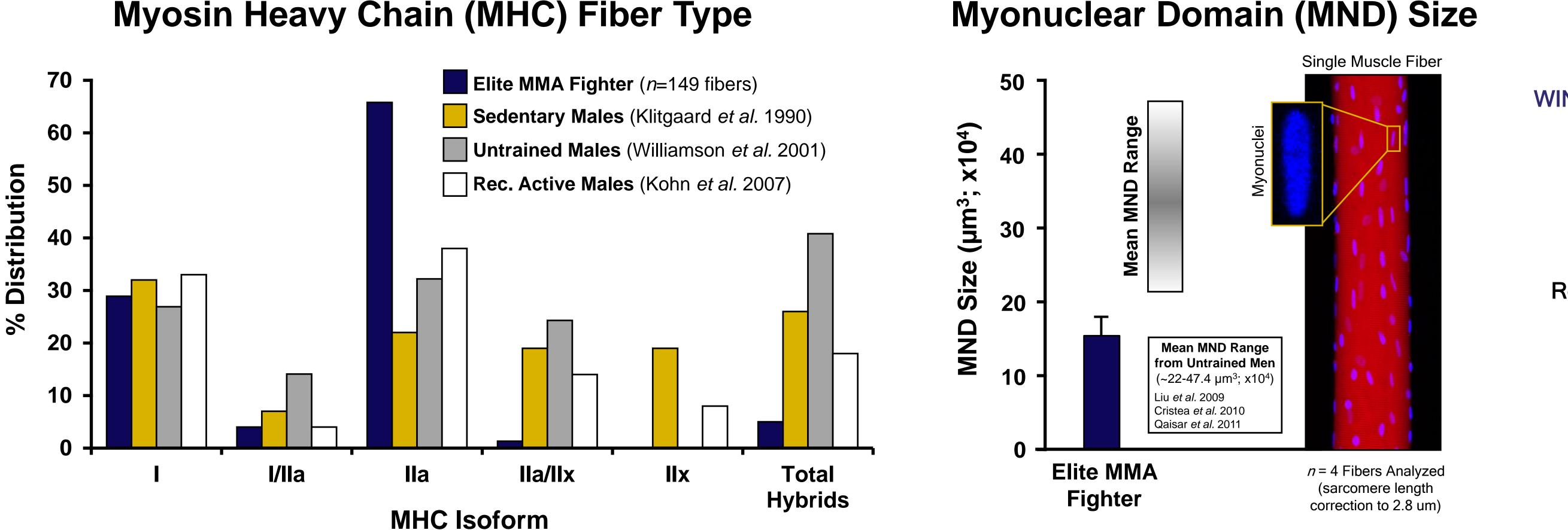




# SAN FRANCISCO STATE UNIVERSITY

# ABSTRACT

**Purpose**: Mixed martial arts (MMA) requires a unique combination of muscular strength, power, and endurance. However, little is known regarding elite MMA athletes muscle characteristics at the cellular level. The purpose of this study was to determine the myocellular phenotype [fiber type, size, and myonuclear domain (MND) size] and whole muscle performance of an elite MMA fighter. Methods: One male MMA athlete [Record: 8 wins, 2 losses; Ranked: top 10 in the Ultimate Fighting Championship (UFC) Light Heavyweight Division] volunteered to participate in this study [Age: 33 y, Height: 1.89 m, Mass: 102.1 kg (competes at 93.0 kg)]. The participant underwent a vastus lateralis muscle biopsy to analyze myocellular characteristics, which included myosin heavy chain (MHC) fiber type distribution (via SDS-PAGE), fiber size (cross-sectional area; CSA), and MND size (via immunofluorescent labeling and confocal microscopy). Whole muscle performance measures included hand grip dynamometry, peak isometric mid-thigh pulls, vertical jump (measured with no counter-movement), and 5 repeat Wingate Anaerobic Tests (WAnT). **Results**: Muscle fiber type composition was 29% MHC I (pure slow-twitch fibers), 66% MHC IIa (pure fast-twitch fibers) and 5% hybrid fibers (containing multiple MHC types). Mean ± SE fiber CSA and MND size were  $3,183 \pm 225 \text{ m}^2$  and  $11,008 \pm 1,331 \text{ m}^3$ , respectively. His grip strength was 78.4 kg, isometric mid-thigh pull peak force was 37.7 N/kg, and vertical jump was 57.2 cm. Additionally, the WAnT determined his peak power (PP): 1,075.89 W, relative PP: 10.45 W/kg, average power (AP): 838.87 W, fatigue index: 43.39%, and PP decrease over 5 rounds: 12.1%. Conclusion: This elite MMA athlete exhibited a homogeneous muscle fiber type (i.e. predominantly fast-twitch with few hybrids) with relatively small MND sizes compared to untrained men in the literature (using similar measures). These cellular characteristics may help partially explain the athletes elevated whole muscle strength, power, and endurance performance. This case study provides initial insight into the muscle physiology of high-level MMA fighters; future research should continue investigating the myocellular structure/function relationship among these unique athletes to further our knowledge regarding elite human muscle physiology.



