

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (http://bmjopen.bmj.com).

If you have any questions on BMJ Open's open peer review process please email <u>info.bmjopen@bmj.com</u>

# **BMJ Open**

# Measuring Duration of Kangaroo Mother Care for Neonates: A Scoping Review

Journal:	BMJ Open
Manuscript ID	bmjopen-2023-079579
Article Type:	Original research
Date Submitted by the Author:	05-Sep-2023
Complete List of Authors:	Tumukunde, Victor; London School of Hygiene & Tropical Medicine Centre of Global Change and Health, Loucaides, Eva; London School of Hygiene & Tropical Medicine Centre of Global Change and Health, Infectious Disease Epidemiology Medvedev, Melissa; University of California San Francisco, Nyirenda, Moffat; London School of Hygiene and Tropical Medicine, Tann, Cally; London School of Hygiene and Tropical Medicine, Lawn, Joy; London School of Hygiene & Tropical Medicine Faculty of Epidemiology and Population Health, Infectious Disease Epidemiology
Keywords:	NEONATOLOGY, PERINATOLOGY, PUBLIC HEALTH





I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our <u>licence</u>.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which <u>Creative Commons</u> licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

terez oni

Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies



# Measuring Duration of Kangaroo Mother Care for Neonates: A Scoping Review

Victor S. Tumukunde<sup>1,4</sup>, Eva M. Loucaides<sup>2</sup>, Melissa M. Medvedev<sup>2,3,4</sup>, Moffat Nyirenda<sup>1,4</sup>, Cally J. Tann<sup>2,4,5</sup> and Joy E. Lawn<sup>2,4</sup>

# **Authors**

- 1. Medical Research Council/Uganda Virus Research Institute and LSHTM Uganda Research Unit, PO Box 49, Entebbe, Uganda.
- 2. Maternal, Adolescent, Reproductive, & Child Health Centre, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, UK.
- 3. Department of Pediatrics, University of California San Francisco, 550 16th Street, Box 1224, San Francisco, CA 94158, USA
- 4. Faculty of Epidemiology and Population Health, London School of Hygiene & Tropical Medicine, Keppel Street, London WC1E 7HT, UK.
- 5. Department of Neonatal Medicine, University College London, 235 Euston Road, London iez ont NW1 2BU, UK.

Corresponding author: Victor S. Tumukunde

Address: Medical Research Council/Uganda Virus Research Institute and LSHTM Uganda Research Unit, PO Box 49, Entebbe, Uganda Email: Victor.tumukunde@mrcuganda.org

# Key words:

Kangaroo mother care, low birthweight, neonatal, prematurity

## Abstract

*Background:* Kangaroo mother care (KMC) is an evidence-based intervention to improve neonatal survival. Optimal duration of skin-to-skin contact is unclear partly because accuracy of duration measurement methods has not been rigorously evaluated. We conducted a scoping review of KMC skin-to-skin contact duration measurement methods, also assessing if validitationwas undertaken.

*Methods*: We searched MEDLINE, Embase, Cochrane Library, PsycINFO, African Index Medicus, International Standard Randomised Controlled Trial Number Registry, Medrxiv, and OpenGrey. Publications with primary data on KMC duration were included. We excluded short procedural skin-to-skin care studies.

*Results*: A total of 213 publications were included, of which 54 (25%) documented a method of measuring KMC duration. Only 20 publications (9%) provided a detailed description of the duration measurement method, and none reported validity. Most studies used caregiver reports (29, 54%) or healthcare worker observations (17, 31%). Other methods included independent observers and electronic monitoring devices.

*Conclusion:* Only 9% of KMC studies reporting duration documented the measurement method applied and no studies were found with documented validation of duration measurement methods. Accurate and comparable data on the dose response of KMC will require duration measurement methods to be validated against a gold standard such as an independent observer.

# Key notes

- KMC is high-impact for survival of low birthweight neonates, but there are few rigorous evaluations of duration required for impact. Reliable data on the dose response of KMC depends on the reliability of assessing KMC duration.
- This scoping review found most of the 213 studies mentioning KMC duration (159, 75%) did not describe the methods used, and those that did were mainly reliant on maternal report (29, 54%) or health worker report (17, 31%), both of which have limitations in accuracy.
- To increase comparability and rigour of measuring KMC duration, accuracy is needed in measurement methods and hence a validation study of gold standard (independent observer) versus maternal report and healthcare worker report would be of value.

## Introduction

Globally, an estimated 2.3 million neonatal deaths occurred in 2021 (1). More than 80% of neonatal deaths occur in babies who are low birthweight [LBW,  $\leq$ 2500 grams (g)], due to being born preterm, small-for-gestational age, or both (2). Major mortality reductions could be achieved by improving facility-based care of small and sick neonates in low- and middle-income countries (LMIC) (2-4). Kangaroo mother care (KMC) as a component of this small and sick newborn care is associated with decreased mortality, sepsis, hypothermia, hypoglycaemia, and length of hospital stay compared to conventional incubator care among clinically stable newborns (5, 6). A WHO-led trial recently reported a 25% reduction in mortality within 28 days among babies born weighing 1000-1799 g who received KMC immediately after birth, relative to those who received standard care with KMC after stabilisation (7). Hence, the WHO has released updated guidelines recommending KMC for all LBW newborns, even prior to stabilisation (8).

KMC is a package including early, continuous, and prolonged skin-to-skin contact (SSC), usually with the mother; promotion of exclusive breastmilk feeding; early hospital discharge; and adequate support and close follow-up at home (9). Duration of KMC is considered important in achieving beneficial health outcomes (10). However, previous research has suggested that continuous KMC for 24 hours a day may be difficult to achieve; for example, women may have complications or be post-caesarean section or find long hours challenging due to incompatibility with household activities or trying to sleep while continuing KMC (11). Clinicians and administrators need to make changes in infrastructure (e.g., showers, toilets) and enable other family members to share in KMC (8).

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

Higher duration of KMC in a given 24-hour period has been demonstrated using descriptive data to be associated with lower mortality risk (12). However, the evidence base on the recommended frequency and duration of KMC for neonatal survival requires more rigorous evaluation [9, 15]. Dose-response studies could inform families and clinicians to optimize outcomes and be more efficient for inputs. Such studies require objective and accurate methods of measuring the duration of KMC.

The aim of this scoping review was therefore to explore available evidence on differing methodologies of measuring KMC duration. Specific objectives were to: 1) develop a framework for categorisation of measurement methods identified in the published and grey literature; 2) abstract and assess studies with KMC duration data to describe the measurement methods used; and 3) describe any studies identified which validated duration measurement methods.

# Study design

We conducted a scoping review of the published and grey literature in accordance with established guidance for conducting scoping review from the Joanna Briggs Institute (13). The review protocol was registered with Open Science Framework (14). Selection of relevant papers, screening, and data charting were conducted by two independent reviewers (VST, EML) to minimise selection bias.

#### Search strategy

We searched the MEDLINE, Embase, Cochrane Library, PsycINFO, African Index Medicus, and Latin American and Caribbean Health Sciences Literature databases, as well as the WHO International Clinical Trials Registry Platform and the International Standard Randomised Controlled Trial Number Registry. We also searched Medrxiv and OpenGrey libraries for relevant unpublished studies. We screened all references of relevant systematic reviews identified as well as the websites of the Kangaroo Foundation and the International Network of Kangaroo Care. WHO guidelines and Google Scholar were searched for relevant publications. Searches were last updated on 21 November 2022 and were limited to the English language but not to the date of publication. Search terms were based on those relating to KMC and LBW/prematurity as well as KMC measurement/monitoring. The search was conducted with assistance of a library clinical research specialist at the British Medical Association.

## Management of search results

The search results were exported as RSI files to the Mendeley reference management system (© 2009-2013, Mendeley Ltd.). Duplication removal as well as title and abstract screening were done using Mendeley. The search results were shared with the second reviewer through a Mendeley group. Retrieved publications from the search were screened for suitability and relevance based on the information in the titles and abstracts. Initially a randomly selected trial set of search results (10% of total number) were screened for inclusion based on title and abstract information by both reviewers and, where necessary, clarifications/adjustments to the inclusion criteria were made, aiming for an agreement rate of >80%. A third reviewer was consulted in cases of disagreement (CJT). Full text articles were screened by two reviewers for inclusion and data charting. An initial pilot set was screened by both reviewers to assess agreement rates before sharing the analysis of the bulk of included full text articles. · Lie

# Eligibility Criteria

Publications were included if they presented primary data on KMC among preterm or LBW newborns and referred to duration of the skin-to-skin component of KMC or KMC monitoring/measurement. Publications referring to short procedural skin-to-skin care, such as for routine postnatal care or pain control, and with no ongoing KMC were excluded.

# Data abstraction

We generated a data charting form by identifying variables that would inform the objectives of the scoping review. Data points of interest included KMC duration, methods used to measure the duration and the validation of the method used. Detailed methodological description was defined

as a study that explained the tools used to document KMC duration measurement, the interval of the observations and how the total or daily KMC duration was calculated from the observations.

to peet eview only

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

## 

# Results

Our search strategy identified 3542 publications, of which 213 presented primary data on duration of KMC. Only 54 (25%) of 213 publications stated the method used to measure KMC duration (Figure 1). More than half of these publications (109, 51%) were clinical trials and the majority were carried out in LMIC settings (139, 65%). Nearly two-thirds (135, 63%) had a sample size of >50 participants and just under half reported on KMC duration of more than 2 hours (102, 48%).

Of the 54 publications that described methods used to measure the duration of KMC, four different methodological categories were identified: caregiver report, healthcare worker report, independent observation, and electronic monitoring device. A method was identified as a healthcare worker report if a person involved in the routine care of study participants reported on KMC duration, and as an independent observation if the person reporting on duration was not involved in the routine care of study participants. Some studies used more than one method, and caregiver reports were either self-reported or based on KMC charts/diaries.

No existing framework for categorisation of the methods used to measure KMC duration was found in the reviewed publications, nor was any basis for the choice of the method used provided. Figure 2 illustrates our proposed framework for the categorisation of KMC measurement methods.

Most of the publications that documented the method used to measure KMC duration used caregiver reports (n=29, 54%) followed by healthcare worker report (n=17, 32%). Other methods included independent observation, a combination of healthcare worker and caregiver report, and a combination of electronic device, healthcare worker, and caregiver monitoring (Figure 1).

Nine (31%) of the 29 publications that used caregiver report described the method used to measure KMC duration. Seven of these 9 publications utilised KMC charts/diaries to report the duration of SSC (15-21), while the remaining 2 mentioned self-report without indicating if documentation was done (22, 23). Four publications (24-27) used more than one method of measuring KMC duration. Of these, 3 (24-26) compared caregiver report with healthcare worker report and one (27) used healthcare worker report and an electronic monitoring device. In the latter study, the device was used in the home setting in combination with caregiver report to evaluate whether it could reliably capture the duration of KMC episodes (27).

#### **BMJ** Open

Three publications used independent observers (28-30) who were not part of the healthcare team. No publication used video recording to monitor KMC duration although video was used to assess other aspects of SSC, such as mother-baby interaction (Figure 2).

Only 20 (9%) publications (15-25, 27-35) with primary data on KMC duration described the measurement method used (Figure 1), and this was in varying degrees of detail (Table 1). Of these 20 publications, 11 (55%) were from LMICs (15, 22, 23, 27-34) and 9 (45%) were from high-income countries (16-21, 24, 25, 35). Nine (45%) of these publications used caregiver report (Figure 1), of which 7 documented the tool used for monitoring KMC duration (charts) (15-21) and 2 mentioned self-report (Table 1) (22, 23). The majority (64%) of the publications that used caregiver report were conducted in high-income countries (16-21), all of which documented the interval of observations. None of the publications gave a description of how the total or daily KMC duration was computed from the reports/observations (table 1).

Three of the 4 publications that used healthcare worker report were conducted in LMICs (32-34). Only 1 of these 4 documented the tool used for monitoring (33), 3 documented the interval of observations (33-35), and 1 described how the daily KMC duration was calculated (34).

The 3 publications that combined caregiver and healthcare worker report documented the tool used to measure KMC duration (24-26), but only 2 documented the interval of observations, and none explained how the daily duration was computed (25, 31). The publication that used a combination of an electronic device, healthcare worker report, and caregiver report documented the interval of monitoring KMC duration but did not document the tool used or how the daily duration was computed(27). The publications that used independent observers documented the interval of observations and described how the daily KMC duration was computed (28-30).

None of the publications with primary KMC duration data validated the method used to measure KMC duration. Only 1 publication measured the accuracy of a new device used to monitor SSC compared to healthcare worker report and caregiver report (27). Direct observation by healthcare workers was used as the reference standard against which an electronic monitoring device was compared for the purposes of accuracy; however, no systematic validation was conducted. Maternal report was used to test the reliability of the electronic device to capture the duration of

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

KMC at home. Four additional publications verified the consistency of measurements but did not undertake systematic validation (20, 24, 25, 33).

to beet terier only

## BMJ Open

# Discussion

In this scoping review, we found 213 publications on KMC of which 54 (25%) documented a method for measuring duration. Only 20 (9%) publications provided a detailed description of the KMC duration measurement method, and none reported validity. Most studies with a detailed description used caregiver report (9, 45%) or healthcare worker report (4, 20%). No framework for categorisation of KMC duration measurement methods was identified, and there was a lack of justification for the choice of method used for individual publications.

The observation that most studies did not document methods used to assess KMC duration is in accord with a previous systematic review, which found that more than 85% of studies did not include data on observations of SSC practice, and that 45% lacked a description of SSC initiation and stopping criteria (36).

The lack of reliable measurement for the intervention dose (KMC duration) is an impediment to interpreting the evidence when meta-analyses that combine studies with different KMC measurement methods are used (37, 38). Hence, although it is plausible that higher KMC duration could improve neonatal health outcomes (39, 40), the evidence remains incomplete without more rigorously validated methods for measuring the dose of KMC. The only study that validated KMC measurement reported duration but did not validate the methods used to measure duration (29). This calls for studies to validate KMC duration measurement methods against a gold standard to enable accurate data on KMC duration as an exposure, compared to outcomes such as mortality and morbidity.

Our new framework for categorising KMC duration measurement methods could be helpful for future studies to report on methods used – essentially these are mainly caregiver report and healthcare worker report, both of which have challenges. Similarly, there is limited information on the recommended duration of SSC for LBW neonates and standardised operational definitions could improve this evidence base (36). In addition, this framework could help in guiding the selection and refining of indicators in routine information systems for assessing KMC duration as a marker for the quality of KMC (41). Chan and others have proposed indicators in the KMC measurement framework to include the duration of SSC (36, 41), and the proposed framework for KMC duration measurement in this review will be helpful for the measurement of this indicator.

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

This scoping review is the first to assess the description and validation of KMC duration measurement methods. Selection and data abstraction were conducted by two independent reviewers to minimise the risk of selection bias. We excluded 5 publications for which no English version was available; however, this is unlikely to change our overall findings. We did not review journal supplementary materials for the included publications, which might have additional information on the methodology such as validation.

# Conclusion

KMC is a high impact intervention for survival of LBW neonates, but there is limited rigorous evaluation on the duration required. Reliable data on the dose response of KMC depends on the reliability of assessing its duration. This scoping review found most studies of KMC duration (91%) did not describe the methods used, and those that did were mainly reliant on caregiver report or healthcare worker report, both of which have limitations. Clarity is needed in reporting KMC duration measurement methods to increase comparability and rigour, and a validation study of gold standard versus caregiver report and healthcare worker report would be of value.

# **Conflict of interest**

The authors have no conflict of interest declare.

# Authors' contributions

VST conceptualised the study, wrote the protocol, analysed and interpreted the data, and wrote the first draft of the manuscript. VST, EML, and CJT selected the publications and abstracted the data. MMM, CJT, MN, and JEL interpreted the data and critically revised the manuscript. All authors reviewed the manuscript and approved the final version.

## Acknowledgements

This study was supported by a grant from the Joint Global Health Trials scheme of the Department of Health and Social Care, the Foreign, Commonwealth and Development Office, the Medical Research Council, and the Wellcome Trust (MR/S004971/1) awarded to JEL. A grant from the

Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health (K23HD092611) awarded to MMM supported her work on this study. We thank the Helen Elwell (Librarian and knowledge clinical research specialist at the British Medical Association) for the support in conducting the literature search.

to beer terien only

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool .

Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies

# References

1. UN-IGME. Levels & Trends in Child Mortality, 2022

https://data.unicef.org/resources/levels-and-trends-in-child-mortality/ (accessed on 10th April 2023)

2. Lawn JE, Blencowe H, Oza S, You D, Lee AC, Waiswa P, et al. Every Newborn: progress, priorities, and potential beyond survival. The Lancet. 2014;384(9938):189-205.

3. Lawn JE, Kinney MV, Belizan JM, Mason EM, McDougall L, Larson J, et al. Born Too Soon: Accelerating actions for prevention and care of 15 million newborns born too soon. Reproductive Health. 2013;10(SUPPL. 1):S6.

4. English M, Karumbi J, Maina M, Aluvaala J, Gupta A, Zwarenstein M, et al. The need for pragmatic clinical trials in low and middle income settings–taking essential neonatal interventions delivered as part of inpatient care as an illustrative example. BMC medicine. 2016;14(1):5.

5. Conde-Agudelo A, Díaz-Rossello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. Cochrane Database of Systematic Reviews. 2016(8).

6. Boundy EO, Dastjerdi R, Spiegelman D, Fawzi WW, Missmer SA, Lieberman E, et al. Kangaroo mother care and neonatal outcomes: a meta-analysis. Pediatrics. 2016;137(1):e20152238.

7. WHO IKsg, Arya S, Naburi H, Kawaza K, Newton S, Anyabolu CH, et al. Immediate "Kangaroo Mother Care" and Survival of Infants with Low Birth Weight. New England Journal of Medicine. 2021;384(21):2028-38.

8. WHO. Recommendations for care of the preterm or low birth weight infant. Geneva: World Health Organization. 2022.

9. WHO. Kangaroo mother care: a practical guide [Internet]. Geneva. Available from: http://www.who.int/maternal\_child\_adolescent/documents/9241590351/en/ 2003.

10. M Ludington-Hoe S. Evidence-based review of physiologic effects of kangaroo care. Current Women's Health Reviews. 2011;7(3):243-53.

11. Chan GJ, Labar AS, Wall S, Atun R. Kangaroo mother care: a systematic review of barriers and enablers. Bulletin of the World Health Organization. 2016;94(2):130.

 12. Group WHOIKS. Impact of continuous Kangaroo Mother Care initiated immediately after birth (iKMC) on survival of newborns with birth weight between 1.0 to < 1.8 kg: study protocol for a randomized controlled trial. Trials. 2020;21(1):280.

13. Peters MD, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. International journal of evidence-based healthcare. 2015;13(3):141-6.

14. Foster ED, Deardorff A. Open science framework (OSF). Journal of the Medical Library Association: JMLA. 2017;105(2):203.

15. Jegannathan S, Natarajan M, Solaiappan M, Shanmugam R, Tilwani SA. Quality improvement initiative to improve the duration of Kangaroo Mother Care in tertiary care neonatal unit of South India. BMJ Open Quality. 2022;11(Suppl 1):05.

16. Sahlen Helmer C, Birberg Thornberg U, Frostell A, Ortenstrand A, Morelius E. A Randomized Trial of Continuous Versus Intermittent Skin-to-Skin Contact After Premature Birth and the Effects on Mother-Infant Interaction. Advances in Neonatal Care. 2020;20(3):E48-E56.

17. Tandberg BS, Froslie KF, Flacking R, Grundt H, Lehtonen L, Moen A. Parent-Infant Closeness, Parents' Participation, and Nursing Support in Single-Family Room and Open Bay NICUs. The Journal of perinatal & neonatal nursing. 2018;32(4):E22-E32.

 Gonya J, Nelin LD. Factors associated with maternal visitation and participation in skinto-skin care in an all referral level IIIc NICU. Acta Paediatrica, International Journal of Paediatrics. 2013;102(2):e53-e6.

