The Academic
International Journal of Multidisciplinary Research

An Online Peer Reviewed / Refereed Journal
Volume 3 | Issue 8 | August 2025
ISSN: 2583-973X (Online)
Website: www.theacademic.in

Bio-Motor Fitness Components for Talent Identification and Development in Badminton in Uttarakhand

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DOI : https://doi.org/10.5281/zenodo.17130410

ARTICLE DETAILS

Research Paper

Accepted: 27-08-2025

Published: 10-09-2025

Keywords:

Bio-motor Fitness, Badminton, Sports Talent Identification and Development

ABSTRACT

This article explores the progress in Indian Badminton world with special reference to talent identification and development through biomotor fitness in Uttarakhand. The game of badminton has a strong foundation in India. The British invented modern badminton during the colonial era at the end of the nineteenth century, most likely in India.. The game was played in various important military base in India. At present time Badminton shows great influence at international level competitions fairly from Poona to popularity in India in many terms. As continue igniting performance by talented Indian girls and Indian boys including have been consistently doing well at top badminton tournaments. The BAI has played a very motivational role in mounting the recognition of Badminton in India as organised international-level tournaments; leagues (PBI) have made the game even more exciting and popular. Uttarakahand's badminton shows rapid growth in each section of game. The organization of 38th National Games 2024-25 by Uttarakhand state government pose remarkable infrastructure growth in the state. With the consistent growth in the sport, the Uttarakhand Badminton Association has now planned to start an academy in

Dehradun to reduce the rate of shifts to bigger cities. High scores and competitive outcomes are the hallmarks of modern sport. Almost all sports have seen a steady improvement in performance due to the use of new technologies and contemporary preparation techniques. The detection of talent in sport has classically depend on genetic-environment framework, physical -physiological needs, bio-motor fitness and tecno-tactical claver, biomechanically smart and many other modalities. This systematic talent identification and development (TID) program is base of future growth in highly demanded art – of- science and training of professional and amateur sports.

Introduction

The only shuttle game in the world, i.e. badminton, is a fairly popular racquet sport for all age groups without gender discrimination worldwide. Given that badminton has a strong foundation in Indian soil. As Han & Aman (2017) mentioned that Badminton has its modern roots in the mid-nineteenth century in India at the time of British rule. At the end of the nineteenth century, when India was still a British colony, the game of badminton was probably invented by the British. The game was played in a number of Indian cities, including Madras, Bombay, Peshawar, Calcutta, and Poona, which was then a significant military installation. (Guillain, 2004; Han & Aman, 2017).

Indian Badminton at Present

At present time Badminton shows great influence at international level competitions fairly from Poona to popularity in India in many terms. As continue igniting performance by Indian girls like Nehwal,Sindhu, Gutta, Ashwini, Trisha, Gayathri and many more or top talented Indian boys including Lakshya, Pronnoy, Srikanth, Rankireddy,Chirag, **Roy- Sai**, etc have been consistently doing well at top badminton tournaments. The extraordinary Thomas Cup win in 2022 is a testament to India's badminton dexterity by defeating 14 times champions Indonesia 3-0 undeniably demonstrated India's rising talent and prowess in the sport, a significant achievement after decades of national effort and investment in badminton. In current times, Alongside, the young shuttlers, Rujula, Anmol,Akarshi, Unnanti, Isharani , Tanya, Anupma, Ashmita, Tanvi, Mithilesh, **Apoorva , Sakshi, Mrunmayee, Prerna, Mansa-Gayatri, etc** have also been smashing at the junior-level tournaments across the world. Such achievements highlight the rising popularity and talent of badminton crossways in India.

The Indian badminton tale is more than just wins and records. It's a saga of resilience, passion, and a collective dream. From the dusty courts of Poona to the dazzling arenas of international tournaments, the shuttle has travelled a remarkable journey, carrying the hopes and aspirations of a nation. As India continues to dominate the sport, one thing remains clear: the love for badminton burns bright in the hearts of millions, echoing across the courts and promising many more thrilling chapters in this extraordinary saga (A shuttle through time, 2025). Though it may not have the same flash and glamour as cricket and tennis in India, a sizable portion of the youth population still plays badminton there, in contrast to the west. (Kumar, & Kumari, 2015).

