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Future Directions in Talent Identification for Track and Field: Integrating Science and Multidisciplinary Perspectives

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ABSTRACT

The identification of talent in athletics remains an essential but delicate problem with the sport's physiological, biomechanical, technical, and psychological heterogeneity. Traditional approaches have relied primarily on results from performance and mere anthropometrics, being prone to bringing forward or biased selections dependent on relative age effects and imbalance in training access. This narrative synthesis combines the current evidence and considers the directions for more efficient, equitable, and evidence-based sporting ability detection systems. It outlines the limitations of uni-dimensional models and proposes multidisciplinary syntheses, involving physiological profiling, biomechanical analysis, psychological testing, and longitudinal observation. New and emerging technologies like wearable sensors, artificial intelligence, machine learning, and digital data analytics are debated for their potential to enhance the accuracy and objectivity of sporting ability detection. The review stresses the need for standardized, culturally sensitive, and ethically sound models that adhere to the principles of long-term athlete development rather than short-term performance. By integrating evidence from sport science, technology, and social environments, future talent identification systems will be more holistic, valid, and inclusive, leading to an improved efficiency of athlete development models in track and field.

Keywords: Talent Identification, Track and Field, Future Directions

Introduction

Track and field athletics is perhaps the most diversified and simplest sport in the world, comprising events that test human speed, strength, endurance, and technical skill. The competence in defining quality athletes for this sport is now more important as standards of competition continue to rise and there remain limited resources for athlete development. Traditional talent identification strategies for sports have long been based on the performance outcome and few physical measures, but of course, with a high likelihood of overlooking the complexity of sporting competence (Vaeyens et al., 2008). In light of the new sport environment, awareness is growing that talent identification is hardly possible without integrated and scientifically grounded methodology. Talent identification theory has developed significantly over the past few decades. Early frameworks focused primarily on spotting athlete's superior in performance at their current age level, the hope being that early success would be translated into elite performance down the stretch of their careers. However, research has consistently shown that this theory is fraught with limitations (Williams et al., 2023). Several factors also contribute to athletic success aside from the performance

