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Impact of the Kangaroo mother care method on weight gain in premature newborns: systematic review

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Abstract

Purpose To evaluate the impact of the Kangaroo Mother Care method on weight gain in premature newborns.

Methods A systematic review was conducted in scientific databases, including Pubmed, Cochrane, Web of Science, and Scopus, as well as clinically relevant articles from Dialnet and Cuiden. The search covered the period from January 1, 2018, to December 31, 2023, using keywords and boolean operators "AND" and "OR."

Results Nine studies meeting the inclusion criteria and undergoing critical reading were included. Despite the high heterogeneity, the results underscore the global relevance of the Kangaroo Mother Care Method, demonstrating that this method positively impacts weight gain in newborns. Additionally, the positive influence of breastfeeding and kinesthetic stimulation on the weight of these preterm infants was observed.

Conclusions The Kangaroo Mother Care method significantly benefits preterm newborns, improving weight gain. Breastfeeding and kinesthetic stimulation combined with KMC further enhance the benefits regarding the weight of preterm infants. These findings highlight the need for broader adoption of Kangaroo Mother Care with standardized protocols.

Keywords Kangaroo mother care, Weight gain, Premature birth, Incubators, Breastfeeding

Introduction

The World Health Organization (WHO) [1] defines prematurity as a birth that occurs before 37 weeks or 259 days of gestation from the first day of the last menstrual period.

After birth, newborns are exposed to temperature changes, stress, feeding intolerance, insensible water loss, and infectious agents. Additionally, medical interventions increase energy expenditure and nutrient loss, affecting growth rates. On the other hand, some premature newborns need an adaptation period to start enteral intake and may require parenteral nutrition [2].

Prematurity is the leading cause of neonatal mortality worldwide and ranks second in infant deaths, accounting

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for 1.1 million annual deaths [3]. There is an increase in this in developed countries, reflecting not only the rising incidence rate but also changes in care practices for these neonates. Advances in obstetric and neonatal care allow the survival of increasingly immature neonates. Statistically, the limitation of the traditional classification into abortion, fetal death, and early neonatal death, and different national legislations that establish obligatory registration limits must be considered, with gestational age descending in light of achieved survivals [4].

It is estimated that 13.4 million newborns were born prematurely (< 37 weeks) in 2020, particularly in regions such as South Asia and Africa, where data gaps are more pronounced. These areas account for approximately 65% of all preterm births worldwide [5]. In contrast, European regions report lower rates, mainly due to the strengthening of their healthcare systems. For example, in 2022, according to data from Spain's National Institute of Statistics (INE), the preterm birth rate reached 7% of total births [6].

The KMC, originating at the San Juan de Dios Hospital in Bogotá [7], involves placing the newborn vertically on the mother's chest and abdomen, maintaining skin-to-skin contact. This practice enhances the mother-child bond, provides warmth, stabilizes the baby's vital signs, and facilitates breastfeeding. It is recommended to start KMC immediately after birth and to continue it for at least the first hour of life. Warmth, breastfeeding, and skin-to-skin contact are the fundamental pillars of this methodology, which can become an alternative in baby care, especially for premature newborns [8].

Regarding morbidity and mortality, it mainly affects those born with a gestational age of less than 32 weeks, "very premature," and especially "extreme preterms" born before 28 weeks [9].

Scientific evidence [10] shows a direct association between the application of Kangaroo Mother Method (KMC) in low-birth-weight (LBW) newborns and a reduction in the incidence of sepsis and hypothermia, leading to decreased perinatal mortality. Additionally, using KMC improves adherence to breastfeeding and has shown more significant weight gain in newborns compared to those not using this method.

A systematic review conducted with studies up to 2017 observed that the duration of KMC influenced neonatal growth [11]. Another meta-analysis conducted with studies until March 2022 compared the effects of KMC versus conventional care and early versus late initiation of KMC and the influence of traditional Chinese medicine. This research helped support the practice of KMC for premature and low-birth-weight babies as soon as possible after birth and for at least 8 h a day [12]. This study arises from the need to update scientific evidence on this topic while exploring new variables that may influence the weight gain of premature newborns practicing KMC. .