### Myosin Heavy Chain (MHC) Fiber Type

# **Skeletal Muscle Phenotype and Performance of an Elite Mixed Martial Artist**

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# PARTICIPANT

### **Elite Male Mixed Martial Artist**

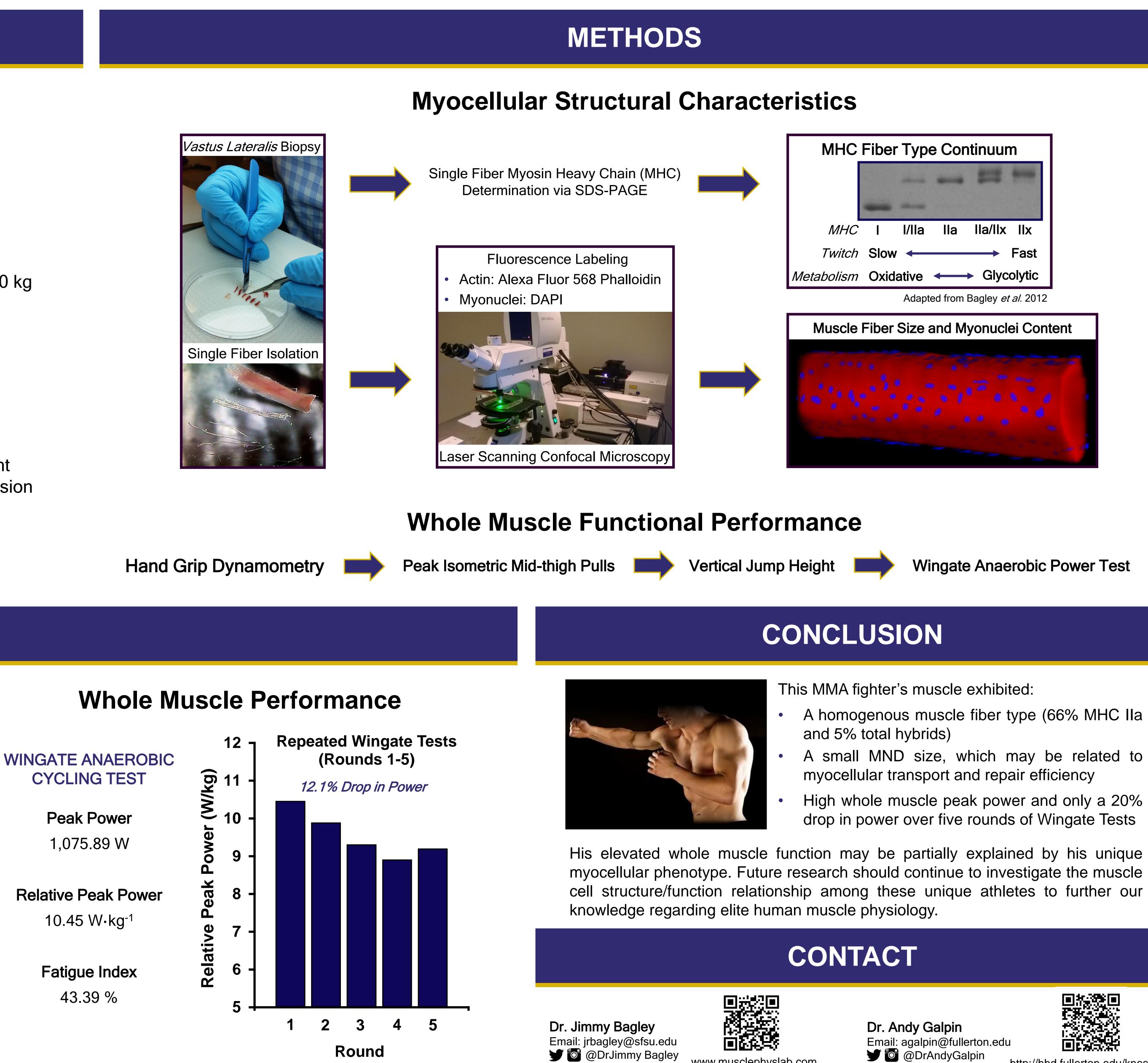


**Age:** 33 y **Height** 1.89 m Mass: 102.1 kg Competes at: 93.0 kg

MMA RECORD 8 wins; 2 losses

UFC RANKING Top 10 in the Light Heavyweight Division

### RESULTS





- A homogenous muscle fiber type (66% MHC IIa
- A small MND size, which may be related to
- High whole muscle peak power and only a 20% drop in power over five rounds of Wingate Tests



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http://hhd.fullerton.edu/knes/Re searchLabs/bmep/index.htm