**Table S1.** Checklist of Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

|  |  |  |  |
| --- | --- | --- | --- |
| **Section/topic** | **#** | **Checklist item** | **Reported on page No.** |
| **TITLE** | | |  |
| Title | 1 | Identify the report as a systematic review, meta-analysis, or both. | 4 |
| **ABSTRACT** | | |  |
| Structured summary | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. | 3 |
| **INTRODUCTION** | | |  |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. | 4 |
| Objectives | 4 | Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). | 4 |
| **METHODS** | | |  |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. | 5 |
| Eligibility criteria | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | 5 |
| Information sources | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | 4-5 |
| Search | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. | 5 |
| Study selection | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | 5 |
| Data collection process | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | 5 |
| Data items | 11 | List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. | 5-6 |
| Risk of bias in individual studies | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. | 5 |
| Summary measures | 13 | State the principal summary measures (e.g., risk ratio, difference in means). | 6 |
| Synthesis of results | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I2) for each meta-analysis. | 5-6 |

**Table S2.** Systematic search of the literature related to interpregnancy interval and risk of perinatal death, by search engine.

|  |  |  |
| --- | --- | --- |
| **Search Engine** | **Search String** | **Number of articles returned** |
| EMBASE (Ovid) | (interpregnancy interval\* or birth spacing or child spacing or birth interval\* or pregnancy interval\*).mp. AND (stillbirth or neonatal death or perinatal death or fetal death or perinatal mortality or fetal mortality).mp. | 235 |
| PubMed/Medline | ((stillbirth[MeSH Subheading]) OR stillbirth[Title/Abstract/Keyword] OR (neonatal death)[Title/Abstract/Keyword]) OR (perinatal death)[Title/Abstract/Keyword]) OR (fetal death)[MeSH Subheading]) OR (fetal death)[Title/Abstract/Keyword] OR (perinatal mortality)[Title/Abstract/Keyword]) OR (fetal mortality)[Title/Abstract/Keyword]) AND ((interpregnancy interval\*)[Title/Abstract/Keyword]) OR (birth spacing)[Title/Abstract/Keyword]) OR (child spacing)[Title/Abstract/Keyword]) OR (birth interval)[MeSH Terms] OR (birth interval\*)[Title/Abstract/Keyword]) OR (pregnancy interval)[MeSH Terms] OR (pregnancy interval\*)[Title/Abstract/Keyword]) | 276 |
| Scopus | (TITLE-ABS-KEY ( "interpregnancy interval" ) OR TITLE-ABS-KEY ( "birth spacing" ) OR TITLE-ABS-KEY ( "child spacing" ) OR TITLE-ABS-KEY ( "birth interval" ) OR TITLE-ABS-KEY ( "pregnancy interval" ) ) AND ( TITLE-ABS-KEY ( stillbirth\* ) OR TITLE-ABS-KEY ( "neonatal death" ) OR TITLE-ABS-KEY ( "perinatal death" ) OR TITLE-ABS-KEY ( "fetal death" ) OR TITLE-ABS-KEY ( "perinatal mortality" ) OR TITLE-ABS-KEY ("fetal mortality")) | 354 |
| **Total** | | **865** |

**Table S3**. Guidance for Reporting Involvement of Patients and the Public Short Form (GRIPP2-SF) checklist.

|  |  |  |
| --- | --- | --- |
| **Section and topic** | **Item** | **Reported on page No.** |
| 1: Aim | Report the aim of PPI in the study | N/A |
| 2: Methods | Provide a clear description of the methods used for PPI in the study | N/A |
| 3: Study results | Outcomes—Report the results of PPI in the study, including both positive and negative outcomes | N/A |
| 4: Discussion and conclusions | Outcomes—Comment on the extent to which PPI influenced the study overall. Describe positive and negative effects | 9 |
| 5: Reflections/critical perspective | Comment critically on the study, reflecting on the things that went well and those that did not, so others can learn from this experience | 14-15 |

PPI=patient and public involvement

