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Effects of Tattoos on Thermoregulation, Pain Perception, and Dermatological Health during Exercise: A 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.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 12 November 2025 and was last updated on 12 November 2025.

INTRODUCTION

Review question / Objective Analyzed the available scientific evidence on the impact of tattoos on thermoregulation, pain perception, and dermatologic health in individuals performing physical exercise.

Rationale In recent years, we have witnessed a radical change in the way tattoos are perceived. In the past, tattoos had a connotation associated with certain groups, but nowadays they are bursting into the culture, becoming a form of artistic expression, both personal and group, which makes them widely accepted in society. This new reality is reflected in the significant increase in the number of people who decide to get tattooed, especially youth and young adults (Laumann & Derick, 2006; Muñoz-Ortiz et al., 2021). Some studies suggest that the decision to get tattoos may be related to the management of perceptions of self-identity in the social context (Atkinson, 2002). This transformation has led to a shift in social and aesthetic norms, challenging traditional perceptions associated with tattoos. This growing acceptance has opened the way for discussions on how this form of body modification can influence people's responses in various sectors and social contexts (Wohlrab et al., 2007).

Condition being studied Against this background of uncertainty, the present systematic review aims to identify, analyze and synthesize the available scientific evidence on the effects of tattoos on dermatologic health, thermoregulation and pain perception in individuals who engage in regular physical activity. The synthesized information will be fundamental to guide future research, clinical decision making and information provided to tattooed athletes.

METHODS

Search strategy The search strategy was adapted to each database, using a combination of keywords, MeSH terms and Boolean operators.

The main keywords will be “tattoo*” AND (“athletes” OR “exercise” OR “sports” OR “physical activity”). Search strategies in each database were adapted to include terms related to pain, skin or thermoregulation, combined with the terms already mentioned to extend the secondary search. Additional filters were applied to limit the search to human studies and publications in the selected languages and year of publication. References of selected articles were examined to identify additional potentially relevant studies.

Participant or population Observational studies (cohort, case-control, cross-sectional), intervention studies (RCTs), systematic reviews and meta-analyses.
Published from the year 2000 onwards
Studies involving participants older than 18 years who perform regular physical activity, including health exercisers, amateur athletes and professional athletes
Presence of tattoos
Qualitative studies exploring the experiences, perceptions, and beliefs of tattooed athletes about the influence of tattoos on their health and performance
Measures related to:
Dermatological health (infections, allergic reactions, scarring).
Thermoregulation (sweating rate, body temperature during exercise)
Pain perception (pain thresholds, pain tolerance).

Intervention Studies that do not evaluate the effects of tattoos on health
Duplicate studies
Studies that do not include a clear and rigorous methodology.
Studies that do not report sufficient data for extraction and analysis.
Studies evaluating the effects of micropigmentation or permanent make-up
Studies investigating the use or effects of electronic tattoos or electronic devices implanted in the skin

Studies that do not assess thermoregulation, pain perception, or dermatologic health.

Comparator Studies that do not evaluate the effects of tattoos on health
Duplicate studies
Studies that do not include a clear and rigorous methodology.
Studies that do not report sufficient data for extraction and analysis.
Studies evaluating the effects of micropigmentation or permanent make-up
Studies investigating the use or effects of electronic tattoos or electronic devices implanted in the skin

Studies that do not assess thermoregulation, pain perception, or dermatologic health.

Study designs to be included Observational (cross-sectional) and experimental.

Eligibility criteria Data extraction will be performed using a standardized form, designed in Google Sheets, to capture key data for each study consistently. This form will include: general study information (title, authors, year of publication and study design), participant characteristics (number, age range, sex, physical activity level and specific attributes of tattoos, including size, location and age), interventions performed (if applicable, describing type, duration and frequency), and outcome measures related to dermatological health (type and frequency of complications), thermoregulation (body temperature and sweating rate) and pain perception (pain thresholds and tolerance). Athletes' perceptions of the influence of tattoos on their dermatological health, thermoregulation, pain perception and sports performance will be recorded. As with study selection, data extraction will be performed independently by at least two reviewers. Any discrepancies between the reviewers will be resolved by discussion or by consulting a third reviewer. If necessary, the authors of the studies will be contacted to request missing information or clarify doubts.