level at a given point, including physical rates of maturation, psychological qualities, training history, and environmental influences. This has led to the demand for more sophisticated and multi-disciplinary talent identification procedures that recognize the complex inter-play of factors leading to athletic excellence. Talent identification strategies in track and field vary considerably across countries and organizations. They use competition performances and ranking lists to some degree in some programs and include physiological testing and anthropometric measurements as well (Ghasemzadeh Mirkolaee et al., 2013). Training camps are presented by the Spanish National Athletics Federation as part of their talent identification, for example, despite studies indicating relative age effects that distort the selection process (Brazo-Sayavera et al., 2017). Similarly, Canadian track and field programs have been questioned regarding the empirical basis of their carding and talent identification systems (Rosenke, 2015). These cases highlight the necessity of more evidence-based solutions for talent identification in the sport. The issues with talent identification in track and field are multifaceted. The largest challenge is the diversity of events in the sport, which require different physical attributes, technical abilities, and mental traits. Sprinters demand explosive speed and power, but distance runners demand exceptional aerobic ability and mental tolerance. Throwers demand tremendous strength and technique, but jumpers demand a combination of power, speed, and coordination (O'Connor et al., 2007). Such diversity makes it challenging to develop talent identification protocols that are effective across the board and are capable of uncovering talent across all areas of track and field. Methodological issues also plague available talent identification studies in track and field. Many studies are plagued by small sample sizes, brief follow-up periods, and inconsistent measurement protocols (Bergkamp et al., 2019). The predictive validity of much of the traditional testing in current use remains suspect, particularly as it is used for adolescent athletes whose physical and psychological maturation has not been completed. Furthermore, the focus on talent identification at earlier and earlier ages has also created alarm regarding early specialization and its ability to have adverse effects on long-term athlete development (Koopmann et al., 2020). The use of multiple disciplines offers promising potential for changing practices concerning talent identification in track and field. Physiological research has provided valuable information on the physical demands of different events and the qualities that contribute to top performers (Nikolaidis & Son'kin, 2023). Psychological research has defined intellectual skills, motivation, and personality types as essential to sporting success (Kruger et al., 2012). Biomechanical examination can detect technical proficiency and movement strategies not apparent through standard performance measures (Fiaud & Shim, 2019). The challenge is to weave together these different perspectives into effective and cohesive talent identification systems. New talent identification opportunities for track and field are being explored using advances in technology. Wearable sensors can provide real-time feedback on movement patterns, physiological responses, and training loads. Artificial intelligence and machine learning algorithms can search huge databases to identify trends and predict future performance (Li et al., 2023). Video analysis systems can quantify technical skills with unmatched precision. However, the integration of such techn ologies into currently existing talent scanning systems needs to be carried out with utmost concern for pragmatic realities, cost-effectiveness, and validity concerns. The globalisation of track and field also presents unique challenges and opportunities for the identification of talent. Every nation has varying resources, culture, and pathways of development for its athletes. A system applied in one context may not work or even be applicable in another. This is why talent identification systems must be created which are flexible and adaptable but are also scientific in nature and can be adapted to the local situation (Farzan, 2025). Existing literature has highlighted the importance of locating talent identification within a wider process of talent development and not as a singular selection occasion (Wormhoudt et al., 2017). Such a realization concedes that talent is developed and evolves over time as a dynamic interaction between personal factors and environmental conditions. It suggests that talent identification systems must be conceptualized in a manner that supports long-term athlete development and not merely the prediction of short-term success. The aime of this narrative review is to examine current approaches to track and field talent identification and reflect on potential future directions for the sport. By bringing together knowledge from a variety of disciplines and an appreciation of emerging technologies and methods, this review seeks to provide a comprehensive overview of the challenges and possibilities presented to track and field talent identification. The review will examine previous studies, identify areas of existing knowledge deficiency, and offer recommendations for improved and evidence-based methods for identifying athletic potential. Review is particularly timely with recent growing competition for limited resources in sport development programs as well as improved awareness of the importance of evidence-based interventions in sport science. By critical analysis of current practice and possible future developments, the review aims to guide practitioners, researchers, and policy-makers who operate with talent identification and

development in track and field. The goal is ultimately to enhance better more efficient and equitable systems for discovering and developing sports talent for this foundation sport.

Methodology

This review narrative was conducted to provide a general overview of current talent identification practices in track and field and to discuss potential future avenues for the discipline. Literature sources were accessed via a number of databases such as PubMed, SPORTDiscus, and Google Scholar, using key search terms "talent identification," "athletics," "track and field," "talent development," and "athlete selection." The search was not limited by date to provide a complete historical overview, although precedence was given to more recent publications from the last two decades. Other sources were located through reference lists to core papers and also through expert recommendations within the discipline.

The inclusion criteria were intentionally wide to capture the multidisciplinary nature of research in talent identification. The studies were included if they investigated talent identification, talent development, or selection of athletes for track and field or related endurance and power events. Empirical studies of research and theory articles were examined, as well as review articles that explained relevant conceptual frameworks. English sources were given priority, but some significant international sources were included where available translation existed.

Current Approaches to Talent Identification in Track and Field

The landscape of track and field talent identification is characterized by diverse methods that reflect the diversity of the sport and the various philosophies of countries and organizations. Familiarity with these current methods is important to establish their strengths and weaknesses, and devise improved future approaches. This section addresses the most fundamental methods currently utilized in talent identification, ranging from traditional performance-based systems to more sophisticated multifaceted systems.