**Table S4.** Summary of studies evaluating the association between interpregnancy interval and perinatal death.

| **Author(s), Year** | **Year(s) of births included** | **Country** | **Study Design** | **Interpregnancy interval (exposure) measurement** | **Perinatal death (outcome) measurement** | **Outcome of preceding birth** | **Sample Size** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Agarwal *et al*, 1998 | 1988-1992 | India | Prospective cohort study | Prospective follow-up of cohort of women until two consecutive missed periods. | Stillbirth at ≥28 weeks | Any outcome | 8,111 births |
| Carmichael *et al*, 2019 | 2007-2011 | United States | Retrospective cohort study | Estimated from consecutive birth registrations. No further definition provided. | Stillbirth at 20-25 weeks | Any outcome | 2,492,078 births |
| Cecatti *et al*, 2008 | 1986-2000 | Brazil | Retrospective cohort study | Estimated as time between previous delivery and the start of the next pregnancy based on hospital medical records. Start of next pregnancy was derived by subtracting gestational age (estimated by somatic evaluation using Capurro or New Ballard method and LMP when such information was not available) from date of birth. | Stillbirth at ≥22 weeks | Any outcome at ≥22 weeks | 14,930 births |
| Chen *et al*, 2015 | 1999-2007 | Canada | Retrospective cohort study | Estimated from linked birth registration data as time between previous date of birth and estimated start of next pregnancy (derived by subtracting gestational age from date of birth). | Stillbirth and early neonatal death (no gestational age given) | Any outcome | 46,243 births |
| Cofer *et al*, 2016 | 2007-2009 | United States | Retrospective cohort study | Estimated as time from date of previous birth and start of next pregnancy based on linked birth registration and patient discharge data | Stillbirth at ≥20 weeks | Live birth | 645,529 births |
| Conde-Agudelo *et al*, 2000 | 1985-1997 | Uruguay, Argentina, Peru, Colombia, Honduras, Paraguay, El Salvador, Chile, Bolivia, Costa Rica, Panama, Dominican Republic, Nicaragua, Brazil, Ecuador, Mexico, Bahamas, Venezuela | Retrospective cohort study | Estimated as time between date of previous birth and start of next pregnancy based on LMP. Data were collected from a prospective registry of antenatal and perinatal care. | Stillbirth at ≥20 weeks | Any outcome at ≥20 weeks | 837,232 births |
| Conde-Agudelo *et al*, 2005 | 1985-2004 | Uruguay, Argentina, Peru, Colombia, Honduras, Paraguay, El Salvador, Chile, Bolivia, Costa Rica, Panama, Dominican Republic, Nicaragua, Brazil, Ecuador, Mexico, Bahamas, Belize, Venezuela | Retrospective cohort study | Estimated as time between date of previous birth and start of next pregnancy based on LMP. Data were collected from a prospective registry of antenatal and perinatal care. | Stillbirth at ≥20 weeks | Any outcome at ≥20 weeks | 1,125,430 births |
| Davanzo *et al*, 2007 | 1982-2002 | Bangladesh | Retrospective cohort study | Estimated as the number of months between date of previous birth and the start of the next pregnancy based on LMP. Data were collected using prospective community follow-up. | Stillbirth at ≥28 weeks | Induced abortion | 510 births |
| Spontaneous abortion | 2,537 births |
| Stillbirth | 1,331 births |
| Live birth | 33,743 births |
| Davanzo *et al*, 2012 | 1977-2008 | Bangladesh | Prospective cohort study | Estimated as the number of months between date of previous birth and the start of the next pregnancy based on either LMP or estimated gestation minus date of birth. Data were collected using prospective community follow-up. | Stillbirth at ≥28 weeks | Spontaneous abortion | 10,453 births |
