosive power of lower limbs
Female players The explosive power of lower limb was significantly related to the age (sig. 0.000) and the level of performance (sig 0.011).

Table 10: Relationship between explosive power of lower limbs and independent variables (Female)

Independent variable	B value	Significance
Age category	7.641	0.000
Level of performance	11.447	0.011

After excluding other confounding variables, regression coefficient value of 7.641 for age category indicated that with increasing age by 1, explosive power of lower limb increased by 7.641. Regression coefficient value of 11.447 for the level of performance indicated that by increasing level of performance by one level, the explosive power of lower limb increased by 11.447.

Male players

The explosive power of lower limb was significantly related to the BMI (sig. 0.008), the age (sig. 0.000) and level of performance (sig 0.015).

Table 11: Relationship between explosive power of lower limbs and independent variables (Male)

Independent variable	B value	Significance
Body mass index	-2.425	0.008
Age category	7.490	0.000
Level of performance	12.217	0.015

After excluding other confounding variables, regression coefficient value of -2.425 for BMI indicated that by increasing BMI by 1, the explosive power of lower limb decreased by 2.425. Regression coefficient value of 7.490 for age category indicated that with increasing age by 1, explosive power of lower limb increased by 7.490.Regression coefficient value of 12.217 for the level of performance indicated that by increasing level of performance by one level, the explosive power of lower limb increased by 12.217.

f) Agility

Female

The agility was significantly related to the age (sig. 0.000) and the practiced duration (sig. 0.001).

Table 12: Relationship between agility and independent variables (Female)

Independent variable	B value	Significance
Age category	-0.511	0.000
Practice duration	-0.027	0.001

After excluding other confounding variables, regression coefficient value of -0.511 for age category indicated that with increasing age by 1, agility test duration decreased by 0.511. Agility of the players increased with age. Regression coefficient value of -0.027 for practiced duration indicated that with increasing practiced duration by 1, agility test duration decreased by 0.0.27. Agility of players increased with practiced duration.

Male

The agility was significantly related to the BMI (sig. 0.001), age (sig. 0.000), level of performance (sig 0.000) and additional sport (sig 0.011).

Table 13: Relationship between agility and independent variables (Male)

Independent variable	B value	Significance
Body mass index	0.155	0.001
Age category	-0.394	0.000
Level of performance	-0.962	0.000
Additional sport	0.853	0.011

After excluding other confounding variables, regression coefficient value of 0.155 for BMI indicated that by increasing BMI by 1, the agility test duration increased by 0.155. Regression coefficient value of -0.394 for age category indicated that with increasing age by 1, agility test duration decreased by 0.394. Agility of players increased with age. Regression coefficient value of -0.962 for the level of performance indicated that by increasing level of performance by one level, the agility test duration decreased by 0.962. Agility of players increased with level of performance. Regression coefficient value of 0.853 for the additional sports indicated that by playing other sport, the agility test duration increased by 0.962.

g) **Speed**

Female players

The speed was significantly related to the age (sig. 0.002) and the BMI (sig. 0.016).

Table 14: Relationship between speed and independent variables (Female)

Independent variable	B value	significance
Age category	-0.105	0.002
Body mass index	0.026	0.016

After excluding other confounding variables, regression coefficient value of -0.105 for age category indicated that with increasing age by 1, speed test duration decreased by 0.105. Speed of the players increased with age. Regression coefficient value of 0.026 for BMI indicated that by increasing BMI by 1, the speed test duration increased by 0.026. Speed of players decreased with body mass index.

Male

Speed was significantly related to the age (sig. 0.000), additional sports (sig 0.000), level of performance (sig 0.007) and the BMI (sig. 0.007).

Table 15: Relationship between speed and independent variables (Male)

Independent variable	B value	significance
Age category	-0.159	0.000
Additional sports	0.318	0.000
Level of performance	-0.170	0.007
Body mass index	0.031	0.007

After excluding other confounding variables, regression coefficient value of -0.159 for age category indicated that with increasing age by 1, speed test duration decreased by 0.159. speed of the players increased with age. Regression coefficient value of 0.318 for additional sports indicated that by doing additional sport, speed test duration increased by 0.318. Speed of players decreased with doing additional sports.

Regression coefficient value of -0.170 for the level of performance indicated that by increasing level of performance by one level, speed test duration decreased by 0.170.Speed of players increased with level of performance. Regression coefficient value of 0.031 for BMI indicated that by increasing BMI by 1, speed test duration increased by 0.031.Speed of players decreased with body mass index.

h) Aerobic endurance

Female players

There was no significant relationship (sig 0.442) between the aerobic endurance and any of the independent variables.

Male players

The aerobic endurance was significantly related to the BMI (sig. 0.000), the age (sig. 0.000) and performance level (sig 0.000).

Table 16: Relationship between aerobic endurance and independent variables (Male)

Independent variable	B	Sig
Body mass index	-0.229	0.000
Age category	0.585	0.000
Performance level	1.060	0.000

After excluding other confounding variables, regression coefficient value of -0.229 for BMI indicated that by increasing BMI by 1, the aerobic endurance decreased by 0.229. Regression coefficient value of 0.585 for age category indicated that with increasing age by 1, aerobic endurance increased by 0.585. Regression coefficient value of 1.060 for the level of performance indicated that by increasing level of performance by one level, the aerobic endurance increased by 1.060.