Performance-Based Identification Systems

The most widely used approach to talent identification in track and field is still the performance-based system, which relies fundamentally on competition performance and time-based achievements. This system is under the impression that those who perform better than peers at an early age will continue to perform exceptionally well as they progress to more advanced levels of competition. National federations tend to implement ranking systems and selection criteria to identify potential athletes for training camps and development programs (Brazo-Sayavera et al., 2017). The performance-based systems have a few evident strengths that explain their popularity. They are simple to implement and understand, requiring minimal specialized equipment or training. The outcome of competition generates objective figures which may be easily contrasted across competitors and tracked across a span of years. Moreover, the systems naturally complement track and field's competitive structure, where ultimate success is determined by performance outcomes in high-level contests. Nonetheless, studies have shown major performance-based identification methods to have considerable limitations. Probably the most contentious issue has been the relative age effect, in which sportspersons born early in the selection year possess growth benefits that can be confused for higher talent potential (Brazo-Sayavera et al., 2017). Empirical studies have confirmed that the bias could systematically rule out potentially gifted players who could end up growing more gradually or achieving best form later in their professional careers. In addition, performance-based systems do not tend to control for the variations in training age, access to coaching, and environmental factors that influence current levels of performance substantially. Early measures of performance have also been challenged by longitudinal research in terms of predictive validity. A number of talented young players lose their curve and do not carry on to senior competition, while others who were underappreciated in their first few years go on to be the peak performers of their lives. This is a topic generally referred to as the "relative age effect" and "late bloomers," illustrating the complexity of talent development and the deficiencies of using only the current performance markers available (Williams et al., 2023).

Physiological and Anthropometric Tests

Knowledge of the limitations of the performance-based system has led most programs to add physiological and anthropometric measurement to their talent identification procedures. Such procedures are based on the belief that there are physical characteristics and physiological capacities that are prerequisites for excellence in some track and field events. Measurement in a laboratory setting can uncover an athlete's innate physiological ability not yet being reached by existing levels of performance. Anthropometric tests are typically focused on physique aspects, limb length, and body composition that are associated with success in different event categories. Elite performers in different track and field events have been described by certain specific anthropometric profiles (O'Connor et al., 2007). Muscle mass and some of the limb length ratios tend to be higher in sprinters, while other skeletal proportions and body fat percentages are lower in distance runners. Field event athletes are usually shown to have specific anthropometric characteristics regarding their individual events, with throwers generally larger and more powerful than jumpers. Physiological testing protocols most frequently employed include determinations of aerobic and anaerobic capacity, muscle strength, neuromuscular control, and flexibility. These tests are employed to differentiate between athletes possessing greater physiological potential that might be utilized to generate competitive excellence using appropriate training. For example, maximal oxygen uptake testing may identify athletes possessing high aerobic potential for distance running, whereas power testing may identify explosive power essential in sprints and track and field events (Nikolaidis & Son'kin, 2023). Although they possess theoretical attractiveness, physiological and anthropometric evaluations encounter a number of conceptual and practical difficulties. Most of the physiological abilities tested in laboratories are very trainable, and it becomes challenging to separate genetic potential and training factors. Furthermore, laboratory test performance tends to be less highly correlated with competitive performance than anticipated, especially in technical events with a significant contribution from skill and technique. The cost and complexity of full physiological testing also limit its practical use in most talent identification programs. Laboratory tests need to be conducted with the aid of special apparatus and expert staff, which renders them not appropriate for mass-screening programs. Moreover, invasiveness of some physiological tests may be inappropriate for young athletes, and thus they are ethically problematic for use in youth talent detection programs.

Technical Skill Assessments

The technical demands of the majority of track and field events have brought about more appreciation for skill-based assessment as a component in the identification of talent. This approach is focused around the decision to determine if an athlete can execute the specific movement patterns and techniques required for achievement in his or her prospective events. Technical assessments are able to uncover details regarding an athlete's ability to learn, movement quality, and potential for certain skills not available via performance or physiological assessment only. Biomechanical evaluation has been more sophisticated in its use for talent identification, with advanced video analysis technology and force measurement technology used to enable sensitive analysis of movement patterns and technical proficiency (Fiaud & Shim, 2019). They can have the potential to identify small technical aspects differentiating the elite from the non-elite performer, potentially identifying technical talent yet to be realized as outstanding performing outcomes. Technical skills assessment presents unique challenges in talent identification contexts. Technical skills tend to be highly specific to particular events and therefore making it quite difficult to develop standardized testing procedures that can be applied across sport disciplines in track and field. Technical skills also tend to be acquired through extensive practice and coaching and hence it is difficult to distinguish inborn technical potential from learned proficiency.

