

Speed, Agility and Explosive Leg Power in Forward and Backward Basketball Players: A Comparative Study of State-Level Male Athletes from Gwalior, India

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Abstract

Background: Basketball places repeated demands on sprinting, changing direction and jumping, yet these demands are not shared equally across playing positions. Little position-specific field-test evidence exists for state-level players in central India.

Objective: To compare speed, agility and explosive leg power between forward (frontcourt) and backward (backcourt) male basketball players of Gwalior.

Methods: Fifty state-level male players aged 17–21 years were recruited by purposive sampling and divided into forward ($n = 25$) and backward ($n = 25$) groups. Speed (50-m dash), agility (10×5 m shuttle run) and explosive leg power (standing broad jump) were measured with standardised field tests. Groups were compared with independent-samples t tests (with Welch correction where variances differed), Hedges' g , 95% confidence intervals, Mann–Whitney U tests and Hotelling's T^2 .

Results: Backward players were faster over 50 m (7.35 ± 0.16 s vs 7.94 ± 0.24 s), completed the shuttle run more quickly (11.43 ± 0.20 s vs 12.03 ± 0.25 s) and jumped farther (198.6 ± 5.5 cm vs 183.9 ± 5.0 cm). All differences were statistically significant (all $p < 0.001$) and very large in magnitude (Hedges' $g = 2.58$ – 2.83). The multivariate comparison agreed ($T^2 = 106.3$, $p < 0.001$).

Conclusion: In this sample, backcourt players showed a clearly superior neuromuscular profile in sprinting, change-of-direction speed and horizontal power. The findings support position-specific conditioning, although body size was not measured and the cross-sectional design prevents causal interpretation.

Keywords: basketball; playing position; speed; agility; explosive leg power; motor fitness; field tests; India

Introduction

Basketball is an intermittent sport in which short, intense efforts are separated by brief periods of lower-intensity activity. Time-motion and physiological studies show that players change activity very frequently during a match and that the physiological load is substantial (McInnes et al., 1995; Abdelkrim et al., 2007). A recent systematic review of match-play demands reached a similar conclusion, emphasising the repeated sprints, decelerations, jumps and directional changes that characterise the modern game (Stojanović et al., 2018). Technical and tactical ability decides many possessions, but a player can only express that ability if the body can get to the right place quickly and under control.

Those physical demands are not identical for every player. A point guard bringing the ball up the floor, a centre contesting a rebound and a wing defender recovering to a shooter all work in different spaces and against different opponents. Evidence from elite men's basketball supports this intuition. In a comparison of national-team players, centres and power forwards were the tallest and heaviest and had the greatest upper-body strength, whereas point guards had the best endurance, agility and short-sprint performance (Ben Abdelkrim et al., 2010). Pojskic et al. (2015) reported that guards and forwards had higher aerobic power and relative anaerobic power, while centres had higher absolute anaerobic power. Broader reviews likewise describe position-related variation in anthropometric and physical characteristics (Ziv & Lidor, 2009).

Three physical qualities are particularly relevant to these positional differences. Linear speed allows a player to win the transition game and recover on defence. Agility, or more precisely the ability to change direction quickly, underlies defensive slides, cuts and closeouts. Explosive leg power supports jumping, finishing and the first step of a drive. All three can be assessed with inexpensive field tests, and several have reasonable criterion validity as indicators of the underlying capacities (Castro-Piñero et al., 2010; Sheppard & Young, 2006). This matters in settings where laboratory testing is rarely available.

In India, basketball is commonly grouped into two broad functional categories at junior and state level: backward players (point guards and shooting guards) and forward players (small forwards, power forwards and centres). Despite the sport's growing popularity in Gwalior, we are not aware of published position-specific field-test data for state-level players in the city or the wider Madhya Pradesh region. Coaches therefore tend to rely on experience

rather than local reference values when planning position-specific training. The present study was designed to help fill that gap.

The aim of this study was to compare speed, agility and explosive leg power between forward and backward male basketball players of Gwalior. We tested three null hypotheses: there is no significant difference between forward and backward players in (H_{01}) speed, (H_{02}) agility, or (H_{03}) explosive leg power.