19. Flacking R, Thomson G, Ekenberg L, Lowegren L, Wallin L. Influence of NICU co-care facilities and skin-to-skin contact on maternal stress in mothers of preterm infants. Sexual and Reproductive Healthcare. 2013;4(3):107-12.

20. Anderson GC, Chiu S-H, Dombrowski MA, Swinth JY, Albert JM, Wada N. Mother-Newborn Contact in a Randomized Trial of Kangaroo (Skin-to-Skin) Care. Journal of Obstetric, Gynecologic, & Neonatal Nursing. 2003;32(5):604-11.

21. Flacking R, Ewald U, Wallin L. Positive Effect of Kangaroo Mother Care on Long-Term Breastfeeding in Very Preterm Infants. JOGNN - Journal of Obstetric, Gynecologic, and Neonatal Nursing. 2011;40(2):190-7.

22. Joshi A, Londhe A, Joshi T, Deshmukh L. Quality improvement in Kangaroo Mother Care: learning from a teaching hospital. BMJ Open Quality. 2022;11(Suppl 1):05.

23. Chavula K, Guenther T, Valsangkar B, Lwesha V, Banda G, Boe Wensaas M, et al. Improving Skin-to-Skin Practice for babies in Kangaroo Mother Care in Malawi through the use of a customized baby wrap: A randomized control trial. PLoS ONE [Electronic Resource]. 2020;15(3):e0229720.

24. Oras P, Blomqvist YT, Nyqvist KH, Gradin M, Rubertsson C, Hellstrom-Westas L, et al. Skin-to-skin contact is associated with earlier breastfeeding attainment in preterm infants. Acta Paediatrica. 2016;105(7):783-9.

25. Blomqvist YT, Ewald U, Gradin M, Nyqvist KH, Rubertsson C. Initiation and extent of skin-to-skin care at two Swedish neonatal intensive care units. Acta Paediatrica, International Journal of Paediatrics. 2013;102(1):22-8.

26. Goudard MJ, Lamy ZC, Marba S, Cavalcante MC, Santos AMd, Azevedo VMdO, et al. Skin-to-skin contact and deaths in newborns weighing up to 1800 grams: a cohort study. Jornal de Pediatria. 2022;98:376-82.

27. Rao S, Thankachan P, Amrutur B, Washington M, Mony PK. Continuous, real-time monitoring of neonatal position and temperature during Kangaroo Mother Care using a wearable sensor: a techno-feasibility pilot study. Pilot and feasibility studies. 2018;4:1-7.

28. Watkins HC, Morgan MC, Nambuya H, Waiswa P, Lawn JE. Observation study showed that the continuity of skin-to-skin contact with low-birthweight infants in Uganda was suboptimal. Acta Paediatrica, International Journal of Paediatrics. 2018;107(9):1541-7.

29. Salim N, Shabani J, Peven K, Rahman QS, Kc A, Shamba D, et al. Kangaroo mother care: EN-BIRTH multi-country validation study. BMC Pregnancy & Childbirth. 2021;21(Suppl 1):231.

30. Adejuyigbe EA, Anand P, Ansong D, Anyabolu CH, Arya S, Assenga E, et al. Impact of continuous Kangaroo Mother Care initiated immediately after birth (iKMC) on survival of newborns with birth weight between 1.0 to < 1.8 kg: study protocol for a randomized controlled trial

Trials. 2020;21(1).

#### **BMJ** Open

31. Goudard MJF, Lamy ZC, Marba STM, Cavalcante MCV, Dos Santos AM, Azevedo V, et al. Skin-to-skin contact and deaths in newborns weighing up to 1800 grams: a cohort study. Jornal de Pediatria. 2022;98(4):376-82.

32. Brotherton H, Gai A, Kebbeh B, Njie Y, Walker G, Muhammad AK, et al. Impact of early kangaroo mother care versus standard care on survival of mild-moderately unstable neonates <2000 grams: A randomised controlled trial. EClinicalMedicine. 2021;39:101050.

33. Soni A, Amin A, Patel DV, Fahey N, Shah N, Phatak AG, et al. The presence of physician champions improved Kangaroo Mother Care in rural western India. Acta Paediatrica, International Journal of Paediatrics. 2016;105(9):e390-e5.

34. Pervin J, Gustafsson FE, Moran AC, Roy S, Persson LA, Rahman A. Implementing Kangaroo mother care in a resource-limited setting in rural Bangladesh. Acta Paediatrica. 2015;104(5):458-65.

35. Feldman R, Eidelman AI. Skin-to-skin contact (Kangaroo Care) accelerates autonomic and neurobehavioural maturation in preterm infants. Developmental medicine and child neurology. 2003;45(4):274-81.

36. Chan GJ, Valsangkar B, Kajeepeta S, Boundy EO, Wall S. What is kangaroo mother care? Systematic review of the literature. Journal of Global Health. 2016;6(1):010701.

37. Lawn JE, Mwansa-Kambafwile J, Horta BL, Barros FC, Cousens S. 'Kangaroo mother care'to prevent neonatal deaths due to preterm birth complications. International journal of epidemiology. 2010;39(suppl\_1):i144-i54.

38. Conde-Agudelo A, Belizán JM, Diaz-Rossello J. Cochrane Review: Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. Evidence-Based Child Health: A Cochrane Review Journal. 2012;7(2):760-876.

39. Udani RH, VR A, Kabra NS, Nanavati RN. Impact of duration of kangaroo mother care on growth in high risk preterm and low birth weight infants. Journal of Neonatology. 2013;27(3):1-9.

40. Charpak N, Montealegre-Pomar A, Bohorquez A. Systematic review and meta-analysis suggest that the duration of Kangaroo mother care has a direct impact on neonatal growth. Acta paediatrica (Oslo, Norway : 1992). 2020.

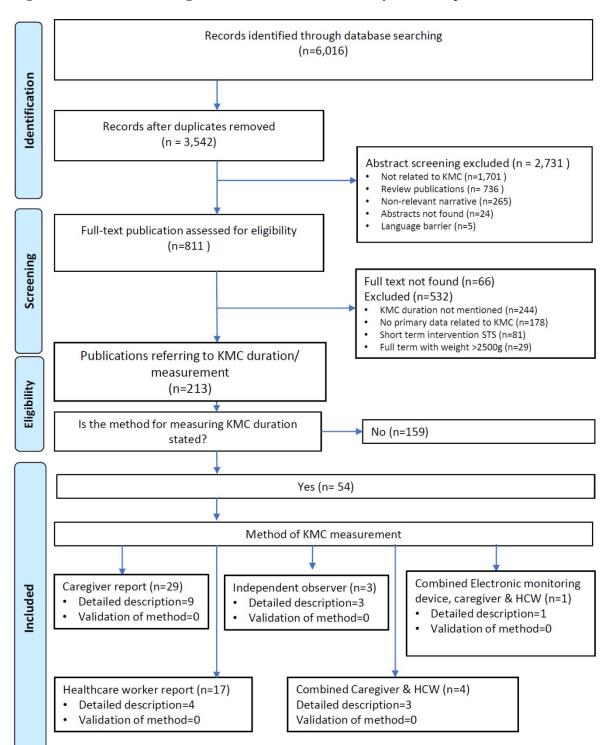
BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool .

Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies

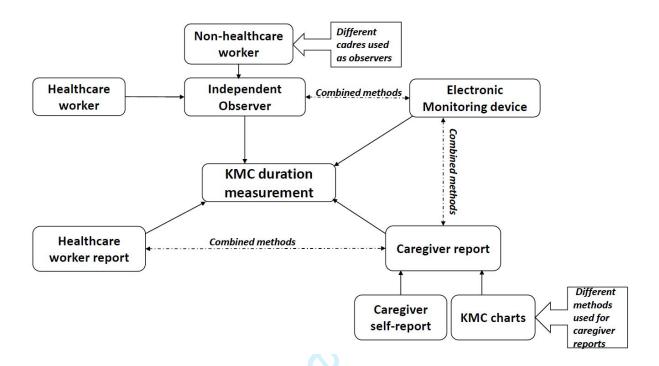
41. Guenther T, Moxon S, Valsangkar B, Wetzel G, Ruiz J, Kerber K, et al. Consensus–based approach to develop a measurement framework and identify a core set of indicators to track implementation and progress towards effective coverage of facility–based Kangaroo Mother Care. Journal of global health. 2017;7(2).

to beet terren ont



# Figure 1: PRISMA flow diagram of search results and study inclusion process

KMC=Kangaroo Mother Care, STS=Skin to Skin, HCW=Health care worker



# Figure 2. Proposed framework for categorisation of KMC measurement methods.

Commonly used methods to measure duration of KMC (Kangaroo Mother Care), ( ) = methods used in combination, caregiver reports use self-report or KMC charts and independent observers can be healthcare workers or non-healthcare workers.

Page	23	of	30
------	----	----	----

1 2	
3	
4 5	
6	
7 8	
9	
10 11	
12	
13 14	
15	
16 17	
18 19	
20	
21 22	
23	
24 25	
26 27	
28	
29 30	
31	
32 33	
34	
35 36	
37	
38 39	
40 41	
42	
43 44	
45	
46 47	

M. J. F. Goudard; 2022       Skin-to-skin contact and deaths in new- borns weighing up to 1800 grams: a cohort study       Observational study; 405       Brazil       Caregiver & Healthcare worker       SSC time was recorded on carting by the health team at the beginning registration, under the supervised of the supervised of healthcare workers.       Image: Caregiver & Healthcare worker       SSC time was recorded on carting by the health team at the beginning registration, under the supervised of the then, parents performed the registration, under the supervised of the then, parents performed the registration of the used to record KMC du uaration documented         S.       Quality improvement in Kangaroo Mother Care: learning from a teaching hospital       Observational study; 86       India: NICU level unknown       Caregiver report (self- report)       The nurse noted the previous div 's the nurse noted the previous div 's the parents and other information as reported by the mother.       Image: market by the mother.       Image: market by the mother.       Image: market by the mother.       Image: market by the mother. </th <th>Skin-to-skin contact and deaths in new- borns weighing up to 1800 grams: a cohort study       Observational study; 405       Brazil       Caregiver &amp; Healthcare worker       SSC time was recorded on carding by the health team at the beginning registration, under the supervised of the supervised of the health team at the beginning then, parents performed the registration, under the supervised of the supervised</th> <th></th> <th></th> <th></th> <th>country; level of NICU</th> <th>KMC duration</th> <th>Method details</th> <th>.1136/bmjopen-2023-079579 on cted by convright, including for</th> <th>Comments</th>	Skin-to-skin contact and deaths in new- borns weighing up to 1800 grams: a cohort study       Observational study; 405       Brazil       Caregiver & Healthcare worker       SSC time was recorded on carding by the health team at the beginning registration, under the supervised of the supervised of the health team at the beginning then, parents performed the registration, under the supervised of the supervised				country; level of NICU	KMC duration	Method details	.1136/bmjopen-2023-079579 on cted by convright, including for	Comments
<ul> <li>S. Quality improvement initiative to improve the duration of Kangaroo Mother Care in tertiary care neonatal unit of South India</li> <li>A. Joshi; 2022</li> <li>Quality improvement in Kangaroo Mother Care in tertiary care neonatal unit of South India</li> <li>Joshi; 2022</li> <li>Quality improvement in Kangaroo Mother Care: learning from a teaching hospital</li> <li>India</li> <li>India</li> <li>Caregiver report (KMC charts were given to KMG of the duration of data coll used to record KMC duration documented.</li> </ul>	Quality improvement han; the duration of Kangaroo Mother Care in tertiary care neonatal unit of South India       Observational study; 86       India       Caregiver report (KMC charts)       KMC Charts were given to KMG get mothers to mark daily hours of KMC by mothers.       Improvement workers to mark daily hours of South India       Improvement Care in tertiary care neonatal unit of South India       Improvement in Kangaroo Mother Care in tertiary care neonatal unit of South India       Improvement in Kangaroo Mother Care in tertiary care neonatal unit of South India       Improvement in Kangaroo Mother Care in tertiary care neonatal unit of South India       Improvement in Kangaroo Mother Care in tertiary care neonatal unit of South India       Improvement in Kangaroo Mother Care is tertiary (self- care: learning from a teaching hospital       Improvement in Kangaroo mother care: EN-BIRTH multi-country validation study       Improvement is tudy; 86       India: NICU level unknown       Caregiver report (self- report)       The nurse noted the previous day's set report by the mother.       Improvemented.       Improvemented.         alim; validation study       Kangaroo mother care: EN-BIRTH multi-country validation study       Observational study; 840       Tanzania, Napal & Bangladesh       Independent observer       Observers monitored components of KMC hourly in other settings and 12-hourly in other settings of the work setting of the work setting observation documented.       Improvemented.         d methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the work setting and 3) how the	,	and deaths in new- borns weighing up to 1800 grams: a cohort			Healthcare	SSC time was recorded on card the health team at the beginning then, parents performed the registration, under the supervis of healthcare workers.	22 January 2029 by Erasmus	used to record KMC duration. ☑ Interval of observation documented. □ Calculation of daily KMC duration documented
A. Joshi; 2022 Quality improvement in Kangaroo Mother Care: learning from a teaching hospital Observational teaching hospital	2022       Quality improvement in Kangaroo Mother Care: learning from a teaching hospital       Observational study; 86       India: NICU level unknown       Caregiver report (self- report)       The nurse noted the previous day's to KMC hours and other information as reported by the mother.       Image: Caregiver used to record KMC duration.         alim;       Kangaroo mother care: EN-BIRTH multi-country validation study       Observational study; 840       Tanzania, Napal & Bangladesh       Independent observer       Observers monitored components of KMC hourly in some settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other settings and 12-hourly in other settings of CMC hourly in other	Jegannathan;	initiative to improve the duration of Kangaroo Mother Care in tertiary care neonatal unit of		India	report (KMC	KMC Charts were given to KM mothers to mark daily hours of KMC by mothers.	Downloader ogeschool	<ul> <li>Mention of data collection for used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC</li> </ul>
	care: EN-BIRTH       study; 840       Napal &       observer       of KMC hourly in some settings       used to record KMC duration.         multi-country       validation study       study; 840       Napal &       observer       of KMC hourly in some settings       used to record KMC duration.         and 12-hourly in other settings       of Comparison       of Comparison       of Comparison       of Comparison         and methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the Subservations and, 3) how the	A. Joshi; 2022	in Kangaroo Mother Care: learning from a		level	report (self-	The nurse noted the previous d KMC hours and other informat as reported by the mother.	http://bmjope <sup>^</sup> sn Ly laraining	used to record KMC duration. ☐ Interval of observation documented. ☐ Calculation of daily KMC
2021 care: EN-BIRTH multi-country validation study study; 840 Napal & Bangladesh Bangladesh observer of KMC hourly in some settings of and 12-hourly in other settings of documented. If and 12-hourly in other settings of documented. If and 12-hourly in other settings of documented. If and 12-hourly in other settings of documented.			care: EN-BIRTH multi-country validation study	study; 840	Napal & Bangladesh	observer	of KMC hourly in some setting and 12-hourly in other settings	.com/ on June 8, 20 imilar technologies	used to record KMC duration. ☑ Interval of observation documented. ☑ Calculation of daily KMC duration documented.

 ient GEZ-LTA

			BI	MJ Open	cted by copyright, includin	-11 1136/bm 1000 Pac Pac Pac Pac Pac Pac Pac Pac
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Method details	
E. A. Adejuyigbe; 2021	Impact of continuous Kangaroo Mother Care initiated immediately after birth on survival of newborns with birth weight between 1.0 to < 1.8 kg	RCT; 4200	Ghana, Tanzania, Malawi, Nigeria & India	Independent observer	Information on the duration of SC contact and the duration of hospital stay was collected by research assistants	used to record KMC duration. Interval of observation documented. Calculation of daily KMC duration documented.
H. Brotherton; 2021	Impact of early kangaroo mother care versus standard care on survival of mild- moderately unstable new-borns <2000 grams	RCT; 279	The Gambia: NICU level not specified	Healthcare worker report	Research nurses observed and the single recorded KMC duration and position. Documented timing out of kare and reason for coming out of kare single and reason fo	<ul> <li>Mention of data collection too used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC</li> </ul>
K. Chavula; 2020	Improving Skin-to- Skin Practice for new- borns in Kangaroo Mother Care in Malawi through the use of a customized baby wrap: A randomized control trial	RCT; 301	Malawi; NICU level II	Caregiver report (self- report)	Mothers reported practicing SSC post-discharge & duration morp than half the day and more than that the night post-discharge.	Mention of data collection too used to record KMC duration. Interval of observation documented. Calculation of daily KMC duration documented
C. Sahlen Helmer; 2020	A Randomized Trial of Continuous Versus Intermittent Skin-to- Skin Contact After Premature Birth and the Effects on Mother-	RCT; 31	Sweden; NICU level unknown	charts)	whether they were off SSC for any reason. Parents in the intermittent group registered when and for bow	<ul> <li>Interval of observation</li> <li>documented.</li> <li>□ Calculation of daily KMC</li> <li>output duration documented.</li> </ul>

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Newborn Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregever

Page 25 of 30		
1 2 3 4	First author,	Publication title
5	year	
6 7		D
8	B.S. Tandberg;	Parent-Infant Closeness, Parents'
9	2018	Participation, and
10		Nursing Support in
11 12		Single-Family Room and Open Bay NIC
13		
14		
15 16		
17		
18	S. Rao; 2018	Continuous, real-tir
19		monitoring of neonatal position ar
20 21		temperature during
22		Kangaroo Mother
23		Care using a wearable sensor: a
24 25		techno-feasibility
26		pilot study
27		
28		
29 30		
31		
32		
33		
34 35	Detailed meth	odological descript
36		KMC duration was
37	KMC=Kanga	roo Mother Care,
38 39		cking in Hospitals,
22		J,

Method for

KMC

chart)

duration

Caregiver

report (KMC

Method details

Parents recorded the duration  $\overline{\mathbf{a}}$ 

SSC care in a KMC diary. Diary

Study design &

sample size

Observational;

64

Setting:

country; level of

Norway:

unknown

NICU level

NICU

SSC care in a KMC diary. Diary entries were made daily for the stirst 14 days following inclusion in the study. Parents reported have a by hour during these 14 days. **The study of the stars** Baby's position captured as presence of "touch" between the documented. rsing Support in ngle-Family Room □ Calculation of daily KMC d Open Bay NICUs duration documented Observational; India: Electronic □ Mention of data collection tool ontinuous, real-time presence of "touch" between the device and the skin of baby/mother was compared against reported observed KMC episodes". In the hospital, the research nurse annotated the starting and ending times of KMC by direct observation. At home KMC duration was self-reported by the mother Direct observation was presence of "touch" between the onitoring of 12 NICU level monitoring used to record KMC duration. onatal position and III device. □ Interval of observation healthcare documented. nperature during □ Calculation of daily KMC ingaroo Mother worker's direct duration documented re using a earable sensor: a observation hno-feasibility & Maternal ot study self-report mother. Direct observation was the "reference standard" in the hose ital against which the device was technologies on June 8, compared for purposes of validation. 20 ological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the abservations and, 3) how the C duration was calculated from the observations 🛛 = Yes 🗆 = No. Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Newborn Birth Indicators g in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver ent 24 GEZ-LTA For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

cted by copyright, including .1136/bmjopen-2023-079579

9

Comments

 $\blacksquare$  Mention of data collection tool

used to record KMC duration.