Table 1 PICO tool

Patient	Premature newborns
Intervention	Kangaroo Mother Method
Comparison	Incubator
Outcomes	Weight gain

Aim

This study aimed to evaluate the impact of the KMC on weight gain in premature newborns. More specifically, to determine the implementation of the KMC and its positive effect on weight gain compared to traditional alternatives such as incubators and artificial feeding. A secondary objective included identifying complementary interventions to KMC that could positively contribute to weight gain in premature newborns.

Methods

A systematic review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology [13]. A protocol was registered with the Open Software Foundation-OSF (DOI https://doi.org/10.17605/OSF.IO/YRV8B).

Search strategy

The PICO tool (Sample, Phenomenon of Interest, Design, Evaluation, and Research strategy) was used to guide the information search process in formulating a research question: "In premature patients, what is the effect of the Kangaroo Mother Method compared to the incubator regarding weight gain?" (Table 1).

Study selection

All retrieved studies were imported into the Zotero bibliographic manager, with duplicate studies being removed. All selected articles met the following inclusion criteria: studies that evaluate the impact of the KMC method published between 1/01/2018 and 12/31/2023 and studies whose research group included children born < 37 weeks of gestation. Narrative or systematic reviews and meta-analyses were excluded from this review, as well as studies that were not in English or Spanish. Additionally, studies on neonatal growth that were not associated with weight gain were excluded; research projects and clinical cases were not considered due to their lack of conclusion, non-representative samples, and difficulty in extrapolating results to the study population.

The selection and evaluation of studies were conducted by a multidisciplinary team, including two nurses specializing in obstetrics and gynecology (midwives) with extensive clinical and research experience. The review process consisted of two phases: an initial screening followed by a detailed evaluation. Both phases were performed

independently by the reviewers, and any discrepancies were resolved through consensus. This approach ensured rigor and consistency in the final selection of studies.

Literature search

For this review, relevant articles found in six electronic databases—Pubmed, Scopus, Cochrane, Web of Science, Dialnet, and Cuiden—were systematically searched between January and February 2024.

For the English-language databases, the MeSH terms "Infant, premature," "Premature birth," "Kangaroo-mother care method," and "Weight gain" were used, in addition to the free term "Kangaroo." Boolean operators AND and OR were used to formulate a search equation that addresses the research question. The resulting search equation was: (("Infant, premature" OR "Premature birth") AND ("Kangaroo-mother care method" OR Kangaroo) AND ("weight gain")).

For the Spanish-language databases, free terms and health descriptors (DeCS) such as "prematuro," "método madre-canguro," "ganancia de peso," and "crecimiento" were used. The final search equation for Dialnet was ("Prematuro" y "Método madre-canguro" y "ganancia de peso") and for Cuiden ("Método Canguro") AND (("Prematuro") AND ("Crecimiento")).

The search equations yielded 48 results in Pubmed's advanced search, 56 for Scopus, 24 for Cochrane, 61 for Web of Science, 2 for Dialnet, and 11 for Cuiden. A time filter for 2018–2023 was then applied to find recent studies. Using the bibliographic tool Zotero, duplicate articles were discarded, resulting in 30 articles. After reading titles and abstracts through keyword searches, 19 articles were discarded for not being related to the research question. A critical review of the remaining 17 articles was conducted, discarding those without a connection to KMC and those with irrelevant results and conclusions concerning the research line. Of the selected articles, nine were discarded after reading titles and abstracts for not meeting the review's inclusion criteria. After a full-text reading of the remaining articles, two were decided to be included in the review.

Assessment of methodological quality

For the evaluation of the methodological quality of the studies eligible for inclusion in the systematic review, the Cochrane tool Risk of Bias was used. Any disagreements between the two principal reviewers were resolved through recourse to the third reviewer. A verification chart (Table 2) was created, grouping all the articles and establishing the risk of bias in each domain using the traffic light method. It is recorded with symbols such as "+" for low risk, "?" for medium risk, and "-" for high risk of bias to be shown clearly and accurately.

The risk of bias analysis of the reviewed studies reveals several critical areas that must be considered when interpreting the results. Regarding the randomization process, significant concerns were identified in some studies, such as [14], where the randomization process was inadequate, potentially introducing biases that affect the validity of the results. Other studies, such as [15] and [16], present an uncertain risk due to insufficient information to assess the quality of the randomization process used conclusively. Despite these concerns, all studies showed a low risk of bias regarding deviations from the intended interventions, suggesting that the interventions were planned without significant deviations that could compromise the results.