India has had a wealth of young, bright badminton players on the home scene. There are many brilliant young players on India's home badminton circuit these days who want to succeed on a worldwide scale.. He acknowledged the point that looking after the youngsters and motivating them by providing better financial incentives was critical for the development of the game. The Badminton Association of India (BAI) has allocated further funds for excellence.

The BAI has played a very motivational role in mounting the recognition of Badminton in India ass organised international-level tournaments, leagues (PBI) have made the game even more admired to provided showcase Indian smasher's skills and gain fans' and sponsors's attention (Badminton & Beyond, 2025). Recently, Keeping in tune with the fast growth of the sport across the country, the BAI has pledged about 10 crore rupees annually to strengthen the game across the country, right from the grass roots level to boost the game. The remarkable decision of federation (BAI) is taken to enhance the prize money for subjunior, junior and senior national championships and veterans also have a lot to cheer. Overall, the BAI has pledged about Rs. 10 crore annually to strengthen the game across the country, right from the grass roots level. (BAI injects bigger finance, 2025).

Badminton in Uttarakhand

Uttarakahand's badminton shows rapid growth in each section of game. The organization of 38th National Games in January 2025 by Uttarakhand state government pose remarkable infrastructure growth in the state. Both the men's and women's badminton team categories featured fierce competitions between Uttarakhand teams during the National Game. The host team won the last doubles rubber because to the tenacity of their players and the enthusiasm of the audience. With significant victories in both singles and doubles to guarantee their spot in the semifinals and finals, the host state narrowly prevailed despite a strong showing from other teams. The Men Singles and women double teams of Uttarakhand got runners up (38th National Games, 2025).

"The mindset has changed. Parents here have seen the success of Lakshya and it has opened a path for them. So, they are encouraging their children to take up the sport and are willing to invest time and effort," says Sen, who brought the team together for a huddle after the win against Gujarat (Roy, 2025).

The players of Uttarakhand like Lakshya Sen, the Thomas Cup winner and bronze medalist of World Championship is inspiring the game's growth in this hilly state of India. Chirag Sen was also won the senior national title in 2023. Most girls in our current team here train at the PPBA. Lakshya is an inspiration for all of us. We talk to him a lot and he tells us about his experiences and that motivates us. I have seen him train and he is so hard working," says 22-year-old Uttarakhand's smasher Aditi, who has played for India in the Uber Cup and Sudirman Cup (Roy, 2025). Uttarakhand badminton scene is experiencing a notable surge in growth, with several factors contributing to its rising prominence. The state has seen a rise in participation, particularly among younger players (Anupama Upadhayaya, Aditi Bhatt, Anushka Juyal, Akshita Manral, Lavanya Karki, Garv Sahni, Abhinav Kandari, Tanuj Mehra, Ishaan Negi, Nishchal Chand, Siddharth Rawat, Ansh Negi, Suryaksh Rawat ,Aanya Bisht, Angel Punera,Mansa Rawat,Gayatri Rawat and many other players), prominent international recognition by senior players and coaches. The talent identification and development may gain acknowledgement specially after the conducting National games by Uttarakhand.

With the consistent growth in the sport, the Uttarakhand Badminton Association has now planned to start an academy in Dehradun. "The sport has become very popular. We need an academy – we have gyms and recovery centres – with the help of the state government. It is difficult for parents to shift to bigger cities, so we are looking into how these youngsters can be trained here," says B.S.Mankoti, secretary of Uttarakhand State Badminton Association (Roy, 2025).

Pushkar Singh Dhami, the chief minister of Uttarakhand, gave a presentation on the state's sports scene and expressed delight in the fact that the state is now known as a sports haven. He also aimed to create a supportive sports environment. Athletes are performing well and have a positive attitude. The government will keep making important decisions for the growth of sports and carrying them out successfully. (Matter of great, 2025).

Here's a breakdown of the growth of badminton in following terms:

Participants:

Increasing number of academies or training centers in Uttarakhand.

Events:

Organisation of different competitions at school, college, university level or open tournaments.

National Recognition:

Uttarakhand players are making their mark in national and International competitions.

Talent Development:

The state is home to talented players like Anupama Upadhay who started her badminton journey at a summer camp and is now making strides in the sport.

Infrastructure and Support:

While more investment is needed, initiatives like those by the Badminton Association of India (BAI) to enhance state associations' programs suggest a growing focus on infrastructure and support systems.