 $\square$  Interval of observation

			В	MJ Open	cted by copy	.1136/bmjopen-2023-0795	Page
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	A method details	n-2023-07957	Comments
H.C. Watkins; 2018	Observation study showed that the continuity of skin-to- skin contact with low-birthweight infants in Uganda was suboptimal	Observational; 12	Uganda: NICU level II	Independent observer	Continuous observation of infag began after birth and up to day 2 life, discharge, or death, which came first. The total duration of hours spent in SSC was calcular by adding together the duration all individual SSC sessions on day. If an infant received at leag hours of SSC, it was considered continuous KMC, and any few hours of SSC per day was documented as intermittent KM	ts of the first of	<ul> <li>used to record KMC duration.</li> <li>□ Interval of observation documented.</li> <li>☑ Calculation of daily KMC duration documented</li> </ul>
P. Oras; 2016	Skin-to-skin contact is associated with earlier breastfeeding attainment in preterm infants	Observational; 104	Sweden: NICU level III	Caregiver report & healthcare worker	Skin to skin duration was recomby by the parents or by staff on a detailed form. Median daily SS duration was the data used for study.	d from http://www.com	■ Mention of data collection tool used to record KMC duration.
A. Soni; 2016	The presence of physician champions improved Kangaroo Mother Care in rural western India	Observational; 648	India: NICU level II	Healthcare worker report	Nursing staff documented KM duration using a standardized for & recorded information for eight The charts were incorporated in the neonate's medical notice updated daily by the nurses and reviewed daily by the physician	rm aysom/ on June 8,	<ul> <li>☑ Interval of observation documented.</li> <li>□ Calculation of daily KMC duration documented.</li> </ul>

Detailed methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the bservations and, 3) how the total or daily KMC duration was calculated from the observations  $\square =$ Yes  $\square =$ No.

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Newborn Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver

tment GEZ-LTA

Page 27 of 30

First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	cted by copyright, including Method details	Comments
J. Pervin; 2015	Implementing Kangaroo mother care in a resource- limited setting in rural Bangladesh	Observational; 423	Bangladesh: NICU level I	Healthcare worker report	Nursing attendants noted the beginning and end of every skip-to- skin contact session and calculated skin-to-skin contact time for each	<ul> <li>Mention of data collection to used to record KMC duration.</li> <li>Interval of observation documented.</li> </ul>
J. Gonya; 2013	Factors associated with maternal visitation and participation in skin- to-skin care in an all- referral level IIIc NICU	Observational; 32	USA: NICU level III	Caregiver report (KMC chart)	session. The times of each session at times of each session at the	<ul> <li>Mention of data collection to used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented</li> </ul>
Y.T. Blomqvist; 2013	Initiation and extent of skin-to-skin care at two Swedish neonatal intensive care units	Observational; 104	Sweden: NICU level III	Caregiver report & healthcare worker	Time of initiation of SSC and who provided this care were recorded continuously in the infants' medicate charts by either the parents or the NICU staff. The reliability of parents' registrations of the time spent with SSC had been assessed prior to the study.	<ul> <li>Mention of data collection to used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented.</li> </ul>
total or daily	KMC duration was cal	lculated from the	observations	Ø= Yes □=No	monitoring, 2) the interval of the	bservations and, 3) how th

First author,					<u>G</u>	n-2
year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Cted by copyright, includin	Pa Pa Pa Comments
R. Flacking; 2013	Influence of NICU co-care facilities and skin-to-skin contact on maternal stress in mothers of preterm infants	Mixed methods feasibility study; 300	Sweden: NICU level III	Caregiver report (KMC chart)	Caregivers provided KMC duration self-reports using calendars. Paren marked the initiation and ending of each SSC episode. At the end of th 2-week period, the nurse revision the mother, collected the calendar and provided a new calendar for following 2-week period.	used to record KMC duration. $\square$ Interval of observation documented.
R. Flacking; 2011	Positive Effect of Kangaroo Mother Care on Long-Term Breastfeeding in Very Preterm Infants	Observational; 300	Sweden: NICU level unknown	Caregiver report (KMC chart)	the mother, collected the calendar for and provided a new calendar for following 2-week period. KMC data gathered through set reports by caregivers in the for a of calendars. Parents marked the initiation and ending of each start to-skin episode rounded to the nearest 5- or 10-minute intervation	Image: Constraint of the second se
G.C. Anderson; 2003	Mother-Newborn Contact in a Randomized Trial of Kangaroo (Skin-to- Skin) Care	RCT; 91	USA: NICU level unknown	Caregiver report (KMC chart)	Contact logs used to document KMC duration (when the contact began and ended) & by whom. Caregivers completed the contact log and researcher verified each entry with the mothers at the end of each 8-hour shift. 92.	<ul> <li>☑ Mention of data collection to used to record KMC duration.</li> <li>☑ Interval of observation documented.</li> <li>□ Calculation of daily KMC duration documented</li> </ul>
R. Feldman; 2003	Skin-to-skin contact (Kangaroo Care) accelerates autonomic and neuro- behavioural maturation in preterm infants	Observational; 70	Israel: NICU level unknown	Healthcare worker report	During KC infants were observed by the nurses who recorded the exact times when the mothers and infants remained in skin-to-sking contact and when the infant returned to standard incubator and	
total or daily KMC=Kango	KMC duration was cal aroo Mother Care, KC	culated from the = Kangaroo Car	observations e, NICU= Ne	Ø= Yes □=Ne conatal Intensi	monitoring, 2) the interval of th b. we Care Unit, EN-BIRTH= Evo V=Health care worker, CG=Card	at Degy Newborn Birth Indicators

Database: Ovid MEDLINE Search Strategy	:
--	---

1 infant, low birth weight/ or infant, small for gestational age/ or infant, very low birth weight/ or infant, extremely low birth weight/ or infant, premature/ or infant, extremely premature/ (80630)

2 (low birth weight or small for gestational age or small gestational age or small for date infant\$ or low birth weight or premature infant\$ or premature neonate\$ or prematurity or preterm infant\$ or preterm neonate\$ or premature babies or preterm babies or premature baby or preterm baby or premature newborn\$ or preterm newborn\$).mp. (113774)

- 3 Premature Birth/ (14139)
- 4 (preterm birth\$ or premature birth\$).mp. (29803)
- 5 shorter gestation.mp. (212)
- 6 preterm pregnancy.mp. (127)
- 7 (sga or lbw or vlbw).mp. (15987)
- 8 or/1-7 (149424)
- 9 Kangaroo-Mother Care Method/ (445)
- 10 (kangaroo mother care or kangaroo care).mp. (996)
- 11 skin to skin.mp. (6463)
- 12 9 or 10 or 11 (7070)
- 13 8 and 12 (873)

14 ((monitor\$ or measur\$ or adher\$) adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] (323)

15 (duration adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] (121)

16 13 or 14 or 15 (1236)

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

BMJ Open

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	
ABSTRACT	1		1
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	
INTRODUCTION		•	
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	



# St. Michael's

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	
Results of individual sources of of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

\* Where sources of evidence (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

<sup>+</sup> A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

<sup>‡</sup> The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

From: Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.



# **BMJ Open**

# Measuring Duration of Kangaroo Mother Care for Neonates: A Scoping Review

Journal:	BMJ Open
Manuscript ID	bmjopen-2023-079579.R1
Article Type:	Original research
Date Submitted by the Author:	26-Apr-2024
Complete List of Authors:	Tumukunde, Victor; London School of Hygiene & Tropical Medicine Centre of Global Change and Health, Loucaides, Eva; London School of Hygiene & Tropical Medicine Centre of Global Change and Health, Infectious Disease Epidemiology Medvedev, Melissa; University of California San Francisco, Nyirenda, Moffat; London School of Hygiene and Tropical Medicine, Tann, Cally; London School of Hygiene and Tropical Medicine, Lawn, Joy; London School of Hygiene & Tropical Medicine Faculty of Epidemiology and Population Health, Infectious Disease Epidemiology
<b>Primary Subject Heading</b> :	Paediatrics
Secondary Subject Heading:	Public health, Paediatrics, Global health, Medical publishing and peer review, Research methods
Keywords:	NEONATOLOGY, PERINATOLOGY, PUBLIC HEALTH





I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our <u>licence</u>.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which <u>Creative Commons</u> licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

terez oni

Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies



2 3				
4	1	Measuring Duration of Kangaroo Mother Care for Neonates: A Scoping Review		
5 6	2	Victor S. Tumukunde <sup>1,4</sup> , Eva M. Loucaides <sup>2</sup> , Melissa M. Medvedev <sup>2,3,4</sup> , Moffat Nyirenda <sup>1,4</sup> , and		
7 8	3	Joy E. Lawn <sup>2,4</sup> , Cally J. Tann <sup>2,4,5</sup>		
9 10 11	4	Authors		
12 13	5	1. Medical Research Council/Uganda Virus Research Institute and LSHTM Uganda Research		
14 15	6	Unit, PO Box 49, Entebbe, Uganda.		
16 17	7	2. Maternal, Adolescent, Reproductive, & Child Health Centre, London School of Hygiene		
18 19	8	& Tropical Medicine, Keppel Street, London WC1E 7HT, UK.		
20 21	9	3. Department of Pediatrics, University of California San Francisco, 550 16th Street, Box		
22 23	10	1224, San Francisco, CA 94158, USA		
24 25 26	11	4. Faculty of Epidemiology and Population Health, London School of Hygiene & Tropical		
26 27 28	12	Medicine, Keppel Street, London WC1E 7HT, UK.		
29 30	13	5. Department of Neonatal Medicine, University College London, 235 Euston Road, London		
31 32	14	NW1 2BU, UK.		
33 34	15			
35 36	16	NW1 2BU, UK.		
37 38	17			
39 40 41	18			
42 43	19	Corresponding author: Victor S. Tumukunde		
44	20	Address: Medical Research Council/Uganda Virus Research Institute and LSHTM Uganda		
45	21	Research Unit, PO Box 49, Entebbe, Uganda		
46 47	22	Email: <u>Victor.tumukunde@mrcuganda.org</u>		
48 49	23			
50 51	24			
52 53	25	Key words:Kangaroo Mother Care, low birthweight, neonatal, prematurity		
54 55 56		1		
57 58				
59 60		For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml		

### **BMJ** Open

Abstract Objectives: Kangaroo mother care (KMC) is high impact for survival of low birthweight neonates, but there are few rigorous evaluations of duration required for impact. We conducted a scoping review of KMC skin-to-skin contact duration measurement methods and assessed their validation. Design: Scoping review in accordance with Joanna Briggs Institute guidance for conducting scoping review. Data sources: MEDLINE, Embase, Cochrane Library, PsycINFO, African Index Medicus(AIM), Latin American and Caribbean Health Sciences Literature(LILACS), Clinical trials.gov, International Clinical Trials Registry Platform (WHO ICTRP), International Standard Randomised Controlled Trial Number (ISRCTN) Registry, Medrxiv, and OpenGrey were searched through November 2022. *Eligibility criteria for selecting studies:* Publications with primary data on KMC duration were included. We excluded short procedural skin-to-skin care studies. Data extraction and synthesis: Selection and data abstraction were conducted by two independent reviewers. A data charting form based on the variables of interest was used to abstract data. Results: A total of 213 publications were included, of which 54 (25%) documented a method of measuring KMC duration. Only 20 publications (9%) provided a detailed description of the 

2	17	duration measurement method, and none reported validity. Most studies used caregiver repo	orts
2	48	(29, 54%) or healthcare worker observations (17, 31%). Other methods included independent	ent
2	19	observers and electronic monitoring devices.	
4	50		
4	51	Conclusion: Only 9% of KMC studies reporting duration documented the measurement methods	ıod
4	52	applied and no studies were found with documented validation of duration measurement method	ods.
4	53	Accurate and comparable data on the dose response of KMC will require duration measurem	ent
4	54	methods to be validated against a gold standard such as an independent observer.	
4	55		
4	56	Strength and limitations of the study	
2	57	• First review to assess KMC duration measurement description and validation.	
4	58	• Selection and data abstraction were conducted by two independent reviewers.	
4	59	• Excluded five publications for which no English version was available.	
(	50	• Did not review journal supplementary materials for the included publications.	
(	51		
(	52	Protocol registration number in Open Science Framework: DOI 10.17605/OSF.IO/463DG.	
(	53		
(	54	Data availability statement	
e	55	Data sharing not applicable as no datasets generated or analysed for this study.	
			3

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

### 66 Introduction

Globally, an estimated 2.3 million neonatal deaths occurred in 2022(1). More than 80% of neonatal deaths occur amongst those who are low birthweight [LBW,  $\leq 2500$  grams (g)], due to being born preterm, small-for-gestational age, or both (2). Mortality risk is highest in low-income and middle-income countries (LMICs) due to gaps in neonatal care (3). Major mortality reductions could be achieved by improving facility-based care of small and sick neonates in these countries (2, 4, 5). Kangaroo mother care (KMC) as a component of this small and sick newborn care is associated with decreased mortality, sepsis, hypothermia, hypoglycaemia, and length of hospital stay compared to conventional incubator care among clinically stable neonates (6-8). A World Health Organisation (WHO)led trial reported a 25% reduction in mortality within 28 days among neonates born weighing 1000-1799 g who received KMC immediately after birth, relative to those who received standard care with KMC after stabilisation (9). Based on these findings and additional evidence from a systematic review(10), WHO updated guidelines recommending KMC for all preterm or LBW neonates to be initiated as soon as possible after birth in the healthcare facility or at home and should be given for 8–24 hours per day (11). 

KMC is the care of preterm or LBW neonates in continuous and prolonged (8–24 hours per day, for as many hours as possible) skin-to-skin contact (SSC) recommended to be initiated immediately after birth with support for exclusive breastfeeding or breast-milk feeding (12). Duration of KMC is considered important in achieving beneficial health outcomes (8, 10, 13, 14). However, previous research has suggested that continuous KMC for 24 hours a day may be difficult to achieve; for example, women may have complications or be post-caesarean section or

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

find long hours challenging due to incompatibility with household activities or trying to sleep while continuing KMC (15). Clinicians and administrators need to make changes in infrastructure (e.g., showers, toilets) and enable other family members to share in KMC (11). Higher duration of KMC in a given 24-hour period has been demonstrated using descriptive data and meta-analyses to be associated with lower mortality risk (8, 16). Evidence also shows that some desired effects disappear when the KMC duration is 2 hours or less (17). However, the evidence base on the recommended frequency and duration of KMC for neonatal survival requires more rigorous evaluation (9, 15). Dose-response studies could inform families and clinicians to optimize outcomes and be more efficient for inputs. Such studies require objective and accurate methods of measuring the duration of KMC. The aim of this scoping review was therefore to explore available evidence on the methods used to measure KMC duration. Specific objectives were to: 1) develop a framework for categorisation of measurement methods identified in the published and grey literature; 2) assess studies with KMC duration data to describe the measurement methods used; and 3) describe any studies 

identified which validated duration measurement methods.

We conducted a scoping review of the published and grey literature in accordance with established guidance for conducting scoping review from the Joanna Briggs Institute (18). The review protocol was registered with Open Science Framework (19). Selection of relevant papers, screening, and data charting were conducted by two independent reviewers (VST, EML) to minimise selection ), vee bias.

We searched the MEDLINE, Embase, Cochrane Library, PsycINFO, African Index Medicus, Latin American and Caribbean Health Sciences Literature (LILACS), Clinical trials.gov, International Clinical Trials Registry Platform(WHO ICTRP) and the International Standard Randomised Controlled Trial Number (ISRCTN) Registry. We also searched Medrxiv and OpenGrey libraries for relevant unpublished studies. We screened all references of relevant systematic reviews identified as well as the websites of the Kangaroo Foundation and the International Network of Kangaroo Care. WHO guidelines and Google Scholar were searched for relevant publications. Searches were last updated on 21 November 2022 with no language or date of publication limitations. Search terms were based on those relating to KMC and LBW/prematurity as well as KMC measurement/monitoring (supplementary file appendix 1). The search was conducted with assistance of a library clinical research specialist at the British Medical Association.

Search strategy

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool .

rasmushogeschool

Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies

Management of search results 

The search results were exported as RSI files to the Mendeley reference management system (© 2009-2013, Mendeley Ltd.). Duplication removal as well as title and abstract screening were done using Mendeley. The search results were shared with the second reviewer through a Mendeley group. Retrieved publications from the search were screened for suitability and relevance based on the information in the titles and abstracts. Initially a randomly selected trial set of search results (10% of total number) were screened for inclusion based on title and abstract information by both reviewers and, where necessary, clarifications/adjustments to the inclusion criteria were made, aiming for an agreement rate of >80%. A third reviewer was consulted in cases of disagreement (CJT). Articles were screened by two reviewers for inclusion and data charting. An initial pilot set was screened by both reviewers to assess agreement rates before sharing the analysis of the bulk el.ez of included articles.

Eligibility Criteria 

Publications were included if they presented primary data on KMC among preterm or LBW newborns and referred to duration of the skin-to-skin component of KMC or KMC monitoring/measurement. Publications referring to short procedural skin-to-skin care, such as delivery room routine skin to skin care and pain control procedures which did not fit in the definition of KMC(12), were excluded. 

### BMJ Open

1		
2 3	145	Data abstraction
4 5	115	
6 7	146	We generated a data charting form by identifying variables that would inform the objectives of the
8 9	147	scoping review. Data points of interest included KMC duration, methods used to measure the
10 11 12	148	duration and the validation of the method used. Detailed methodological description was defined
13 14	149	as a study that explained the instruments used to document KMC duration measurement, the
15 16	150	interval of the observations and how the total or daily KMC duration was calculated from the
17 18 19	151	observations.
20 21 22	152	
23 24	153	Patient and Public Involvement
25 26	154	There was no patient or public involvement in this review.
27 28	155	
29 30	156	Ethical approval
31 32 33	157 158	This study, being a scoping review, does not contain any personal or medical information about an identifiable individual and no ethical approvals or patient consent were sought.
34 35 36 37 38 39	159	
40 41		
42 43		
44		
45 46		
47		
48		
49 50		
51		
52		
53		
54 55		
56		8
57		
58		
59		

# **Results**

161 Our search strategy identified 3542 publications, of which 213 presented primary data on KMC 162 duration. Only 54 (25%) of 213 publications documented the method used to measure KMC 163 duration (Figure 1). Of the 213 publications, 139 (65%) were carried out in LMIC, 109 (51%) were 164 clinical trials, 135 (63%) had a sample size of >50 participants and 102 (48%) reported on daily 165 KMC duration of more than 2 hours.

### 

167 KMC duration measurement methods

Of the 54 publications that documented the methods used to measure KMC duration, four different methodological categories were identified: caregiver report, healthcare worker report, independent observation, and electronic monitoring device. A method was identified as a healthcare worker report if a person involved in the routine care of study participants reported on KMC duration, and as an independent observation if the person reporting on duration was not involved in the routine care of study participants. Some studies used more than one method, and caregiver reports were either self-reported through interviews or based on KMC charts/diaries. 

No existing framework for categorisation of the methods used to measure KMC duration was
 found in the reviewed publications, nor was any basis for the choice of the method used provided.
 Figure 2 illustrates our proposed framework for the categorisation of KMC measurement methods.

Of the 54 publications that documented the method used to measure KMC duration 29 (54%) used and 17 (32%) used healthcare worker reports. Other methods included caregiver reports independent observation, a combination of healthcare worker and caregiver report, and a combination of electronic device (wearable sensor for determining skin contact), healthcare worker, and caregiver monitoring (Figure 1). 

*KMC duration measurement description*. Nine (31%) of the 29 publications that used caregiver 185 report described the method used to measure KMC duration. Seven of these 9 publications utilised 186 KMC charts/diaries to report the duration of SSC (20-26), while the remaining 2 mentioned self-187 report through interviews (27, 28). Four publications (29-32) used more than one method of

### **BMJ** Open

measuring KMC duration. Of these, 3 (29, 31, 32) compared caregiver report with healthcare worker report and one (30) used healthcare worker report and an electronic monitoring device to monitor skin to skin contact. In the latter study, the device was used in the home setting in combination with caregiver report to evaluate whether it could reliably capture the duration of KMC episodes (30).

Three publications used independent observers (33-35) who were not part of the healthcare team. No publication used video recording to monitor KMC duration although video was used to assess other aspects of SSC, such as mother-baby interaction. 

Only 20 (9%) out of 213 publications (20-30, 32-40) with primary data on KMC duration described in detail the measurement method used (Figure 1), and this was in varying degrees of detail (supplementary table 1). Of these 20 publications, 11 (55%) were from LMICs (20, 27, 28, 30, 32-36, 38, 39) and 9 (45%) were from high-income countries (21-26, 29, 31, 40). Nine (45%) out of the 20 publications used caregiver report (Figure 1), of which 7 documented the tool used for monitoring KMC duration (charts) (20-26) and 2 mentioned self-report (supplementary table 1) (27, 28). The majority (64%) of the publications that used caregiver report were conducted in high-income countries (21-26), all of which documented the interval of observations. None of the publications gave a description of how the total or daily KMC duration was computed from the reports/observations (supplementary table 1). 