Table 2 Cochrane tool risk of bias

	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result
(21)	+	+	-	?	+
(14)	-	+	-	+	+
(18)	+	+	-	+	+
(19)	+	+	-	+	+
(20)	+	+	-	+	+
(15)	?	+	-	+	+
(17)	+	+	-	+	+
(16)	?	+	+	+	+
(22)	+	+	-	+	+

"+": low risk, "?": some concerns, "-": high risk

However, handling missing data is one of the most recurring and concerning issues. Several studies, including [14, 15, 17–20], showed a high risk of bias in this domain, suggesting that the loss of data could have significantly skewed the results. Only [16] demonstrated adequate missing data management, strengthening confidence in its results' validity.

Regarding outcome measurement, most studies were found to be reliable, although some, like [21], present uncertainties that could affect the accuracy of their findings. Nevertheless, all studies, without exception, reported relevant and appropriate results, indicating a proper selection of outcomes, thus reducing the risk of bias.

Results

The search retrieved 202 articles. The process for selecting articles is outlined in Fig. 1. Finally, the systematic review included nine studies.

When considering the country of origin of the included studies, it is noteworthy that the majority, 37.5%, were published in India. Following India, the distribution is as follows: China, Zambia, Colombia, Jordan, and Brazil.

The review's results include the number of participants, design, main objectives, and principal conclusions (Table 3). Only one study conducted in Spain is shown, specifically in the neonatal intensive care unit of Almería. Regarding the methodology of the studies, there is a notable disparity in the type of study used and its different objectives. Randomized clinical trials and cohort studies have been the most representative. However, observational studies, quasi-experimental studies, and interviews are also observed.

Discussion

The general objective of this review was to analyze and evaluate the impact of KMC on weight gain in premature newborns. In this regard, the results show that KMC has a positive influence on weight gain in premature newborns. Below, we present the discussion, grouping the results into three thematic areas. Although Kangaroo Mother Care (KMC) is a standardized and widely used intervention, the geographical heterogeneity observed in the results of the analyzed studies suggests that cultural and social factors specific to each region may influence the outcomes. Variations in study design, demographic characteristics of the studied populations, and the implementation of KMC contribute to differences in the observed effects. For example, in some regions, social practices and the availability of resources may affect how KMC is implemented and the resulting outcomes. This underscores the importance of considering the cultural and social context when interpreting the findings and assessing their applicability to different settings.