| El Behery *et al*, 2013 | 2009-2012 | Egypt | Prospective cohort study | Time interval between occurrence of previous abortion (based on positive urine or serum pregnancy test) or hospital admission date for previous abortion and estimated date of conception (based on sonograph determined gestation subtracted from date of birth). | Stillbirth (no gestational age given) | Spontaneous abortion | 4,619 births |
| Fedrick & Adelstein, 1973 | 1958 | United Kingdom | Retrospective cohort study | Estimated by subtracting date of previous birth from LMP derived from personal interview. | Stillbirth (no gestational age given) and neonatal death (no age given) | Any outcome (excluding ectopic or molar pregnancies) | 24,111births |
| Hathout *et al*, 1982 | 1982 | Kuwait | Retrospective cohort study | Estimated as time from previous birth to beginning of next pregnancy based on self-report during personal interview. No further information given. | Stillbirth (no gestational age given) | Live birth | 2,053 births |
| Spontaneous abortion | 219 births |
| Stillbirth | 60 births |
| Hegelund *et al*, 2018 | 1994-2010 | Denmark | Retrospective cohort study | Estimated as time from woman’s first live birth and conception of next pregnancy based on birth registry data. | Stillbirth at ≥22 weeks | Live birth | 261,247 births |
| Love *et al,*  2010 | 1981-2000 | Scotland | Retrospective cohort study | Estimated as time between hospital record for end of previous pregnancy and conception of next pregnancy (derived as estimated number of weeks’ gestation subtracted from the date of delivery) as recorded in hospital inpatient data. | Stillbirth (No gestational age given) | Spontaneous abortion | 30,937 births |
| Mahande & Obure, 2016 | 2000- 2010 | Tanzania | Retrospective cohort study | Estimated as the time between beginning of first pregnancy and date of LMP of subsequent pregnancy as measured by linked hospital medical records and questionnaire administered after delivery. | Stillbirth at ≥28 weeks and death <7 days after birth | Any outcome at ≥28 weeks | 17,030 births |
| Makhlouf *et al*, 2014 | July 2003-February 2008 | United States | Prospective cohort study | Estimated as the time from the previous spontaneous abortion to LMP of beginning of the next pregnancy based on self-report. | Stillbirth and neonatal death (no gestational age given) | Spontaneous abortion | 10,154 births |
| Mignini *et al*, 2016 | 1990- 2009 | Argentina, Bahamas, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela | Retrospective cohort study | Defined as the time between the end of the previous pregnancy and first day of LMP for the next pregnancy. Information was obtained from a longitudinal perinatal information system. | Stillbirth at ≥20 weeks and death <28 days after birth | Any outcome | 894,476 births |
| Nabukera *et al*, 2008 | 1978-1997 | United States | Retrospective cohort study | Estimated as the time between the end of the first pregnancy and the beginning of the second pregnancy (based on LMP). | Stillbirth at ≥28 weeks and early neonatal death <7 days after birth | Any outcome (excluding spontaneous abortion and terminations) | 242,559 births |
| Reime *et al*, 2009 | 1990,1995, 1999 | Germany | Retrospective cohort study | IPI estimated from medical records. No further definition provided. | Stillbirth of infant weighing ≥500g (no gestational age given) | Any outcome (excluding spontaneous abortion and terminations) | 182,444 births |
| Regan *et al*, 2019 | 1980-2015 | Australia, Finland, Norway | Retrospective cohort study | Estimated as the time between the previous birth and conception of next pregnancy as derived from birth registers. | Stillbirth at ≥22 weeks | Stillbirth | 14 ,452 births |
| Smith *et al,* 2003 | 1992-1998 | Scotland | Retrospective cohort study | Estimated by subtracting estimated gestational age (based on ultrasound) from date of delivery and date of previous birth based on birth registrations | Stillbirth at ≥24 weeks resulting from fetal abnormality | Live birth | 69,055 births |
