INFLUENCE OF THE DAME 8 BASKETBALL SHOES ON JUMP KINETICS AFTER 150 MILES OF SIMULATED RUNNING

Jeremy Portillo[1], **Giorgio Zucca**[1], **Karah Bell**[1], **Ernie Rimer**[1], **Petway Adam**[1,2]
[1]Department of Athletics, The University of Louisville, Louisville, KY, USA;
[2]Human Factors & Athlete Engineering, Center for Advanced Vehicular Systems, Starkville, MS, USA.

Basketball involves high-mileage running and repeated jumps. The goal of this study was to compare pre- and post-kinetic variables involved in jumping between basketball shoes with different inflicted mileage. Eleven NCAA Division I basketball athletes (20.5±1.4 years, 195.1±5.7 cm, 86.7±10.9 kg) performed a countermovement jump (CMJ), a rebound countermovement jump (CMJ-R), and a Multi-Rebound (MR) for four rounds on force platforms. Each round, athletes switched between brand-new (New) and worn (Worn) Dame 8 basketball shoes. Kinetic variables associated with each jump task were compared across shoe type. Several kinetic variables differed significantly between shoe type; however, the magnitude of difference was small-to-moderate. These results suggest that the Dame 8 withstands the high mileage imposed by high-level competition basketball.

KEYWORDS: BASKETBALL, SHOES, JUMP, KINETICS, MILEAGE, INJURY.

INTRODUCTION: In basketball, performing repeated jumping and landings is an essential component. Athletes may experience landing forces up to several times that of body weight, with forces increasing with jump height (Alonzo, 2020). Over the span of a single season, the requirements of the sport put a high demand on the neuromuscular and musculoskeletal systems. A recent systematic review revealed that out of 12,960 musculoskeletal injuries in basketball, 63.7% were lower limb injuries (Andreoli, 2018). Assessing footwear design can mitigate lower-limb basketball injuries as it has been shown to influence lower-limb biomechanics and neuromuscular performance (Alonzo, 2020).
Within basketball, standardized jump protocols are now commonplace to assess neuromuscular function and jump performance. However, footwear manufacturers have only recently begun to test their products against these protocols to assess shoe quality and performance. An observational analysis reported that, on average, basketball players perform 45 jumps per game and run between 4,500 and 7,500 m per game (Schelling, 2013). Therefore, it is logical that to achieve an optimal assessment of a shoe's durability and quality, footwear manufacturers would subject their shoes to not only a standardized jump protocol relevant to basketball but repeatedly test their product over the course of a full-length season. This is particularly important since athletes cannot always accurately perceive the intensity of their landing forces, as they are altered by jump heights and footwear features (Alonzo, 2020).
As basketball has evolved, so has the demand for shoes to serve as ergogenic and protective equipment for optimizing performance and minimizing injury risk. Therefore, a modern basketball shoe must support movement in all planes of motion, as well as withstand repetitive changes in direction, and accept and assist with the production of ground reaction forces (Luczak, 2020). To meet these demands, Adidas released the Dame 8 basketball shoes, containing their dual-density *Bounce Pro* material, designed for improved energy return, cushion, and support. However, while the Dame 8 has received a 4.7-star rating out of 5 stars (354 Reviews) across several metrics including size, width, comfort, and quality, the shoe has not yet been evaluated against a standardized jump protocol relevant to the kinetic demands of a full-length, competitive basketball season (Adidas Basketball, 2023). To the best of the author's knowledge, no modern basketball shoe has been evaluated in a strict jump protocol to assess durability and potential injury risk. Therefore, the main purpose of this study is to examine how mileage on the Dame 8 affects the pre- and post-kinetic variables of single and repeated jumping. However, due to the novelty of this experiment, no primary kinetic metric was analyzed; rather, several variables were evaluated to more broadly represent changes in jump pattern and potential injury risk. While this study was exploratory, it was hypothesized that, despite high usage, the shoes would remain robust, and therefore, preserve several

kinetic variables across jump tasks. Results from this study are expected to assist players, equipment managers, and sport scientists to make more informed decisions on footwear selection to aid in the management of injury risk.

METHODS: A prospective comparative study was conducted. Kinetic variables were assessed on a single training day via a CMJ, CMJ-R, and a MR. All testing was performed on a single day to account for any acute fluctuations in neuromuscular readiness that may have been imposed by a training session or basketball play the day before. Players were familiarized with both the standardized warm-up and the experimental jump protocol over the course of several months prior to experimental conditions as part of a routine for the daily assessment of fatigue and player loads (Petway, 2021). All data was collected by the strength and conditioning staff.