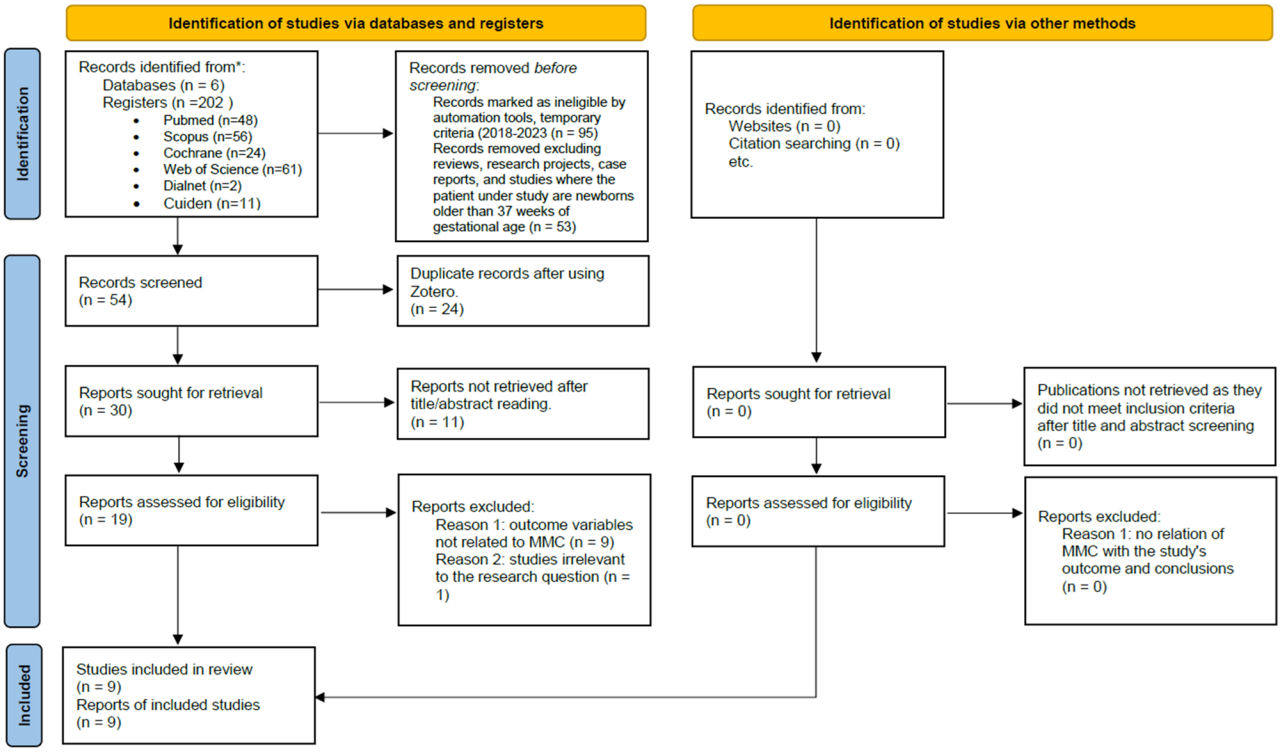

Fig. 1 PRISMA 2020 flow diagram

Table 3 Results of the systematic review

Author	Sample	Methods	Objectives	Results and Conclusions
Flórez Meza et al., 2023 [22]	30 preterm newborns between 28 weeks and 36 + 6 weeks, or with a weight under 2500 g.	Descriptive retrospective study.	To determine the weight gain of preterm and/or low birth weight infants who participated in the Kangaroo Mother Method (KMC). Program until 40 weeks of post-conceptional age.	By the end of 40 weeks of post-conceptional age, 90% of the infants were exclusively breastfed; additionally, only 20% of the infants in the KMC program did not achieve adequate weight gain.
Foong et al., 2023 [15]	Parents of preterm infants who experienced KMC.	Qualitative study with key informant interviews.	To identify potential solutions for the development of relevant interventions to improve the adoption of KMC and make the practice routine for all infants.	Findings indicate more significant newborn weight gain, stronger parent-infant bonding, and earlier hospital discharge in cases where KMC was adopted.
Muttau et al., 2022 [18]	573 newborns, divided into three groups based on birth weight (< 1500 g; 1500–2499 g; ≥2500 g).	Prospective descriptive study.	To reduce neonatal mortality in preterm infants, a stepped-wedge design was used, including KMC.	KMC positively impacted weight gain in newborns, with an average weight gain of 30 g per day.
Cristobal Canadas et al., 2022 [18]	112 preterm newborns. Two groups were compared based on the daily average duration of KMC over 12 days.	Cohort study.	To estimate the effect of KMC on physiological and biochemical stress parameters in preterm infants and maternal stress in neonatal intensive care units.	KMC for more than 90 min daily in preterm infants during the first two weeks of life significantly decreased maternal and neonatal blood cortisol levels, improved weight gain, contributed to improving infants' physiological constants, and mitigated maternal postpartum depression.
Liu et al., 2022 [20]	8240 infants, of whom 2093 (25.4%) received KMC.	Observational study.	To examine the sustainability of KMC as a practice over a 12-month period and the characteristics of preterm infants who received it.	Follow-up weights of preterm infants who continued with KMC after discharge were significantly higher compared to those who did not continue with the practice, especially in younger gestational age groups.
Pandya et al., 2021 [14]	192 neonates with a gestational age ≤ 34 weeks and birth weight ≤ 1250 g.	Prospective cohort study was conducted with two groups: one with routine care without KMC and another with KMC care.	To evaluate whether the early initiation of KMC is safe and reduces the time to full feeding in preterm neonates.	Food intolerance and duration of parenteral nutrition were decreased significantly, and discharge weight significantly improved in the group that received KMC.
Cantanhede et al., 2020 [16]	Mothers aged 18 to 45 years of preterm infants.	Qualitative exploratory descriptive study. Data were analyzed using collective subject discourse.	To describe mothers' experiences in caring for preterm infants using the kangaroo method.	Mothers acknowledged that this method significantly benefits their infants, such as improved immune systems, emotional bonding, weight gain, and temperature control.
Aldana Acosta et al., 2019 [17]	Cohort of 66 infants with a gestational age between 30 and 33 weeks.	Randomized clinical trial with weight gain measurements (g/kg/day) at 5 and 15 days and 4 weeks.	To evaluate early growth in preterm infants receiving kinesthetic stimulation with massage in kangaroo position or in an incubator.	Daily weight gain was significantly higher with kinesthetic stimulation in the kangaroo position, showing growth of 11.0 g/kg/day at 5 days and 12.1 g/kg/day at 15 days, compared to 2.1 g/kg/day and 9.4 g/kg/day in the incubator. Early kinesthetic stimulation in the kangaroo position reduces initial weight loss in infants born at 30–33 weeks without major health issues.
Shattnawi & Al-Ali., 2019 [21]	89 preterm newborns.	Quasi-experimental study with experimental and control groups.	To evaluate the effect of short-term skin-to-skin contact on short-term physiological and behavioral outcomes.	Newborns in the experimental group (skin-to-skin contact) showed a higher daily weight gain (32.6 g vs. 53.7 g) compared to the control group, which received routine care in an incubator.