Three of the 4 publications that used healthcare worker report were conducted in LMICs (36, 38, 39). Only 1 of these 4 documented the tool used for monitoring (38), 3 documented the interval of observations (38-40), and 2 described how the daily KMC duration was calculated (38, 39). 

The 3 publications that combined caregiver and healthcare worker report documented the tool used to measure KMC duration (29, 31, 32), but only 2 documented the interval of observations, and none explained how the daily duration was computed (29, 32). The publication that used a combination of an electronic device, healthcare worker report, and caregiver report documented the interval of monitoring KMC duration but did not document the tool used or how the daily duration was computed (30). The publications that used independent observers documented the interval of observations and described how the daily KMC duration was computed (33-35). 

### Validation of the measurement methods

None of the publications with primary KMC duration data validated the method used to measure KMC duration. Only 1 publication measured the accuracy of a new device used to monitor skin to skin contact compared to healthcare worker report and caregiver report (30). Direct observation by healthcare workers was used as the reference standard against which an electronic monitoring device was compared for the purposes of accuracy; however, no validation was conducted. Maternal report was used to test the reliability of the electronic device to capture the duration of KMC at home. Four additional publications verified the consistency of measurements but did not undertake validation of the methods used (25, 29, 31, 38). Two of these studies only compared the agreement between the observation by the healthcare workers and the parents without comparing with the set gold standard(29, 31), while the other two only used a second person to verify entries without calculation of the agreement(25, 38). 

rasmushogesch

Discussion 

In this scoping review, we found 213 publications on KMC of which 54 (25%) documented a method for measuring duration. Only 20 (9%) publications provided a detailed description of the KMC duration measurement method, and none reported validity. Most studies with a detailed description used caregiver reports (9, 45%) or healthcare worker report (4, 20%). No framework for categorisation of KMC duration measurement methods was identified, and there was a lack of justification for the choice of method used for individual publications. 

The observation that most studies did not document methods used to assess KMC duration is in accord with a previous systematic review, which found that more than 85% of studies did not include data on observations of skin to skin contact practice, and that 45% lacked a description of skin to skin contact initiation and stopping criteria (41). Similarly, a most recent review that generated evidence leading to policy change by WHO found that 19% (5 out of 27) of the included studies did not report on duration of KMC(10). 

The lack of reliable measurement for the intervention dose (KMC duration) is an impediment to interpreting the evidence when meta-analyses that combine studies with different KMC measurement methods are used (42, 43). Hence, although it is plausible that higher KMC duration could improve neonatal health outcomes (44, 45), the evidence remains incomplete without more rigorously validated methods for measuring the dose of KMC. This is seen by variations in evidence generated by different reviews where the Cochrane review (2016) found KMC reduction on mortality was only when the daily duration was 20 hours or more(6), while another found significant benefit when daily duration was at least 8 hours(10). There were no published studies on validation of methods used to measure KMC duration. This calls for studies to validate KMC duration measurement methods against a gold standard (a reliable method for continuous monitoring of KMC) to enable accurate data on KMC duration as an exposure, compared to outcomes such as mortality and morbidity. Video recording has been used in skin to skin care studies mainly for short duration like heel pricks procedures where by the camera focuses on the neonate's face not the environment(46, 47). This could be an alternative as a gold standard against 

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

which the commonly used methods in KMC studies could be validated. However, for continuous video recording of KMC has ethical challenges like limitations of anonymity, recording other non-research related private experiences of the participants which might cause reluctance of the ethical committees to allow its use (48). The use of artificial intelligence (AI) platforms like it has been tried in a drug adherence trial could be a best alternative for a gold standard to evaluate the commonly used KMC duration measurement methods (49). This trial utilized visual confirmation of ingestion of the drug by using the AI platform mobile app and the same can be used to confirm skin to skin contact in KMC studies(49).

Although WHO recommends KMC duration of at least 8 hours a day (11), there is limited evidence on the minimum duration of KMC with beneficial clinical effects given that the evidence base used to draw the recommendation found insufficient data on KMC duration less than 8 hours(10). Therefore, standardised operational definitions which could improve this evidence base (41). In addition, our framework could help in guiding the selection and refining of indicators in routine information systems for assessing KMC duration as a marker for the quality of KMC (50). Chan and others have proposed indicators in the KMC measurement framework to include the duration of skin to skin contact (41, 50), and the proposed framework for KMC duration measurement in this review will be helpful for the measurement of this indicator. 

278 Strength and limitations of the study

279 Strengths

- First review to assess the description and validation of KMC duration measurement methods.
  - Selection and data abstraction were conducted by two independent reviewers.

283 Limitations

• We excluded 5 publications for which no English version was available and could not get translation.

1 2 3 4 5	286 287	• We did not review journal supplementary materials for the included publications.
6 7		
8	288	Conclusion
9 10	289	KMC is a high impact intervention for survival of LBW neonates, but there is limited rigorous
11 12	290	evaluation on the duration required. Reliable data on the dose response of KMC depends on the
13	291	reliability of assessing its duration. This scoping review found most studies of KMC duration
14 15	292	(91%) did not describe the methods used, and those that did were mainly reliant on caregiver report
16 17	293	or healthcare worker report, both of which have limitations. Clarity is needed in reporting KMC
18	294	duration measurement methods to increase comparability and rigour, and a validation study of gold
19 20	295	standard versus caregiver report and healthcare worker report would be of value.
21 22 23	296	
24 25	297	Conflict of interest
26 27 28	298	The authors have no conflict of interest declare.
29 30 31	299	
32 33	300	Authors' contributions
34 35 36	301	Victor S. Tumukunde conceptualised the study, wrote the protocol, analysed and interpreted the
37 38	302	data, and wrote the first draft of the manuscript. Victor S. Tumukunde, Eva M. Loucaides, and
39 40 41	303	Cally J. Tann selected the publications and abstracted the data. Melissa M. Medvedev, Cally J.
42 43	304	Tann, Moffat Nyirenda, and Joy E. Lawn interpreted the data and critically revised the manuscript.
44 45 46	305	All authors reviewed the manuscript and approved the final version.
47 48 49	306	
50 51	307	Acknowledgements
52 53 54	308	We thank Helen Elwell (Librarian and knowledge clinical research specialist at the British Medical
54 55 56 57 58	309	Association) for the support in conducting the literature search. 14
59 60		For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool .

Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies

This study was supported by a grant from the Joint Global Health Trials scheme of the Department of Health and Social Care, the Foreign, Commonwealth and Development Office, the Medical Research Council, and the Welcome Trust (MR/S004971/1) awarded to JEL. A grant from the Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health (K23HD092611) awarded to MMM supported her work on this study.

for beer teries only

1

### **BMJ** Open

2		
3 4	316	References
5	317	1. UNICEF. UN Inter-agency Group for Child Mortality Estimation. Levels and Trends in
6	318	Child Mortality: Report 2023 https://datauniceforg/wp-content/uploads/2024/03/UNICEF-2023-
7	319	Child-Mortality-Report. 2023.
8	320	2. Lawn JE, Blencowe H, Oza S, You D, Lee AC, Waiswa P, et al. Every Newborn: progress,
9	320	priorities, and potential beyond survival. The Lancet. 2014;384(9938):189-205.
10	321	<ol> <li>WHO. Born too soon: decade of action on preterm birth: World Health Organization; 2023.</li> </ol>
11		
12 13	323	4. Lawn JE, Kinney MV, Belizan JM, Mason EM, McDougall L, Larson J, et al. Born Too
13 14	324	Soon: Accelerating actions for prevention and care of 15 million newborns born too soon.
14	325	Reproductive Health. 2013;10(SUPPL. 1):S6.
16	326	5. English M, Karumbi J, Maina M, Aluvaala J, Gupta A, Zwarenstein M, Opiyo N. The need
17	327	for pragmatic clinical trials in low and middle income settings-taking essential neonatal
18	328	interventions delivered as part of inpatient care as an illustrative example. BMC medicine.
19	329	2016;14(1):5.
20	330	6. Conde-Agudelo A, Díaz-Rossello JL. Kangaroo mother care to reduce morbidity and
21	331	mortality in low birthweight infants. Cochrane Database of Systematic Reviews. 2016(8).
22	332	7. Boundy EO, Dastjerdi R, Spiegelman D, Fawzi WW, Missmer SA, Lieberman E, et al.
23	333	Kangaroo mother care and neonatal outcomes: a meta-analysis. Pediatrics.
24	334	2016;137(1):e20152238.
25 26	335	8. Organization WH. Kangaroo mother care: implementation strategy for scale-up adaptable
26 27	336	to different country contexts. 2023.
27	337	9. WHO IKsg, Arya S, Naburi H, Kawaza K, Newton S, Anyabolu CH, et al. Immediate
29	338	"Kangaroo Mother Care" and Survival of Infants with Low Birth Weight. New England Journal
30		
31	339	of Medicine. 2021;384(21):2028-38.
32	340	10. Sivanandan S, Sankar MJ. Kangaroo mother care for preterm or low birth weight infants:
33	341	a systematic review and meta-analysis. BMJ Global Health. 2023;8(6):e010728.
34	342	11. WHO. Recommendations for care of the preterm or low birth weight infant. Geneva: World
35	343	Health Organization. 2022.
36	344	12. WHO. Kangaroo mother care: a transformative innovation in health care: global position
37	345	paper. 2023.
38 39	346	13. M Ludington-Hoe S. Evidence-based review of physiologic effects of kangaroo care.
40	347	Current Women's Health Reviews. 2011;7(3):243-53.
41	348	14. Zengin H, Suzan OK, Hur G, Kolukısa T, Eroglu A, Cinar N. The effects of kangaroo
42	349	mother care on physiological parameters of premature neonates in neonatal intensive care unit: A
43	350	systematic review. Journal of Pediatric Nursing. 2023.
44	351	15. Chan GJ, Labar AS, Wall S, Atun R. Kangaroo mother care: a systematic review of barriers
45	352	and enablers. Bulletin of the World Health Organization. 2016;94(2):130.
46	353	16. Group WHOIKS. Impact of continuous Kangaroo Mother Care initiated immediately after
47	354	birth (iKMC) on survival of newborns with birth weight between 1.0 to $< 1.8$ kg: study protocol
48	355	for a randomized controlled trial. Trials. 2020;21(1):280.
49 50	356	17. Charpak N, Montealegre-Pomar A, Bohorquez A. Systematic review and meta-analysis
50 51	357	suggest that the duration of Kangaroo mother care has a direct impact on neonatal growth. Acta
52		
53	358	Paediatrica. 2021;110(1):45-59.
54		
55		

59 60

Peters MD, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for 18. conducting systematic scoping reviews. International journal of evidence-based healthcare. 2015;13(3):141-6. 19. Foster ED, Deardorff A. Open science framework (OSF). Journal of the Medical Library Association: JMLA. 2017;105(2):203. Jegannathan S, Natarajan M, Solaiappan M, Shanmugam R, Tilwani SA. Quality 20. improvement initiative to improve the duration of Kangaroo Mother Care in tertiary care neonatal unit of South India. BMJ Open Quality. 2022;11(Suppl 1):05. Sahlen Helmer C, Birberg Thornberg U, Frostell A, Ortenstrand A, Morelius E. A 21. Randomized Trial of Continuous Versus Intermittent Skin-to-Skin Contact After Premature Birth and the Effects on Mother-Infant Interaction. Advances in Neonatal Care. 2020;20(3):E48-E56. Tandberg BS, Froslie KF, Flacking R, Grundt H, Lehtonen L, Moen A. Parent-Infant 22. Closeness, Parents' Participation, and Nursing Support in Single-Family Room and Open Bay NICUs. The Journal of perinatal & neonatal nursing. 2018;32(4):E22-E32. Gonya J, Nelin LD. Factors associated with maternal visitation and participation in skin-23. to-skin care in an all referral level IIIc NICU. Acta Paediatrica, International Journal of Paediatrics. 2013;102(2):e53-e6. Flacking R, Thomson G, Ekenberg L, Lowegren L, Wallin L. Influence of NICU co-care 24. facilities and skin-to-skin contact on maternal stress in mothers of preterm infants. Sexual and Reproductive Healthcare. 2013;4(3):107-12. Anderson GC, Chiu S-H, Dombrowski MA, Swinth JY, Albert JM, Wada N. Mother-25. Newborn Contact in a Randomized Trial of Kangaroo (Skin-to-Skin) Care. Journal of Obstetric, Gynecologic, & Neonatal Nursing. 2003;32(5):604-11. Flacking R, Ewald U, Wallin L. Positive Effect of Kangaroo Mother Care on Long-Term 26. Breastfeeding in Very Preterm Infants. JOGNN - Journal of Obstetric, Gynecologic, and Neonatal Nursing. 2011;40(2):190-7. Joshi A, Londhe A, Joshi T, Deshmukh L. Quality improvement in Kangaroo Mother Care: 27. learning from a teaching hospital. BMJ Open Quality. 2022;11(Suppl 1):05. Chavula K, Guenther T, Valsangkar B, Lwesha V, Banda G, Boe Wensaas M, et al. 28. Improving Skin-to-Skin Practice for babies in Kangaroo Mother Care in Malawi through the use of a customized baby wrap: A randomized control trial. PLoS ONE [Electronic Resource]. 2020;15(3):e0229720. 29. Blomqvist YT, Ewald U, Gradin M, Nyqvist KH, Rubertsson C. Initiation and extent of skin-to-skin care at two Swedish neonatal intensive care units. Acta Paediatrica, International Journal of Paediatrics. 2013;102(1):22-8. Rao S, Thankachan P, Amrutur B, Washington M, Mony PK. Continuous, real-time 30. monitoring of neonatal position and temperature during Kangaroo Mother Care using a wearable sensor: a techno-feasibility pilot study. Pilot and feasibility studies. 2018;4:1-7. 31. Oras P BY, Nyqvist KH, Gradin M, Rubertsson C, Hellstrom-Westas L, Funkquist E-L. Skin-to-skin contact is associated with earlier breastfeeding attainment in preterm infants. Acta Paediatrica. 2016;105(7):783-9. 32. Goudard MJF, Lamy ZC, Marba STM, Cavalcante MCV, Dos Santos AM, Azevedo V, et al. Skin-to-skin contact and deaths in newborns weighing up to 1800 grams: a cohort study. Jornal de Pediatria. 2022;98(4):376-82. 

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

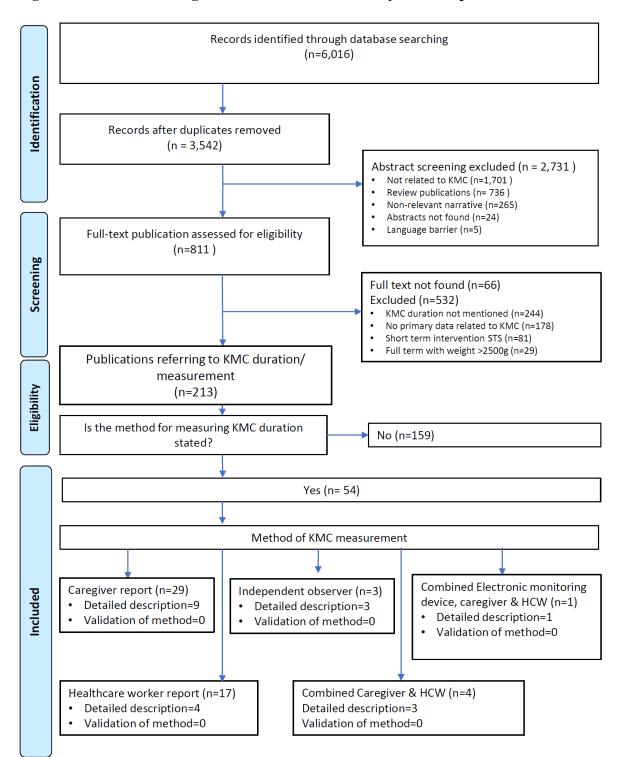
### BMJ Open

Watkins HC, Morgan MC, Nambuya H, Waiswa P, Lawn JE. Observation study showed 33. that the continuity of skin-to-skin contact with low-birthweight infants in Uganda was suboptimal. Acta Paediatrica, International Journal of Paediatrics. 2018;107(9):1541-7. 34. Salim N, Shabani J, Peven K, Rahman QS, Kc A, Shamba D, et al. Kangaroo mother care: EN-BIRTH multi-country validation study. BMC Pregnancy & Childbirth. 2021;21(Suppl 1):231. Adejuyigbe EA, Anand P, Ansong D, Anyabolu CH, Arya S, Assenga E, et al. Impact of 35. continuous Kangaroo Mother Care initiated immediately after birth (iKMC) on survival of newborns with birth weight between 1.0 to < 1.8 kg: study protocol for a randomized controlled trial Trials. 2020;21(1). 36. Brotherton H, Gai A, Kebbeh B, Njie Y, Walker G, Muhammad AK, et al. Impact of early kangaroo mother care versus standard care on survival of mild-moderately unstable neonates <2000 grams: A randomised controlled trial. EClinicalMedicine. 2021;39:101050. Oras P, Blomqvist YT, Nyqvist KH, Gradin M, Rubertsson C, Hellstrom-Westas L, 37. Funkquist E-L. Skin-to-skin contact is associated with earlier breastfeeding attainment in preterm infants. Acta Paediatrica. 2016;105(7):783-9. 38. Soni A, Amin A, Patel DV, Fahey N, Shah N, Phatak AG, et al. The presence of physician champions improved Kangaroo Mother Care in rural western India. Acta Paediatrica, International Journal of Paediatrics. 2016;105(9):e390-e5. Pervin J, Gustafsson FE, Moran AC, Roy S, Persson LA, Rahman A. Implementing 39. Kangaroo mother care in a resource-limited setting in rural Bangladesh. Acta Paediatrica. 2015;104(5):458-65. Feldman R, Eidelman AI. Skin-to-skin contact (Kangaroo Care) accelerates autonomic and 40. neurobehavioural maturation in preterm infants. Developmental medicine and child neurology. 2003;45(4):274-81. Chan GJ, Valsangkar B, Kajeepeta S, Boundy EO, Wall S. What is kangaroo mother care? 41. Systematic review of the literature. Journal of Global Health. 2016;6(1):010701. Lawn JE, Mwansa-Kambafwile J, Horta BL, Barros FC, Cousens S. 'Kangaroo mother 42. care'to prevent neonatal deaths due to preterm birth complications. International journal of epidemiology. 2010;39(suppl 1):i144-i54. Conde-Agudelo A, Belizán JM, Diaz-Rossello J. Cochrane Review: Kangaroo mother care 43. to reduce morbidity and mortality in low birthweight infants. Evidence-Based Child Health: A Cochrane Review Journal. 2012;7(2):760-876. Udani RH, VR A, Kabra NS, Nanavati RN. Impact of duration of kangaroo mother care on 44. growth in high risk preterm and low birth weight infants. Journal of Neonatology. 2013;27(3):1-9. 45. Charpak N, Montealegre-Pomar A, Bohorquez A. Systematic review and meta-analysis suggest that the duration of Kangaroo mother care has a direct impact on neonatal growth. Acta paediatrica (Oslo, Norway : 1992). 2020. Nimbalkar SM, Chaudhary NS, Gadhavi KV, Phatak A. Kangaroo mother care in reducing 46. pain in preterm neonates on heel prick. The Indian journal of pediatrics. 2013;80:6-10. Johnston CC, Filion F, Campbell-Yeo M, Goulet C, Bell L, McNaughton K, et al. 47. Kangaroo mother care diminishes pain from heel lance in very preterm neonates: a crossover trial. BMC pediatrics. 2008;8:1-9. 