| Stillbirth at ≥24 weeks with unexplained cause | Live birth | 69,055 births |
| Smith *et al*, 2007 | 1992-2001 | Scotland | Retrospective cohort study | Estimated by subtracting estimated gestational age (based on ultrasound) from date of delivery and date of previous birth based on birth registrations | Stillbirth at ≥24 weeks | Live birth | 133,163 births |
| Stephansson *et al*, 2003 | 1983-1997 | Sweden | Retrospective cohort study | Estimated as the time between first birth and estimated conception of second pregnancy (derived by subtracting gestational age based on ultrasound from date of birth), based on birth registry data. | Stillbirth at ≥28 weeks | Any outcome (excluding spontaneous abortions and terminations) | 410,021 births |
| Swenson & Harper, 1978 | 1966-1972 | Bangladesh | Prospective cohort study | Estimated as time between date the previous pregnancy ended and estimated date of conception of next pregnancy as derived from linked surveillance data. The start of next pregnancy was estimated by subtracting the population average gestation for second pregnancy from date of birth. | Stillbirth at ≥28 weeks | Any outcome | 9,295 births |
| Tolefac *et al*, 2017 | 2006-2015 | Cameroon | Case-control study | Estimated from hospital records. No further definition provided. | Stillbirth at ≥22 weeks weighing ≥500g | Any outcome | 743 births |
| Wolfers & Scrimshaw, 1975 | 1962-1971 | Ecuador | Retrospective cohort study | Estimated as time in months between end of previous pregnancy and estimated start of the next pregnancy as derived from questionnaire data. Estimated start of the next pregnancy was defined by subtracting the gestational age from the date of birth. | Stillbirth at ≥28 weeks | Any outcome | 1,934 births |

**Table S5.** Risk of bias of selected case-control, cohort and cross-sectional studies of interpregnancy interval and perinatal death (N=26), based on Newcastle-Ottawa Scale criteria.[[1]](#footnote-1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Study Design** | **Selection** | **Comparability** | **Outcome/ Exposure** | **Total Score** |
| **Low- & Middle-Income Countries** | | | | | |
| Agarwal *et al*, 1998 | Prospective cohort study | ⁎⁎⁎⁎ |  | ⁎ | ⁎⁎⁎⁎⁎ |
| Cecatti *et al*, 2008 | Retrospective cohort study | ⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Conde-Agudelo *et al*, 2000 | Retrospective cohort study | ⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Conde-Agudelo *et al*, 2005 | Retrospective cohort study | ⁎⁎⁎ | ⁎ | ⁎ | ⁎⁎⁎⁎⁎ |
| Davanzo *et al*, 2007 | Retrospective cohort study | ⁎⁎⁎ | ⁎ | ⁎ | ⁎⁎⁎⁎⁎ |
| Davanzo *et al*, 2012 | Prospective cohort study | ⁎⁎⁎ | ⁎ | ⁎ | ⁎⁎⁎⁎⁎ |
| El Behery *et al*, 2013 | Prospective cohort study | ⁎⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎⁎ |
| Mahande & Obure, 2016 | Retrospective cohort study | ⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Mignini *et al*, 2016 | Retrospective cohort study | ⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Swenson & Harper, 1978 | Prospective cohort study | ⁎⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎⁎ |
| Tolefac *et al*, 2017 | Case-control study | ⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Wolfers & Scrimshaw, 1975 | Retrospective cohort study | ⁎⁎ |  |  | ⁎⁎ |
| **High-Income Countries** | | | | | |
| Carmichael *et al*, 2019 | Retrospective cohort study | \*\*\* | \*\* | \* | \*\*\*\*\*\* |
| Chen *et al*, 2015 | Retrospective cohort study | ⁎⁎⁎ | ⁎ | ⁎ | ⁎⁎⁎⁎⁎ |
| Cofer *et al*, 2016 | Retrospective cohort study | ⁎⁎⁎ |  | ⁎ | ⁎⁎⁎⁎ |
| Fedrick & Adelstein, 1973 | Retrospective cohort study | ⁎⁎ |  |  | ⁎⁎ |
| Hathout *et al*, 1982 | Retrospective cohort study | ⁎⁎⁎⁎ | ⁎ |  | ⁎⁎⁎⁎⁎ |