Integrated Assessment Approaches

Recognition of the shortcomings of single-factor models has led some programs to adopt more multi-dimensional talent identification systems that integrate multiple methods of evaluation (Vaeyens et al., 2008). These integrated models attempt to capture the multi-dimensional nature of athletic potential by combining performance measures with physiological, anthropometric, and technical assessments (Güllich, 2017). The goal is to provide a more comprehensive profile of an athlete’s potential, reflecting the diverse physical, technical, and biological factors that contribute to success in track and field (Baker et al., 2003). Integrated approaches often employ statistical modeling techniques such as multivariate analysis or composite

scoring systems—to weight and aggregate different assessment domains into a unified talent index. Some national programs have developed event-specific talent identification batteries tailored to the unique demands of different event groups (O'Connor et al., 2007). For example, systems targeting sprinters typically emphasize measures of power, speed, and anaerobic capacity (e.g., vertical jump, 30m sprint), while those for distance runners prioritize aerobic capacity, running economy, and lactate threshold. Field event athletes, such as jumpers and throwers, are assessed using combinations of strength, power, coordination, and technical proficiency tests (Kusnanik et al., 2018). While these integrated methods represent a more sophisticated evolution of talent selection, they also pose significant implementation challenges. Such systems require substantial financial resources, access to specialized equipment, and trained personnel, limiting their feasibility in low-resource or community-based programs (Beauchamp et al., 2012). Moreover, the validity of composite scoring systems depends heavily on the appropriateness of the weighting assigned to each component, which may vary across age groups, sexes, and cultural contexts. Inappropriate weighting can lead to biased outcomes, misidentifying athletes whose strengths lie in underweighted domains. The talent identification landscape in track and field today reflects a clear shift away from simplistic, performance-based systems toward more integrative, science-informed models (Güllich, 2017). However, challenges remain in developing identification methods that are consistent, practical, and equitable across diverse settings (Baker et al., 2003). The limitations of current strategies underscore the need for continued research and innovation in talent identification, particularly in refining multidisciplinary frameworks and incorporating emerging technologies topics that will be explored in subsequent sections of this review.

Multidisciplinary Talent Identification Approaches

The complexity of sporting talent has led researchers and practitioners to adopt multidisciplinary models that draw on various disciplines in a bid to make sense of and identify potential in track and field athletes. This is a significant shift from unifactorial approaches to identification to more holistic models that recognize talent as a complex construct. The integration of knowledge from psychology, biomechanics, genetics, and social sciences has instigated new possibilities for clarifying how talent in track and field athletics develops and manifests.

Psychological Factors and Mental Skills

The psychological component of talent identification has gained increasing focus because it has been established by research that mental aspects have a determining role in sporting achievement. The traditional pathways of talent identification overlooked psychological qualities, and they focused less on psychological qualities and more on physical qualities and present levels of performance. However, recent studies have suggested that psychological aspects can be as important, if not more important, than physical qualities in long-term sporting achievement (Kruger et al., 2012). Mental toughness is the most studied psychological characteristic in talent identification research. Athletes that possess the ability to remain focused, manage pressure, and persevere through adversity are likely to have greater long-term potential than athletes whose foundation relies on physical ability. In sport, where margins are often tight and performers are under intense pressure at big competitions, mental toughness is particularly important. The application of psychological skills training has been shown to have a significant influence on performance outcomes, which would suggest that the capacity to develop and use mental skills should be part of talent identification processes (Beauchamp et al., 2012).

Motivation and goal orientation are critical components of talent development and must be systematically considered in talent identification processes. Athletes who exhibit strong intrinsic motivation and adaptive goal-setting behaviors such as mastery-oriented goals rather than performance- or ego-oriented goals are more likely to commit to the sustained, deliberate practice required for elite performance in track and field. Research consistently shows that long-term athletic success is not solely determined by physical attributes, but significantly influenced by an athlete's capacity to remain committed through periods of stagnation, injury, and increasing training demands (Gould et al., 2002). This persistence is often rooted in self-determined motivation, which has been shown to predict greater adherence to training and resilience in the face of adversity (Ryan & Deci, 2000).