Page 20 of 33

BMJ Open

1 2 3 4 5 6 7 8 9 10 11 2 3 4 5 6 7 8 9 10 11 2 3 14 5 6 7 8 9 10 11 2 3 14 5 6 7 8 9 10 11 2 3 4 5 6 7 8 9 10 11 2 3 4 5 6 7 8 9 10 11 2 3 4 5 6 7 8 9 10 11 2 3 4 5 6 7 8 9 10 11 2 3 4 5 6 7 8 9 10 11 2 3 4 5 6 7 8 9 10 11 12 13 14 5 16 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 13 14 5 6 7 8 9 10 11 12 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	447 448 449 450 451 452 453 454 455 456 457 458 459	<ol> <li>Scott M, Watermeyer J, Wessels TM. Video-recording complex health interactions in a diverse setting: Ethical dilemmas, reflections and recommendations. Developing World Bioethics. 2020;20(1):16-26.</li> <li>Bain EE, Shafher L, Walling DP, Othman AA, Chuang-Stein C, Hinkle J, Hanina A. Use of a novel artificial intelligence platform on mobile devices to assess dosing compliance in a phase 2 clinical trial in subjects with schizophrenia. JMIR mHealth and utHealth. 2017;5(2):e7030.</li> <li>Guenther T, Moxon S, Valsangkar B, Wetzel G, Ruiz J, Kerber K, et al. Consensus-based approach to develop a measurement framework and identify a core set of indicators to track implementation and progress towards effective coverage of facility-based Kangaroo Mother Care. Journal of global health. 2017;7(2).</li> </ol>
49		19 For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml



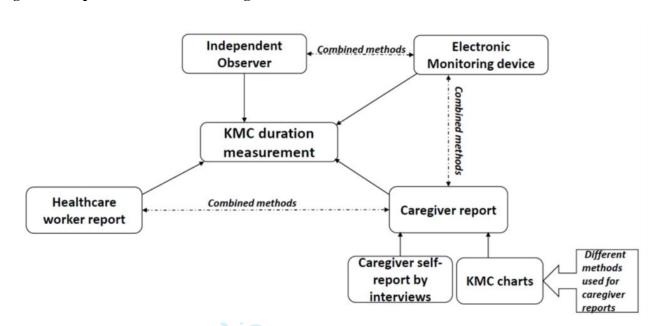
### Figure 1: PRISMA flow diagram of search results and study inclusion process

KMC=Kangaroo Mother Care, STS=Skin to Skin, HCW=Health care worker

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool .

Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies



### Figure 2. Proposed framework for categorisation of KMC measurement methods.

Commonly used methods to measure duration of KMC (Kangaroo Mother Care), (\* ----->) = methods used in combination, caregiver reports use self-report or KMC charts and independent observers can be healthcare workers or non-healthcare workers.

**Appendix 1: Search strategies** 

1 2 3 4 5	
6 7 8 9 10	
11 12 13 14 15 16	
17 18 19 20 21	
22 23 24 25 26 27	
28 29 30 31 32	
33 34 35 36 37 38	
39 40 41 42 43	
44 45 46 47 48 49	
50 51 52 53 54	
55 56 57 58 59 60	
00	

	Ovid MEDLINE(R)	Results
	Date: 22/11/2022	per line
	infant, low birth weight/ or infant, small for gestational age/ or infant, very low birth weight/ or	r89966
1	infant, extremely low birth weight/ or infant, premature/ or infant, extremely premature/	
	(low birth weight or small for gestational age or small gestational age or small for date infants	
	or low birth weight or premature infant\$ or premature neonate\$ or prematurity or preterm	122782
	infant\$ or preterm neonate\$ or premature babies or preterm babies or premature baby or preterm	125785 N
2	baby or premature newborn\$ or preterm newborn\$).mp.	
3	Premature Birth/	19559
4	(preterm birth\$ or premature birth\$).mp.	35716
5	shorter gestation.mp.	229
5	preterm pregnancy.mp.	132
7	(sga or lbw or vlbw).mp.	18124
8	or/1-7	164261
9	Kangaroo-Mother Care Method/	688
10	(kangaroo mother care or kangaroo care).mp.	1265
11	skin to skin.mp.	7174
12	or/9-11	7943
13	8 and 12	1106
14	((monitor\$ or measur\$ or adher\$) adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.	374
15	(duration adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.	151
16	or/13-15	1549

	Embase	
	Date: 22/11/2022	per line
1	low birth weight/ or small for date infant/	56972
2	very low birth weight/ or extremely low birth weight/	17072
	(low birth weight or small for gestational age or small gestational age or small for date	2
	infant\$ or low birth weight or premature infant\$ or premature neonate\$ or prematurity or	r
	preterm infant\$ or preterm neonate\$ or premature babies or preterm babies or premature	
	baby or preterm baby or	
3	premature newborn\$ or preterm newborn\$).mp.	202428
4	prematurity/	119803
5	(preterm birth\$ or premature birth\$).mp.	41903
6	shorter gestation.mp.	289
7	preterm pregnancy.mp.	204
8	(sga or lbw or vlbw).mp.	27042
9	or/1-8	225402
10	kangaroo care/	1724
11	(kangaroo mother care or kangaroo care).mp.	2070
12	skin to skin.mp.	10333
13	or/10-12	11652
14	9 and 13	1594
15	((monitor\$ or measur\$ or adher\$) adj10 (kangaroo mother care or kangaroo care or "skir	540
	to skin")).mp.	
16	(duration adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.	216
17	or/14-16	2217

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

	APA PsycInfo	Results
	Date: 22/11/2022	per line
1	Birth Weight/	3453
	(low birth weight or small for gestational age or small gestational age or small for date infant\$ or low birth weight or premature infant\$ or premature neonate\$ or prematurity or preterm infant\$ or preterm neonate\$ or premature babies or preterm babies or premature baby or preterm baby or	
2	premature newborn\$ or preterm newborn\$).mp.	10046
3	premature birth/	6254
4	(preterm birth\$ or premature birth\$).mp.	7931
5	shorter gestation.mp.	42
6	preterm pregnancy.mp.	2
7	(sga or lbw or vlbw).mp.	2008
8	or/1-7	13930
9	(kangaroo mother care or kangaroo care).mp.	183
10	skin to skin.mp.	519
11	or/9-10	615
12	8 and 11	187
13	((monitor\$ or measur\$ or adher\$) adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.	56
14	(duration adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.	21
15	or/12-14	249

	Database of Systematic Reviews (CDSR)	
	Date: 22/11/2022	
#1	MeSH descriptor: [Infant, Low Birth Weight] explode all trees	2338
#2	MeSH descriptor: [Infant, Premature] explode all trees	4277
#3	"low birth weight" or "small for gestational age" or "small gestational age" or "small f date" NEXT infant* or "low birth weight" or premature NEXT infant* or prematu NEXT neonate* or prematurity or preterm NEXT infant* or preterm NEXT neonate* "premature babies" or "preterm babies" or "premature baby" or "preterm baby" premature NEXT newborn* or preterm NEXT newborn*	re or
#4	MeSH descriptor: [Premature Birth] this term only	1814
#5	preterm NEXT birth* or premature NEXT birth*	4614
#6	"shorter gestation"	11
#7	"preterm pregnancy"	26
#8	sga or lbw or vlbw	3218
#9	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8	22856
#10	MeSH descriptor: [Kangaroo-Mother Care Method] this term only	111
¥11	"kangaroo mother care" or "kangaroo care"	651
¥12	"skin to skin contact" or "skin to skin care"	547
#13	#10 or #11 or #12	1002

1	
2	
3	
4	
5	
5	
6	
7	
,	
8	
4 5 7 8 9 10 11	
10	
10	
11	
12	
12 13	
13	
14	
15	
15	
16	
17	
10	
18	
19	
15 16 17 18 19 20	
20	
21	
22	
23	
25	
24	
25	
20	
26	
24 25 26 27 28	
28	
20	
29	
30	
31	
32	
33	
55	
34 35 36	
35	
26	
50	
37	
38	
39	
40	
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	
51	
52	
53	
54	
55	
56	
57	
58	
59	
60	

Clinicaltrials.gov	Resul
Date: 18/11/2022	
kangaroo OR "skin to skin"	119

WHO International Clinical Trials Registry Platform (ICTRP)	Results		
Date: 18/11/2022			
kangaroo	203		

The ISRCTN registry	Results
Date: 21/11/2022	
Kangaroo <u>https://www.isrctn.com/search?q=kangaroo</u> +	12
· L.	

Latin American and Caribbean He	ealth Sciences Literature (LILACS)	Results
Date: 21/11/2022	2	
Kangaroo	0	315

MedRxiv	J.	Results
Date: 21/11/2022		
"skin to skin"		166

9

Open Grey libraries, references from relevant systematic reviews and web	sites of Resul
the Kangaroo Foundation	
Date: 21/11/2022	
Open Grey libraries:	175
search term "skin to skin"	
AND	
Search terms Kangaroo care or kangaroo unit*	
References and google scholar:	
"kangaroo mother care" or "kangaroo care"	
OR	
"skin to skin contact" or "skin to skin care"	

Page	29	of	33
------	----	----	----

1 2	
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 5 36 37 37 37 37 37 37 37 37 37 37	
5 6	
7 8	
9 10	
11 12	
13 14	
15 16 17	
18 19	
20 21	
22 23	
24 25	
26 27	
28 29	
30 31	
33 34	
35 36	
37 38	
39 40	
41 42	
43 44	
45 46	
47	

able 1. Publica	tions with a detailed de	scription of KMC		MJ Open irement	cted by copyright, including	.1136/bmjopen-2023-
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	for	Comments 0795 070
M. J. F. Goudard; 2022	Skin-to-skin contact and deaths in new- borns weighing up to 1800 grams: a cohort study	Observational study; 405	Brazil	Caregiver & Healthcare worker	SSC time was recorded on cards by the health team at the beginning then, parents performed the registration, under the supervise of healthcare workers.	used to record KMC duration. ☑ Interval of observation documented. □ Calculation of daily KMC duration documented
S. Jegannathan; 2022	Quality improvement initiative to improve the duration of Kangaroo Mother Care in tertiary care neonatal unit of South India	Observational study; 86	India	Caregiver report (KMC charts)	KMC Charts were given to KMC or mothers to mark daily hours of the second KMC by mothers.	<ul> <li>Mention of data collection tool used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented</li> </ul>
A. Joshi; 2022	Quality improvement in Kangaroo Mother Care: learning from a teaching hospital	Observational study; 86	India: NICU level unknown	Caregiver report (self- report)	The nurse noted the previous day's KMC hours and other information as reported by the mother.	used to record KMC duration. Interval of observation documented. Calculation of daily KMC duration documented.
Nahya Salim; 2021	Kangaroo mother care: EN-BIRTH multi-country validation study	Observational study; 840	Tanzania, Napal & Bangladesh	Independent observer	of KMC hourly in some settings and 12-hourly in other settings	<ul> <li>Mention of data collection tool used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented.</li> </ul>

total or daily KMC duration was calculated from the observations \$\overlambda = Yes \$\overlambda = No.\$\$\$\$KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every New Born Birth Indicators

Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver rtment GEZ-LTA

			BI	MJ Open		1.1136/bmjope	Page
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Method details	en-2023-07957 riabt includin	
E. A. Adejuyigbe; 2021	Impact of continuous Kangaroo Mother Care initiated immediately after birth on survival of newborns with birth weight between 1.0 to < 1.8 kg	RCT; 4200	Ghana, Tanzania, Malawi, Nigeria & India	Independent observer	Information on the duration of contact and the duration of hos stay was collected by research assistants	ital	used to record KMC duration.
H. Brotherton; 2021	Impact of early kangaroo mother care versus standard care on survival of mild- moderately unstable new-borns <2000 grams	RCT; 279	The Gambia: NICU level not specified	Healthcare worker report	Research nurses observed and recorded KMC duration and position. Documented timing of each KMC session, KMC prove and reason for coming out of K position.	5. Downloa	☐ Interval of observation documented.
K. Chavula; 2020	Improving Skin-to- Skin Practice for new- borns in Kangaroo Mother Care in Malawi through the use of a customized baby wrap: A randomized control trial	RCT; 301	Malawi; NICU level II	Caregiver report (self- report)	Mothers reported practicing SS post-discharge & duration more than half the day and more than the night post-discharge.	Althaining and	<ul> <li>Mention of data collection tool used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented.</li> </ul>
C. Sahlen Helmer; 2020	A Randomized Trial of Continuous Versus Intermittent Skin-to- Skin Contact After Premature Birth and the Effects on Mother- Infant Interaction	RCT; 31	Sweden; NICU level unknown	Caregiver report (KMC charts)	Parents in continuous SSC documented who provided SSC whether they were off SSC for reason. Parents in the intermitte group registered when and for long they provided SSC.	and on June 8,	<ul> <li>☑ Interval of observation documented.</li> <li>□ Calculation of daily KMC duration documented.</li> </ul>

Detailed methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the observations and, 3) how the total or daily KMC duration was calculated from the observations  $\square =$ Yes  $\square =$ No. at

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every New Born Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

Page 31 of 33 1 2				B	MJ Open	Cted by copyright, includin Method details	
3 4 5 6	First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Method details	Comments
7 8 9 10 11 12 13 14 15 16 17	B.S. Tandberg; 2018	Parent-Infant Closeness, Parents' Participation, and Nursing Support in Single-Family Room and Open Bay NICUs	Observational; 64	Norway: NICU level unknown	Caregiver report (KMC chart)	Parents recorded the duration of SSC care in a KMC diary. Diary entries were made daily for the 14 days following inclusion in the study. Parents reported hour by hour during these 14 days.	used to record KMC duration. ☑ Interval of observation documented. □ Calculation of daily KMC
18         19         20         21         22         23         24         25         26         27         28         29         30         31         32         33         34	S. Rao; 2018	Continuous, real-time monitoring of neonatal position and temperature during Kangaroo Mother Care using a wearable sensor: a techno-feasibility pilot study	Observational; 12	India: NICU level III	Electronic monitoring device, healthcare worker's direct observation & Maternal self-report	Baby's position captured as presence of "touch" between the device and the skin of baby/mother was compared against reported observed KMC episodes". In the hospital, the research nurse annotated the starting and ending times of KMC by direct observation. At home KMC duration was self-reported by the mother. Direct observation was "reference standard" in the hospital against which the device was compared for purposes of validation.	used to record KMC duration. ☐ Interval of observation documented. ☐ Calculation of daily KMC duration documented

 total or daily KMC duration was calculated from the observations \$\overline{U}=Yes \$\overline{U}=No\$. 

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Netborn Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver Partment GEZ-LTA

		cted by copy	1136/bm jopen-2023-0795 Соттентя			
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	cted by copyright, includin	20 23 23 0795 57
H.C. Watkins; 2018	Observation study showed that the continuity of skin-to- skin contact with low-birthweight infants in Uganda was suboptimal	Observational; 12	Uganda: NICU level II	Independent observer	Continuous observation of infagts began after birth and up to day <b>2</b> o life, discharge, or death, which we came first. The total duration of hours spent in SSC was calculated by adding together the duration all individual SSC sessions on day. If an infant received at leas hours of SSC, it was considered continuous KMC, and any fewer hours of SSC per day was documented as intermittent KM	of 2 er 2 anuary 2025 Granuary
P. Oras; 2016	Skin-to-skin contact is associated with earlier breastfeeding attainment in preterm infants	Observational; 104	Sweden: NICU level III	Caregiver report & healthcare worker	Skin to skin duration was recorded by the parents or by staff on a detailed form. Median daily S duration was the data used for the study.	d d Mention of data collection to used to record KMC duration. □ Interval of observation documented. □ Calculation of daily KMC duration documented
A. Soni; 2016	The presence of physician champions improved Kangaroo Mother Care in rural western India	Observational; 648	India: NICU level II	Healthcare worker report	Nursing staff documented KM duration using a standardized form & recorded information for eight day The charts were incorporated into the neonate's medical notice updated daily by the nurses and reviewed daily by the physician	documented.

Detailed methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the  $a_{B}$  set  $a_{B}$  and, 3) how the total or daily KMC duration was calculated from the observations  $\square =$  Yes  $\square =$ No. 

Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver Department GEZ-LTA

Page 33 of 33

			BI	MJ Open	ted by	
					.1136/bmjopen-2 cted by copyrigh	
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Cted by copyright, including Method details	Comments
J. Pervin; 2015	Implementing Kangaroo mother care in a resource- limited setting in rural Bangladesh	Observational; 423	Bangladesh: NICU level I	Healthcare worker report	Nursing attendants noted the beginning and end of every skin-to- skin contact session and calculated skin-to-skin contact time for each session. The times of each session in the 24h period was added together to determine total skin to skin contact duration per day.	☐ Interval of observation
J. Gonya; 2013	Factors associated with maternal visitation and participation in skin- to-skin care in an all- referral level IIIc NICU	Observational; 32	USA: NICU level III	Caregiver report (KMC chart)	A log was provided to mothers was recorded when they visited the small baby NICU, if they participated in SSC, how long participated in SSC, and if therm were any issues involved in the SSC process.	<ul> <li>Mention of data collection to used to record KMC duration.</li> <li>Interval of observation</li> </ul>
Y.T. Blomqvist; 2013	Initiation and extent of skin-to-skin care at two Swedish neonatal intensive care units	Observational; 104	Sweden: NICU level III	Caregiver report & healthcare worker	Time of initiation of SSC and who provided this care were recorded continuously in the infants' medicate charts by either the parents or the NICU staff. The reliability of parents' registrations of the time spent with SSC had been assessed prior to the study.	used to record KMC duration. ☐ Interval of observation documented. ☐ Calculation of daily KMC duration documented.

Detailed methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the observations and, 3) how the total or daily KMC duration was calculated from the observations  $\square =$ Yes  $\square =$ No.

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Newborn Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver artment GEZ-LTA



aj

			В	MJ Open	ted by copyr	Pag Pag Comments
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Cted by copyright, including	Comments
R. Flacking; 2013	Influence of NICU co-care facilities and skin-to-skin contact on maternal stress in mothers of preterm infants	Mixed methods feasibility study; 300	Sweden: NICU level III	Caregiver report (KMC chart)	Caregivers provided KMC duration self-reports using calendars. Parents marked the initiation and ending of each SSC episode. At the end of the 2-week period, the nurse revision the mother, collected the calendar	used to record KMC duration. ☑ Interval of observation documented. □ Calculation of daily KMC duration documented
R. Flacking; 2011	Positive Effect of Kangaroo Mother Care on Long-Term Breastfeeding in Very Preterm Infants	Observational; 300	Sweden: NICU level unknown	Caregiver report (KMC chart)	KMC data gathered through setting reports by caregivers in the formation of calendars. Parents marked the initiation and ending of each sland to-skin episode rounded to the mo- nearest 5- or 10-minute interval	<ul> <li>Mention of data collection too used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented.</li> </ul>
G.C. Anderson; 2003	Mother-Newborn Contact in a Randomized Trial of Kangaroo (Skin-to- Skin) Care	RCT; 91	USA: NICU level unknown	Caregiver report (KMC chart)	Contact logs used to document KMC duration (when the contact began and ended) & by whom. Caregivers completed the contact log and researcher verified each entry with the mothers at the end of each 8-hour shift.	<ul> <li>Mention of data collection too used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented</li> </ul>
R. Feldman; 2003	Skin-to-skin contact (Kangaroo Care) accelerates autonomic and neuro- behavioural maturation in preterm infants	Observational; 70	Israel: NICU level unknown	Healthcare worker report	During KC infants were observed by the nurses who recorded the exact times when the mothers and infants remained in skin-to-sking contact and when the infant returned to standard incubator ware.	<ul> <li>Mention of data collection too used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented.</li> </ul>

Detailed methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the observations and, 3) how the total or daily KMC duration was calculated from the observations D = Yes = No.

