Dimensional Structure of Wrestling Fitness: Principal Component Analysis and Test Battery Construction for Elite Wrestlers

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***Abstract*—Principal component analysis of 23 wrestling fitness variables in 52 elite wrestlers (mean age 21.88 ± 1.50 years) identified four components explaining 76.20% of total variance: Dynamic Strength (50.95%), Flexibility (14.98%), Leg Movement Coordination (5.60%), and Muscular Endurance (4.68%). A streamlined test battery comprising Curl-ups (λ = 0.83), Bridge Test (λ = −0.88), Sidestep Test (λ = 0.77), and Wheel Barrow Push-ups (λ = 0.87) was constructed. All tests demonstrated excellent test reliability ($\alpha \geq 0.89$) and objectivity coefficients (≥0.95). This streamlined assessment reduces testing time while maintaining comprehensive coverage of wrestling-specific physical capacities, providing evidence-based guidance for fitness evaluation in competitive and educational settings.**

***Index Terms*—Factor analysis, fitness assessment, wrestling performance, test development, elite wrestlers.**

I. INTRODUCTION

Wrestling demands multidimensional fitness across strength, flexibility, speed, agility, and coordination.[1] Comprehensive fitness batteries (20–30 tests) create logistical constraints in training environments.[2] Principal component analysis offers statistical frameworks for identifying latent fitness structures without redundancy.[3] This study determined the underlying factorial architecture of 23 wrestling-specific fitness variables and constructed a practical test battery with superior test reliability and validity for applied use.

II. METHODS

Participants: Fifty-two elite wrestlers (age: 21.88 ± 1.50 years; height: 176.31 ± 8.55 cm; body weight: 79.79 ± 19.10 kg) representing state, national, and international competition levels participated. Measures: Twenty-three measures spanning strength, power, speed, endurance, flexibility, agility, Coordination, and anthropometric variables were administered. Statistical procedure: IBM SPSS 26.0 performed principal component analysis with Kaiser normalization (KMO = 0.687, $p < 0.001$) and Varimax rotation. Factor loadings ≥ 0.75 determined variable-component assignment.

III. RESULTS

Four components with eigenvalues ≥1.0 explained 76.20% of variance. Component 1 (50.95%): Dynamic Strength—Age (0.89), Competition Level (0.85), Curl-ups (0.83), Run 30m (−0.82). Component 2 (14.98%): Anthropometric Configuration and Flexibility—Weight Category (0.96), Body Weight (0.96), Height (0.94), Bridge Test (−0.88). Component 3 (5.60%): Leg Movement Coordination—Sidestep Test (0.77), Nelson Foot Reaction (−0.79). Component 4 (4.68%): Muscular Endurance—Wheel Barrow Push-ups (0.87). All retained tests demonstrated communalities ≥0.74, test reliability ≥0.89, and objectivity ≥0.95.

Test Battery Construction

Test	Component	Loading	Communality	Reliability	Objectivity
Curl-ups	1	0.83	0.74	0.92	0.95
Bridge Test	2	−0.88	0.82	0.98	0.96
Sidestep Test	3	0.77	0.79	0.89	0.98
Wheel Barrow Push-ups	4	0.87	0.86	0.97	0.99

Table 1: Prathap N and Prakash S M Wrestling Fitness Test Battery

IV. DISCUSSION

Principal component analysis successfully identified four orthogonal dimensions underlying wrestling fitness. Component 1's dominance reflects strength-endurance-speed integration essential to wrestling performance [4]. Component 2's anthropometric prominence reflects weight-category classification constraints on flexibility [5]. Component 3's leg movement specificity echoes wrestling's footwork demands [6]. Component 4's push-up emphasis validates wrestling-specific grappling endurance patterns [7]. The streamlined 4-test battery reduces assessment from 23 tests while retaining 76.20% variance coverage. Superior test reliability and validity coefficients (0.89–0.99) confirm exceptional measurement stability and objectivity, positioning the battery for implementation in coach education, talent identification, and training monitoring programs.

V. CONCLUSION

Wrestling fitness comprises four distinct yet complementary dimensions. The developed test battery efficiently assesses these constructs with excellent test reliability and validity. The streamlined approach facilitates practical implementation in competitive and educational settings, supporting evidence-based fitness evaluation and training optimization for wrestlers across competitive levels. Future investigation with larger, geographically diverse populations is warranted to confirm generalizability and establish normative standards across weight categories.

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