Prominent Players:

Lakshya Sen, a player from Uttarakhand, has achieved significant success, including representing India at the Paris Olympics and winning medals in various tournaments, showcasing the state's badminton potential.

Rising Stars:

The rise of players like Anupma, Suranksh and the performance of Uttarakhand's team at the National Games badminton championship further highlight the growing badminton talent in the region, according to Yugvarta News (38th National Games, 2025).

Sports Talent Identification

Anyone, regardless of age or skill level, can participate in the popular sport of badminton. The majority of the body's muscular groups are used in the game, and both aerobic and anaerobic processes are used to obtain energy. Frequent badminton practice improves physical fitness, particularly strength, speed, stamina, and movement coordination. Additionally, badminton necessitates a continuous examination of the ever-changing circumstances on the court, which forces the player to respond accurately and swiftly, enhancing his or her assessment and prediction abilities. (Stelter, 2001).

The attainment of high scores and competitive outcomes is a representation of modern sport. In practically every discipline, the introduction of new technologies and contemporary preparation techniques has contributed to a steady improvement in sports performance. As evidenced by Olympic and World Games medals, the cost of the resources and equipment required for the practice or growth of competitive activity in several sports has widened the income gap between rich and developing nations. There are various phases in a high-performance athlete's development. swiftly, strengthening his or her ability to evaluate and anticipate. Eight to twelve year age range is often considered a good stage for initial sports talent identification, as it represents the first phase of multi-stage selection processes. This is the first stage and is crucial to the child's orientation. Although other sports, like swimming and gymnastics, have earlier selection and various stages, it is often able to identify these age ranges with the selection phases that are assigned to them. It is specifically the selection and sports initiation processes that analyze the key traits they have in relation to the sport at hand and their significance in paving the path for great athletic accomplishments. (Perez, 2017).

The word talent, which comes from the Latin "talentum" and Greek "talaton," is defined as "the capacity to achieve exceptional outcomes through the application of intelligence, ability, or aptitude for a particular thing" (Pila, 2003). Individual sports with unique physical and physiological requirements, like bout games as strong personalities and endurance events like cycling, running, rowing, and other comparable activities, have historically been linked to the identification of talent in athletic disciplines. Nonetheless, Hoare's main research projects on a variety of sports, including basketball (Hoare & Hunt, 1999), women's football (Hoare, 2000), and others, have been successful in identifying the role of specific anthropometric and physiological characteristics in athletic performance. A person is considered to have sports talent if it is recognized that they have a unique ability for performing in sports, either because of their conduct, aptitudes, or inherited and acquired behavioral circumstances. (Pila, 2003).

Games that encourage motivation and enduring enthusiasm in the activity must be a major part of children's training. Additionally, because their biology is still developing, many systems cannot withstand the same physical and psychological demands as adults. (Perez, 2017).

Through the process of talent identification, a student's latent abilities and untapped potential in the realm of physical activities and sporting prowess can be uncovered. The process of determining a performer's level of competence and providing that individual with the opportunity to engage in an activity that plays to his or her strengths is known as talent identification. It has been suggested in multiple studies (Gould and Carson, 2008; Meylan, Cronin, Oliver, & Hughes,2010; & Davids, Lees, & Burtwitz,2000) that

brilliant children should be selected for opportunities based on how good they will be in the future rather than on how good they are now. Talent detection, talent identification, talent selection, and talent development are the four common aspects that should be covered in a talent identification program, according to William & Franks (1998). These four phases are all related to talent recruitment and development process.

According to Williams and Franks (1998), talent in sports is the capacity to perform at a level above the norm and those abilities are not yet fully developed or refined. Talents that are linked to physical activity are described as the ability to perform at a level that is higher than the normal standard. According to Pinder, et al., (2013) that people who are talented in sports will have particular qualities and these attributes have the potential to lead to achievement in future performances. Therefore, it is essential to run programmes aimed at recognizing potential talent in order to locate young athletes with a lot of talent who could become trainers in the future. There are many sports sciences areas to explore talent in sports such as anthropo-morphological, medical-biological, physical-physiological, socio-psychological, pedagogical, motor abilities and many more criteria for the selection of sports talent. This other set of criteria is also of great importance (Perez, 2017).

