INVESTIGATION OF RELATIONS BETWEEN LINE DRILL TEST PERFORMANCE WITH AEROBIC AND ANAEROBIC PERFORMANCE OF YOUNG BASKETBALL PLAYERS

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Received: 15/02/2017

Accepted: 06/04/2017

ABSTRACT

Success in basketball during to competition depend on both aerobic and anaerobic pathways. Using sport special testing method like Line Drill Test (LD) gives comprehensive advantage players and coaches to follow training and to achieve better performance in basketball. The aim of this study was to determine the relations of maximal aerobic power (VO_{2max}) level, anaerobic power and capacity on LD test performance in young male basketball players.15 young experienced male basketball players volunteered participated in the study. Spearman rank correlation analysis was used to examine relations between LD test performance test with VO_2max, peak power (PP), mean power (MP), power drop (PD). All data were processed at the significance level $p < 0.05$. Mean LD tests T1, T2, T3 were 29.53 ± 0.99s, 31.20 ± 1.55s and 32.19 ± 1.62s respectively. There were no significant relations between PP and LD test performances ($p > 0.05$), strong negative significant relations found between VO2max and LD T1, T2, T3 (P = -0.651, P = -0.704, P =0.729, p< 0.05 respectively), MP and LD T2, T3 (P = -0.668, P = -0.726, p< 0.05 respectively), moderate positive significant relations found between PD and LD T3 (P = 0.521, p< 0.05), PD and Line Drill Fatigue Index (FILD) and (P = 0.557, p< 0.05). The correlation results MP and VO2max with LD test performances may show LD test has availability field base protocol on anaerobic endurance evaluation in basketball players.

Keywords: Basketball, Line Drill Test, Anaerobic Power, Anaerobic Capacity.

GENÇ BASKETBOLCULARIN LİNE DRİLL TEST PERFORMANSLARI İLE AEROBİK VE ANAEROBİK PERFORMANSLARI ARASINDAKİ İLİŞKİLERİN İNCELENMESİ

ÖZ

Basketbolda, müsabaka başarısı hem aerobik hem de anaerobik enerji sistemlere bağlıdır. Line Drill Testi (LD) gibi spora özel test yöntemleri, antrenörlere ve oyunculara antrenman takibi ve performans geliştirmek için kapsamlı bir avantaj sağlar. Bu çalışmanın amacı genç erkek basketbolcularda maksimal aerobik güç ($_{maks}VO_2$) düzeyi, anaerobik güç ve kapasite ile LD test performansı arasındaki ilişkiyi saptamaktır. Çalışmaya 15 erkek basketbolcu gönüllü olarak katılmıştır. Maksimal oksijen tüketimi ($_{maks}VO_2$), zirve güç (PP), ortalama güç (MP), yorgunluk indeksi (PD) ile LD test performans testi zamanları (T1, T2, T3 ve FILD) arasındaki ilişkileri incelemek için Spearman korelasyon analizi kullanılmıştır. Tüm veriler anlamlılık $p < 0.05$ düzeyinde işlenmiştir. LD test T1, T2, T3 sırasıyla 29.53 ± 0.99s, 31.20 ± 1.55s ve 32.19 ± 1.62s idi. PP ve LD test performansları arasında $p < 0.05$ olan anlamlı bir ilişki bulunamamıştır, maksVO2 ve LD T1, T2, T3 arasında güçlü negatif anlamlı ilişkiler bulunmuştur (sırasıyla P = -0.651, P = -0.704, P = 0.729, $p < 0.05$), MP ve LD T2, T3 (sırasıyla P = -0.668, P = -0.726, $p < 0.05$), PD ile LD T3 ve FILD arasında (P = 0.521, P = 0.557, $p < 0.05$) orta dereceli pozitif anlamlı ilişkiler tespit edilmiştir. Sonuçlar, LD testinin genç erkek basketbol oyuncularının anaerobik kapasitelerinin değerlendirilmesinde kullanılabilir bir saha protokolü olduğu göstermiştir.

Anahtar Kelimeler: Basketbol, Line Drill Testi, Anaerobik Güç, Anaerobik Kapasite.

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INTRODUCTION

Success in basketball during to competition depend on both aerobic and anaerobic fitness[7,8]. Studies shows that the aerobic fitness indicators of basketball are total spent time during game and total work load[3,18,20], the anaerobic fitness indicators are mean heart rate response[5], total high intensity movements. Young male basketball players spent 56% of the playing time above 95% and at 85-95% of maximal Heart rate, respectively and covers 1743 m with high intensity movements of total 7558m[2]. This structure of basketball is complicated and hard to evaluate for players and coaches.