| Hegelund *et al*, 2018 | Retrospective cohort study | ⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Love *et al*, 2010 | Retrospective cohort study | ⁎⁎⁎ | ⁎ | ⁎ | ⁎⁎⁎⁎⁎ |
| Makhlouf *et al*, 2014 | Prospective cohort study | ⁎⁎⁎⁎ | ⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Nabukera *et al*, 2008 | Retrospective cohort study | ⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Reime *et al*, 2009 | Retrospective cohort study | ⁎⁎⁎ | ⁎ | ⁎ | ⁎⁎⁎⁎⁎ |
| Regan *et al*, 2019 | Retrospective cohort study | \*\*\*\* | \* | \*\* | \*\*\*\*\*\*\* |
| Smith *et al*, 2003 | Retrospective cohort study | ⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Smith *et al*, 2007 | Retrospective cohort study | ⁎⁎⁎ | ⁎⁎ | ⁎ | ⁎⁎⁎⁎⁎⁎ |
| Stephansson *et al*, 2003 | Retrospective cohort study | ⁎⁎⁎ | ⁎⁎ | ⁎⁎ | ⁎⁎⁎⁎⁎⁎⁎ |

**Table S6.** Covariates included in analysis of interpregnancy interval and risk of perinatal death among selected studies (n=26).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, Year** | **Covariate(s)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Maternal age** | **SES** | **Household size** | **Residence** | **Insurance status** | **Religion** | **Maternal country of birth** | **Race/ethnicity** | **Pregnancy intention** | **Paternal education** | **Maternal education** | **Maternal occupation** | **Plurality** | **Maternal conditions** | **Maternal height** | **Maternal BMI** | **Gravidity** | **Parity/Birth order** | **Prenatal care** | **Smoking** | **Alcohol use** | **Marital/cohabitation status** | **Obstetric history** | **Infant sex** | **Birth year/month** | **Birth outcomes\*** |
| **Low- & Middle-Income Countries** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Agarwal *et al*, 1998 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Cecatti *et al*, 2008 | ● |  |  |  |  |  |  |  |  |  | ● |  |  | ● |  | ● |  | ● | ● | ● |  | ● | ● |  |  |  |
| Conde-Agudelo *et al*, 2000 | ● |  |  |  |  |  |  |  |  |  | ● |  |  |  |  | ● |  |  | ● | ● |  | ● |  |  |  |  |
| Conde-Agudelo *et al*, 2005 | ● |  |  |  |  |  |  |  |  |  | ● |  |  |  |  | ● |  | ● | ● |  |  | ● | ● |  |  | ● |
| Davanzo *et al*, 2007 | ● |  | ● |  |  | ● |  |  | ● | ● | ● |  |  |  |  |  |  | ● |  |  |  |  |  |  | ● |  |
| Davanzo *et al*, 2012 | ● |  |  | ● |  |  |  |  |  |  | ● |  |  |  |  |  | ● | ● |  |  |  |  |  |  | ● |  |
| El Behery *et al*, 2013 | ● |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mahande & Obure, 2016 | ● |  |  | ● |  |  |  |  | ● |  | ● | ● |  |  |  |  |  | ● | ● |  | ● | ● |  |  |  |  |
| Mignini *et al*, 2016 | ● |  |  |  |  |  |  |  |  |  |  |  | ● | ● |  |  |  | ● |  |  |  |  | ● |  |  |  |
| Swenson & Harper, 1978 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Tolefac *et al*, 2017 | ● |  |  |  |  |  |  |  |  |  | ● |  |  | ● |  |  |  |  | ● |  |  | ● | ● |  |  | ● |
| Wolfers & Scrimshaw, 1975 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **High-Income Countries** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Carmichael *et al*, 2019 |  |  |  |  | ● |  | ● | ● |  |  | ● |  |  | ● |  | ● |  |  |  | ● |  |  | ● |  |  |  |
| Chen *et al*, 2015 | ● | ● |  |  |  |  |  |  |  |  |  |  |  | ● |  |  |  | ● |  | ● |  |  | ● | ● |  | ● |
| Cofer *et al*, 2016 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Fedrick & Adelstein, 1973 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hathout *et al*, 1982 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Hegelund *et al*, 2018 | ● |  |  |  |  |  |  | ● |  |  | ● |  |  |  |  |  |  |  |  |  |  | ● |  |  | ● |  |
| Love *et al*, 2010 | ● | ● |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ● |  |
| Makhlouf *et al*, 2014 | ● |  |  |  |  |  |  | ● |  |  | ● |  |  |  |  | ● |  |  |  | ● |  | ● |  |  |  |  |
| Nabukera *et al*, 2008 |  |  |  |  |  |  |  | ● |  |  | ● |  |  | ● |  | ● |  |  | ● | ● |  | ● | ● |  |  |  |