According to Angga (2018), a number of intricate factors influence sports performance, such as anthropometry, body composition, psychological factors like motivation and personality, physical factors like body morphology, and physical circumstances like general and particular ones. It is thought that a number of elements, including physiological, anthropometric, and psychological ones, influence an athlete's performance. One of the subjects of anthropometric research and a crucial component of analysis is the correlation between factors pertaining to athletic performance and morphology. It is crucial to understand that the finest athletic performance concerns are multidimensional, meaning they are not just dependent on physical elements. Therefore, the endeavor to create sports achievements cannot be founded solely on intuition and conjecture. From the standpoint of some of these sciences, the following characteristics should be considered when choosing talents. In addition, mapping the physical and physiological traits or motor performance of badminton players is crucial because, in addition to providing information about athletes' physical and physiological traits or motor performance, it can also be utilized as a source of information for athletic nurseries and improved sports performance (Anga, 2018). Improving the performance of badminton players will be impacted by the significance of determining the traits and factors that contribute to playing the game.

Anthropometric measurements: The proportion of body and performance (optimal, minimum, and maximum weight) will be the focus of applied anthropometry research in the sports industry. Anthropometric and fundamental meteoric variations may be unique for branches in talent identification, as may the physical attributes and performances of elite athletes competing in other sports (Australian Sports Commission, 1998). According to certain research, players that are taller tend to perform better in badminton (Phomsoupha & Laffaey, 2017). The majority of research on anthropometric traits in badminton players fails to distinguish between singles and doubles players, indicating that generic anthropometric traits are not essential for comprehending the distinctions between these sports (Guomundsdottir, 2017; Phomsoupha & Laffaey, 2015). According to Cinthuja, Jayakody, Perera, Weerarathna, Nirosha, Indeewari, and Adikari (2015), players' upper body power also increases when their BMI rises, but their upper body strength, endurance, and speed decrease.

Physical Fitness: The five motor capacities—speed, strength, endurance, flexibility, and coordination—as well as their complex forms, such as strength, endurance, maximum strength, explosive strength, maximum speed, and agility, were required for human motor activity and comprised physical fitness (Ahmed, 2010). Frequent badminton practice improves physical fitness, particularly cardio, strength, and speed. Additionally, badminton demands a player to constantly analyze the ever-changing circumstances on the court, concentrate on hitting the racket accurately and swiftly, enhance assessment, and predict the next move (Cinthuja et al., 2015). As a result, these skills are also more important for badminton performance. The primary goal of sports training is to maintain and enhance a particular level of physical fitness or condition. Different forms of fitness training are needed for different sports because each one demands a different kind and degree of particular fitness.

Motor Fitness: According to Abdullahi, Toriola, Ter Goon, Paul, Igbokwe, and Suarau (2017), researchers compared the same traits, such as anthropometric traits and motor performance, and found a significant correlation between the two in Nigerian badminton players. In order to determine the varied motor fitness components (muscular power, strength, and endurance) among the various racket sports, Singh & Singh (2017) proposed that motor fitness tests be given. Motor fitness exams are widely used to assess the motor fitness abilities of children, adolescents, and adults.

Physiological Variables: The foundation for appropriate performance evaluation and evidence-based training regimen creation is knowledge of the cardiovascular, metabolic, and pulmonary demands of certain sports (Meyer, Davison, & Kindermann, 2005). Using energy from both anaerobic and aerobic processes, the game uses the majority of the body's muscles. According to experts, physical fitness is the

optimum way for physiological systems to function. The significance of anaerobic alactacid and aerobic energy production in competitive badminton is demonstrated by the high average intensity of badminton match play and the significant variability of numerous physiological indicators. A strong aerobic endurance capacity appears to be required for quick recovery in between rallies or intense training sessions, according to Faude, Meyer, Rosenberger, Fries, Huber, and Kindermann (2007).

In this way, a greater stretch out on these capacities is necessary for the sports performance. Anthropometric and physiological factors do play a part in a comprehensive surveillance of young athletes with talent, according to Reilly, Bangsbo, and Franks (2000).

