

A comprehensive literature review on Trials cycling

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Abstract

Trials cycling is a captivating and challenging sport that combines technical skills, precision, and athleticism. This comprehensive literature review aims to explore and synthesize the existing body of literature on trials cycling and provide a comprehensive understanding of the sport. The review utilized multiple search engines, including Google Scholar, BASE, CORE, and Semantic Scholar, to ensure a thorough examination of relevant scholarly publications. A total of 684 results were obtained from the literature search, which were subsequently categorized based on the search engine used. Applying rigorous selection criteria and removing duplicates, we identified 25 works for inclusion. Additionally, an in-depth investigation of authors with significant contributions in the field led to the inclusion of one additional work, resulting in a total of 26 selected works. A qualitative narrative synthesis approach was employed to analyse the key findings from the selected articles by organizing them by fields of study. This approach facilitated the identification of similarities, differences, and emerging trends within each field. This review covers various aspects of trials cycling, including its historical context, technical aspects, training methodologies, and performance analysis. By examining these dimensions, this review offers a comprehensive understanding of trials cycling as a competitive discipline. Furthermore, it seeks to identify research gaps, trends, and emerging areas for further investigation, providing valuable insights for future studies, training protocols, and skill-development strategies in trials cycling. Understanding the existing literature on trials cycling is crucial for athletes, coaches, and researchers. The findings of this review have practical implications for the development and advancement of trials cycling. Moreover, the review serves as a valuable reference for researchers, practitioners, and stakeholders in the sport and emphasises the ongoing need for research efforts to deepen the understanding and practice of trials cycling. In conclusion, this comprehensive literature review serves as a significant contribution to the field of trials cycling. It provides an inclusive and multidimensional analysis of the sport and synthesises the key findings from a wide range of scholarly works. This review also highlights the importance of further research and exploration in trials cycling, which can advance the sport and contribute to its continued growth and development.

Keywords: bike trial, bici trial, uci trials, mountain bike trials, vtt trial.

Introduction

Trials cycling is a thrilling off-road discipline that challenges riders to navigate obstacle courses without touching the ground with their feet, all within a specified time limit. This unique sport utilizes special bicycles with 20 or 26-inch wheel sizes. While the Union Cycliste Internationale (UCI, 2023) regulates the activity referred to as "Trials," similar sports with slight rule variations are governed and promoted by other federations such as the BikeTrial International Union (BIU, 2022).

Trials cycling, also known by different names in various regions around the world, has a rich history and diverse cultural associations. In Spain, where trials cycling originated, it was initially called "trialsin" (derived from the Catalan "trial sin motor") to emphasize its connection to motorcycle trials and the absence of an engine. However, "bici trial" is now the more commonly used term in the Spanish-speaking community. In France, a popular country for the sport, it is referred to as "vtt trial" (vélo tout terrain trial), highlighting its association with off-road cycling. English-speaking countries use terms like "observed trials" (referring to judges observing performances to assign penalties and scores) or "mountain bike trials" (specifically for 26-inch bicycles). For the purposes of this discussion, the more general term "trials cycling" will be used to encompass the activity as a whole.

The history of trials cycling dates back to the 1970s in Europe, with Spain recognized as its birthplace and main hub. It evolved from motorcycle trials, where modified bicycles were used for children's training. The sport gained popularity and recognition, eventually becoming a standalone discipline officially recognized by the UCI in 1985 (Pi, 2012; Pi, 2011). In 1991, due to internal conflicts, delegates from various countries separated from the UCI and established the autonomous BIU (BikeTrial International Union), which governs BikeTrial (Pi, 2012; Pi, 2011). While Trials (UCI) and BikeTrial (BIU) have differing regulations, they both involve using

bicycles and participating in similar competitive contexts. It's worth noting that Trials is the only variant officially recognized by the International Olympic Committee (IOC), which highlights its global significance within the realm of competitive cycling.