| Regan *et al*, 2019 | ● |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | ● |  |  |  |  | ● |  | ● |  |
| Reime *et al*, 2009 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Smith *et al*, 2003 | ● | ● |  |  |  |  |  |  |  |  |  |  |  |  | ● |  |  |  |  | ● |  | ● | ● |  |  |  |
| Smith *et al*, 2007 | ● | ● |  |  |  |  |  |  |  |  |  |  |  |  | ● |  |  |  |  | ● |  | ● |  |  |  |  |
| Stephansson *et al*, 2003 | ● |  |  |  |  |  |  |  |  |  | ● |  |  | ● |  |  |  |  |  | ● |  | ● | ● |  | ● |  |

\*Birth outcomes included either congenital anomalies or infant birthweight or gestational age

**Table S7.** Summary of studies evaluating the association between interpregnancy interval and perinatal death, by World Bank Category.

| **Author(s), Year** | **Outcome of preceding birth** | | **Deaths per 1,000 births, by interpregnancy interval** | **Unadjusted OR (95% CI)** | **Adjusted OR (95% CI)†** | **Absolute risk difference**  **% (95% CI)** | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Low and Middle-Income Countries** | | | | | | |
| Agarwal *et al*, 1998 | Any outcome | | <24 months: 34.4 ≥24 months: 23.5 | <24 months: 1.48 (1.01, 2.18)  ≥24 months: Reference | --- | <24 months: +1.9 (0.09, 2.09)  ≥24 months: Reference | |
| Cecatti *et al*, 2008 | Any outcome at ≥22 weeks | | < 6 months: 48  6-11 months: 47  12-17 months 45 18-23 months: 88  24-59 months: 46      ≥60 months: 61 | <6 months: 0.55 (0.19, 3.47)  6-11 months: 0.53 (0.16, 1.32)  12-17 months: 0.52 (0.21, 1.24)  18-23 months: Reference  24-59 months: 0.41 (0.19, 0.88)  >59 months: 0.69 (0.32, 1.49) | <6 months: 1.74 (1.18, 2.55) 6-11 months: 0.49 (0.12, 1.96) 12-17 months: 0.69 (0.19, 2.47) 18-23 months: Reference 24-59 months: 0.73 (0.24, 2.22) ≥60 months: 0.75 (0.22, 2.57) | <6 months: -4.00 (-6.08, -1.92) 6-11 months: -4.10 (-6.00, -2.20) 12-17 months: -4.30 (-6.16, -2.44) 18-23 months: Reference 24-59 months: -4.20 (-5.93, -2.47) ≥60 months: -2.70 (-4.55, -0.85) | |
| Conde-Agudelo *et al*, 2000 | Any outcome at ≥20 weeks | | <6 months: 48.5 6-23 months: 17.8  ≥24 months: 17.7 | <6 months: 2.83 (2.59, 3.09)  6-23 months: 1.01 (0.97, 1.05)  ≥24 months: Reference | <6 months: 2.09 (1.75, 2.46) 6-23 months: 1.00 (0.93, 1.07)  ≥24 months: Reference | <6 months: +3.08 (2.69, 3.47)  6-23 months: +0.01 (-0.07, 0.09)  ≥24 months: Reference | |
| Conde-Agudelo *et al*, 2005 | Any outcome at ≥20 weeks | | <6 months: 49.1 6-11 months: 19.8 12-17 months: 18.0 18-23 months: 14.9 24-59 months: 17.2  ≥60 months: 18.3 | <6 months: 3.41 (3.20, 3.64)  6-11 months: 1.34 (1.27, 1.41)  12-17 months: 1.21 (1.15, 1.28)  18-23 months: Reference  24-59 months: 1.16 (1.10, 1.21)  ≥60 months: 1.23 (1.17, 1.30) | <6 months: 1.54 (1.28, 1.83) 6-11 months: 1.24 (1.14, 1.35) 12-17 months: 1.07 (1.00, 1.15) 18-23 months: Reference 24-59 months: 1.01 (0.93, 1.12) ≥60 months: 1.21 (1.15, 1.27) | <6 months: +3.42 (3.19, 3.65)  6-11 months: +0.49 (0.40, 0.58)  12-17 months: +0.31 (0.22, 0.40)  18-23 months: Reference  24-59 months: +0.23 (0.16, 0.30)  ≥60 months: +0.34 (0.26, 0.42) | |
| Davanzo *et al*, 2007 | Induced abortion | | <6 months: 13.0  6-14 months: 51.0  15-26 months: 48.0  27-50 months: 53.0 | <6 months: 0.62 (0.15, 2.53)  6-14 months: 2.62 (1.27, 5.42)  15-26 months: 2.16 (0.94, 4.95)  27-50 months: 2.61 (1.05, 6.50)  Reference† | <6 months: 0.62 (0.15, 2.53)  6-14 months: 2.56 (1.22, 5.37)  15-26 months: 2.13 (0.93, 4.90)  27-50 months: 2.54 (1.02, 6.32)  Reference† | <6 months: -1.20 (-0.63, 3.03)  6-14 months: +2.60 (-1.07, 6.27)  15-26 months: +2.30 (-1.44, 6.04)  27-50 months: +2.80 (-1.71, 7.31)  Reference† | |