In addition to motivation, several cognitive and psychological processes play a vital role in talent identification. Decision-making ability, attention control, and learning capacity are particularly crucial in technically demanding track and field events such as pole vault, hurdles, or throwing events, where split-second decisions and precise neuromuscular coordination are

required under pressure (Ford et al., 2010). Athletes with superior perceptual-cognitive skills can anticipate movement patterns, adjust technique in real time, and learn complex motor sequences more efficiently—qualities that may not be evident through physical testing alone (Williams & Hodges, 2005).

Sport psychology has developed validated tools to assess these psychological constructs, including the Sport Motivation Scale (SMS) (Pelletier et al., 1995), the Test of Performance Strategies (TOPS) (Thomas et al., 1999), and the Athletic Coping Skills Inventory (ACSI-28) (Smith et al., 1995). Despite their psychometric robustness, these instruments remain underutilized in routine talent identification systems, often due to logistical constraints, lack of trained personnel, or prioritization of physical metrics. Assessing psychological traits in youth athletes presents additional challenges. Personality and psychological skills are still developing during adolescence, and early assessments may lack predictive validity due to maturational variability and environmental influences (Côté et al., 2009). Therefore, evaluations must be age-appropriate, longitudinally administered, and interpreted within the context of the athlete's developmental stage. Furthermore, cultural differences in expression of motivation, emotion regulation, and goal orientation necessitate culturally sensitive assessment tools to ensure fairness and validity across diverse populations. To enhance the integration of psychological factors into talent identification, future systems should adopt a dynamic, multi-time-point assessment model that tracks motivational trajectories and mental skill development over time, rather than relying on single-point evaluations. This approach aligns with long-term athlete development (LTAD) frameworks and supports ethical, holistic talent development (Balyi et al., 2013).

Biomechanical Analysis and Movement Patterns

Biomechanical analysis has been an effective means for dealing with the technical and movement-specific aspects of talent in track and field. The discipline provides objective methods for analyzing movement patterns, force production, and technical efficacy that can potentially reveal talent characteristics that are not obvious through traditional performance measures. Biomechanical contribution to talent identification has been particularly beneficial for technical events where optimal movement patterns are essential for performance excellence. Modern biomechanical analysis techniques can provide detailed information on the quality of movement and technical proficiency of a sportsperson. Three-dimensional motion analysis systems can capture precise kinematic data on joint angles, segment velocities, and coordination patterns during sporting movements. Force platform technology can quantify ground reaction forces and provide feedback on power production and force application methods. They enable scientists and coaches to establish optimum movement patterns and quantify how closely individual athletes approximate these optimums (Fiaud & Shim, 2019).

The biomechanical approach to talent identification is based on the understanding that there are movement features and technical abilities that are associated with high performance and can indicate talent potential. For example, certain biomechanical patterns have been found in elite sprinters, including optimal step frequency and length ratios, effective force production angles, and efficient energy transfer within the kinetic chain. Those individuals who naturally display these qualities or have the capacity to acquire them through training have the potential to be more successful in the sprint events. Field events yield particularly fascinating applications for biomechanical talent identification due to their technical demands being very high. Throwing events entail intricate coordination patterns and force application strategies of a specific nature that may be objectively analyzed through biomechanical analysis. Jumping events necessitate accurate timing and coordination that may be evaluated through kinematic analysis. The ability to execute these complicated movement patterns effectively, or to learn them quickly, may be an indication of talent potential that is more than the present level of performance. Biomechanical talent identification methods are not without considerable challenges, however. Advanced biomechanical analysis equipment and expertise can be expensive and technically exacting, limiting the day-to-day application of such methods in most talent identification contexts. Additionally, the most efficient movement patterns may vary between individuals as a function of anthropometric characteristics and other variables, making it difficult to establish universal biomechanical criteria for talent identification (Slawinski et al., 2010)..

Technological Advancements and New Strategies

The pace of technological advance has ushered in unprecedented potential for innovation in talent selection methods in track and field sports. These advances in technology are revolutionizing how talent is tracked, assessed, and developed and offer

new dimensions for more efficient, precise, and comprehensive systems of identification. The integration of digital technologies, artificial intelligence, and advanced monitoring systems is a paradigm that may be able to address most of the issues related to traditional talent identification methods.

