INPLASY

Analysis of the Determinant Factors in Bicycle Motor Cross (BMX) Sport Performance: Systematic Review

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ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202480036

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 07 August 2024 and was last updated on 07 August 2024.

INTRODUCTION

*R*eview question / Objective To conduct a systematic review of published studies on BMX performance variables and establish recommendations for coaches, researchers and practitioners.

Condition being studied Bicycle Motor Cross (BMX) was confirmed as an Olympic sport for Beijing in 2008 and much research has been conducted on it. However, to date there is no systematic review that analyzes the determinants of sport performance in BMX.
It confirms the need to continue developing studies that analyze the effects of the indicators on sports performance, because the knowledge acquired is useful to promote a better understanding of the sport discipline, and, with this, to seek to understand the knowledge and findings found to be used by coaches and transferred to the real context of sports preparation and, especially for competition. To our knowledge, there is no systematic review that evaluates the determinants of BMX performance.
In this review, studies focused on the collection of statistical analyses in search of a better understanding of the relationship between physiological factors and sports performance were considered.

METHODS

Search strategy The review of the different searches was carried out by two authors independently in order to define which were the terms that yielded the largest number of documents on the subject. The terms selected were: "BMX", "Elite Riders", "Physiological indicators", "Profile", "Biomechanical variables", "Psychological factors", "Performance". Finally, based on these terms, the search equation was constructed: (BMX OR Elite Riders) AND ("Physiological indicators" OR Profile OR "Biomechanical variables" OR "Psychological factors" OR Performance).

Participant or population The 21 studies that make up the sample of this systematic review have a total sample participation of 287 athletes, of which 13 evaluate men, three studies consider women and two studies consider both men and women. This fact is shown in Table 3, which specifies the characteristics of the sample selected in each of the studies, in order to contextualize this information. It is detailed that there are several studies that do not refer to the characteristics of the sample evaluated (sex, number of athletes, age and other variables of analysis).

Intervention The outcome measures included in the current systematic review were those that were evaluated by at least 2 of the 21 articles. These variables were: i) BMX and physiological profile; ii) BMX and bicarbonate; iii) BMX and strength characteristics (power, velocity); and, iv) psychological, biomechanical and technological variables for BMX performance.

Comparator Assessment of at least one physiological, biomechanical or fitness variable in training and competition. Results relating physiological indicators (e.g., HR, power), physical (e.g., strength, endurance), biomechanical (accelerations, angles, etc.) and psychological (feedback) profiles of physical abilities.

Study designs to be included Original research that has been peer-reviewed by academic peers, Cross-sectional studies, randomized controlled trials, longitudinal studies.

Eligibility criteria Exclusion criteria were:
Participants who are not physically active. Focused only on the evaluation of subjective variables. Results not relating physiological indicators (e.g., HR, Power), profiles of physical (e.g., strength, endurance), biomechanical (accelerations, angles, etc) and psychological (feedback) capabilities. Systematic reviews, meta-analyses, bibliometric analyses, narrative or literature reviews, patents, abstracts, meetings, books, reviews, letters and editorials; iv) instrument validation; v Non-peer written articles, studies without full access to the original text.

Information sources The search strategies considered the following characteristics: Date: April 1, 2024. Databases consulted: PubMed (Medline), and Web of Science (WoS).

Main outcome(s) Three studies were found that took into account the BMX categories and physiological profile with a total of 34 participants. In this regard, Petruolo et al, expressed several outcome measures reflecting the following physiological demands: maximal oxygen consumption (Vo2max), of 55.7±4.8 ml/min/kg, with a Pmax during a short bicycle sprint of 1498±189 W, and an average power during the Wingate test (WT) of 1344±158 W. In addition, peaks in the vertical jump of 58.6±7.7 cm, 4625±768 W and 64.3±7.5 N/kg were recorded. Furthermore, in the BMX race simulation, a slight improvement in performance times was observed, accompanied by a significant increase in perceived exertion, as well as a significant increase in blood lactate and hydrogen ion concentrations throughout the races, whereas, bicarbonate concen-trations decreased (p<0.001). These results underline the high anaerobic demand and intensity of BMX competitions, as well as the importance of power capacity and muscular endurance in cyclists.