Methodology

Study design

We used a cross-sectional, comparative design. Two intact groups, forward and backward players, were compared on three dependent variables measured on a single occasion. Playing position was the grouping variable; no intervention was applied. This design follows the recommendations of Thomas and Nelson (2001) for descriptive comparative research.

Participants

Fifty male basketball players who had represented Gwalior or Madhya Pradesh at state-level competitions took part. They were recruited by purposive sampling through basketball academies in Gwalior. Eligible players were aged 17–21 years, had a clearly defined playing position, had at least two years of competitive experience at district or state level, were free from acute or chronic injury on the day of testing, and gave written informed consent (with parental or guardian consent for those under 18). Group A comprised 25 forward players (small forwards, power forwards and centres) and Group B comprised 25 backward players (point guards and shooting guards), with positions assigned by each player's coach. The two groups were identical in age (both 19.12 ± 1.27 years; range 17–21 years). Height and body mass were not recorded.

Testing procedures

Testing took place over two consecutive days at a standardised venue in Gwalior, supervised by trained officials in cooperation with the academy coaches. The three tests analysed here were administered as follows.

- *Speed (50-m dash)*. Players sprinted 50 m on a straight, level track from a standing start on the command “Ready... Set... Go!”. Two timing officials, one at each end, recorded time

to 0.01 s with stopwatches. Each player completed two trials separated by at least five minutes of rest, and the faster time was retained.

- *Agility (10 × 5 m shuttle run)*. Two lines were marked 5 m apart. Starting behind one line, the player sprinted to the other, touched it with a foot, turned and returned; this was repeated until ten lengths (50 m in total) were completed. Total time was recorded in seconds. Two trials were allowed and the better one retained. Because the task has a fixed, pre-planned course, it is best described as a test of change-of-direction speed rather than reactive agility (Sheppard & Young, 2006).
- *Explosive leg power (standing broad jump)*. From behind a take-off line, with feet shoulder-width apart, players used an arm swing and countermovement to jump forward as far as possible and land on both feet. Distance from the line to the nearest point of contact was measured to the nearest centimetre. The best of three trials was retained.

Ethical considerations

Participation was voluntary and all players could withdraw at any time without penalty. Written informed consent was obtained before testing, consistent with the principles of the Declaration of Helsinki (World Medical Association, 2013). Players were informed of the nature and physical demands of each test before they began.

Statistical Analysis

All analyses were run on the individual raw scores of the 50 participants. Means and standard deviations were calculated for each group. Normality within each group was checked with the Shapiro–Wilk test (Shapiro & Wilk, 1965) and equality of variances with Levene’s test (Levene, 1960). Group differences were tested with independent-samples *t* tests (two-tailed, $\alpha = 0.05$; $df = 48$ for the pooled-variance version). Where Levene’s test suggested unequal variances, Welch’s correction was also computed; this is increasingly recommended as a default (Delacre et al., 2017). Mean differences are given with 95% confidence intervals.

Standardised effect sizes were expressed as Hedges’ *g* (Cohen’s *d* with a small-sample correction), with approximate 95% confidence intervals (Lakens, 2013), and interpreted using the thresholds of Hopkins et al. (2009): 0.2 small, 0.6 moderate, 1.2 large, 2.0 very large and 4.0 extremely large. As a sensitivity check that does not rely on distributional assumptions, we also ran Mann–Whitney *U* tests (Mann & Whitney, 1947). Because three outcomes were tested, we considered a Bonferroni-adjusted threshold of 0.0167 alongside the nominal 0.05; no

conclusion depended on the choice. An omnibus multivariate test, Hotelling's T^2 (Hotelling, 1931), was used to compare the three variables jointly. Pearson correlations described the relationships among the three tests. Computations were performed in Python 3 with the SciPy library.

Results

The two groups did not differ in age (19.12 ± 1.27 years in both). Table 1 presents the descriptive statistics and test results for the three variables, and Table 2 the effect sizes and the non-parametric check. The distributions are shown in Figure 1.