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Newborn Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver GEN-

# **BMJ Open**

### Measuring Duration of Kangaroo Mother Care for Neonates: A Scoping Review

Journal:	BMJ Open
Manuscript ID	bmjopen-2023-079579.R2
Article Type:	Original research
Date Submitted by the Author:	12-Sep-2024
Complete List of Authors:	Tumukunde, Victor; London School of Hygiene & Tropical Medicine Centre of Global Change and Health, Loucaides, Eva; London School of Hygiene & Tropical Medicine Centre of Global Change and Health, Infectious Disease Epidemiology Medvedev, Melissa; University of California San Francisco, Nyirenda, Moffat; London School of Hygiene and Tropical Medicine, Lawn, Joy; London School of Hygiene & Tropical Medicine Faculty of Epidemiology and Population Health, Infectious Disease Epidemiology Tann, Cally; London School of Hygiene and Tropical Medicine,
<b>Primary Subject Heading</b> :	Paediatrics
Secondary Subject Heading:	Public health, Paediatrics, Global health, Medical publishing and peer review, Research methods
Keywords:	NEONATOLOGY, PERINATOLOGY, PUBLIC HEALTH





I, the Submitting Author has the right to grant and does grant on behalf of all authors of the Work (as defined in the below author licence), an exclusive licence and/or a non-exclusive licence for contributions from authors who are: i) UK Crown employees; ii) where BMJ has agreed a CC-BY licence shall apply, and/or iii) in accordance with the terms applicable for US Federal Government officers or employees acting as part of their official duties; on a worldwide, perpetual, irrevocable, royalty-free basis to BMJ Publishing Group Ltd ("BMJ") its licensees and where the relevant Journal is co-owned by BMJ to the co-owners of the Journal, to publish the Work in this journal and any other BMJ products and to exploit all rights, as set out in our <u>licence</u>.

The Submitting Author accepts and understands that any supply made under these terms is made by BMJ to the Submitting Author unless you are acting as an employee on behalf of your employer or a postgraduate student of an affiliated institution which is paying any applicable article publishing charge ("APC") for Open Access articles. Where the Submitting Author wishes to make the Work available on an Open Access basis (and intends to pay the relevant APC), the terms of reuse of such Open Access shall be governed by a Creative Commons licence – details of these licences and which <u>Creative Commons</u> licence will apply to this Work are set out in our licence referred to above.

Other than as permitted in any relevant BMJ Author's Self Archiving Policies, I confirm this Work has not been accepted for publication elsewhere, is not being considered for publication elsewhere and does not duplicate material already published. I confirm all authors consent to publication of this Work and authorise the granting of this licence.

terez ony

Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, AI training, and similar technologies



1

2		
3 4	1	Measuring Duration of Kangaroo Mother Care for Neonates: A Scoping Review
5 6	2	Victor S. Tumukunde <sup>1,4</sup> , Eva M. Loucaides <sup>2</sup> , Melissa M. Medvedev <sup>2,3,4</sup> , Moffat Nyirenda <sup>1,4</sup> , and
7 8	3	Joy E. Lawn <sup>2,4</sup> , Cally J. Tann <sup>2,4,5</sup>
9 10 11	4	Authors
12 13	5	1. Medical Research Council/Uganda Virus Research Institute and LSHTM Uganda Research
14 15	6	Unit, PO Box 49, Entebbe, Uganda.
16 17	7	2. Maternal, Adolescent, Reproductive, & Child Health Centre, London School of Hygiene
18 19	8	& Tropical Medicine, Keppel Street, London WC1E 7HT, UK.
20 21	9	3. Department of Pediatrics, University of California San Francisco, 550 16th Street, Box
22 23	10	1224, San Francisco, CA 94158, USA
24 25 26	11	4. Faculty of Epidemiology and Population Health, London School of Hygiene & Tropical
26 27 28	12	Medicine, Keppel Street, London WC1E 7HT, UK.
20 29 30	13	5. Department of Neonatal Medicine, University College London, 235 Euston Road, London
31 32	14	NW1 2BU, UK.
33 34	15	
35 36	16	NW1 2BU, UK.
37 38 39	17	
40 41	18	
42 43	19	Corresponding author: Victor S. Tumukunde
43 44	20	Address: Medical Research Council/Uganda Virus Research Institute and LSHTM Uganda
45	21	Research Unit, PO Box 49, Entebbe, Uganda
46		
47	22	Email: <u>Victor.tumukunde@mrcuganda.org</u>
48 49	23	
49 50 51	24	
52 53 54 55 56	25	Key words:Kangaroo Mother Care, low birthweight, neonatal, prematurity
57 58 59		

### **BMJ** Open

### Abstract Objectives: Kangaroo mother care (KMC) is high-impact for survival of low birthweight neonates, but there are few rigorous evaluations of duration required for impact. We conducted a scoping review of KMC duration measurement methods and assessed their validation. Design: Scoping review in accordance with Joanna Briggs Institute guidance for conducting scoping review. Data sources: MEDLINE, Embase, Cochrane Library, PsycINFO, African Index Medicus(AIM), Latin American and Caribbean Health Sciences Literature(LILACS), Clinical trials.gov, International Standard International Clinical Trials Registry Platform (WHO ICTRP), Randomised Controlled Trial Number (ISRCTN) Registry, Medrxiv, and OpenGrey were searched through November 2022 Eligibility criteria for selecting studies: Publications with primary data on KMC duration were included. We excluded short procedural skin-to-skin care studies. Data extraction and synthesis: Selection and data abstraction were conducted by two independent reviewers. A data charting form based on the variables of interest was used to abstract data. Results: A total of 213 publications were included, of which 54 (25%) documented a method of measuring KMC duration. Only 20 publications (9%) provided a detailed description of the duration measurement method, and none reported validity. Most studies used caregiver reports (29, 54%) or healthcare worker observations (17, 31%). Other methods included independent observers and electronic monitoring devices. Conclusion: Only 9% of KMC studies reporting duration documented the measurement method applied and no studies were found with documented validation of duration measurement methods.

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

1

2		
3	48	Accurate and comparable data on the dose response of KMC will require duration measurement
4 5 6	49	methods to be validated against a gold standard such as an independent observer
6 7	49	methods to be validated against a gold standard such as an independent observer.
8 9	50	Strength and limitations of the study
9 10		
11		
12	51	• Unrestricted search across databases and grey literature reduced publication bias.
13		
14 15	52	• Selection and data abstraction were conducted by two independent reviewers.
16	-	
17		
18	53	• Pilot testing and support from a clinical research specialist ensured precise data collection.
19		
20 21	54	• Excluded five publications for which no English version was available.
21	51	Excluded five publications for which he English version was available.
23		
24	55	<ul> <li>Did not review journal supplementary materials for the included publications.</li> </ul>
25		
26 27	56	
27 28	20	
29		
30	57	Open Science Framework registration number DOI 10.17605/OSF.IO/463DG
31		
32	58	
33 34	00	
35		
36	59	
37		
38		
39 40		
41		
42		
43		
44 45		
45 46		
47		
48		
49		
50 51		
51 52		
53		
54		
55		3
56 57		3
58		
58 59		

### BMJ Open

60	Introduction
----	--------------

Globally, an estimated 2.3 million neonatal deaths occurred in 2022(1). More than 80% of neonatal deaths occur amongst those who are low birthweight [LBW,  $\leq 2500$  grams (g)], due to being born preterm, small-for-gestational age, or both (2). Mortality risk is highest in low-income and middle-income countries (LMICs) due to gaps in neonatal care (3). Major mortality reductions could be achieved by improving facility-based care of small and sick neonates in these countries (2, 4, 5). Kangaroo mother care (KMC) as a component of this small and sick newborn care is associated with decreased mortality, sepsis, hypothermia, hypoglycaemia, and length of hospital stay compared to conventional incubator care among clinically stable neonates(6-8). A World Health Organisation (WHO)led trial recently reported a 25% reduction in mortality within 28 days among neonates born weighing 1000-1799 g who received KMC immediately after birth, relative to those who received standard care with KMC after stabilisation (9). Based on these findings and additional evidence from a systematic review(10), WHO updated guidelines recommending KMC for all preterm or LBW neonates to be initiated as soon as possible after birth in the healthcare facility or at home and should be given for 8–24 hours per day (11). 

KMC is the care of preterm or LBW neonates in continuous and prolonged (8–24 hours per day, for as many hours as possible) skin-to-skin contact (SSC) recommended to be initiated immediately after birth with support for exclusive breastfeeding or breast-milk feeding (12). Duration of KMC is considered important in achieving beneficial health outcomes (8, 10, 13, 14). However, previous research has suggested that continuous KMC for 24 hours a day may be difficult to achieve; for example, women may have complications or be post-caesarean section or find long hours challenging due to incompatibility with household activities or trying to sleep while continuing KMC (15). Policy makers, and healthcare administrators should improve facility 

infrastructure and implement policies that encourage family support and involvement in KMC toimprove duration (11).

Higher duration of KMC in a given 24-hour period has been demonstrated using descriptive data and meta-analyses to be associated with lower mortality risk (8, 16). Evidence also shows that some desired effects disappear when the KMC duration is 2 hours or less(17). However, the evidence base on the recommended frequency and duration of KMC for neonatal survival requires more rigorous evaluation [9, 15]. Dose-response studies could inform families and clinicians to optimize outcomes and be more efficient for inputs. Such studies require objective and accurate methods of measuring the duration of KMC.

The aim of this scoping review was therefore to explore available evidence on the methods used to measure KMC duration. Specific objectives were to: 1) develop a framework for categorisation of measurement methods identified in the published and grey literature; 2) assess studies with KMC duration data to describe the measurement methods used; and 3) describe any studies identified which validated duration measurement methods.

# 100 Study design

We conducted a scoping review of the published and grey literature in accordance with established guidance for conducting scoping review from the Joanna Briggs Institute (18). The review protocol was registered with Open Science Framework (19). Selection of relevant papers, screening, and data charting were conducted by two independent reviewers (VST, EML) to minimise selection bias.

106 Search strategy

We searched the MEDLINE, Embase, Cochrane Library, PsycINFO, African Index Medicus, Latin American and Caribbean Health Sciences Literature(LILACS), Clinical trials.gov, International Clinical Trials Registry Platform(WHO ICTRP) and the International Standard Randomised Controlled Trial Number (ISRCTN) Registry. We also searched Medrxiv and OpenGrey libraries for relevant unpublished studies. We screened all references of relevant systematic reviews identified as well as the websites of the Kangaroo Foundation and the International Network of Kangaroo Care. WHO guidelines and Google Scholar were searched for relevant publications. Searches were first done 15th October 2020 last updated on 21st November 2022 with no language or date of publication limitations. Search terms were based on those relating to KMC and LBW/prematurity as well as KMC measurement/monitoring (supplementary file appendix 1). The search was conducted with assistance of a library clinical research specialist at the British Medical Association. 

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

Management of search results 

The search results were exported as RSI files to the Mendeley reference management system (© 2009-2013, Mendeley Ltd.). Duplication removal as well as title and abstract screening were done using Mendeley. The search results were shared with the second reviewer through a Mendeley group. Retrieved publications from the search were screened for suitability and relevance based on the information in the titles and abstracts. Initially a randomly selected trial set of search results (10% of total number) were screened for inclusion based on title and abstract information by both reviewers and, where necessary, clarifications/adjustments to the inclusion criteria were made, aiming for an agreement rate of >80%. A third reviewer was consulted in cases of disagreement (CJT). Articles were screened by two reviewers for inclusion and data charting. An initial pilot set was screened by both reviewers to assess agreement rates before sharing the analysis of the bulk of included articles.

#### Eligibility Criteria

Publications were included if they presented primary data on KMC among preterm or LBW newborns and referred to duration of the skin-to-skin component of KMC or KMC monitoring/measurement. Publications referring to short procedural skin-to-skin care, such as delivery room routine skin to skin care and pain control procedures which did not fit in the definition of KMC(12), were excluded. 

Data abstraction

We generated a data charting form by identifying variables that would inform the objectives of the scoping review. Data points of interest included KMC duration, methods used to measure the 

### **BMJ** Open

Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.	Erasmushogeschool .	MJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-L
--	---------------------	---

Ā

duration and the validation of the method used. Detailed methodological description was defined as a study that explained the instruments used to document KMC duration measurement, the interval of the observations and how the total or daily KMC duration was calculated from the observations. Patient and Public Involvement There was no patient or public involvement in this review. To beer to wiew only 

#### **Results**

Our search strategy identified 3542 publications, of which 213 presented primary data on KMC duration. Only 54 (25%) of 213 publications documented the method used to measure KMC duration (Figure 1). Of the 213 publications, 139 (65%) were carried out in LMIC, 109 (51%) were clinical trials, 135 (63%) had a sample size of >50 participants and 102 (48%) reported on daily KMC duration of more than 2 hours. 

KMC duration measurement methods 

Of the 54 publications that documented themethods used to measure KMC duration, four different methodological categories were identified: caregiver report, healthcare worker report, independent observation, and electronic monitoring device. A method was identified as a healthcare worker report if a person involved in the routine care of study participants reported on KMC duration, and as an independent observation if the person reporting on duration was not involved in the routine care of study participants. Some studies used more than one method, and caregiver reports were either self-reported through interviews or based on KMC charts/diaries. 

No existing framework for categorisation of the methods used to measure KMC duration was found in the reviewed publications, nor was any basis for the choice of the method used provided. Figure 2 illustrates our proposed framework for the categorisation of KMC measurement methods. 

Of the 54 publications that documented the method used to measure KMC duration 29 (54%) used caregiver reports and 17 (32%) used healthcare worker reports. Other methods included independent observation, a combination of healthcare worker and caregiver report, and a combination of electronic device (wearable sensor for determining skin contact), healthcare worker, and caregiver monitoring (Figure 1). 

KMC duration measurement description. Nine (31%) of the 29 publications that used caregiver report described the method used to measure KMC duration. Seven of these 9 publications utilised KMC charts/diaries to report the duration of SSC (20-26), while the remaining 2 mentioned self-report through interviews (27, 28). Four publications (29-32) used more than one method of measuring KMC duration. Of these, 3 (29, 31, 32) compared caregiver report with healthcare worker report and one (30) used healthcare worker report and an electronic monitoring device to 

Page 11 of 41

## **BMJ** Open

monitor skin to skin contact. In the latter study, the device was used in the home setting in combination with caregiver report to evaluate whether it could reliably capture the duration of KMC episodes (30).

Three publications used independent observers (33-35) who were not part of the healthcare team. No publication used video recording to monitor KMC duration although video was used to assess other aspects of SSC, such as mother-baby interaction.

Only 20 (9%) out of 213 publications (20-30, 32-40) with primary data on KMC duration described in detail the measurement method used (Figure 1), and this was in varying degrees of detail (supplementary table 1). Of these 20 publications, 11 (55%) were from LMICs (20, 27, 28, 30, 32-36, 38, 39) and 9 (45%) were from high-income countries (21-26, 29, 31, 40). Nine (45%) out of the 20 publications used caregiver report (Figure 1), of which 7 documented the tool used for monitoring KMC duration (charts) (20-26) and 2 mentioned self-report (supplementary table 1) (27, 28). The majority (64%) of the publications that used caregiver report were conducted in high-income countries (21-26), all of which documented the interval of observations. None of the publications gave a description of how the total or daily KMC duration was computed from the reports/observations (supplementary table 1). 

Three of the 4 publications that used healthcare worker report were conducted in LMICs (36, 38, 39). Only 1 of these 4 documented the tool used for monitoring (38), 3 documented the interval of observations (38-40), and 2 described how the daily KMC duration was calculated (38, 39). 

The 3 publications that combined caregiver and healthcare worker report documented the tool used to measure KMC duration (29, 31, 32), but only 2 documented the interval of observations, and none explained how the daily duration was computed (29, 32). The publication that used a combination of an electronic device, healthcare worker report, and caregiver report documented the interval of monitoring KMC duration but did not document the tool used or how the daily duration was computed (30). The publications that used independent observers documented the interval of observations and described how the daily KMC duration was computed (33-35). 

Validation of the measurement methods BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

None of the publications with primary KMC duration data validated the method used to measure KMC duration. Only 1 publication measured the accuracy of a new device used to monitor skin to skin contact compared to healthcare worker report and caregiver report (30). Direct observation by healthcare workers was used as the reference standard against which an electronic monitoring device was compared for the purposes of accuracy; however, no validation was conducted. Maternal report was used to test the reliability of the electronic device to capture the duration of KMC at home. Four additional publications verified the consistency of measurements but did not undertake validation of the methods used (25, 29, 31, 38). Two of these studies only compared the agreement between the observation by the healthcare workers and the parents without comparing with the set gold standard (29, 31), while the other two only used a second person to verify entries without calculation of the agreement(25, 38). agreent. 

### **BMJ** Open

#### Discussion

In this scoping review, we found 213 publications on KMC of which 54 (25%) documented a method for measuring duration. Only 20 (9%) publications provided a detailed description of the KMC duration measurement method, and none reported validity. Most studies with a detailed description used caregiver report (9, 45%) or healthcare worker report (4, 20%). No framework for categorisation of KMC duration measurement methods was identified, and there was a lack of justification for the choice of method used for individual publications. 

The observation that most studies did not document methods used to assess KMC duration is in accord with a previous systematic review, which found that more than 85% of studies did not include data on observations of KMC practice, and that 45% lacked a description of KMC initiation and stopping criteria (41). Similarly, a most recent review that generated evidence leading to policy change by WHO found that 19% (5 out of 27) of the included studies did not report on duration of KMC(10). 

The lack of reliable measurement for the intervention dose (KMC duration) is an impediment to the evidence when meta-analyses that combine studies with different KMC interpreting measurement methods are used (42, 43). Hence, although it is plausible that higher KMC duration could improve neonatal health outcomes (44, 45), the evidence remains incomplete without more rigorously validated methods for measuring the dose of KMC. This is seen by variations in evidence generated by different reviews where the Cochrane review (2016) found KMC reduction on mortality was only when the daily duration was 20 hours or more(6), while another found significant benefit when daily duration was at least 8 hours(10). There were no published studies on validation of methods used to measure KMC duration. This calls for studies to validate KMC duration measurement methods against a gold standard (a reliable method for continuous monitoring of KMC) to enable accurate data on KMC duration as an exposure, compared to outcomes such as mortality and morbidity. Video recording has been used in skin to skin care studies mainly for short duration like heel pricks procedures where by the camera focuses on the neonate's face not the environment (46, 47). This could be an alternative as a gold standard against which the commonly used methods in KMC studies could be validated. However, for continuous video recording of KMC has ethical challenges like limitations of anonymity, recording other non-research related private experiences of the participants which might cause reluctance of the ethical 

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

committees to allow its use (48). The use of artificial intelligence (AI) platforms like it has been tried in a drug adherence trial could be a best alternative for a gold standard to evaluate the commonly used KMC duration measurement methods (49). This trial utilized visual confirmation of ingestion of the drug by using the AI platform mobile app and the same can be used to confirm skin to skin contact in KMC studies(49).

Although WHO recommends KMC duration of at least 8 hours a day (11), there is limited evidence on the minimum duration of KMC with beneficial clinical effects given that the evidence base used to draw the recommendation found insufficient data on KMC duration less than 8 hours(10). Therefore, standardised operational definitions which could improve this evidence base (41). In addition, our framework could help in guiding the selection and refining of indicators in routine information systems for assessing KMC duration as a marker for the quality of KMC (50). Chan and others have proposed indicators in the KMC measurement framework to include the duration of skin to skin contact (41, 50), and the proposed framework for KMC duration measurement in this review will be helpful for the measurement of this indicator.

# 260 Strength and limitations of the study

# 261 Strengths

This scoping review had several strengths. It followed Joanna Briggs Institute guidelines and was pre-registered on the Open Science Framework, ensuring transparency and methodological rigor. Two independent reviewers were involved, with a third resolving any disagreements, which minimized bias during study selection and data charting. The search strategy was comprehensive, covering both published and grey literature across multiple databases, with no restrictions on language or publication date. This helped reduce publication bias and expanded the scope of the review. Additionally, support from a clinical research specialist and pilot testing ensured accurate data collection and consistent analysis. 

271 Limitations

Page 15 of 41

### **BMJ** Open

The review had several limitations and potential biases. By focusing solely on KMC duration and monitoring, we might have excluded studies on related practices, such as short procedural skin-to-skin care, potentially narrowing the scope and limiting relevant insights. Although the search had no language restrictions, five studies were excluded due to unavailable translations, which could reduce the comprehensiveness of the findings. Additionally, we did not review supplementary materials from included studies might have resulted in the omission of critical information, introducing bias in data interpretation and affecting the overall robustness of the review. These factors may have led to selective inclusion and gaps in the evidence base. 

