CHAPTER I
INTRODUCTION

A. Background of The Problem

Speed is widely recognized as one of the most decisive physical components influencing athletic performance across various competitive sports. In contemporary sport science, speed is no longer understood merely as the ability to run quickly in a straight line, but rather as a multidimensional physical capacity involving acceleration, maximal velocity, rapid deceleration, and the ability to change direction efficiently in response to external stimuli. These components are influenced by complex interactions among neuromuscular activation, biomechanical efficiency, and physiological adaptations such as rate of force development, motor unit recruitment, muscle stiffness, and movement coordination. Recent studies have emphasized that speed-related performance is highly dependent on the integration of technical, physical, and neural factors that enable athletes to perform explosive movements effectively under competitive conditions (Cormie et al., 2021; Haugen et al., 2023). As the intensity and tempo of modern sports continue to increase, the systematic development of speed capacities has become an essential focus in athletic training programs.

Volleyball represents a sport in which movement speed plays a critical role in determining competitive performance. Unlike endurance-oriented sports, volleyball performance is characterized by repeated short-duration and high-intensity movements such as rapid accelerations, lateral shuffling, diagonal movements, backward repositioning, and explosive transitions between offensive and defensive situations. These movements are generally performed within limited spatial distances, often less than ten meters, and must be executed rapidly in response to changing game situations. Consequently, the ability to initiate movement quickly and efficiently is essential for successful performance in volleyball, particularly during defensive coverage, blocking, and transition phases (Sheppard et al., 2021). In high-level volleyball competition, even small differences in movement speed may significantly influence match outcomes.

Recent empirical studies have demonstrated a strong relationship between movement speed and volleyball performance indicators. Research has shown that acceleration ability, sprint speed, and lower-limb explosive power are closely associated with successful defensive actions, blocking efficiency, and overall court movement performance among volleyball athletes (Loturco et al., 2021). Furthermore, studies conducted in the last five years indicate that volleyball players with superior short-distance sprint ability tend to exhibit better agility, reaction speed, and movement efficiency during match play (Romandoni et al., 2025). These findings suggest that speed development should be considered a fundamental component within volleyball conditioning programs, rather than merely a supplementary physical attribute.

Despite the recognized importance of speed, traditional volleyball training programs have historically focused more heavily on technical drills, tactical preparation, jumping exercises, and general physical conditioning. In many cases, speed development has been addressed indirectly through agility drills and game-based activities under the assumption that sport-specific movement repetition alone would sufficiently enhance movement speed. However, recent evidence suggests that such approaches may not provide adequate stimulus for optimizing acceleration and explosive sprint capabilities, especially when not combined with structured sprint-oriented training methods (Zhao & Lu, 2024). Consequently, there has been growing interest among coaches and sport scientists in integrating sprint training principles into volleyball conditioning programs.

Track and field sprinting represents one of the most scientifically developed domains of speed training. Sprint events such as the 60-meter and 100-meter races require athletes to optimize acceleration, maximal velocity, and running mechanics through highly specialized neuromuscular and biomechanical adaptations. Because sprint performance occurs within a controlled linear environment, researchers have been able to examine variables such as stride length, stride frequency, ground reaction force, and contact time in considerable detail (Haugen et al., 2023). Over time, these investigations have contributed to the development of evidence-based sprint training methodologies designed specifically to improve short-distance running performance.

Modern sprint training methods include resisted sprint training, assisted sprinting, velocity-based resistance training, plyometric exercises, and complex training models integrating strength and explosive movement exercises. These approaches have consistently demonstrated effectiveness in improving acceleration, maximal speed, and force–velocity characteristics through enhanced neuromuscular efficiency and rapid force production (Cormie et al., 2021; Loturco et al., 2022). Importantly, the physiological adaptations generated by sprint training are not exclusive to track athletes. Improvements in explosive strength, rate of force development, and neural activation are also highly relevant to sports such as volleyball that require rapid multidirectional movements and explosive acceleration over short distances.

In recent years, researchers have increasingly explored the application of sprint-based training methods within team sports, including volleyball. Experimental studies have reported that short-distance sprint training, repeated sprint training, and sprint interval training can significantly improve acceleration performance, sprint time, and on-court movement speed among volleyball athletes (Romandoni et al., 2025). Similarly, Zhao and Lu (2024) found that volleyball athletes who participated in structured sprint-based conditioning programs demonstrated greater improvements in movement speed and explosive performance compared with athletes who performed only traditional agility-based training. These findings indicate that sprint training methods derived from track and field may have substantial applicability within volleyball performance development.

From a theoretical perspective, the transferability of sprint training effects to volleyball performance can be explained through shared neuromuscular and biomechanical mechanisms. Both volleyball movement speed and short-distance sprinting rely heavily on rapid force production during ground contact, efficient utilization of the stretch–shortening cycle, lower-limb power generation, and coordinated muscular activation. Enhancements in these mechanisms through sprint training may therefore improve acceleration and explosive movement performance in volleyball athletes as well (Scanlan et al., 2020; Loturco et al.,

2022). This theoretical overlap supports the possibility that sprint training methodologies developed for track and field may be interoperable with volleyball movement speed training.