Despite being practiced worldwide for over 50 years, trials cycling is not as well-known as other cycling disciplines. This is evident in the limited scientific literature available, with only a few studies and research papers dedicated to this sport. Surprisingly, no comprehensive literature review has been conducted to present the current state of research in this field. This lack of attention from the academic community presents an opportunity to delve deeper into trials cycling and shed light on its unique characteristics, challenges, and potential for further development.

The primary objective of this review is to provide a comprehensive and multifaceted understanding of trials cycling. Through a critical analysis of the existing literature, this study aims to present a coherent narrative that encompasses the historical context, technical aspects, training methodologies, and performance analysis associated with trials cycling. By examining previous research and identifying gaps in knowledge, this review also seeks to inspire future studies and investigations that can contribute to the advancement of trials cycling as a competitive discipline.

Understanding the existing literature on trials cycling is crucial for athletes, coaches, and researchers involved in the sport. It not only enhances their knowledge of the sport's evolution and progression but also helps identify areas that require further investigation. By bridging the gap between scientific research and practical application, this review can guide future studies, training protocols, and skill development strategies, ultimately elevating trials cycling to new heights as a recognized and respected sport within the global cycling community.

Materials and Methods

In this review, we utilized several search engines including Google Scholar, BASE, CORE, and Semantic Scholar. The search was conducted using the following keywords: "bike trial," "bici trial," "uci trials," "vtt trial," and "mountain bike trials."

All research papers that primarily focused on trials were selected without applying any specific filters such as language, scientific area, or time frame.

However, it was noticed that some articles, which were already known, were not identified using the aforementioned criteria. To address this, a further investigation was carried out by examining the scientific production of the authors found, in order to discover any additional previously unidentified works.

The choice of keywords was based on the fact that trials is a sport with a long-standing tradition in certain regions of Europe, especially in Spain and France. Hence, "bici trial" and "vtt trial" were included as they are commonly used terms in those areas. The other keywords were chosen as alternative terms used to refer to this sport. The inclusion of "uci trials" was necessary as the term "trials" alone is not specific enough and would have resulted in an overwhelming number of results. This decision helped to narrow down the search and make it more focused.

The use of search engines, rather than specific databases, was preferred to ensure a comprehensive overview of the current state of the art in this sport, aligning with the purpose of this review.

To synthesize the collected data, a qualitative narrative synthesis approach was employed, organizing the results by fields of study. This approach involved analyzing the key findings from the selected articles and categorizing them based on themes or main categories. Subsequently, similarities, differences, and emerging trends within each field of study were identified.

Results

The research conducted yielded a total of 684 results, which were divided according to the search tool used, as shown in Table I. After applying the selection criteria and removing duplicates, a total of 25 works remained. Further research on selected authors led to the addition of 1 more work, resulting in a total of 26 selected works. To provide an overview of the research areas involved, specific domains were identified, and the number of relevant works was indicated for each domain in Table II. Also, the type of publication was reported in Table III.

Table I Results grouped by search engine used.

Search engine	Key words					Sum
	bike trial	mountain bike trials	bici trial	vtt trial	uci trials	
Google Scholar	330	46	6	31	10	423
BASE	39	1	1	3	0	44
CORE	96	17	5	3	3	124
Semantic Scholar	73	13	0	5	2	93
Sum	538	77	12	42	15	684

Table II Results grouped by field of study.

<i>Field of Study</i>	<i>Number of works</i>
<i>Architecture and Design</i>	<i>1</i>
<i>Arts</i>	<i>2</i>
<i>Economics</i>	<i>1</i>
<i>Engineering and Technology</i>	<i>9</i>
<i>Geography</i>	<i>1</i>
<i>Human physical performance and recreation</i>	<i>13</i>

Table III Results grouped by type of publication.

<i>Type of publication</i>	<i>Number of works</i>
<i>Dissertation</i>	<i>9</i>
<i>Journal paper</i>	<i>14</i>
<i>Proceeding</i>	<i>4</i>

Architecture and Design

The article by Arif & Putra (2020) discusses the importance of proper safety measures for the legs in trial bike activities. It focuses on designing shoes with unique technical and design characteristics that can support trial bike activities. The research analyzes trial bike sport activities, examines the relationship between elements influencing shoe design, and surveys the anatomical dimensions of users' feet to explore comfort. The aim is to develop a trial bike shoe design that meets specifications in terms of design, strength, and comfort, with the goal of enhancing performance, safety, and user comfort.