Digital Test Equipment and Data Analysis

Sport has enabled the development of sophisticated test equipment capable of capturing and analyzing performance data with unprecedented precision and specificity. Computerized timing systems (e.g., electronic timing gates), electronic measuring instruments (e.g., laser distance meters), and computer-aided testing protocols have significantly improved the accuracy and consistency of talent identification assessments (Pearson et al., 2006). These digital tools provide objective, reliable measurements that minimize human error and subjective bias, enhancing the scientific rigor of talent screening processes. Advanced data analytics techniques are transforming how talent identification data is interpreted. Statistical modeling and machine learning algorithms can analyze complex, multidimensional datasets to uncover non-linear patterns and interactions between variables—such as performance, physiology, growth, and training history—that traditional methods may overlook (Li et al., 2023). These approaches allow for the construction of predictive models that better reflect the dynamic nature of athletic development, enabling the detection of subtle indicators of talent potential that are not evident through isolated performance metrics. Database systems and athlete monitoring platforms now facilitate longitudinal tracking of development, a capability that was previously impractical due to logistical and technological constraints. These systems store comprehensive athlete profiles, including competition results, training loads, physiological test outcomes, and maturation status, across multiple time points. Longitudinal data allows practitioners to assess developmental trajectories rather than relying on single-point evaluations, improving the accuracy of talent predictions and reducing the risk of misidentifying early or late maturers (Vaeyens et al., 2008). Furthermore, data visualization tools—such as interactive dashboards and dynamic reporting interfaces—are making complex information more accessible to coaches, administrators, and athletes. These tools present multidimensional talent profiles in user-friendly formats, translating advanced analytical insights into actionable decisions for training and selection (Li et al., 2023). Despite these advantages, the integration of digital technologies and data analytics into talent identification presents challenges. Data quality, standardization, and interoperability issues can compromise the validity of findings. Privacy and ethical concerns arise when collecting and storing sensitive personal and performance data, especially from minors. Additionally, the technical expertise required to implement and interpret advanced analytical models may exceed the capacity of many national or regional programs, particularly in low-resource settings (Vaeyens et al., 2008). Therefore, while digital advancements offer transformative potential, their successful implementation requires investment in infrastructure, training, data governance, and ethical frameworks to ensure equitable, valid, and sustainable talent identification systems.

Artificial Intelligence Applications

Artificial intelligence is one of the most sophisticated technologies used for talent identification in the sport of track and field. AI platforms are able to process gigantic data volumes, identify complex patterns, and predict outcomes that surpass human analysis abilities. AI applications for talent identification can redefine athletic potential assessment and forecasting as a more accurate and objective identification process (Li et al., 2023). Artificial intelligence (AI) is emerging as one of the most transformative technologies in talent identification for track and field. Machine learning algorithms can analyze vast multidimensional datasets—including performance metrics, physiological profiles, training histories, and maturation status—to detect complex patterns associated with long-term athletic success (Li et al., 2023). These systems learn from historical data of athletes who have progressed to elite levels, enabling them to identify young athletes with similar developmental trajectories and latent potential, even if their current performance is unremarkable. The ability of AI to process multiple interacting variables simultaneously makes it particularly well-suited for modeling the non-linear and dynamic nature of talent development (Güllich, 2017). Unlike traditional linear statistical models, machine learning can uncover hidden interactions between biological, psychological, and environmental factors that collectively influence athletic outcomes. Computer vision and image recognition technologies are enabling automated, objective analysis of movement and technique. AI-powered video analysis systems can assess biomechanical efficiency, coordination, and technical execution by processing footage from