Correlation between dependent variables and BMI, practiced duration

BMI

Pearson correlation test was done to find out the strength of relationship. It showed BMI was significantly correlated to upper body power (r=0.323, p=0.00), sprint speed test duration (r=0.245, p=0.001) agility test duration (r=0.202, p=0.006), upper body strength and endurance (r=-0.355, p=0.001), explosive power of lower limb (r=-0.245, p=0.001) and aerobic endurance (r=-0.320, p=0.000).

Practiced duration

Pearson correlation test showed that the practice duration was significantly correlated to the shoulder flexibility (r=0.226, p=0.002), upper body strength and endurance (r=0.258, p=0.000), aerobic endurance (r=0.187, p=0.011), speed test duration(r=-0.159, p=0.032), agility test duration (r=-0.293, p=0.000).

DISCUSSION

Discussion of results

The findings of the present study showed that the BMI was significantly related to upper body power, upper body strength and endurance and the speed in female players. When BMI increased, the upper body power, upper body strength and endurance increased, but the speed decreased in female players. BMI was significantly related to upper body power, flexibility of the lower back and hamstrings, explosive power of the lower limbs, upper body strength and endurance, aerobic endurance, agility and speed in male players. When BMI increased upper body power increased but flexibility of the lower back and hamstrings, explosive power of the lower limbs, upper body strength and endurance, aerobic endurance, agility and speed of male players decreased. The current findings were in line with the previous studies where it have been shown that basic anthropometric parameters such as body height and BMI contribute more to the prediction of upper body power [8]. Theory shows that body weight can influence the speed, endurance and power of players, whereas body composition can influence the strength and the agility of players. A lean body is often advantageous in sports where speed is involved.

Pearson correlation test confirmed that BMI had a positive influence on upper body power and a negative influence on speed, agility, upper body strength and endurance, explosive power of lower limbs and aerobic endurance. It indicated that only upper body power increased with BMI but the speed, agility, upper body strength and endurance, explosive power of lower limbs and aerobic endurance decreased when BMI went up.

Our study showed that age was significantly related to upper body power, flexibility of shoulder, explosive power of lower limbs, agility and speed in female players. When age increased above mentioned fitness parameter increased. In male players also the upper body power, explosive power of lower limbs, aerobic endurance, agility, and speed increased with increasing age but upper body strength and endurance decreased with increasing age. Except upper body strength and endurance, other fitness parameter above mention increased with age.

Explosive power of lower limbs, upper body strength and endurance in females increased with level of performance while in males the explosive power of lower limbs, upper body power, agility, and speed increased with level of performance but aerobic endurance decreased.

Duration of training sessions was significantly related to flexibility of shoulder, agility in female and upper body strength and endurance in male players. Above mention parameter were increased with duration of practice session. Pearson correlation test also confirmed that the shoulder flexibility, upper body strength and endurance, aerobic endurance, speed, and agility increased with practiced duration.

Limitations of the current study

All schools participating in provincial badminton tournaments in the Kandy district could not be included in the sample due to conduction of school term tests during the period of data collection and the difficulty in carrying equipment used for the study to some of the schools that were far away from Peradeniya.

Multi stage shuttle run test and speed test were carried out in school play grounds due to the limited space inside the badminton court in most of the schools. But in some schools the tests were performed inside the badminton court since the school principals in those schools did not allow taking students to the grounds.

There were difficulties when performing tests in school play grounds due to unfavourable weather conditions. The effects of the environment might not have been the same at all schools since the data collection was done at school level on different days rather than in one place on the same day. There was no strict control over the clothing of the players but irrespective of the gender they were wearing cloths suitable for playing badminton.

CONCLUSION

Based on the results of the present study, it can be concluded that BMI significantly affects the upper body power, upper body strength and endurance and speed both in male and female student badminton players between 9-15 years. When BMI of player's increases, upper body power increases while upper body strength and endurance and speed decrease. Furthermore, this study shows that the duration of practice has no significant effect on upper body strength, lower body and hamstring flexibility and explosive power of lower limbs in both male and female student badminton players between 9-15 years. But the duration of practice significantly affects the speed, agility, flexibility of shoulder and aerobic endurance. A study involving larger sample size would explain why some physical fitness parameters did not increase with increased duration of practice.

The results of this study indicate that the upper body power, explosive power of lower limb increase with age but, agility and speed decrease with age both on male and female. But level of performance has positive influence only on explosive power of lower limb in both male and female. Further involvement in additional sports with badminton will not enhances the performance of players. But it might decreases players performance by decreasing specific skill such as agility and speed.

Similar studies could be done on national level and club level badminton players involving larger samples in order to find the factors that affect the performance of players so that policy decisions could be taken to improve the performance of our players.

REFERENCES

[1] AVL Kerry; JJL Adrian ; *African Journal for Physical, Health Education, Recreation and Dance* **(2003)**. 2, 114-120.

[2] T Wrigley; G strauss; Stregth assessment by isokinetic dynamometry. In : C.Gore (Ed.), Physiological Tests for Elite athletes / Australian Sports commission, **(2000),** 155-199.

[3] SE Beckenholdt; JL Mayhew; *Journal of Sports Medicine*, **(1983),** 23, 326-332.

[4] MK Todd; CA Mahoney; Determination of pre-season physiological characteristics of elite male squash players, **(1995).**

[5] MK Chin; AS Wong; and et al. *British Journal of Sports Medicine*, **(1995),** 29(3), 153-157.

[6] BC Elliot; *Australian Journal of Science and Medicine in sport*, **(1989),** 21(3), 14-21.

[7] T Reilly; Physiology of Sports. London, **(1990).**

[8] S Semproli; The influence of anthropometric characteristics to the handgrip and pinch strength in 6-10 year old children, **(2007),** 65(3): 293-302.