Arts

The dissertation by Fadhillah (2016) explores the art of bike trial, particularly within the Bandung Bike Trial Community in Indonesia. It examines the presentation of this art through a documentary film, aiming to provide a deeper understanding of bike trial and promote the sport in Indonesia. Another study by Isa Ersal (2013) discusses effective strategies for utilizing audiovisual media, specifically films, to promote urban sport bike trial among Indonesian youth as a healthy alternative. It emphasizes the benefits of urban sport for physical and mental well-being and highlights the importance of audiovisual media in conveying the values and culture associated with this sport.

Economics

The thesis by Fiallo (2020) presents a market research and financial viability analysis for the development of an Indoor Trial Learning Center for children in Quito, Ecuador. It aims to promote comprehensive learning through sports techniques and covers a five-year timeframe with monthly financial evaluations. The thesis also focuses on attracting investors and presents the business structure and philosophy based on the conducted research.

Geography

This thesis by Faville (2009) explores the author's personal journey in bike trials, parkour, and capoeira, examining how these activities have transformed emotions, perceptions, and physicality. It argues for the importance of playful engagement with the world, drawing inspiration from these practices and their potential to create new connections with places. The thesis advocates for a participatory and experiential approach to understanding place, where individuals actively co-create new spaces through contact with their surroundings.

Engineering and Technology

A series of papers (Shibuya & Takashima, 2007; Shigetoh et al., 2013; Saito et al., 2014; Saito et al., 2015) and a dissertation (Saito, 2016) from a research group in Japan discuss the development of robots capable of performing complex tasks in various situations, with a focus on bike-trial techniques. The studies aim to create robots with human-level athletic abilities by incorporating specialized movement techniques. Another paper by Firmansyah (2014) discusses the design of a bike bag for transporting bike trial bicycles, addressing the challenge of long-distance trips. Additionally, a thesis by Avilés (2019) focuses on the design and structural analysis of a trials bike frame, utilizing modern techniques in frame design and structural calculations.

Human Physical Performance and Recreation

Several studies explore different aspects of bike trials from a physical performance perspective. They investigate the learning process of trials athletes (Albano et al., 2022; Ellmer & Rynne, 2016), the technical aspects of trials movements (Thomas et al., 2018; Eibl, 2016; Tarnas et al., 2012), the use of motion analysis systems (Albano et al., 2020; Albano et al., 2019; Vastola et al., 2017; Vastola et al., 2016; Bertucci & Rogier, 2015), and the physical characteristics and strength profiles of trials athletes (McFall et al., 2022; Palau, 2021; Albano et al., 2019; Tarnas & Wielinski, 2005). These studies provide insights into the learning experiences, skill acquisition, biomechanics, and physical attributes relevant to the sport of bike trials.

Discussion

The present literature review has examined the available studies on trials cycling. In the following section, we will discuss the results obtained from our analysis and explore their implications, highlighting the limitations of the included studies.

The results highlight how trials cycling involves various disciplines and fields of study. It is approached from different perspectives, such as architecture and design, arts, economics, geography, engineering and technology, human physical performance, and recreation. This emphasizes the interdisciplinary nature and complexity of this sport. Many of the articles and theses mentioned in the text are based on academic and scientific research in the field of trials cycling. These research efforts often aim to improve understanding of trials cycling, develop new technologies or methodologies, and optimize athlete performance. This underscores the importance of a close link between theoretical research and sports practice.

Several studies highlight the use of technology, such as motion analysis, electromyography, and optoelectronic systems, to understand and enhance performance. Employing technology can provide valuable data on the biomechanical, kinematic, and physical aspects of trials cycling, enabling athletes and coaches to optimize their strategies and techniques. Some of the mentioned studies highlight the importance of trials cycling as part of urban culture and youth activities. The use of audiovisuals, documentaries, and films can contribute to the promotion and dissemination of this sport, positively influencing its image and participation. Furthermore, trials cycling can be seen as a form of artistic expression and connection with one's surrounding environment.