| Miscarriage | | <6 months: 30.0  6-14 months: 41.0  15-26 months: 43.0  27-50 months: 42.0 | <6 months: 1.27 (0.91, 1.76)  6-14 months: 1.76 (1.20, 2.58)  15-26 months: 1.82 (1.00, 3.31)  27-50 months: 1.83 (0.85, 3.93)  Reference† | <6 months: 1.31 (0.94, 1.82)  6-14 months: 1.76 (1.20, 2.61)  15-26 months: 1.79 (0.98, 3.27)  27-50 months: 1.74 (0.81, 3.76)  Reference† | <6 months: +0.50 (-0.44, 1.44)  6-14 months: +1.60 (0.11, 3.09)  15-26 months: +1.80 (-0.49, 4.09)  27-50 months: +1.70 (-1.36, 4.76)  Reference† | |
|  | Stillbirth | | <6 months: 55.0  6-14 months: 88.0  15-26 months: 75.0  27-50 months: 90.0 | <6 months: 2.37 (1.59, 3.54)  6-14 months: 3.96 (2.71, 5.78)  15-26 months: 3.27 (1.91, 5.57)  27-50 months: 4.11 (2.16, 7.82)  Reference† | <6 months: 2.35 (1.57, 3.50)  6-14 months: 4.03 (2.74, 5.92)  15-26 months: 3.15 (1.85, 5.38)  27-50 months: 3.65 (1.91, 6.97)  Reference† | <6 months: +3.00 (1.08, 4.92)  6-14 months: +6.30 (3.54, 9.06)  15-26 months: +5.00 (1.66, 8.34)  27-50 months: +6.50 (1.61, 11.39)  Reference† | |
| Live birth | | <6 months: 32.0 6-14 months: 29.0 15-26 months: 24.0 27-50 months: 25.0 51-74 months: 25.0 ≥75 months 36.0 | <6 months: 1.57 (1.17, 2.12)  6-14 months: 0.99 (0.76, 1.29)  15-26 months: 0.97 (0.80, 1.16)  27-50 months: Reference | <6 months: 1.61 (1.20, 2.18) 6-14 months: 1.00 (0.76, 1.31) 15-26 months: 0.93 (0.77, 1.12) 27-50 months: Reference | <6 months: +0.70 (-0.19, 1.59)  6-14 months: +0.40 (-0.28, 1.08)  15-26 months: +0.10 (-0.32, 0.52)  27-50 months: Reference  51-74 months: 0 (-0.50, 0.50)  ≥75 months: +1.10 (0.31, 1.89) | |
| Davanzo *et al*, 2012 | Miscarriage | | ≤3 months: 41 3-6 months: 36 6-12 months: 39 12-18 months: 46 18-24 months: 30 24-36 months: 50 36-48 months: 31 >48 months: 34 | ≤3 months: 1.39 (0.85, 2.28) 3-6 months: 1.23 (0.75, 2.02) ≤6 months: 1.53 (0.96, 2.45) 6-12 months: 1.31 (0.82, 2.09) 12-18 months: 1.33 (0.82, 2.16) 18-24 months: Reference >24 months: 1.39 (0.82, 2.35) | --- | ≤3 months: +1.10 (-0.44, 2.64)  3-6 months: +0.60 (-0.88, 2.08)  ≤6 months: +0.80 (-0.60, 2.20)  6-12 months: +0.90 (-0.57, 2.37)  12-18 months: +1.60 (-0.23, 3.43)  18-24 months: Reference  >24 months: +1.10 (-0.59, 2.79) | |
| El Behery *et al*, 2013 | Miscarriage | | <6 months: 9.4 >12 months: 18.2 | <6 months: Reference  >12 months: 1.40 (0.70, 2.30) | <6 months: Reference >12 months: 2.49 (1.00, 3.90 | <6 months: Reference  >12 months: +0.88 (0.20, 1.56) | |
| Mahande & Obure, 2016 | Any outcome at ≥28 weeks | | <24 months: 41.4 24-36 months: 29.4 37-59 months: 31.0 ≥60 months: 32.4 | <24 months: 1.42 (1.13, 1.79)  24-36 months: Reference  37-59 months: 1.06 (0.85, 1.31)  ≥60 months: 1.10 (0.84, 1.45) | <24 months: 1.63 (1.22, 1.91) 24-36 months: Reference 37-59 months: 1.06 (0.86, 1.32)  ≥60 months: 1.07 (0.87, 1.32) | <24 months: -1.20 (-1.97, -0.43)  24-36 months: Reference  37-59 months: -1.04 (-1.73, -0.35)  ≥60 months: -0.90 (-1.77, -0.03) | |
| Mignini *et al*, 2016 | Any outcome | | --- | --- | 3-11 months: 1.00 (0.93, 1.07) 12-23 months: Reference  24 -35 months: 0.99 (0.94, 1.03) 36-47 months: 0.99 (0.95, 1.03) 48-59 months: 0.99 (0.95, 1.04) 60-71 months:0.94 (0.89, 0.99) 72- 83 months: 0.97 (0.91, 1.03) 84-95 months: 0.97 (0.90, 1.05) 96-107 months: 1.04 (0.96, 1.13)  108-119 months: 1.14 (1.03, 1.27) | --- | |
| Swenson & Harper, 1978 | Any outcome | | <12 months: 43.2 12-24 months: 27.9  >24 months: 27.7 | <12 months: 1.59 (1.16, 2.18)  12-24 months: 1.01 (0.74, 1.38)  >24 months: Reference | --- | <12 months: +1.55 (0.52, 2.58)  12-24 months: +0.02 (-0.81, 0.85)  >24 months: Reference | |
| Tolefac *et al*, 2017 | Any outcome | | ≤ 24 months: 120 >24 months: 227 | ≤ 24 months: Reference  >24 months: 2.06 (1.22, 3.49) | ≤24 months: Reference >24 months: 3.59 (1.29, 9.98) | --- | |
| Wolfers & Scrimshaw, 1975 | Any outcome | | 0-2 months: 11.2 3-14 months: 14.3 15-26 months: 7.7 27-38 months: 20.8 ≥39 months: 29.2 | 0-2 months: 1.50 (0.89, 2.2)  3-14 months: 1.99 (1.53, 2.60)  15-26 months: Reference  27-38 months: 2.43 (1.55, 3.83) ≥39 months: 2.43 (1.55, 3.83) | --- | 0-2 months: +0.35 (-0.70, 1.40)  3-14 months: +0.66 (0.09, 1.23)  15-26 months: Reference  27-38 months: +1.31 (0.10, 2.52)  ≥39 months: +2.15 (0.81, 3.49) | |