Table 1. Descriptive statistics and independent-samples t test results for speed, agility and explosive leg power (n = 25 per group)

Variable	Forward (M ± SD)	Backward (M ± SD)	Mean diff. (F – B)	t (df = 48)	Welch t	p
50-m dash (s)	7.94 ± 0.24	7.35 ± 0.16	0.59	10.17	10.17	< 0.001
Shuttle run (s)	12.03 ± 0.25	11.43 ± 0.20	0.61	9.28	9.28	< 0.001
Standing broad jump (cm)	183.9 ± 5.0	198.6 ± 5.5	-14.7	-9.86	-9.86	< 0.001

Note. Lower values indicate better performance for the 50-m dash and shuttle run; higher values indicate better performance for the jump. Levene's test indicated unequal variances for the 50-m dash only ($p = 0.016$); Welch's degrees of freedom were 42.0, 45.9 and 47.6 for the three tests, respectively. Shapiro–Wilk p values exceeded 0.05 in every group (range 0.073–0.762).

Table 2. Mean differences, effect sizes and non-parametric comparison

Variable	Mean (95% CI)	diff. (95% CI)	Hedges' g	Relative diff.	Mann– Whitney U	p
50-m dash (s)	0.59 (0.48 to 0.71)	2.83 (2.05–3.62)	8.1%	621.0	< 0.001	
Shuttle run (s)	0.61 (0.47 to 0.74)	2.58 (1.83–3.33)	5.3%	608.5	< 0.001	

Standing	broad	-14.7 (-17.7 to 2.74	(1.97– 7.4%	11.0	<
jump (cm)		-11.7)	3.52)		0.001

Note. Differences are forward minus backward. Hedges' g is shown as an absolute value; all effects favoured backward players. Relative difference is expressed as a percentage of the backward-group mean.

Figure 1. Distribution of individual scores by playing position for (a) 50-m dash, (b) 10×5 m shuttle run and (c) standing broad jump. Boxes show the median and interquartile range; dots are individual players.

Backward players were faster over 50 m by 0.59 s (95% CI 0.48–0.71 s), a difference of about 8.1%. They completed the shuttle run 0.61 s faster (95% CI 0.47–0.74 s; about 5.3%) and jumped 14.7 cm farther (95% CI 11.7–17.7 cm; about 7.4%). Every difference was statistically significant (all $p < 0.001$) and very large by the Hopkins scale (g from 2.58 to 2.83). Welch-corrected tests and Mann–Whitney tests gave the same conclusions. The joint test of the three variables was also significant ($T^2 = 106.3$, $F(3, 46) = 33.94$, $p < 0.001$). All three null hypotheses were therefore rejected.

The distributions overlapped very little. No forward player ran faster, shuffled faster or jumped farther than the backward-group mean on any test: in the 50-m dash, for example, the fastest forward player (7.60 s) was only marginally quicker than the slowest backward player (7.65 s).

Table 3. Pearson correlations among the three tests

Pair of tests	All players (n = 50)	Forward (n = 25)	Backward (n = 25)
50-m dash $\times$ shuttle run	0.97	0.88	1.00
50-m dash $\times$ broad jump	-0.97	-0.89	-0.99
Shuttle run $\times$ broad jump	-0.96	-0.82	-0.98

Note. All coefficients were significant at $p < 0.001$. The negative signs arise because shorter times (better) accompany longer jumps (better).

Interpretation of Results

The statistical picture is consistent across all three outcomes. Backward players were around 8% faster over 50 m, about 5% faster in the shuttle run and roughly 7% better in the broad jump. The confidence intervals for the mean differences are narrow and lie well away

from zero, so the size of the gap, and not just its direction, is reasonably well estimated for this sample. Hedges' g values between 2.58 and 2.83 fall in the "very large" band of the Hopkins scale. Effects of this size are unusual in sport-science comparisons and mean that the groups are almost separable on these tests.