Biomechanical Variables: Biomechanical variables crucial for badminton performance include joint angles, ground reaction forces, and center of mass movement, with elite players were demonstrating more coordinated and powerful movements than recreational players. Key biomechanical factors involve effective body rotation for power generation, especially from the hips and shoulders, proper racket technique to control the shuttle and strong postural stability for balance and accuracy during dynamic movements. Analyzing athletic performances may benefit from evaluating various movement speeds. Larger joint contact forces were found for all hip, knee, and ankle joints as movement speed increased (Cui, Lam, Gao, Wang & Zhao, 2022).

Psychological Abilities: A key factor in enhancing performance is sports psychology. Athlete performance has been found to be significantly impacted by psychological elements as motivation, competitive anxiety, focus, and mental toughness (Bafirman, Hidayat, Sabillah, Rahman, Zarya, Ockta, & Festiawan, 2024). To predict their displacement, the players concentrate on the shuttlecock and their opponents. Psychological variables like confidence, focus, motivation, and emotional control are crucial for badminton performance, influencing a player's ability to execute shots, maintain consistency, and manage stress.

Genetic Factors: According to Astrand and Rodahl (1986), hereditary factors most likely have a significant impact on an individual's performance capability, at least for those who aim to reach the levels necessary to win Olympic gold. They claim that hereditary variables account for around 70% of an individual's maximum force, strength, or ability. The fact that talent identification must also take into account the potential for development of the various performance prerequisites complicates the process. This is a particularly challenging endeavor because training activity and genetics are the main factors that determine how trainable performance prerequisites are, and both are influenced by a variety of events throughout life. Munoz, Maestro, Aguilar-Navarro, Varillas-Delgado, Del Coso, Gutierrez-Hellin, and

Morencos (2022) provided a thorough analysis of the data regarding how genetics affects endurance and power-based exercise performance in order to ascertain the possible use of genotyping for identifying athletic talent, improving training, or avoiding exercise-related ailments.

Bio-motor Components: The key bio-motor components for badminton performance are speed, agility, explosive strength, endurance, coordination, flexibility, and reaction time, which are all crucial for executing quick movements, covering the court, and executing precise shots during the fast-paced rallies of the game. Like various sports sciences, biomotor features have a significant position in mounting performance by supporting technical- tactical skills. The French & Stalter technique test and reaction visual right hand, vertical jump, hand grip left hand, handgrip right hand visual reaction left hand, auditory reaction right hand, and auditory reaction left hand were found to be significantly correlated with technical tests, while Accınar & Ekin (2020) examined specific biomotor ability and technical skills in 10–11-year-old badminton athletes. Because a player's performance is impacted by strength rather than constrained by it, badminton is a sport that is strength-related rather than strength-limited (Wrigley & Strauss, 2000). One such component is muscle power, often known as explosive strength, and it is acknowledged that the capacity to produce a significant amount of power is a key component of athletic performance (Beckenholdt & Mayhew, 1983). The main goals of this badminton fitness training should be speed, agility, strength, flexibility, and endurance. Because badminton players must vary their speed, height, and angle of approach to the shuttle, they also need to be agile and fast runners. Another advantage for a badminton player is the capacity to move fast across small distances (Todd & Mahoney, 2013). The badminton players cover every area of the court by reaching, diving, and turning thanks to their flexibility. For sports, having above-average shoulder and trunk flexibility is advantageous (Chin, Wong, So, Siu, Steininger & Lo, 1995). Along with hip and hamstring flexibility, the stork arms' increased flexibility is unquestionably a significant factor. Because flexibility enables players to execute a variety of strokes well, badminton players are expected to possess above-average shoulder, trunk, and hip flexibility. Flexibility promotes agility on the court and enables more fluid strokes when stretched (Reilly, Secher, Snell & Williams, 1990). Additionally, this study demonstrates that for both male and female student badminton players aged 9 to 15, practice length had no discernible impact on upper body strength, lower body and hamstring flexibility, or lower limb explosive power. There are numerous performance aspects in badminton, which highlights the intricacy of the game. High-intensity, sporadic actions are what define badminton. Men's and women's singles, men's and women's doubles, and mixed doubles are the five events in this sport, and each one calls for a particular level of technique, control, and physical fitness..