Eleven male NCAA Division I basketball athletes (20.5±1.4 years, 195.1±5.7 cm, 86.7±10.9 kg) were recruited for the study. The inclusion criteria were (1) male, (2) aged between 18 and 25 years old, and (3) shoe size US 12 to 14. Participants were excluded if they (1) had any serious musculoskeletal injury in the 6 months prior to testing, or (2) experienced pain during the test.

Two pairs of Dame 8 basketball shoes were used. The New shoes were brand new and had not been broken in prior to delivery. The Worn shoes, however, were broken in with 150 miles of simulated running at an 8 minute/mile pace using Heeluxe's proprietary Time Machine Rapid Durability test prior to the experiment (Heeluxe, LLC, Goleta, CA., US).

To evaluate kinetics, athletes performed a jump task protocol consisting of four rounds of one CMJ, one CMJ-R, and one MR on two side-by-side force platforms that recorded ground reaction forces at 1000 Hz (0668, Hawkin Dynamics, Inc., Westbrook, ME, USA). For the first and third rounds, athletes dressed in the Worn shoes. For the second and fourth rounds, athletes dressed in the New shoes.

To perform the CMJ, athletes began by standing tall, with their feet placed between hip and shoulder-width apart, with equal distribution of their weight on each force plate. Hands were affixed to each hip. From this position, athletes performed a rapid descent to a self-selected depth, followed by a rapid ascent into a maximal vertical jump. Landings slightly differed between each task; however, each athlete was prompted to return to the force plates in an athletic stance with knees slightly flexed and torso upright. After each task, participants reset to the starting position before performing the subsequent task (Heishman, 2020). For the CMJ-R, athletes performed a standard CMJ, but upon landing, the subject immediately rebounded into a second vertical jump. Therefore, athletes completed the task when a total of two maximal vertical jumps were executed sequentially. Athletes were instructed to maximize jump height and minimize contact time. To execute the MR, upon landing on the force plate, athletes immediately rebounded into a total of five vertical jumps. Instructions were similar to the CMJ-R. If participants lost contact between their hands and hips at any time throughout any part of any task, the trial was repeated. Likewise, data was not considered if athletes did not land back on the force plates throughout the entire duration of the task.

Due to the novelty of this experiment and the accessibility to numerous kinetic variables measured by the Hawkin Dynamics (HD) software, no primary performance metric was examined. Instead, several kinetic metrics measured by the HD software were analyzed across each phase of the force-time curve for each jump task, i.e., the unweighting, braking, transfer, propulsive, flight, and landing phases. All jumps were uploaded to the HD Cloud and then exported to Microsoft Excel for statistical analysis using Analysis ToolPak. Data is presented as means and standard deviation. Paired *T*-Tests were performed to compare kinetic variables between Worn and New. Two jumps per jump task dressing Old and New, respectively, per athlete, were included in the Paired *T*-Tests. Cohen's d_s effect sizes (ES) were calculated to determine the magnitude of differences and were classified as: small ($d \geq 0.2$), medium ($d \geq 0.5$), and large ($d \geq 0.8$) (Sullivan, 2012). Statistical significance was set at $p < 0.5$.

RESULTS AND DISCUSSION: Table 1 shows the descriptive data and the comparison between kinetic variables when wearing the Worn and New Dame 8 shoes.

Table 1: CMJ and CMJ-R, and MR kinetic variables and comparison between Worn and New

Jump Type	Kinetic Variable	Shoe Type			
		Worn	New	*p*	ES
CMJ	Peak Rel. Braking Force (%)	243.54 ± 36.72	259.45 ± 47.82	0.004*	–0.373
CMJ	Rel. F @ Min Disp. (%)	243.71 ± 36.64	259.93 ± 48.20	0.004*	–0.379
CMJ	Braking RFD (N/s)	9135.00 ± 4663.65	10866.33 ± 6406.78	0.015*	–0.309
CMJ	Avg. Rel. Prop. Power (W/kg)	31.78 ± 5.14	33.00 ± 5.79	0.016*	–0.222
CMJ	Avg. Rel. Braking Force (%)	174.23 ± 19.52	181.20 ± 23.76	0.019*	–0.320
CMJ	Avg. Rel. Prop. Force (%)	227.31 ± 28.06	233.40 ± 31.68	0.023*	–0.204
CMJ	Avg. Prop. Velocity (m/s)	1.60 ± 0.13	1.63 ± 0.15	0.041*	–0.243
CMJ	Avg. Rel. Braking Power (W/kg)	–10.47 ± 2.51	–11.18 ± 2.72	0.045*	0.269
CMJ-R	Rebound Impulse Ratio (ratio)	1.07 ± 0.07	1.01 ± 0.10	0.046*	0.58
MR	Top 5 Jumps Avg. Modified RSI (unitless)	0.93 ± 0.31	0.93 ± .30	0.47	–0.01