Anaerobic measurement generally has been carried out with the Wingate Anaerobic Test (WANT). However, WANT is sport specific testing method for cycling, its' validation for basketball has not well established. Expensive equipment's and laboratory experts are required during process of the test in other respects. Using sport special testing method gives comprehensive advantage to players and coaches to follow training and achieve better performance in basketball[6,14]. Several types of sprint tests such as Repeated Sprint Ability test, Running based Anaerobic sprint test, FIFA Interval Test Sprint Fatigue Test, Phosphate Recovery Test, AFL Sprint Recovery Test and The line drill anaerobic field test (LD) have been find out for testing intermittent sports anaerobic performance on field conditions[10,16,21,22].

The test protocols like repeated sprint ability test, running based anaerobic sprint test and LD test are generally used as anaerobic field tests especial in basketball. Studies showed that LD is a test which it has been created as a viable and practical test of the anaerobic performance of basketball players[20]. In addition to this aspect LD test is easy and cheap applicability and to anaerobic fitness assessment. Previous studies have suggested that the LD test is more familiar anaerobic fitness protocol has reliability and validity in the context of youth basketball[6,9]. However, to perform this protocol players need to have both endurance of aerobic and anaerobic structure. Studies about aerobic endurance field tests have validated in basketball players especially young's[7]. In this vision LD test performance response may have relations with aerobic and anaerobic performance in young. As it well known that during the puberty period, being based on growth changes maximal oxygen capacity, power output can be improved[17]. According to complicated structure of basketball this means young players are more sensitive to training and especially adaptations. The aim of this study was to investigate relations between LD test performance response with maximal aerobic, anaerobic power and capacity in young male basketball players.

METHOD

Participants

15 male young basketball players with least three years experienced, from three different club volunteered participate in the study. The demographic characteristics of the participants are given in Table 1. All subjects were informed about the purpose and procedures of the study.

Table 1. Demographic characteristics of the participants

Variables	*Mean*	*Std.*
Age (year)	14.88	0.39
Height (cm)	184.93	6.58
Body Weight (kg)	72.33	9.51
Body percentage fat (%)	10.43	4.38
VO_{2max} (mL/kg/min)	60.09	5.30
Peak Power (w/kg)	10.30	1.08

Study Design

All subjects participated in WANT and LD test sessions designed to get them familiarization before the first measurement. The measurement of LD test was taken place in regular basketball hall. Studies were carried out in three measurement sessions. Participants were asked 48 hours rest which were given between measurements and not to participate in any physical activity during this period. First session included all the anthropometric measurements and maximal oxygen consumption test. Maximal oxygen consumption levels of athletes was determined by gas analyzer during treadmill test. Second session included 30-second Wingate anaerobic test which was conducted on a cycle ergometer. Third session took place in field and consisted three repeat LD Test Measurements, were performed between 10.00-12.00 hours.

Testing Procedures

Anthropometric Measurements: On the first session participants enter the laboratory. Body height (cm), body weight (kg), and percentage of body fat (%) measurements were applied. The body height was measured using a stadiometer with the accuracy to 1 cm (SECA, Germany). The body weight and percentage of body fat measurements were conducted by Segmental Body Composition Analyzer (AVIS 333 PLUS Body Composition Analyzer, Korea) with accurate to 0.1 kg.

Maximal Oxygen Consumption Test: Maximal Oxygen Consumption levels of athletes (VO_{2max}) was determined by automatic gas analyzer (Master screen-CPX, Jaeger, Hoechberg, Germany) during treadmill test in a standardized laboratory environment. Auto volume and gas calibration were performed as suggested by the device manufacturer before each subject participated in VO_{2max} test. Measurements were applied through using bread-by-bread mode. Laboratory indoor temperature was 22-25 ºC and relative humidity was between 30-42% during trails. Maximal oxygen consumption test protocol consist of 8 minute warm up session; participants warmed-up 3 min at 8.0 km/h on the treadmill followed by 5 min of self-stretching. Test protocol started at 10.0 km/h and zero gradient for 2 minute. Then speed increased to 12.0 km/h for following 2 minute. Thereafter, gradient was gradually increased by 2% every minute until reach 12%. By this time, if participant was not achieved volitional exhaustion, the speed was increased by 1.0 km/h every minute until volitional exhaustion is attained[1]. The protocol provided that participants reached VO_{2max} between 8 and 12 minutes. Maximal Oxygen consumption, expiration carbon dioxide amount and respiratory gas exchange rate were calculated in 5 second cycle mode and the highest 3 cycle 5 second cycle average. Participants maximal oxygen consumption was determined by three criteria and the average of the highest 3 values of at least two criteria was taken[7].