In terms of perceived exertion, there were no significant differences between conditions, although running influenced scales 1-5 ($F_{2, 43.79} = 3.34$, p=0.04) and RPE 6-20 ($F_{2, 42.93} = 3.69$, p=0.03). NaHCO3- increased heart rate variability (%rMSSD30s, $F_{1, 69.56} = 5.05$, p=0.02)). No sig-nificant effects of condition on Vo2, VCo2 and VE were observed, although there were significant differences between pre and post measurements (p<0.001). These results suggest that NaHCO3- improves some aspects of acid-base balance and heart rate variability, but does not significantly affect direct physical performance or perception of exertion compared to placebo.

Subsequently, Rylands et al. investigated the effect of cadence selection on Pmax and time to Pmax in elite BMX riders. The analysis revealed no significant differences in Pmax (p=0.424), and time to reach Pmax (p=0.532), between cadences of 80, 100, 120 and 140 rev/min. However, the optimal cadence for time to reach Pmax was 120 rev/min.

Data management After identifying the studies, the documents were downloaded in Excel format based on the following data for each study: i) title; ii) authors; iii) journal; iv) year; v) database. Once the documents were downloaded from each database, they were unified in a single database. Likewise, if any document was found that did not appear in the search strategy, it was added through external sources. The process was carried out independently by two of the authors ("A.M.-B." and "B.A.B.-P."). Any disagreement (5% of the total number of papers) on the final inclusion-exclusion status was resolved through academic discussion, both in the selection and exclusion phases. In the discussion process, the two independent authors analyzed the article at the same time following the criteria set out in the order in Table 1. This process

was systematized in Excel format. Thus, to follow the PRISMA guidelines, data extraction was carried out by "A.M.-B." and "B.A.B.-P.".

Quality assessment / Risk of bias analysis The quality of the evidence of the articles included in this review was assessed on the basis of the PEDro scale. This scale is based on criteria to identify whether the studies have sufficient internal validity and statistical information to interpret the results (external validity (item 1), internal validity (items 2-9), and statistical information (items 10-11). Each item was classified as yes or no (1 or 0, respectively), depending on whether the criterion was met in the study. The total score considers items 2 to 11; therefore, the maximum score was 10. Regarding the quality of evidence, scores < 4 are considered poor quality, 4-5 moderate quality, 6-8 good, and 9-10 as excellent. In this review, 203 items (96.6%) were assessed by agreement between two reviewers, and the remaining items were assessed by agreement with the average of the studies (Table 2). The quality of the evidence ranged between the "Moderate-Good" category, given that there were some studies that did not present randomization in the sample selection, nor did they have a control group. In addition, the quality of the evidence was heterogeneous among the studies. Therefore, the quality of the evidence was defined by consensus of the investigators as "Moderate", which means that it does not have a good methodological quality.

Strategy of data synthesis The data for each of the studies was elaborated in an excel document with different categories identified, these are:
Author(s)/ year
Number of participants
Sex
Age (Yrs) and sports level
Weight (kg)
Height (cm) BMI (kg/m²)
Fat mass (%)
Muscle mass (kg* / %**)
Study's aim
Variables
Results
Instruments
Conclusions.

Subgroup analysis Subgroups were identified based on outcome measures. The outcome measures included in the current systematic review were those that were assessed by at least 2 of the 21 articles. These variables were: i) BMX and physiological profile; ii) BMX and bicarbonate; iii) BMX and strength characteristics (power, ve-locity); and, iv) psychological, biomechanical and technological variables for BMX performance.

Sensitivity analysis Sensitivity analyses were carried out by the two main authors of the research.

Language restriction No language restrictions were made.

Country(ies) involved Colombia, Spain, Chile.

Keywords BMX race; cadence; heart rate; power binning; Cycling; peak power; Profile.

Contributions of each author
Author 1 - Aura Daniela Montenegro - Author 1 wrote the Introduction, method, analyses and results.
Author 2 - Víctor Hernández-Beltrán - Author 2 provided analysis, writing and preparation of the paper, and review and editing.
Author 3 - José Martin Gamonales - Author 3 provided analysis, writing and preparation of the paper, and review and editing.
Author 4 - Jorge Olivares-Arancibía - Author 4 provided writing and preparation of the paper, and review and editing.
Author 5 - Rodrigo Yáñez-Sepúlveda - Author 5 provided writing and preparation of the paper, and review and editing.
Author 6 - José Francisco López Gil - Author 6 provided writing and preparation of the paper, and review and editing.
Author 7 - Boryi A. Becerra-Patiño - Author 7 contributed the introduction, method, analysis, results, discussion and conclusions, writing and preparation of the paper, and review and editing.