#### Conclusion

KMC is a high impact intervention for survival of LBW neonates, but there is limited rigorous evaluation on the duration required. Reliable data on the dose response of KMC depends on the reliability of assessing its duration. This scoping review found most studies of KMC duration (91%) did not describe the methods used, and those that did were mainly reliant on caregiver report or healthcare worker report, both of which have limitations. Clarity is needed in reporting KMC duration measurement methods to increase comparability and rigour, and a validation study of gold standard versus caregiver report and healthcare worker report would be of value.

#### **Conflict of interest**

The authors have no conflict of interest declare. 

#### **Ethical approval statement**

No ethical approval or informed consent was sought as this manuscript does not contain any personal or medical information about an identifiable individual. 

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

# 297 Authors' contributions

VST conceptualised the study, wrote the protocol, analysed and interpreted the data, and wrote the first draft of the manuscript. VST, EML, and CJT selected the publications and abstracted the data. MMM, CJT, MN, and JEL interpreted the data and critically revised the manuscript. All authors reviewed the manuscript and approved the final version. VST is responsible for the overall content

302 as the guarantor

304 Acknowledgements

We thank Helen Elwell (Librarian and knowledge clinical research specialist at the British Medical
Association) for the support in conducting the literature search.

Funding statement

This study was supported by a grant from the Joint Global Health Trials scheme of the Department of Health and Social Care, the Foreign, Commonwealth and Development Office, the Medical Research Council, and the Wellcome Trust (MR/S004971/1) awarded to JEL. A grant from the Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health (K23HD092611) awarded to MMM supported her work on this study.

**Data availability statement**Data are available upon reasonable request.

# BMJ Open

2		
3 4	315	References
5	316	1. UNICEF. UN Inter-agency Group for Child Mortality Estimation. Levels and Trends in
6	317	Child Mortality: Report 2023. https://datauniceforg/wp-content/uploads/2024/03/UNICEF-2023-
7	318	Child-Mortality-Report 2023.
8	319	2. Lawn JE, Blencowe H, Oza S, You D, Lee AC, Waiswa P, et al. Every Newborn: progress,
9	320	priorities, and potential beyond survival. The Lancet. 2014;384(9938):189-205.
10		
11	321	
12 13	322	4. Lawn JE, Kinney MV, Belizan JM, Mason EM, McDougall L, Larson J, et al. Born Too
13 14	323	Soon: Accelerating actions for prevention and care of 15 million newborns born too soon.
15	324	Reproductive Health. 2013;10(SUPPL. 1):S6.
16	325	5. English M, Karumbi J, Maina M, Aluvaala J, Gupta A, Zwarenstein M, Opiyo N. The need
17	326	for pragmatic clinical trials in low and middle income settings-taking essential neonatal
18	327	interventions delivered as part of inpatient care as an illustrative example. BMC medicine.
19	328	2016;14(1):5.
20	329	6. Conde-Agudelo A, Díaz-Rossello JL. Kangaroo mother care to reduce morbidity and
21	330	mortality in low birthweight infants. Cochrane Database of Systematic Reviews. 2016(8).
22	331	7. Boundy EO, Dastjerdi R, Spiegelman D, Fawzi WW, Missmer SA, Lieberman E, et al.
23	332	Kangaroo mother care and neonatal outcomes: a meta-analysis. Pediatrics.
24 25	333	2016;137(1):e20152238.
25 26	334	8. Organization WH. Kangaroo mother care: implementation strategy for scale-up adaptable
20	335	to different country contexts. 2023.
28	336	9. WHO IKsg, Arya S, Naburi H, Kawaza K, Newton S, Anyabolu CH, et al. Immediate
29	337	"Kangaroo Mother Care" and Survival of Infants with Low Birth Weight. New England Journal
30	338	of Medicine. 2021;384(21):2028-38.
31	339	10. Sivanandan S, Sankar MJ. Kangaroo mother care for preterm or low birth weight infants:
32		a systematic review and meta-analysis. BMJ Global Health. 2023;8(6):e010728.
33	340	
34	341	11. WHO. Recommendations for care of the preterm or low birth weight infant. Geneva: World
35 36	342	Health Organization. 2022.
30 37	343	12. WHO. Kangaroo mother care: a transformative innovation in health care: global position
38	344	paper. 2023.
39	345	13. M Ludington-Hoe S. Evidence-based review of physiologic effects of kangaroo care.
40	346	Current Women's Health Reviews. 2011;7(3):243-53.
41	347	14. Zengin H, Suzan OK, Hur G, Kolukısa T, Eroglu A, Cinar N. The effects of kangaroo
42	348	mother care on physiological parameters of premature neonates in neonatal intensive care unit: A
43	349	systematic review. Journal of Pediatric Nursing. 2023.
44	350	15. Chan GJ, Labar AS, Wall S, Atun R. Kangaroo mother care: a systematic review of barriers
45	351	and enablers. Bulletin of the World Health Organization. 2016;94(2):130.
46 47	352	16. Group WHOIKS. Impact of continuous Kangaroo Mother Care initiated immediately after
47 48	353	birth (iKMC) on survival of newborns with birth weight between 1.0 to < 1.8 kg: study protocol
49	354	for a randomized controlled trial. Trials. 2020;21(1):280.
50	355	17. Charpak N, Montealegre-Pomar A, Bohorquez A. Systematic review and meta-analysis
51	356	suggest that the duration of Kangaroo mother care has a direct impact on neonatal growth. Acta
52	357	Paediatrica. 2021;110(1):45-59.
53		
54		
55		16
56		10

59 60

Peters MD, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for 18. conducting systematic scoping reviews. International journal of evidence-based healthcare. 2015;13(3):141-6. 19. Foster ED, Deardorff A. Open science framework (OSF). Journal of the Medical Library Association: JMLA. 2017;105(2):203. Jegannathan S, Natarajan M, Solaiappan M, Shanmugam R, Tilwani SA. Quality 20. improvement initiative to improve the duration of Kangaroo Mother Care in tertiary care neonatal unit of South India. BMJ Open Quality. 2022;11(Suppl 1):05. Sahlen Helmer C, Birberg Thornberg U, Frostell A, Ortenstrand A, Morelius E. A 21. Randomized Trial of Continuous Versus Intermittent Skin-to-Skin Contact After Premature Birth and the Effects on Mother-Infant Interaction. Advances in Neonatal Care. 2020;20(3):E48-E56. Tandberg BS, Froslie KF, Flacking R, Grundt H, Lehtonen L, Moen A. Parent-Infant 22. Closeness, Parents' Participation, and Nursing Support in Single-Family Room and Open Bay NICUs. The Journal of perinatal & neonatal nursing. 2018;32(4):E22-E32. Gonya J, Nelin LD. Factors associated with maternal visitation and participation in skin-23. to-skin care in an all referral level IIIc NICU. Acta Paediatrica, International Journal of Paediatrics. 2013;102(2):e53-e6. Flacking R, Thomson G, Ekenberg L, Lowegren L, Wallin L. Influence of NICU co-care 24. facilities and skin-to-skin contact on maternal stress in mothers of preterm infants. Sexual and Reproductive Healthcare. 2013;4(3):107-12. Anderson GC, Chiu S-H, Dombrowski MA, Swinth JY, Albert JM, Wada N. Mother-25. Newborn Contact in a Randomized Trial of Kangaroo (Skin-to-Skin) Care. Journal of Obstetric, Gynecologic, & Neonatal Nursing. 2003;32(5):604-11. Flacking R, Ewald U, Wallin L. Positive Effect of Kangaroo Mother Care on Long-Term 26. Breastfeeding in Very Preterm Infants. JOGNN - Journal of Obstetric, Gynecologic, and Neonatal Nursing. 2011;40(2):190-7. Joshi A, Londhe A, Joshi T, Deshmukh L. Quality improvement in Kangaroo Mother Care: 27. learning from a teaching hospital. BMJ Open Quality. 2022;11(Suppl 1):05. Chavula K, Guenther T, Valsangkar B, Lwesha V, Banda G, Boe Wensaas M, et al. 28. Improving Skin-to-Skin Practice for babies in Kangaroo Mother Care in Malawi through the use of a customized baby wrap: A randomized control trial. PLoS ONE [Electronic Resource]. 2020;15(3):e0229720. 29. Blomqvist YT, Ewald U, Gradin M, Nyqvist KH, Rubertsson C. Initiation and extent of skin-to-skin care at two Swedish neonatal intensive care units. Acta Paediatrica, International Journal of Paediatrics. 2013;102(1):22-8. Rao S, Thankachan P, Amrutur B, Washington M, Mony PK. Continuous, real-time 30. monitoring of neonatal position and temperature during Kangaroo Mother Care using a wearable sensor: a techno-feasibility pilot study. Pilot and feasibility studies. 2018;4:1-7. 31. Oras P BY, Nyqvist KH, Gradin M, Rubertsson C, Hellstrom-Westas L, Funkquist E-L. Skin-to-skin contact is associated with earlier breastfeeding attainment in preterm infants. Acta Paediatrica. 2016;105(7):783-9. 32. Goudard MJF, Lamy ZC, Marba STM, Cavalcante MCV, Dos Santos AM, Azevedo V, et al. Skin-to-skin contact and deaths in newborns weighing up to 1800 grams: a cohort study. Jornal de Pediatria. 2022;98(4):376-82. 

# BMJ Open

Watkins HC, Morgan MC, Nambuya H, Waiswa P, Lawn JE. Observation study showed 33. that the continuity of skin-to-skin contact with low-birthweight infants in Uganda was suboptimal. Acta Paediatrica, International Journal of Paediatrics. 2018;107(9):1541-7. 34. Salim N, Shabani J, Peven K, Rahman QS, Kc A, Shamba D, et al. Kangaroo mother care: EN-BIRTH multi-country validation study. BMC Pregnancy & Childbirth. 2021;21(Suppl 1):231. Adejuyigbe EA, Anand P, Ansong D, Anyabolu CH, Arya S, Assenga E, et al. Impact of 35. continuous Kangaroo Mother Care initiated immediately after birth (iKMC) on survival of newborns with birth weight between 1.0 to < 1.8 kg: study protocol for a randomized controlled trial Trials. 2020;21(1). 36. Brotherton H, Gai A, Kebbeh B, Njie Y, Walker G, Muhammad AK, et al. Impact of early kangaroo mother care versus standard care on survival of mild-moderately unstable neonates <2000 grams: A randomised controlled trial. EClinicalMedicine. 2021;39:101050. Oras P, Blomqvist YT, Nyqvist KH, Gradin M, Rubertsson C, Hellstrom-Westas L, 37. Funkquist E-L. Skin-to-skin contact is associated with earlier breastfeeding attainment in preterm infants. Acta Paediatrica. 2016;105(7):783-9. 38. Soni A, Amin A, Patel DV, Fahey N, Shah N, Phatak AG, et al. The presence of physician champions improved Kangaroo Mother Care in rural western India. Acta Paediatrica, International Journal of Paediatrics. 2016;105(9):e390-e5. Pervin J, Gustafsson FE, Moran AC, Roy S, Persson LA, Rahman A. Implementing 39. Kangaroo mother care in a resource-limited setting in rural Bangladesh. Acta Paediatrica. 2015;104(5):458-65. Feldman R, Eidelman AI. Skin-to-skin contact (Kangaroo Care) accelerates autonomic and 40. neurobehavioural maturation in preterm infants. Developmental medicine and child neurology. 2003;45(4):274-81. Chan GJ, Valsangkar B, Kajeepeta S, Boundy EO, Wall S. What is kangaroo mother care? 41. Systematic review of the literature. Journal of Global Health. 2016;6(1):010701. 42. Lawn JE, Mwansa-Kambafwile J, Horta BL, Barros FC, Cousens S. 'Kangaroo mother care'to prevent neonatal deaths due to preterm birth complications. International journal of epidemiology. 2010;39(suppl 1):i144-i54. Conde-Agudelo A. Belizán JM. Diaz-Rossello J. Cochrane Review: Kangaroo mother care 43. to reduce morbidity and mortality in low birthweight infants. Evidence-Based Child Health: A Cochrane Review Journal. 2012;7(2):760-876. Udani RH, VR A, Kabra NS, Nanavati RN. Impact of duration of kangaroo mother care on 44. growth in high risk preterm and low birth weight infants. Journal of Neonatology. 2013;27(3):1-9. 45. Charpak N, Montealegre-Pomar A, Bohorquez A, Systematic review and meta-analysis suggest that the duration of Kangaroo mother care has a direct impact on neonatal growth. Acta paediatrica (Oslo, Norway : 1992). 2020. Nimbalkar SM, Chaudhary NS, Gadhavi KV, Phatak A. Kangaroo mother care in reducing 46. pain in preterm neonates on heel prick. The Indian journal of pediatrics. 2013;80:6-10. Johnston CC, Filion F, Campbell-Yeo M, Goulet C, Bell L, McNaughton K, et al. 47. Kangaroo mother care diminishes pain from heel lance in very preterm neonates: a crossover trial. BMC pediatrics. 2008;8:1-9. 

BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies rasmushogesc

Scott M, Watermeyer J, Wessels TM. Video-recording complex health interactions in a 48. diverse setting: Ethical dilemmas, reflections and recommendations. Developing World Bioethics. 2020;20(1):16-26. 49. Bain EE, Shafner L, Walling DP, Othman AA, Chuang-Stein C, Hinkle J, Hanina A. Use of a novel artificial intelligence platform on mobile devices to assess dosing compliance in a phase 2 clinical trial in subjects with schizophrenia. JMIR mHealth and uHealth. 2017;5(2):e7030. Guenther T, Moxon S, Valsangkar B, Wetzel G, Ruiz J, Kerber K, et al. Consensus-based 50. approach to develop a measurement framework and identify a core set of indicators to track implementation and progress towards effective coverage of facility-based Kangaroo Mother Care. Journal of global health. 2017;7(2). for oper teries only For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml 

Page 21 of 41	BMJ Open	cted by			
1 2		cted by copyright, including for uses related to text and data mining, Al training, and similar technolog			
3		nt, ir			
4 5					
6		ding	ĺ		
7		g fon			
8 9		r us			
10		Jan es r	-		
11		elat			
12		asm ed t	s		
13 14		to te			
15		Xt	2		
16		and			
17		100 dat			
18 19		a – eq m	- 		
20		inin			
21		۱ <u>9</u> , ۱			
22					
23 24		ain	- -		
25		ing,			
26		ano	•	 	
27			•		
28 29		mila			
30		n te	•		
31		Al training, and similar technologies	•		
32					
33 34		-			
34 35		≥uzo es.		 	
36		at			
37		Dep	,		
38 39					
39 40		nen	1		
41		i G		20	
42					
43 44		- I A	!		
44	For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml				
46					
47					

	BMJ Open	o.1136/bmjopen-2023-079579 Incted by copyright, including	Page 22	of 41
1		omjope / copy		
2		₽n-2 righ	,	
3 4		t, in		
5		-079		
6		9579 ding		
7		g for		
8 9		. 22 . us	8	
9 10		22 Jar uses I	•	
11		relar		
12		ted		
13		nus to t		
14 15		Jahuary 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 203 Erasmushogeschool . es related to text and data mining, Al training, and similar technologies.	۱	
16		)wn		
17				
18		tar		
19 20		nini		
20		ng,		
22		A t		
23	er review only	rair		
24 25		ning		
25		, ar		
27		s pu		
28		ini S		
29		lari		
30 31		on ,		
32		Juno		
33		e 8, logi	,	
34		2025 les.		
35		5		
36 37		Ť D		
38		epai		
39		rtm		
40		ent	21	
41		GE	21	
42 43		at Department GEZ-LTA		
44		TA		
45	For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml			
46				
47				

2	
3	
4	
5	
6	
6 7	
, 0	
8	
9	
10	
11	
12	
12 13	
14	
15	
16	
17	
18	
19	
20	
21	
20 21 22 23	
22	
24	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	
43	
43 44	
44	
46	
47	
48	
49	
50	
51	
52	
53	
54	
55	
56	
57	
58	
59	
22	

· Z .	
2	_
O	

2	
0	

	$\sim$
	Ľ.
	2
	O
	2/

**BMJ** Open

	-	

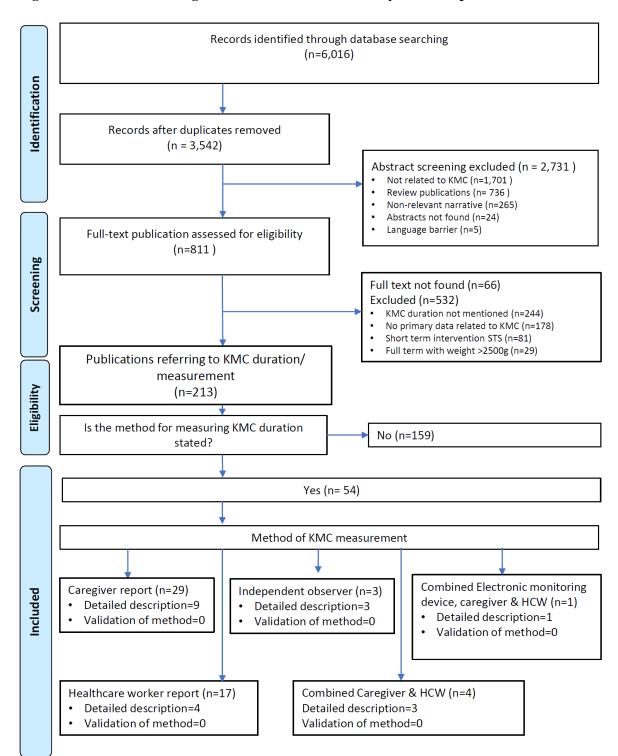
Protected by copyright, including for uses re	
5	
related to text and data mining,	Erasmushogeschool .
ext and data mining, Al training	rasmushog
ext and data mining,	rasmushog

0	
2	
O	



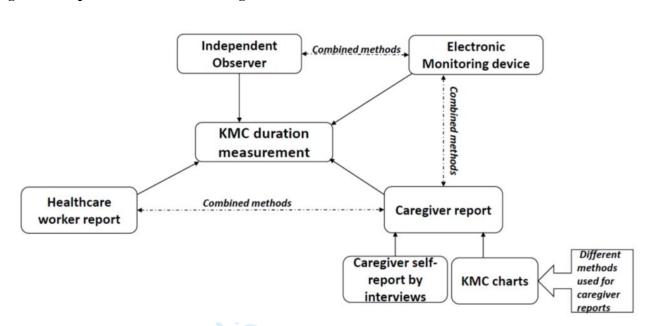
BMJ Open: first published as 10.1136/bmjopen-2023-079579 on 22 January 2025. Downloaded from http://bmjopen.bmj.com/ on June 8, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

	<b>I</b>
2	
	27
	27
For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml	



### Figure 1: PRISMA flow diagram of search results and study inclusion process

KMC=Kangaroo Mother Care, STS=Skin to Skin, HCW=Health care worker



# Figure 2. Proposed framework for categorisation of KMC measurement methods.

Commonly used methods to measure duration of KMC (Kangaroo Mother Care), (\* ----->) = methods used in combination, caregiver reports use self-report or KMC charts and independent observers can be healthcare workers or non-healthcare workers.