These criteria are; A) the rate continues to increase but the plateau formation in VO_{2max}, B) the RER value is greater than 1.10; c) the estimated heart rate is greater than 95% of the estimated heart rate calculated from the 220 - age formula

Wingate anaerobic test: On the second session participants anaerobic power and capacity were determined by Wingate Test protocol in laboratory. The 30 second Wingate anaerobic test was conducted on a cycle ergometer (Monarch 894E Ergomedic, Sweden). A 5-minute standardized warm-up was performed on the cycle ergometer. Thereafter, the subjects were asked to pedal for 30 seconds at maximal speed against a constant load equivalent to 0. 75 kg body mass.

Line Drill test: Session 3 has taken place in field and consisted three repeat LD Test consists of a 143.3m sprint. The LD test applied as required protocol (143.4m sprint, 3 times, 2-minute passive recovery) on basketball court. The participants has started run at the baseline to the near free throw line, baseline to the half court line, baseline to far free throw line, and baseline to far baseline. As they arrive at each line, they sprinted back to the original baseline for complete each 143.3m sprint repeat[13]. Repeats were recorded LD test times as LD test trail 1 (T1), trail 2 (T2), trail 3 (T3). The slowest recorded time of the 3 sprints divided the fastest recorded time of the 3 sprints. By mean of this a fatigue index (FI_{LD}) was calculated[6,13,15].

Statistical analysis

The data were evaluated with the SPSS 20 statistical package program. A descriptive statistical method was used to calculate mean and standard deviation for all variables. Spearman rank correlation analysis was used to examine relations between LD test performance Test with VO_{2max}, PP, MP, PD. All data were processed at the significance level $p < 0.05$.

RESULTS

Aerobic capacity VO_{2max} level, anaerobic power and capacity WANT and LD test performance outcomes were shown in Table 2. Mean of LD test T1, T2 and T3 were 29.53 ± 0.99s, 31.20 ± 1.55s and 32.19± 1.62s respectively. Mean of PP, MP and DP were 10.30 ± 1.08 w/kg, 8.19 ± 0.76 w/kg, 46.70 ± 8.79 %. Mean of $_{max}VO_2$ was 60.55 ± 5.06 ml.kg.min^{-1}.

Table 2. Performance outcomes of participants.

n=15	***mean***	***Std.***
VO_{2max} (mL/kg/min)	60.55	5.06
$_{Peak}$Power (w/kg)	10.30	1.08
$_{Mean}$Power (w/kg)	8.19	0.76
$Power_{Drop}$ (%)	46.70	8.79
Line Drill T1 (sec)	29.53	0.99
Line Drill T2 (sec)	31.20	1.55
Line Drill T3 (sec)	32.19	1.62
Line Drill FI_{LD} (%)	1.09	0.04

Spearman rank correlation analysis results were shown in table 3. Significant high negative correlations were observed between VO_{2max} and LD T1 (P= -0.651, p

= 0.009), LD T2 (P= -0.704, p = 0.003), LD T3 (P= -0.729, p = 0.20), MP and LD T2 (P= -0.668, p = 0.006), T3 (P= -0.726, p = 0.002), positive correlations were PD and LD T3, LD FI_{LD} (P= 0.521, p = 0.046 and P= 0.557, p = 0.031).No significant correlations were observed between PP and LD T1 (P= -0.341, p = 0.213), T2 (P= -0.468, p = 0.079), T3 (P= -0.457, p = 0.87), MP and LD T1 (P= -0.419, p = 0.120), PD and LD T3 (P= 0.521, p = 0.046).