**** Significance set at *p* < 0.05; Rel.: Relative; Prop.: Propulsive; ES: effect size; RFD: Rate of Force Development; Rel. F @ Min. Disp.: Relative Force at Minimum Displacement; RSI, Reactive Strength Index; CMJ: Countermovement Jump; CMJ-R: Rebound Countermovement Jump**

CMJ revealed significant differences in the Braking, Propulsive, and Transfer phases. In the Braking phase, Peak Relative Braking Force (p = 0.004; ES = –0.373), Average Relative Braking Force (p = 0.019; ES = –0.320), Braking Rate of Force Development (p = 0.015; ES = –0.309), and Average Relative Braking Power (p = 0.045; ES = 0.269) demonstrated significant differences between New and Worn; however, all variables revealed only small ES. Likewise, in the Propulsive phase, significant changes in Average Relative Propulsive Force (p = 0.023; ES = –0.204), Average Propulsive Velocity (p = 0.041; ES = –0.243), and Average Relative Propulsive Power (p = 0.016; ES = –0.222) occurred, however, like the Braking phase, each variable demonstrated a small ES. Finally, in the Transfer phase, Relative Force at Minimum Displacement (p = 0.004; ES = –0.379) demonstrated a significant change, however, like all other variables, the ES was small. During the CMJ-R, Rebound Impulse Ratio (p = 0.046; ES = 0.58) demonstrated a significant change, as well as revealed a medium ES. MR indicated no significant differences between New and Worn.

The main purpose of this study was to examine how mileage on the Dame 8 basketball shoes affects the pre- and post-kinetic variables of single and repeated jumping. The main findings revealed that after 150 miles of simulated running, the Dame 8 basketball shoes significantly alter several kinetic variables associated with jumping; however, the magnitude of difference is predominately weak. Thus, the Dame 8 basketball remains robust despite the high mileage associated with high-level competition basketball.

While this study is novel in nature, several limitations exist. First, Heeluxe's proprietary Time Machine only delivered impact forces from a running gait set at a constant speed. Therefore, inflicted mileage did not account for the volume of jumps, cuts, or changes of direction and/or speeds accumulated during a basketball season. However, while true basketball play may alter the material properties of the shoes in different ways, to maximize internal validity, a standardized jump protocol validated to assess neuromuscular fatigue in athletes was implemented (Petway, 2020). Also, 150 miles was selected because it is just below the average distance traveled per season by the top-50 athletes over the past 5 complete seasons (2017/18-2021/22) in the National Basketball Association. Similarly, an 8 minute/mile pace was selected because the average speed per season by the same cohort is 14.28 minute/mile

(Second Spectrum, Los Angeles, CA., US). However, this speed accounts for both peak and minimum speed achieved during play. Therefore, it was rationalized by our group to standardize a speed that is likely between peak and average speed. Second, only one shoe model was tested. Different shoe models may not have been able to withstand the volume applied in this study. Third, each athlete had two jumps per jump task, for both Old and New shoes, entered into the statistical analysis to optimize the reliability of the jump protocol. Further research is warranted to examine the effects that tread may have on the material properties of athletic shoes. Like a car needing a checkup after a certain amount of mileage, athletic shoes should be tested in a standardized and repeatable manner for kinetic variables and energy return after a finite amount of tread. Future investigation is necessary to understand the amount of volume that when applied to this model would be deleterious to kinetics. Prospective research lines should investigate different models of shoes to find what is optimal for which sport and athletic population.

CONCLUSION: This study revealed that after 150 miles of simulated running, the Dame 8 basketball shoes significantly alter several kinetic variables associated with jumping; however, the magnitude of difference is small-to-moderate. Only one kinetic variable across three jump tasks revealed a moderate effect. Thus, the Dame 8 basketball shoes remain robust despite the high mileage associated with high-level competition basketball. These findings validate the durability of the Dame 8 and support its effectiveness as a potential ergogenic aid for basketball. Practitioners are advised to understand the effects that shoe ergonomics can have on biomechanical factors related to athletic performance.

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