Nevertheless, despite the growing body of evidence supporting sprint-based interventions in volleyball, the existing literature remains fragmented and largely sport-specific. Most previous studies have investigated training methods within isolated sport contexts without systematically examining the interaction or transferability of training methods between volleyball and track sprinting. As a result, the concept of training interoperability — namely, the extent to which training methods from one sport can be effectively adapted and applied to another — has received limited scientific attention. This gap in the literature highlights the need for integrative studies examining the relationship between volleyball movement speed training and short-distance sprint training within a unified analytical framework.

Another important limitation in the current literature concerns the integration of linear sprint mechanics with the multidirectional movement demands characteristic of volleyball. While sprint training is highly effective for improving acceleration and maximal running velocity, volleyball performance also requires rapid deceleration, lateral movement, changes of direction, and reactive movement responses to unpredictable stimuli. The extent to which sprint-induced adaptations can support these multidirectional and reactive demands remains insufficiently understood. Without comprehensive investigation, the application of sprint-based methods within volleyball training may remain incomplete or suboptimal.

The investigation of training interoperability between volleyball and track sprinting possesses significant practical and scientific value. From a practical standpoint, identifying effective cross-disciplinary training strategies may help coaches optimize training efficiency, reduce unnecessary training redundancy, and maximize athletic performance within limited preparation time. For developing athletes, exposure to scientifically structured sprint training may contribute to broader motor development and long-term athletic progression. From a scientific

perspective, examining the integration between volleyball movement speed training and sprint training contributes to a more comprehensive understanding of speed development across different sporting contexts.

Given the critical importance of speed in both volleyball and track and field sprinting, the shared neuromuscular and biomechanical foundations underlying explosive movement performance, and the limited integrative research currently available, there is a clear need for systematic investigation into the interoperability of training methods between these two sports. Exploring how volleyball movement speed training and short-distance sprint training interact, complement, and differ may provide valuable insights for optimizing training design and advancing contemporary sport science knowledge. Therefore, this study seeks to develop and examine a model of training methods for volleyball movement speed and short-distance running speed in track and field as an effort to improve athletic performance through scientifically integrated speed development approaches.

B. Research Focus

Based on the theoretical considerations and empirical evidence outlined in the background of the study, the present research focuses on examining the interoperability of training methods used to develop movement speed in volleyball and short-distance running speed in track and field. Specifically, this study concentrates on understanding how training interventions traditionally associated with sprint performance—such as short-distance sprint training and related speed-strength conditioning methods—can influence volleyball movement speed, and how volleyball-specific speed training may relate to short-distance sprint performance.

The primary focus of this research is the relationship between sprint-based training methods and sport-specific movement speed outcomes across two distinct yet physiologically comparable sporting contexts. By analyzing both volleyball movement speed and short-distance running speed, the study seeks to identify shared neuromuscular and biomechanical adaptations that may facilitate

performance transfer between linear sprinting and multidirectional court movements. This focus allows for an integrated examination of speed development beyond single-sport boundaries.

Furthermore, the research emphasizes the comparative effectiveness of training approaches, with particular attention given to short-distance sprint training protocols and their impact on acceleration, explosive movement, and neuromuscular responsiveness. The study also considers how these training methods interact with sport-specific movement demands, thereby addressing the extent to which sprint training principles can be adapted to volleyball performance without compromising technical or tactical requirements.

In addition, the research focuses on identifying gaps between theoretical speed development models and practical training implementation in volleyball and track sprint contexts. By examining training interoperability, the study aims to clarify whether current conditioning practices sufficiently reflect contemporary scientific understanding of speed development, or whether greater integration between disciplines is warranted.

Ultimately, this research is focused on generating evidence-based insights that can inform the design of more effective, efficient, and scientifically grounded training programs. The findings are expected to contribute to both theoretical advancement in sports training science and practical application for coaches and practitioners involved in volleyball and track and field athlete development.

Based on the theoretical and empirical considerations presented in the background of this study, the present research is focused on two main aspects related to the development of speed performance in volleyball and track and field.

1. Research focus is to examine the effect of short-distance sprint training methods on movement speed in volleyball athletes. This focus emphasizes how sprint-based training interventions, traditionally applied in track and field, influence volleyball-specific movement speed, particularly acceleration and rapid movement execution within short distances. Through this focus, the study seeks to determine the extent to which sprint training principles can be adapted to enhance performance in a multidirectional team sport context.

2. Research focus is to analyze the relationship between volleyball movement speed training and short-distance running speed performance in track and field contexts. This focus aims to identify shared physiological and neuromuscular characteristics that underlie speed development across both sports, thereby clarifying the degree of interoperability between volleyball speed training and track sprint performance.

C. Problem Formulation

Based on the background of the problem and the defined research focus, this study formulates the research problems as follows:

1. How is the model of training methods for volleyball movement speed and short-distance running speed in track and field developed?
2. How effective is the model of training methods for volleyball movement speed and short-distance running speed in track and field in improving athletes' speed performance?