training or competition (Fiaud & Shim, 2019). These systems detect subtle kinematic patterns such as joint angles, stride symmetry, or force application timing—that may be imperceptible to the human eye but are indicative of high-performance potential. By standardizing technical evaluations, AI reduces subjectivity and increases reliability in skill-based assessments, offering a scalable solution for evaluating athletes across diverse locations. Natural language processing (NLP) further enhances AI's utility by extracting meaningful insights from unstructured qualitative data, such as coaching notes, injury reports, and psychological evaluations. This capability allows AI models to integrate narrative-based information into predictive frameworks, creating a more holistic view of an athlete's potential (Li et al., 2023). For example, recurring themes in coach feedback like "quick learner" or "handles pressure well"—can be quantified and correlated with future performance outcomes. AI-driven predictive modeling also surpasses traditional methods in forecasting athlete development. It can model non-linear growth curves, account for maturation differences, and simulate future performance trajectories based on current trends (Güllich, 2017). This enables the identification of "late bloomers" athletes who may not currently rank highly but possess the underlying traits for future excellence. However, the application of AI in talent identification raises significant ethical and practical concerns. The accuracy and fairness of AI predictions depend heavily on the quality and representativeness of training data; biased or non-diverse datasets can perpetuate historical inequities, such as underrepresentation of certain demographics or regions (Breitbach et al., 2014). Additionally, many AI models operate as "black boxes," where the decision-making process is not transparent, leading to challenges in accountability and trust among coaches and athletes. Ensuring data privacy, especially when collecting sensitive information from minors, is another critical consideration. Therefore, while AI holds immense promise, its implementation must be guided by rigorous validation, ethical oversight, and stakeholder transparency.

Wearable Technology and Real-Time Monitoring

Wearable technology has emerged as a powerful tool for talent discovery, enabling continuous monitoring of athletes' characteristics and responses during training and competition. Unlike traditional laboratory-based assessments, wearables can collect real-time data on movement patterns, physiological responses, and performance metrics in naturalistic environments, providing insights that are ecologically valid and context-specific (Buchheit et al., 2012). This capacity to observe athletes in their authentic training settings allows for a more nuanced understanding of their physical capabilities, adaptability, and consistency factors critical to long-term athletic development. Global Positioning System (GPS) units and micro-electromechanical accelerometers are now widely used to track movement patterns, speed profiles, and external training loads with high temporal and spatial accuracy (Scott et al., 2013). In track and field, these devices can quantify sprint mechanics (e.g., stride parameters, acceleration profiles), endurance running patterns, and recovery between bouts of high-intensity effort. Such data can reveal subtle indicators of athletic potential, such as superior movement efficiency or resilience to fatigue, which may not be apparent through competition times alone. Heart rate monitors and other physiological sensors provide concurrent internal load data, offering real-time feedback on cardiovascular responses, training adaptations, and autonomic nervous system regulation. These measures—particularly heart rate variability (HRV) can detect individual differences in training responsiveness and recovery capacity, which are increasingly recognized as markers of athletic potential. Longitudinal monitoring of HRV and resting heart rate can identify athletes with superior adaptive capacity, a trait associated with successful long-term development. Emerging wearables also track sleep quality, activity levels, and recovery markers, enabling a holistic assessment of an athlete's readiness and resilience. Recovery capacity is a critical determinant of talent development, as athletes who recover more effectively can sustain higher training volumes and intensities—key drivers of performance improvement. Continuous monitoring of sleep duration, sleep efficiency, and nocturnal HRV provides actionable data for individualized training planning and early detection of maladaptation.The integration of multiple sensor systems (e.g., GPS, accelerometry, HR, inertial measurement units) allows for the creation of comprehensive athlete profiles that capture biomechanical, physiological, and behavioral dimensions simultaneously. This multi-modal approach supports a more complete picture of an athlete's potential beyond isolated performance metrics. However, practical challenges remain in the widespread adoption of wearable technology for talent identification. High-quality devices and data management platforms can be costly, limiting access for low-resource programs. Data interpretation requires specialized knowledge in sports science and data analytics, which may exceed the capacity of many coaching staff (Buchheit et al., 2012). Furthermore, the validity and reliability of consumer-grade wearables vary significantly, raising concerns about measurement accuracy for critical decision-making

(Olmos et al., 2024). Finally, ethical and privacy issues arise when collecting continuous personal data, especially from minors, necessitating robust data governance and informed consent protocols. Despite these challenges, wearable technology holds transformative potential for talent identification when implemented thoughtfully, validated rigorously, and integrated within a long-term athlete development framework.