KMC (Kangaroo Mother Method)

Weight gain

All studies included in this systematic review positively associate Kangaroo Mother Care (KMC) with weight gain in preterm newborns. Specifically, it is recommended to perform KMC for more than 90 min per day during the first two weeks of life [19]. Muttau et al. observed that the average weight gain could reach 30 g/day [18]. Additionally, other authors, such as Liu et al., studied the benefits of KMC at home after hospital discharge. Their study demonstrated that the weights of preterm newborns who continued KMC after discharge were significantly higher compared to those who did not continue the practice,

particularly in extremely preterm infants [20]. These findings remain consistent with and support previous systematic reviews and meta-analyses [12, 23, 24]. These previous reviews, including that of Evereklian & Posmontier [21], have also highlighted the need for standardized protocols for the implementation of Kangaroo Mother Care (KMC). Despite its proven efficacy, KMC is not universally adopted due to various barriers, including a lack of awareness regarding its benefits. Establishing KMC as a formalized and widespread practice could be achieved once healthcare providers and parents are fully educated on its numerous benefits for preterm infants.

Breastfeeding

In a study conducted in a Neonatal Intensive Care Unit (NICU) in Almería, Spain [19], demonstrated that, compared to the control group, infants who received KMC were more likely to be fed breast milk during hospitalization, experienced less feeding intolerance at discharge, and had higher rates of exclusive breastfeeding. Although most studies reported an increase in the weight of infants receiving KMC, controlling for other variables in the NICU environment, such as intravenous fluids and treatments, remains challenging.

Flórez Meza et al. further identified exclusive breastfeeding as a protective factor in 90% of preterm or low birth weight infants. It provides antibodies and nutrients that shield the newborn from prevalent childhood diseases, promote emotional development, strengthen the mother-infant bond, and prevent malnutrition or hypoglycemia [22].

Furthermore, better adherence to breastfeeding, greater weight gain, and earlier hospital discharge have been observed [16, 22]. These results are consistent with other studies reviewed [25].

This enhanced adherence to breastfeeding among newborns is supported by studies such as that of Pandya et al. [14], which provides evidence that early KMC is associated with significantly higher rates of exclusive breastfeeding in the NICU.

Neonatal care methods: incubators and kinesthetic stimulation

Shattnawi & Al-Ali in 2019 observed through a clinical trial that newborns in the experimental group (KMC) showed a higher daily weight gain (32.6 g vs. 53.7 g) compared to the control group, which received routine incubator care [21].

As KMC becomes increasingly common in neonatal care units, studies like that of Aldana Acosta et al. [17] have explored the impact of adding kinesthetic stimulation to KMC to ensure that preterm infants and their parents receive the best sensory stimulation and environmental enrichment. Healthcare professionals regard kinesthetic stimulation as a gentle intervention that can enhance the outcomes of KMC. Consequently, a randomized controlled trial was conducted to evaluate whether kinesthetic stimulation in the kangaroo position is more effective than traditional kinesthetic techniques with incubators. The trial revealed that at 40 weeks, infants in the KMC group had higher average weights ($p = 0.05$) at 2,904 g compared to 2,722 g in the incubator group (95% CI 2,784; 3,007). Furthermore, daily weight gain, adjusted for chronological age at randomization, was more significant when kinesthetic stimulation was initiated within the first five days of life in the kangaroo position, with a gain of 1.53 g/kg/day (95% CI: 5.9; 9.0) compared to -11.9 g/kg/day (95% CI: -19.0; -4.8) in the incubator group.