Physical (general & specific conditions), psychological (personality & motivation), sociological, and physical (body morphology, anthropometry, & body composition) factors are among the many complex and intricate variables that influence sports performance (Campos, Daros, Mastrascusa, Dourado, & Stanganelli, 2009). The performance level in games and sports is influenced by a variety of things. However, in competitive sports, biomechanical, psychological, and physiological factors are given a lot of weight. Finding the precise characteristics and factors that influence a player's playing skill is crucial for enhancing badminton players' performance. The criteria needed for badminton skill performance have been the subject of numerous studies. Being a very intense sport, badminton requires a special strength and movement style over a very tiny court surface. Typically, a player's technical skill, tactical efficiency, courage, mental attitude, and physical condition all work together to win the match. The physical and physiological aspects of badminton, however, have not been extensively studied in the literature (Faude et al, 2007; Chin et al., 1995). According to Cabello Manrique and Gonzalez-Badillo (2003), coaches can find and select new badminton players with the use of the anthropometric and motor test results of young junior badminton players. But the relationship between physical- motor characteristics is not much explored on budding Indian smashers. Few researchers (Singh, Raza, & Mohammad, 2011) worked on but not on young badminton players. Thus, there is need to conduct specific bio motor fitness assessments for early buds in badminton.

Specific Motor Fitness Tests and Assessments for Young Badminton Players

Many researchers (Tiwari, Rai, & Srinet, 2011; Singh, Raza,& Mohammad, 2011) suggested that specific motor fitness tests may considered to talent identification markers- at early age in Indian badminton athletes.

- Standing Broad / Long Jump: Measures explosive power of lower body.
- Vertical Jump: Assess lower body power and jump height.
- Shuttle Run: Evaluate speed and agility.
- 10 x 5 Mtr Shuttle Run: Assess agility and speed.
- 5-Step Bounding: Measure lower body power and coordination.
- 1.6 km Run: Evaluate aerobic endurance.
- One-Foot Balance Test: Assess balance and proprioception.
- Handgrip Strength: Measures upper body strength.
- Medicine Ball Throw: Assesses upper body power.
- Visual and Auditory Reaction Time Tests: Measure reaction speed to visual and auditory stimuli.

- Flexibility Tests (Sit-and-Reach, Shoulder Flexibility): Assesses range of motion in key joints

Talent Identification Process and Development: It has main various stages as referred by many researchers as Williams & Franks, 1998; Pinder, Renshaw, & Davids, (2013); Pila, (2003); Singh, (1991). Here it may conclude main four stages of talent identification and development process-

Preliminary Screening: Firstly age verification anatomically and chronologically, uses basic demography or physical assessments (basic anthropometric measures, Socio-economical and living conditions. health, and physique) and fitness tests to identify potential candidates.

Systematic Comprehensive Evaluation: Conduct more in-depth appraisals of specific fitness, motor skills and coordination abilities.

Techno- Tactical Evaluation: Assess technical skills (footwork, strokes etc.) and tactical awareness.

Psycho-sociological Evaluation: Evaluate mental toughness, focus, and ability to handle pressure of pear, coaches and spectaculars.

Continuous Longitudinal Monitoring: Track improvement over time and modify training programs accordingly.

Creates a foundation for consistent, fair, and effective evaluation and learning by using a combination of these assessments and establishing clear norms, badminton coaches and talent identification programs can more effectively identify and develop future smasher champions. To avoid or minimize the missing the talent at right time catch up as reported by Chakraborty (2025) reported in his talk entitled “Many of India’s female badminton players in the 70s and 80s were unsung heroes” with Father-son duo Vijay and Akshay Lokapally, the authors of *Net Flicks*, discusses the past, present, and future of Indian badminton, bestselling book on badminton.

Conclusion

Talent in sports is a product of both environment and genetics. However, a person can only grow their biological potential to the level required for performance sports through training and other contextual circumstances if they are born with a minimal amount of it. India and badminton share a story stringed with colonial echoes, passionate players, and a swift rise to a global powerhouse (A Shuttle through Time, 2025).

Motor fitness profiling is a valuable tool for talent identification and development in badminton, particularly in a region like Uttarakhand, where sports like badminton are gaining popularity. By assessing physical attributes and motor skills, coaches and trainers can identify promising young athletes and tailor training programs for optimal performance. This approach can help streamline the process of nurturing badminton talent in Uttarakhand after conducting 38th National games and the ripple effect the success of many shutters not only in national games/ competition even at remarkable presence at international level too.

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