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

2	
3 4	
5 6	
7 8	
9 10	
11	
12 13	
14 15	
16 17	
18 19	
20	
21 22	
23 24	
25 26	
27 28	
29 30	
31	
32 33	
34 35	
36 37	
38 39	
40 41	
42	
43 44	
45 46	
47 48	
49 50	
51 52	
53	
54 55	
56 57	
58 59	
60	

	Ovid MEDLINE(R)	Results
	Date: 22/11/2022	per line
	infant, low birth weight/ or infant, small for gestational age/ or infant, very low birth weight/ or	89966
l	infant, extremely low birth weight/ or infant, premature/ or infant, extremely premature/	
	(low birth weight or small for gestational age or small gestational age or small for date infants	
	or low birth weight or premature infant\$ or premature neonate\$ or prematurity or preterm	123783
	infant\$ or preterm neonate\$ or premature babies or preterm babies or premature baby or preterm	125765
2	baby or premature newborn\$ or preterm newborn\$).mp.	
3	Premature Birth/	19559
1	(preterm birth\$ or premature birth\$).mp.	35716
5	shorter gestation.mp.	229
5	preterm pregnancy.mp.	132
7	(sga or lbw or vlbw).mp.	18124
3	or/1-7	164261
Ð	Kangaroo-Mother Care Method/	688
10	(kangaroo mother care or kangaroo care).mp.	1265
11	skin to skin.mp.	7174
12	or/9-11	7943
13	8 and 12	1106
14	((monitor\$ or measur\$ or adher\$) adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.	374
15	(duration adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.	151
16	or/13-15	1549

1       2         3	1 2	
10       2         11       2         12       13         14       15         16       17         18       19         19       3         20       21         21       4         22       4         23       2         24       5         25       6         27       26         28       7         30       31         31       8         32       33         33       9         34       10         37       11         39       40         40       12         41       14         45       14         46       14         47       15         48       14         45       16         52       53         54       17         55       56         57       58         59       16	3 4 5 6	
10       2         11       2         12       13         14       15         16       17         18       19         19       3         20       21         21       4         22       4         23       2         24       5         25       6         27       26         28       7         30       31         31       8         32       33         33       9         34       10         37       11         39       40         40       12         41       14         45       14         46       14         47       15         48       14         45       16         52       53         54       17         55       56         57       58         59       16	7 8 0	1
13       14         15       16         17       18         19       3         20       4         23       4         24       5         26       6         27       6         28       7         30       31         31       8         32       9         34       9         35       10         37       1         38       11         39       40         40       12         41       13         44       14         45       16         52       53         54       17         55       56         57       58         59       59	10 11	2
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	13 14 15	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	17 18	3
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	20 21	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	23	4
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	25	5
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	27	6
31       8         32       9         33       9         34       10         35       10         36       10         37       11         39       40       12         40       12         41       13         42       13         43       14         45       14         46       15         47       15         48       19         50       16         52       53         54       17         55       56         57       58         59       59	29	7
33       9         34       10         35       10         36       17         38       11         39       12         40       12         41       13         42       13         43       14         45       14         46       15         47       15         48       15         50       16         52       53         54       17         55       56         57       58         59       59	31	8
36       10         37       11         39       40         40       12         41       13         42       13         43       14         45       14         46       15         48       19         50       16         52       53         54       17         55       56         57       58         59       59	33 34	9
38       11         39       12         40       12         41       13         42       13         43       14         45       14         46       15         47       15         48       16         50       16         52       53         54       17         55       56         57       58         59       59	36	10
40       12         41       13         42       13         43       14         45       14         46       15         47       15         48       16         50       16         52       53         54       17         55       56         57       58         59       59	38	11
42     13       43     14       45     14       46     47       47     15       48     49       50     51       51     16       52     53       53     17       55     56       57     58       59     59	40	12
45       14         46       15         47       15         48       9         50       16         52       53         53       17         55       56         57       58         59       59	42 43	13
47 15 48 49 50 51 16 52 53 54 17 55 56 57 58 59	45	14
51       16         52       53         53       17         55       56         57       58         59       59	47 48 49	15
54 17 55 56 57 58 59	51 52	16
57 58 59	54 55	17
	57 58 59	

	Results
Date: 22/11/2022	per line
low birth weight/ or small for date infant/	56972
very low birth weight/ or extremely low birth weight/	17072
(low birth weight or small for gestational age or small gestational age or small for date	
infant\$ or low birth weight or premature infant\$ or premature neonate\$ or prematurity or	
preterm infant\$ or preterm neonate\$ or premature babies or preterm babies or premature	
baby or preterm baby or	
premature newborn\$ or preterm newborn\$).mp.	202428
prematurity/	119803
(preterm birth\$ or premature birth\$).mp.	41903
shorter gestation.mp.	289
preterm pregnancy.mp.	204
(sga or lbw or vlbw).mp.	27042
or/1-8	225402
kangaroo care/	1724
(kangaroo mother care or kangaroo care).mp.	2070
skin to skin.mp.	10333
or/10-12	11652
9 and 13	1594
((monitor\$ or measur\$ or adher\$) adj10 (kangaroo mother care or kangaroo care or "skin	540
to skin")).mp.	
(duration adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.	216
or/14-16	2217
	Date: 22/11/2022 low birth weight/ or small for date infant/ very low birth weight/ or extremely low birth weight/ (low birth weight or small for gestational age or small gestational age or small for date infant\$ or low birth weight or premature infant\$ or premature neonate\$ or prematurity or preterm infant\$ or preterm neonate\$ or premature babies or preterm babies or premature baby or preterm baby or premature newborn\$ or preterm newborn\$).mp. prematurity/ (preterm birth\$ or premature birth\$).mp. shorter gestation.mp. preterm pregnancy.mp. (sga or lbw or vlbw).mp. or/1-8 kangaroo care/ (kangaroo mother care or kangaroo care).mp. skin to skin.mp. or/10-12 9 and 13 ((monitor\$ or measur\$ or adher\$) adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp. (duration adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.

	APA PsycInfo	Results
	Date: 22/11/2022	per line
1	Birth Weight/	3453
	(low birth weight or small for gestational age or small gestational age or small for	
	date infant\$ or low birth weight or premature infant\$ or premature neonate\$ or	
	prematurity or preterm infant\$ or preterm neonate\$ or premature babies or preterm	
	babies or premature baby or preterm baby or	
2	premature newborn\$ or preterm newborn\$).mp.	10046
3	premature birth/	6254
4	(preterm birth\$ or premature birth\$).mp.	7931
5	shorter gestation.mp.	42
6	preterm pregnancy.mp.	2
7	(sga or lbw or vlbw).mp.	2008
8	or/1-7	13930
9	(kangaroo mother care or kangaroo care).mp.	183
10	skin to skin.mp.	519
11	or/9-10	615
12	8 and 11	187
	((monitor\$ or measur\$ or adher\$) adj10 (kangaroo mother care or kangaroo care or	
	"skin to skin")).mp.	
13		56
14	(duration adj10 (kangaroo mother care or kangaroo care or "skin to skin")).mp.	21
15	or/12-14	249

	Database of Systematic Reviews (CDSR)	per line
	Date: 22/11/2022	
#1	MeSH descriptor: [Infant, Low Birth Weight] explode all trees	2338
#2	MeSH descriptor: [Infant, Premature] explode all trees	4277
#3	"low birth weight" or "small for gestational age" or "small gestational age" or "small fo date" NEXT infant* or "low birth weight" or premature NEXT infant* or premature NEXT neonate* or prematurity or preterm NEXT infant* or preterm NEXT neonate* o "premature babies" or "preterm babies" or "premature baby" or "preterm baby" o premature NEXT newborn* or preterm NEXT newborn*	r
#4	MeSH descriptor: [Premature Birth] this term only	1814
#5	preterm NEXT birth* or premature NEXT birth*	4614
#6	"shorter gestation"	11
#7	"preterm pregnancy"	26
#8	sga or lbw or vlbw	3218
#9	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8	22856
#10	MeSH descriptor: [Kangaroo-Mother Care Method] this term only	111
#11	"kangaroo mother care" or "kangaroo care"	651
#12	"skin to skin contact" or "skin to skin care"	547
#13	#10 or #11 or #12	1002

1 2 3 4	
5 6 7 8 9	
1 1 1 1	0 1 2 3 4
1 1 1 1	5 6 7 8
2 2	0 1 2 3
2	4 5 6 7 8
2 3 3 3	9 0 1 2
3 3 3 3	4 5 6
3 3	8 9 0 1
4 4 4 4	3 4 5 6
4 4 5 5	8 9 0
5 5 5 5	2 3 4 5
5 5 5 6	7 8 9

Clinicaltrials.gov	R	Results
Date: 18/11/2022		
kangaroo OR "skin to skin"	1	19

WHO Intern	national Clinical Trials Registry Platform (ICTRP)	Results
Date: 18/11/	2022	
kangaroo		203

The ISRCTN registry	Results
Date: 21/11/2022	
Kangaroo <u>https://www.isrctn.com/search?q=kangaroo</u> +	12
· L.	

Latin American and Caribbean Ho	ealth Sciences Literature (LILACS)	Results
Date: 21/11/2022	2	
Kangaroo	0	315

MedRxiv	J.	Results
Date: 21/11/2022		
"skin to skin"		166

Results
9

Open Grey libraries, references from relevant systematic reviews and web	sites of Resul
the Kangaroo Foundation	
Date: 21/11/2022	
Open Grey libraries:	175
search term "skin to skin"	
AND	
Search terms Kangaroo care or kangaroo unit*	
References and google scholar:	
"kangaroo mother care" or "kangaroo care"	
OR	
"skin to skin contact" or "skin to skin care"	

Page	37	of	41
------	----	----	----

1	
$\begin{array}{c} 2\\ 3\\ 4\\ 5\\ 6\\ 7\\ 8\\ 9\\ 10\\ 11\\ 12\\ 13\\ 14\\ 15\\ 16\\ 17\\ 18\\ 19\\ 20\\ 21\\ 22\\ 23\\ 24\\ 25\\ 26\\ 27\\ 28\\ 29\\ 30\\ 31\\ 32\\ 33\\ 4\\ 35\\ 36\\ 37\end{array}$	
3 4	
5	
6 7	
7 8	
9	
10	
12	
13	
14	
16	
17	
18	
20	
21	
22	
24	
25	
26 27	
28	
29	
30 31	
32	
33	
34	
36	
37	
38 39	
40	
41	
42 43	
44	
45	
46 47	
4/	

able 1. Publica	tions with a detailed de	scription of KMC		MJ Open rement	cted by copyright, including for	. 1136/bm jopen-2023
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Method details	Comments
M. J. F. Goudard; 2022	Skin-to-skin contact and deaths in new- borns weighing up to 1800 grams: a cohort study	Observational study; 405	Brazil	Caregiver & Healthcare worker	SSC time was recorded on cards by the health team at the beginning then, parents performed the registration, under the supervise of healthcare workers.	<ul> <li>Mention of data collection tool used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented</li> </ul>
S. Jegannathan; 2022	Quality improvement initiative to improve the duration of Kangaroo Mother Care in tertiary care neonatal unit of South India	Observational study; 86	India	Caregiver report (KMC charts)	KMC Charts were given to KMC oges chool mothers to mark daily hours of a chool to the second	<ul> <li>Mention of data collection tool used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented</li> </ul>
A. Joshi; 2022	Quality improvement in Kangaroo Mother Care: learning from a teaching hospital	Observational study; 86	India: NICU level unknown	Caregiver report (self- report)	The nurse noted the previous day's, KMC hours and other information as reported by the mother.	<ul> <li>Mention of data collection tool</li> <li>used to record KMC duration.</li> <li>Interval of observation</li> <li>documented.</li> <li>Calculation of daily KMC</li> <li>duration documented.</li> </ul>
Nahya Salim; 2021	Kangaroo mother care: EN-BIRTH multi-country validation study	Observational study; 840	Tanzania, Napal & Bangladesh	Independent observer	of KMC hourly in some settings and 12-hourly in other settings	<ul> <li>Mention of data collection tool used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented.</li> <li>8</li> </ul>

total or daily KMC duration was calculated from the observations \$\vec{D}\$ = Yes \$\vec{D}\$ = No. KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Nevro Birth Indicators

Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver rtment GEZ-LTA

			sted by cop	Page Page		
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Cted by copyright, or copyright, includin	G -2023 Comments -2079 57
E. A. Adejuyigbe; 2021	Impact of continuous Kangaroo Mother Care initiated immediately after birth on survival of newborns with birth weight between 1.0 to < 1.8 kg	RCT; 4200	Ghana, Tanzania, Malawi, Nigeria & India	Independent observer	Information on the duration of SC contact and the duration of hospital stay was collected by research ses assistants	used to record KMC duration.
H. Brotherton; 2021	Impact of early kangaroo mother care versus standard care on survival of mild- moderately unstable new-borns <2000 grams	RCT; 279	The Gambia: NICU level not specified	Healthcare worker report	Research nurses observed and recorded KMC duration and position. Documented timing objects and reason for coming out of Kave position.	documented. □ Interval of observation
K. Chavula; 2020	Improving Skin-to- Skin Practice for new- borns in Kangaroo Mother Care in Malawi through the use of a customized baby wrap: A randomized control trial	RCT; 301	Malawi; NICU level II	Caregiver report (self- report)	Mothers reported practicing S post-discharge & duration more than half the day and more than that the night post-discharge.	documented. Calculation of daily KMC duration documented
C. Sahlen Helmer; 2020	A Randomized Trial of Continuous Versus Intermittent Skin-to- Skin Contact After Premature Birth and the Effects on Mother- Infant Interaction	RCT; 31	Sweden; NICU level unknown	Caregiver report (KMC charts)	Parents in continuous SSC documented who provided SSC and whether they were off SSC for any reason. Parents in the intermittent group registered when and for bow long they provided SSC.	<ul> <li>Interval of observation</li> <li>documented.</li> <li>□ Calculation of daily KMC</li> <li>duration documented.</li> </ul>

Detailed methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the observations and, 3) how the total or daily KMC duration was calculated from the observations  $\square =$ Yes  $\square =$ No. at

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every New Born Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver

For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml

	BMJ Open								
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Cted by copyright, including Method details	٠ ٠			
B.S. Tandberg; 2018	Parent-Infant Closeness, Parents' Participation, and Nursing Support in Single-Family Room and Open Bay NICUs	Observational; 64	Norway: NICU level unknown	Caregiver report (KMC chart)	Parents recorded the duration of SSC care in a KMC diary. Diary entries were made daily for the 14 days following inclusion in the study. Parents reported hour by hour during these 14 days.	used to record KMC due			
S. Rao; 2018	Continuous, real-time monitoring of neonatal position and temperature during Kangaroo Mother Care using a wearable sensor: a techno-feasibility pilot study	Observational; 12	India: NICU level III	Electronic monitoring device, healthcare worker's direct observation & Maternal self-report	Baby's position captured as presence of "touch" between the device and the skin of baby/mother was compared against reported observed KMC episodes". In the hospital, the research nurse annotated the starting and ending times of KMC by direct observation. At home KMC duration was self-reported by the mother. Direct observation was the "reference standard" in the hospital against which the device was compared for purposes of validation.	used to record KMC dur Interval of observation documented. Calculation of daily I duration documented			

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Netborn Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver partner

			В	MJ Open	cted by copyright Method details	Page Page Comments		
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Ght, including	Comments		
H.C. Watkins; 2018	Observation study showed that the continuity of skin-to- skin contact with low-birthweight infants in Uganda was suboptimal	Observational; 12	Uganda: NICU level II	Independent observer	Continuous observation of infagts began after birth and up to day 2 of life, discharge, or death, which ver came first. The total duration of hours spent in SSC was calculated by adding together the duration of all individual SSC sessions on day. If an infant received at leas hours of SSC, it was considered continuous KMC, and any fewer hours of SSC per day was documented as intermittent KMC	used to record KMC duration. ☐ Interval of observation documented. ☑ Calculation of daily KMC duration documented		
P. Oras; 2016	Skin-to-skin contact is associated with earlier breastfeeding attainment in preterm infants	Observational; 104	Sweden: NICU level III	Caregiver report & healthcare worker	Skin to skin duration was recorded by the parents or by staff on a detailed form. Median daily S duration was the data used for the study.	<ul> <li>Mention of data collection tool used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented</li> </ul>		
A. Soni; 2016	The presence of physician champions improved Kangaroo Mother Care in rural western India	Observational; 648	India: NICU level II	Healthcare worker report	Nursing staff documented KM duration using a standardized form & recorded information for eight tays The charts were incorporated into the neonate's medical notice updated daily by the nurses and	Mention of data collection tool used to record KMC duration.		

Detailed methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the severations and, 3) how the total or daily KMC duration was calculated from the observations = Yes = No.

Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver Department GEZ-LTA

Page 41 of 41

		ted by	138 80/h			
					cted by copyrig	
First author year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Cted by copyright, including	Comments
J. Pervin; 2015	Implementing Kangaroo mother care in a resource- limited setting in rural Bangladesh	Observational; 423	Bangladesh: NICU level I	Healthcare worker report	Nursing attendants noted the beginning and end of every skip-to skin contact session and calculated skin-to-skin contact time for each session. The times of each session in the 24h period was added together to determine total skin skin contact duration per day.	used to record KMC duration. ☑ Interval of observation documented. ☑ Calculation of daily KMC duration documented
J. Gonya; 2013	Factors associated with maternal visitation and participation in skin- to-skin care in an all- referral level IIIc NICU	Observational; 32	USA: NICU level III	Caregiver report (KMC chart)	A log was provided to mothers was recorded when they visited the <b>D</b> small baby NICU, if they participated in SSC, how long participated in SSC, and if ther <u>B</u> were any issues involved in the <u>B</u> SSC process.	Mention of data collection to
Y.T. Blomqvist; 2013	Initiation and extent of skin-to-skin care at two Swedish neonatal intensive care units	Observational; 104	Sweden: NICU level III	Caregiver report & healthcare worker	Time of initiation of SSC and who provided this care were recorded continuously in the infants' medica charts by either the parents or the NICU staff. The reliability of parents' registrations of the time spent with SSC had been assessed prior to the study.	used to record KMC duration. ☑ Interval of observation documented. □ Calculation of daily KMC duration documented.

Detailed methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the observations and, 3) how the total or daily KMC duration was calculated from the observations  $\square =$ Yes  $\square =$ No.

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Newborn Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver artment GEZ-LTA



Page 42 of 41

aj

	BMJ Open					Page Page Comments
First author, year	Publication title	Study design & sample size	Setting: country; level of NICU	Method for KMC duration	Method details	Comments
R. Flacking; 2013	Influence of NICU co-care facilities and skin-to-skin contact on maternal stress in mothers of preterm infants	Mixed methods feasibility study; 300	Sweden: NICU level III	Caregiver report (KMC chart)	Caregivers provided KMC duration self-reports using calendars. Parents marked the initiation and ending of each SSC episode. At the end of the 2-week period, the nurse revision the mother, collected the calendar and provided a new calendar for	used to record KMC duration. ☐ Interval of observation documented. ☐ Calculation of daily KMC duration documented
R. Flacking; 2011	Positive Effect of Kangaroo Mother Care on Long-Term Breastfeeding in Very Preterm Infants	Observational; 300	Sweden: NICU level unknown	Caregiver report (KMC chart)	KMC data gathered through setting reports by caregivers in the formation of calendars. Parents marked the initiation and ending of each slope to-skin episode rounded to the model nearest 5- or 10-minute intervation	<ul> <li>Mention of data collection tool used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented.</li> </ul>
G.C. Anderson; 2003	Mother-Newborn Contact in a Randomized Trial of Kangaroo (Skin-to- Skin) Care	RCT; 91	USA: NICU level unknown	Caregiver report (KMC chart)	Contact logs used to document KMC duration (when the contact began and ended) & by whom. Caregivers completed the contact log and researcher verified each entry with the mothers at the end of each 8-hour shift.	<ul> <li>Mention of data collection tool used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented</li> </ul>
R. Feldman; 2003	Skin-to-skin contact (Kangaroo Care) accelerates autonomic and neuro- behavioural maturation in preterm infants	Observational; 70	Israel: NICU level unknown	Healthcare worker report	by the nurses who recorded the exact times when the mothers and infants remained in skin-to-sking contact and when the infant returned to standard incubator when	<ul> <li>Mention of data collection too used to record KMC duration.</li> <li>Interval of observation documented.</li> <li>Calculation of daily KMC duration documented.</li> </ul>

Detailed methodological description of; 1) tools used to document KMC duration monitoring, 2) the interval of the observations and, 3) how the total or daily KMC duration was calculated from the observations D = Yes = No.

KMC=Kangaroo Mother Care, KC= Kangaroo Care, NICU= Neonatal Intensive Care Unit, EN-BIRTH= Every Newborn Birth Indicators Research Tracking in Hospitals, STS=Skin to Skin, SSC=Skin-to-skin care, HCW=Health care worker, CG=Caregiver GEN-