Emerging Assessment Methodologies

Along with proven technologies, several new techniques are starting to emerge on the horizon for the identification of talent in track and field. Virtual reality and simulation techniques promise to become tools for assessing decision-making ability, reaction times, and information processing under controlled conditions. These techniques offer standardized test environments that eliminate many of the confounding variables inherent in testing in naturalistic environments.

Smartphone applications are making advanced testing capabilities accessible and at lower cost. Smartphone applications are able to conduct a variety of assessments including reaction time tests, balance testing, and basic movement analysis using onboard sensors and cameras. Smartphone applications have the ability to democratize access to talent identification assessment and allow for mass screening programs previously not practical due to cost and logistics. Crowd-sourcing and citizen science approaches are emerging as methods for talent identification in populations that may not be in a position to access conventional talent identification processes. These approaches employ technological platforms to enable mass engagement of assessment activity and hold the potential to detect hidden talent that would otherwise be overlooked under conventional identification mechanisms. Social media and websites also can provide new avenues for talent spotting through video submissions and cyber contests that enable scouts and coaches to identify budding players. The development of standardized electronic test protocols is another important emerging pattern. These protocols aim to create reproducible, validated measurement methods that can be implemented in different locations and settings with technology platforms. Standardization has the potential to increase the reliability and comparability of talent identification testing while reducing the variability that currently characterizes existing identification practices. The integration of these new methods with operational talent identification systems must be adequately tested and validated. New technologies and methods must be proven better than existing methods in terms of accuracy, speed, or accessibility. Rollout of new methods must also consider practical issues such as cost, technical requirements, and user training. As such technologies continue to evolve and mature, their uses in talent identification will likely expand and continue to develop.

Future Directions and Recommendations

The future of talent identification in athletics is the development of more comprehensive, technology-enhanced systems that engage multiple perspectives and address the severe limitations in current methods. Future systems must move away from unidimensional approaches to identification and toward more global frameworks that consider the complex interplay of physiological, psychological, technical, social, and environmental factors in contributing to sporting success. The use of artificial intelligence and machine learning capability has particular promise for dealing with the large amounts of multidimensional data required for effective holistic assessment. Future talent identification systems must include continuous monitoring and longitudinal tracking capability that is able to log development trajectories rather than single-point testing. This approach requires the development of standardized procedures that can be implemented in diverse environments with enough flexibility to accommodate cultural and resource differences. There is a need to invest in validation studies to ensure that these novel systems actually improve identification accuracy and athlete outcomes compared to existing practice.

The establishment of future talent identification systems requires the cooperation of a number of stakeholders including sport scientists, technology developers, coaches, administrators, and policy makers. Training and education programs must be developed to allow talent identification staff to have the knowledge and skills required to use and interpret complex assessment methods effectively. Ethical guidelines and regulatory structures need to be formulated to manage concerns of privacy, equity, and responsible technological application in athlete testing, particularly with young athletes. Future research needs to be aimed at the development of more sophisticated understandings of talent development processes, including the identification of critical development windows and conditions that facilitate or hamper talent realization. International research collaborations could help address the standardization problems and cultural issues that are presently limiting the effectiveness of talent identification

systems. The development of low-cost and available technological solutions will be central to facilitating the application of advanced talent identification methods in a variety of settings, and particularly in low-resource settings where talent may otherwise go unnoticed.

Conclusion

This narrative review has highlighted both the significant progress and ongoing problems in talent identification in track and field athletics. While traditional performance-based approaches continue to dominate practice, the integration of multidisciplinary perspectives and emerging technologies offers encouraging possibilities for more integrated and successful identification systems. Standardization, alignment with long-term development, cultural issues, and methodology issues are the main challenges to be addressed through coordinated research and development efforts. Long-term effectiveness of talent identification in track and field will depend on the ability to create integrated systems that can incorporate the best possible knowledge from across disciplines but are also possible, ethical, and achievable in diverse environments. By finding a balance between scientific progress and implementation concerns, the sport can inch towards more efficient and equitable approaches to identifying and nurturing athletic talent in track and field athletics.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants. Written consent was obtained from all participants in the study.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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