D. Research purposes

Based on the formulation of the research problems, the purposes of this study are as follows:

1. To develop a model of training methods for volleyball movement speed and short-distance running speed in track and field.
2. To determine the effectiveness of the model of training methods for volleyball movement speed and short-distance running speed in track and field in improving athletes' speed performance.

E. State of the Art

Over the last five years, research in sport science has increasingly emphasized the importance of speed development as a critical determinant of athletic performance across various sports. Contemporary studies have shown that acceleration, movement speed, and explosive running ability are influenced by neuromuscular efficiency, biomechanical coordination, and force-production capacity. Recent investigations in sprint training science have contributed

significantly to the understanding of how structured speed-training methods improve athletic performance through adaptations in the neuromuscular and musculoskeletal systems (Haugen et al., 2023). These advances have encouraged the application of sprint-based training approaches not only in track and field but also in team sports that require rapid and explosive movements.

In the context of volleyball, studies conducted during the last five years have demonstrated that movement speed is strongly associated with successful match performance. Volleyball athletes frequently perform short accelerations, multidirectional movements, and rapid transitions during offensive and defensive play. Research by Sheppard et al. (2021) emphasized that movement speed and reactive agility are fundamental physical capacities supporting defensive coverage, blocking performance, and court mobility. Similarly, Loturco et al. (2021) reported that sprint ability and lower-limb explosive power are significantly correlated with volleyball-specific movement efficiency. These findings indicate that speed-related physical capacities have become increasingly important in modern volleyball performance.

Recent developments in sprint-training methodologies have also influenced conditioning practices in team sports. Studies by Loturco et al. (2022) demonstrated that resisted sprint training, velocity-based training, and plyometric integration effectively improve acceleration and short-distance sprint performance through enhanced rate of force development and neuromuscular activation. Such methods have traditionally been associated with track and field sprint preparation; however, current evidence suggests that the physiological adaptations generated by sprint training are transferable to sports requiring explosive movement patterns, including volleyball.

Within the last five years, several studies have specifically examined the effectiveness of sprint-based training interventions in volleyball athletes. Romandoni et al. (2025) found that repeated sprint training significantly improved acceleration performance and movement speed among volleyball players. Likewise, Zhao and Lu (2024) reported that volleyball athletes who participated in sprint-oriented conditioning programs demonstrated greater improvements in speed and explosive movement ability compared to athletes trained using

conventional agility-based methods. These findings support the growing perspective that sprint training principles from track and field can be adapted effectively to volleyball conditioning programs.

Despite these advances, the current body of literature remains limited in terms of integrating volleyball movement speed training with short-distance sprint training within a unified conceptual framework. Most previous studies have investigated speed training separately according to sport-specific contexts, resulting in limited understanding regarding the interoperability of training methods between volleyball and track sprinting. Existing studies generally focus on isolated interventions such as agility drills, repeated sprint training, or resisted sprint exercises without developing a comprehensive model that systematically combines volleyball-specific movement demands with sprint-training principles.

Another limitation identified in recent studies concerns the lack of integration between linear sprint mechanics and the multidirectional movement requirements of volleyball. Although sprint training has been shown to improve acceleration and explosive movement capacity, volleyball performance also requires rapid deceleration, lateral movement, directional changes, and reactive movement execution under unpredictable conditions. The relationship between sprint-induced neuromuscular adaptations and volleyball-specific movement performance remains insufficiently explored in contemporary sport science literature.

Therefore, the novelty of the present study lies in the development of an integrated training model that combines volleyball movement speed exercises with short-distance sprint training methods derived from track and field. Unlike previous studies that examined isolated training interventions, this study seeks to systematically integrate sprint mechanics, acceleration training, and volleyball-specific movement patterns within a single training framework. Furthermore, this study evaluates not only the development process of the training model but also its effectiveness in improving athletes' speed performance.

Accordingly, this research contributes to the advancement of contemporary sport science by bridging the gap between team sport conditioning and sprint-training methodology. The study is expected to provide both theoretical

contributions regarding cross-disciplinary speed development and practical implications for coaches and athletes seeking more effective approaches to improving volleyball movement speed and short-distance running performance.

No	Previous Studies	Findings	Research Gap	Novelty of Present Study
1	Thomas Haugen et al. (2023)	Sprint training improves acceleration and maximal velocity through neuromuscular adaptations	Focused only on track sprint athletes	Integrates sprint principles into volleyball movement training
2	Irineu Loturco et al. (2022)	Resisted sprint training enhances explosive speed performance	Limited application in volleyball movement contexts	Combines sprint resistance methods with volleyball-specific movements
3	Jeremy Sheppard et al. (2021)	Volleyball requires rapid multidirectional movement speed	Did not integrate track sprint methodology	Develops interoperability between volleyball and sprint training
4	A. Romandoni et al. (2025)	Repeated sprint training improves volleyball acceleration	Focused only on isolated sprint intervention	Creates a comprehensive integrated speed training model
5	Y. Zhao & X. Lu (2024)	Sprint-based conditioning is more effective than agility-only training	Did not examine long-term integrated training models	Evaluates effectiveness of integrated volleyball–sprint training model