Information sources The electronic databases PubMed (Medline), Web of Science (Clarivate), Science Direct (Elsevier), Google Scholar and SportDiscus (EBSCO) were searched extensively for relevant studies.

Main outcome(s) The types of exercise included cycling, running, and fitness sessions. This variability in exercise protocols introduces a degree of heterogeneity that is important to consider when comparing results across studies. In total, these studies included 116 participants, of whom 68 were men and 48 were women. Of these studies, only two specified the total number of tattoos analyzed: Keyes et al. (2022) examined 48 tattoos, and Beliveau et al. (2020) reported data that allow us to estimate a total of 44 tattoos analyzed in their study. The other studies did not report this data, despite the fact that some participants had multiple tattoos, which makes an accurate comparison of the size and density of tattoos between studies difficult. In terms of study

design, four were observational (Brown et al., 2022; Keyes et al., 2022; King et al., 2022; Merritt et al., 2024) and two experimental (Beliveau et al., 2020; Rogers et al., 2019).

Data management A narrative synthesis of the results of all included studies will be performed, organizing the findings by theme (dermatologic health, thermoregulation, and pain perception). While meta-analysis was considered, significant heterogeneity in study designs, populations, interventions, and outcome measures precluded a combined quantitative analysis. Specifically, variations in the types of exercise used to induce sweating, methods of measuring sweating (absorbent patches, vented capsules, thermography), tattoo characteristics (size, location, age), and participant characteristics (age, sex, physical activity level) made it difficult to combine data in a meaningful way. Tables and figures will be used to present the results clearly and concisely.

Quality assessment / Risk of bias analysis Figure 1 presents the results of the risk of bias assessment using the JBI Critical Appraisal Checklist for analytical cross-sectional studies (Barker et al., 2025). The methodological quality of the articles included in this review was assessed via the PEDro scale (Table 2). The methodological quality of the experimental studies was good (Cashin & McAuley, 2010).

Strategy of data synthesis The study selection process was carried out in two main stages. First, an initial review of titles and abstracts was conducted using the Zotero tool and Excel to facilitate a collaborative process among reviewers. This process was performed independently by at least two reviewers (J.M.S and D.R-V.). Studies that met the inclusion criteria during this phase were subjected to a detailed full-text review to determine their final eligibility. Again, the two independent reviewers will analyze the full texts. Any discrepancies between reviewers in both the initial and complete review phases were resolved through discussion and consensus, or, if necessary, by consulting a third reviewer.

Subgroup analysis Data extraction will be performed using a standardized form, designed in Google Sheets, to capture key data for each study consistently. This form will include: general study information (title, authors, year of publication and study design), participant characteristics (number, age range, sex, physical activity level and specific attributes of tattoos, including size, location and age), interventions performed (if applicable, describing type, duration and frequency), and outcome measures related to dermatological health (type and frequency of complications), thermoregulation (body temperature and sweating rate) and pain perception (pain thresholds and tolerance). Athletes' perceptions of the influence of tattoos on their dermatological health, thermoregulation, pain perception and sports performance will be recorded. As with study selection, data extraction will be performed independently by at least two reviewers. Any discrepancies between the reviewers will be resolved by discussion or by consulting a third reviewer. If necessary, the authors of the studies will be contacted to request missing information or clarify doubts.

Sensitivity analysis None.

Language restriction None.

Country(ies) involved Costa Rica, Colombia, Chile.

Keywords Tattoos; Physical Exercise; Sport; Dermatological Health; Thermoregulation; Pain Perception.

Dissemination plans None.

Contributions of each author

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