The results for speed and agility run in the expected direction and are consistent with the elite-level pattern in which guards sprint and change direction better than frontcourt players (Ben Abdelkrim et al., 2010). The broad-jump result needs a little more care. A forward player's greater size might lead one to expect equal or better jump output, and indeed larger players often produce higher absolute power (Pojskic et al., 2015). The standing broad jump, however, is expressed as a distance and is not scaled to body mass, so a heavier player must project more mass over the same distance. Because we did not measure height or body mass, we cannot say how much of the difference reflects the quality of force production and how much reflects body size.

The correlations in Table 3 are also worth reading with caution. The three tests were strongly related across the whole sample ($|r| \geq 0.96$), which partly reflects the large between-group gap: players in one group sit at one end of every scale. Even within groups, however, the correlations were high ($|r|$ from 0.82 in the forward group to 0.998 in the backward group). Players who were fast also tended to be agile and to jump far. Such strong coupling suggests that the three tests may be capturing a shared underlying dimension of athletic quality as much as three separate abilities.

Discussion

The main finding is that backward players in Gwalior outperformed forward players on every neuromuscular test we applied. The superiority in speed and change-of-direction ability fits the functional description of the backcourt role. Guards initiate the offence, cover long distances in transition, and defend perimeter players who attack space; these tasks reward a quick first step, high running speed and the capacity to decelerate and re-accelerate. Our data suggest that the pattern reported for elite players (Ben Abdelkrim et al., 2010) is also visible at state level in a regional setting, which is not something that could be assumed in advance.

There are several plausible explanations for why the groups differ, and the study design cannot choose between them. Position-specific training over several years may gradually shape physical qualities, since guards tend to spend more training time on sprints, dribble drives and defensive slides. Selection may also play a part: quicker, more mobile players may be steered

towards the backcourt while taller, heavier players are moved towards the frontcourt, and the physical gap would then partly pre-date the positional training. A third possibility is that body size accounts for much of the difference. The relative contribution of each of these processes can only be tested with longitudinal designs and with measures of body composition.

The jump result deserves a brief comment about practical interpretation. Horizontal jump distance is a useful, simple screening measure, but basketball's signature jumping tasks, including rebounding, shot-blocking and finishing at the rim, are largely vertical. Our findings should therefore not be read as showing that backward players are better at vertical jumping or at contested rebounding. Adding a vertical jump test and a body-mass-adjusted score would give a more complete picture.

For coaches in the region, the findings point to three practical messages. First, forward players, as a group, have more to gain from structured sprint and change-of-direction work, which is often under-emphasised for taller players. Second, plyometric and lower-limb power training deserves a place in frontcourt programmes, though the exact emphasis should be adjusted to the individual player's body mass and injury history. Third, the low-cost tests used here are feasible in resource-limited settings, so they could be repeated across a season to track progress. The group means in Table 1 may serve as provisional reference values for similar players, but they should not be used as selection cut-offs.

Limitations

Several limitations should be borne in mind. The sample was small, purposive and drawn from a single city, and it comprised male players only, so generalisation is limited. Grouping players into two broad categories masks differences between, for instance, point guards and shooting guards, or between small forwards and centres. Height, body mass, maturation, training history, nutrition and sleep were not recorded or controlled. Times were taken with hand-held stopwatches, which are less precise than electronic timing gates and can introduce systematic error. The testers were not blinded to playing position. The effect sizes we observed are much larger than those usually reported in this field, and the within-group correlations among tests were very high; both observations suggest that replication with a larger, independent sample and electronic timing would be valuable before the results are used for practical standards.

Conclusion

Among state-level male basketball players of Gwalior aged 17–21 years, backward players were significantly faster, quicker in the 10 × 5 m shuttle run and better in the standing broad jump than forward players, and the differences were very large. All three null hypotheses were rejected. The results support position-specific conditioning, with particular attention to speed, change-of-direction speed and lower-limb power development for forward players. Future work should add anthropometric data, vertical jump tests, electronic timing and larger multi-centre samples, and should follow players longitudinally to establish how these positional profiles develop.

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