Table 3. Relations between LD Test Performance with Aerobic Power, Anaerobic Power and Capacity.

n=15	VO_{2max} (ml/kg/dk)		$_{Peak}$Power (w/kg)		$_{Mean}$Power (w/kg)		$Power_{Drop}$ (%)	
	P	***p***	***P***	***p***	***P***	***p***	***P***	***p***
Line Drill T1 (sec)	-.651	.009*****	-.341	.213	-.419	.120	.120	.671
Line Drill T2 (sec)	-.704	.003*****	-.468	.079	-.668	.006*****	.671	.265
Line Drill T3 (sec)	-.729	.020*****	-.457	.870	-.726	.002*****	.521	.046*
Line Drill FI_{LD} (%)	-.393	.147	-.086	.761	-.393	.147	.557	.031*
**p< 0.05*								

Discussion

The present investigation examined relations aerobic and anaerobic structure of LD test. Test in young basketball players. LD test is a popular and common use as a conditioning drill which has been developed as field based anaerobic performance test with running by basketball coaches and players[9,15]. The studies have suggested that the LD test is a familiar anaerobic fitness protocol has reliability and validity in youth basketball players[6]. In addition, LD test is both an efficient and practical test by reason of several players simultaneously conducive for testing. The results of this investigation showed that the LD test is a field test which has appropriate on evaluation of anaerobic fitness, most especially anaerobic endurance in young male basketball players. Basketball is considered an intermittent high-intensity sport that requires both aerobic and anaerobic metabolism[8]. This means LD test may represent Basketball involving both anaerobic and aerobic metabolic pathways. Study results show that the mean VO_{2max} of participants were 60.55 ± 5.06 mL/kg/min. Earlier literature findings were showed that mean VO_{2max} of young basketball players were between 50.2 to 60.4 mL/kg/min[3,4,7,8,12,14,19] which study results has similarity. Castagna et.al (2008) calculated mean VO_{2max} 60.40 ± 5.10 mL/kg/min on twenty two male junior basketball players. The other study shows that mean VO_{2max} were 60.90 ± 6.26 mL/kg/min[8].

Dawes and Spiteri (2016) showed the LD test has moderate correlation with playing time. Similarly previous study LD test T1,T2, T3 has low negative correlation with VO_{2max} [13]. Our results, VO_{2max} and LD T1 (P= -0.651, p = 0.009), LD T2 (P= -0.704, p= 0.003), LD T3 (P= -0.729, p = 0.20) support these indication. The high negative relations between LD times may show aerobic structure. However, VO_{2max} has no relation with FI_{LD}, this means performance drop during LD test does not effected by maximal oxygen capacity. Also 2-minute recovery may not adequate performance relation.

The anaerobic structure and LD test relations was reported that LD test and WANT PP were strong significant correlate (τ=0.78), moderate correlate[11]. Considering this findings, it can be assumed that LD T1 and WANT PP would have a correlation. According the Fatouros et. al. (2011) reports has found positively relation between LD T1 and WANT PP. However, we have not found any relations through observations in our study. Earlier literature findings were similar on PP with our result[13]. The LD test performance range were reported in several studies as 28-30 second of 16-19 year old basketball players[1,6,7,14,15,19]. Also LD test and WANT were significantly correlated with training years[6]. Participants best mean LD test performance may accepted in this range, results may be considered reflecting elite basketball players power. Addition of this no significant rank correlations were observed between PP and the LD T2, LD T3, FI_{LD}. LD test may not certainly represent anaerobic power on field conditions. Hoffman 2000 reported that MP and LD T1 and T2 has moderate positive rank correlation 17 years old basketball players. We observed that the strong negative correlation MP and LD T2 and T3. In this case when MP increase, LD T2 and T3 performances improved. However, Fatouros et al (2011) reported negative moderate MP and T1. These finding was similar with our observations. These result may indicate that LD test has strongly represent anaerobic capacity in young basketball player. For this reason fatigue index relations can promote argument. Spearman rank correlation analysis results were significant positive moderate correlation WANT fatigue index (PD) and LD fatigue index (P= 0.557, p = 0.031)

Conclusion

Surprisingly, there is limited study appear to be previous study that examined the relationship of performance in the LD test to anaerobic and aerobic structure. However, LD test is a popular and common use as a conditioning drill by basketball coaches and players[15]. As generally called “suicide” drill. These results suggest that the LD test may be suitable for field assessment of anaerobic performance and endurance of youth basketball players. Results suggest that the LD test may be field measures of anaerobic power specific for basketball players. However, the small sample size should take into consideration during explication of these results and future studies.

Acknowledgment

This study was presented at The 2014 Wingate Congress of Exercise and Sport Sciences, scheduled to take place June 12-15, 2014 at The Zinman College, Israel.

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