The field of Human Physical Performance and Recreation seems to be the most relevant. It delves into various aspects of trials cycling, including learning processes, skill acquisition, muscle activity analysis, jump techniques, motion analysis, and performance evaluation. It highlights the influence of social and physical affordances on the learning process and proposes theoretical frameworks and practical applications for skill development. In this field of study, many works concentrate on the technical analysis of techniques and the evaluation of athletes' physical abilities. However, there is a lack of more in-depth studies on the psychology, motivation, and social aspects of the activity, which could provide a more comprehensive understanding of participants' experience and the factors influencing performance.

These considerations provide a broad and diversified overview of the relevant and interesting aspects of trials cycling as a sports discipline and field of study. During the analysis of the available studies, some potential methodological limitations emerge. One of the main concerns is the limited sample size used in some studies. This can affect the representativeness of the results, as larger and more diverse samples could provide greater statistical validity and improve the generalizability of the findings. Another criticism pertains to the study design, which may be weak in some cases or lack an adequate control group. Furthermore, a limitation identified is the lack of longitudinal studies, as most of the reviewed studies appear to be cross-sectional in nature, based on observations and measurements taken at a single time point. The absence of long-term insights may restrict the understanding of changes over time and the long-term effects.

It has also been observed that some studies lack diversity in their samples, in terms of gender, age, or cultural background. The lack of diversity may impact the representativeness of the results and limit the comprehensive understanding of trials cycling. Therefore, it would be desirable to include more diverse samples to obtain a more complete and representative view of the activity.

Additionally, some studies may have limitations in measurement, such as using subjective assessment tools or having limitations in accuracy or validity. The utilization of validated measurement tools and the adoption of multiple data collection methods could enhance the quality of measurements and obtained results.

Lastly, it should be noted that some studies may be conducted in specific geographical contexts, limiting the generalizability of the findings to other regions or countries. Expanding the geographical context of studies can provide a broader and more diverse perspective on trials cycling, allowing for a better understanding of its dynamics in different settings. These considerations provide a broad and diversified overview of the relevant and interesting aspects of trials cycling as a sports discipline and field of study.

Conclusions

The extensive literature search conducted using diverse databases has allowed for a comprehensive analysis of trials cycling research from various disciplinary perspectives. This review consolidates knowledge and provides a valuable resource for individuals interested in trials cycling, including researchers, coaches, athletes, and enthusiasts. The findings of this review emphasize the significance of further research to address gaps in the literature, explore new methodologies, and enhance our understanding of the biomechanics, psychological aspects, and performance optimization in trials cycling.

The lack of scientific literature dedicated to trials cycling may be attributed to several factors. The discipline's niche status within the cycling world, with fewer participants and organized competitions compared to more popular disciplines, could result in limited scientific interest and funding availability. Additionally, trials cycling is a relatively young discipline with a less-established history, which may contribute to the lack of in-depth studies and research. The specialized technical skills required and the difficulty in accessing a willing participant pool for research purposes could further hinder scientific exploration. To address this gap, raising awareness and interest in trials cycling among both the scientific community and athletes is essential. Creating

dedicated research networks, organizing conferences and workshops, and fostering collaborations between researchers and elite athletes could stimulate the production of studies and research in this field.

Overall, these studies contribute to the understanding of trials cycling from multiple perspectives. They provide insights into the technical, creative, and physical aspects of trials cycling and offer potential implications for design, education, and sport development. The identified methodological limitations in trials cycling studies offer valuable insights and opportunities for future research to improve the methodological approach and deepen our understanding of various aspects related to this fascinating sport activity.

In summary, this comprehensive literature review offers an encompassing analysis of trials cycling, presenting a broad range of perspectives from the available scholarly literature. It serves as a valuable reference for researchers and practitioners involved in trials cycling and highlights the need for continued research efforts to advance the understanding and practice of this sport.

Conflicts of interest

The authors declare no conflict of interest.

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