Additionally, it has been shown that infants receiving KMC have better digestion and metabolism of food, maintain overall better development, and gain weight more rapidly than those receiving only incubator care [19]. This discussion emphasizes the critical role of KMC and kinesthetic stimulation in promoting optimal growth and development in preterm infants, underscoring the importance of integrating these practices into standardized neonatal care protocols. These findings are consistent with those reported by Rodovaski et al. [26].

Strengths and limitations

The strengths of this review include a comprehensive and systematic literature search using the PRISMA methodology with updated evidence until December 2023. In comparison to Cochrane reviews and other existing ones on KMC, our review identified studies that include additional tools such as breastfeeding or kinesthetic stimulation, which could increase the weight gain of preterm infants undergoing KMC, allowing for an update and improvement of the evidence. Despite these strengths, this research presents a series of limitations. Firstly, the heterogeneity of the included studies, both in methodological design and in the characteristics of the analyzed populations, makes direct comparison of results challenging. Additionally, the scarcity of randomized clinical trials in favor of observational and cohort studies limits the ability to establish solid causal relationships. Likewise, variability in the implementation of KMC, influenced by sociocultural and hospital-related factors, may affect the generalization of results to different contexts. Another relevant limitation is the lack of long-term follow-up studies that would allow for an evaluation of the sustained impact of KMC on infant weight gain. Regarding selection bias, the inclusion criteria for articles may have led to the omission of relevant studies that did not meet predefined methodological standards, which could influence the scope of the findings and limit a broader understanding of the topic. Finally, linguistic bias is

another important limitation, as the search was restricted to studies in English and Spanish, which may exclude relevant evidence published in other languages and affect the overall interpretation of the results. On the other hand, concerning the risk of bias, while most of the evaluated studies show significant strengths in the execution of interventions and the selection of reported outcomes, there are significant concerns related to randomization and especially the management of missing data. This could compromise the overall validity of the conclusions. Therefore, when interpreting the results of this systematic review, it is essential to consider these risks of bias to ensure a critical and nuanced evaluation of the available evidence.

Conclusions

It can be concluded that the Kangaroo Mother Care (KMC) method demonstrates significant benefits in weight gain for premature newborns. Similarly, the review highlights the importance of breastfeeding and kinesthetic stimulation as tools that, when combined with KMC, increase weight gain in premature newborns, result in higher rates of exclusive breastfeeding, and lead to better nutritional outcomes. The consistent findings across various studies advocate for a broader adoption of KMC in neonatal care settings, emphasizing the need for standardized protocols to maximize its benefits and overcome existing barriers to its implementation. This study reinforces the need for hospitals to consider the inclusion of MMC as a fundamental part of their care strategy in neonatal units.

Abbreviations

INE	Statistics National Institute of Spain
KMO	Kangaroo Mother Method
LBW	Low Birth Weight
MeSH	Medical Subject Headings
NICU	Neonatal Intensive Care Unit
SGA	Small for Gestational Age
WHO	World Health Organization

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Author contributions

Ismael Bueno-Pérez: Conceptualization, Methodology, Formal analysis, Investigation, Visualization, Writing – Original Draft. Cristian Martín-Vázquez: Conceptualization, Methodology, Formal analysis, Investigation, Visualization, Writing – Review & Editing. Pablo Martínez-Angulo: Conceptualization, Methodology, Writing – Review & Editing, Supervision. Natalia Calvo-Ayuso: Conceptualization, Methodology, Writing – Review & Editing, Supervision Rubén García-Fernández: Conceptualization, Methodology, Formal analysis, Investigation, Visualization, Writing – Review & Editing. All authors read and approved the final manuscript.

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Data availability

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Declarations

Ethics approval and consent to participate

Ethical clearance was not required as this is a systematic review of literature, and anonymized data was used.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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