|  | | **High-Income Countries** | | | | |
| Carmichael *et al*, 2019§ | Any outcome | | <6 months: 382.4  6-23 months: 452.8  24-47 months: 443.1  ≥48 months: 419.7 | <6 months:1.69 (1.42, 2.01)  6-23 months: Reference  24-47 months: 1.01 (0.90, 1.13)  ≥48 months: 1.58 (1.43, 1.74) | <6 months: 1.55 (1.28, 1.87)  6-23 months: Reference  24-47 months: 0.95 (0.84, 1.08)  ≥48 months: 1.28 (1.14, 1.44) | <6 months: -7.04 (-7.41, -6.67)  6-23 months: Reference  24-47 months: -0.97 (-1.17, -0.77)  ≥48 months: -3.31 (-3.51, -3.11) | |
| Chen *et al*, 2015 | Any outcome | | Not provided | <6 months: 1.42 (0.85, 2.38)  6-11 months: 1.03 (0.67, 1.58)  12-17 months: Reference  18-23 months: 1.11 (0.73, 1.70)  24-35 months: 1.14 (0.76, 1.71)  ≥36 months: 1.73 (1.17, 2.55) | <6 months: 0.90 (0.51, 1.59) 6-11 months: 0.96 (0.61, 1.50) 12-17 months: Reference 18-23 months: 1.20 (0.77, 1.86) 24-35 months: 1.13 (0.73, 1.73) ≥36 months: 1.60 (1.06, 2.43) | --- | |
| Cofer *et al*, 2016 | Live birth | | <6 months: 3.4 6-17 months: 2.5 18-50 months: 2.9 | <6 months: 1.20 (0.99, 1.44)  6-17 months: 0.87 (0.79, 0.97)  18-50 months: Reference | --- | <6 months: +0.05 (-0.01, 0.11)  6-17 months: -0.04 (-0.07, -0.01)  18-50 months: Reference | |
| Fedrick & Adelstein, 1973 | Any outcome (excluding ectopic or molar pregnancies) | | <6 months: 30.9 12 months: 25.1 24 months: 26.6 36 months: 26.9 72 months: 30.5 108 months: 41.2 >108 months: 48.0 | --- | --- | --- | |
| Hathout *et al*, 1982 | Miscarriage | | <6 months: 52.6 ≥6 months: 44.4 | <6 months: 1.19 (0.26, 5.54)  ≥6 months: Reference | --- | <6 months: +0.82 (-4.96, 6.60)  ≥6 months: Reference | |
| Live birth | | <6 months: 23.5 ≥6 months: 15.9 | <6 months: 1.49 (0.64, 3.46)  ≥6 months: Reference | --- | <6 months: +0.76 (-0.97, 2.49)  ≥6 months: Reference | |
| Stillbirth | | <6 months: 333.3 ≥6 months: 181.8 | <6 months: 2.25 (0.60, 8.42)  ≥6 months: Reference | --- | <6 months: +15.15 (-8.37, 38.67)  ≥6 months: Reference | |
| Hegelund *et al*, 2018 | Live birth | | 0-5 months: 4.7 6-11 months: 3.2 12-17 months: 2.7 18-23 months: 3.4  24-59 months: 3.2 ≥ 60 months: 5.5 | 0-5 months: 1.40 (1.25, 1.57)  6-12 months: 0.94 (0.87, 1.02)  12-17 months: 0.79 (0.73, 0.85)  18-23 months: Reference  24-59 months: 0.94 (0.89, 1.00)  ≥ 60 months: 1.65 (1.52, 1.80) | ---¶ | 0-5 months: +0.13 (-0.03, 0.29)  6-12 months: -0.02 (-0.06, 0.10)  12-17 months: -0.07 (-0.14, 0.00)  18-23 months: Reference  24-59 months: -0.02 (-0.04, 0.08)  ≥60 months: +0.21 (0.08, 0.34) | |
| Love *et al*, 2010 | Miscarriage | | <6 months: 5.5  6-11 months: 7.1  12-17 months: 8.8  18-24 months: 6.5  >24 months: 6.4 | <6 months: 0.78 (0.55, 1.11)  6-11 months: Reference  12-17 months: 1.25 (0.78, 1.99)  18-24 months: 0.92 (0.50, 1.69)  >24 months: 0.91 (0.59, 1.39) | <6 months: 0.70 (0.38, 1.29)  6-11 months: Reference  12-18 months: 1.20 (0.54, 2.67)  18-24 months: 0.83 (0.28, 2.44)  >24 months: 1.07 (0.54, 2.15) | <6 months: -0.16 (-0.07, 0.39)  6-11 months: Reference  12-18 months: +0.17 (-0.21, 0.55)  18-24 months: -0.06 (-0.34, 0.46)  >24 months: -0.07 (-0.21, 0.35) | |
| Makhlouf *et al*, 2014 | Miscarriage | | <6 months: 33.0 6-12 months: 28.0 >12 months: 38.0 | <6 months: Reference  6-12 months: 0.84 (0.31, 2.24)  >12 months: 1.14 (0.54, 2.40) | <6 months: Reference 6-12 months: 0.7 (0.3, 2.0) >12 months: 0.8 (0.3, 1.7) | <6 months: Reference  6-12 months: -0.50 (-2.32, 3.32)  >12 months: +0.50 (-2.03, 3.03) | |
| Nabukera *et al*, 2008 | Any outcome\*\* | | --- | <6 months: 1.41 (1.11, 1.78)  ≥6 months: Reference | <6 months: 1.13 (0.87, 1.47) ≥6 months: Reference | --- | |
| Reime *et al*, 2009 | Any outcome\*\* | | <11 months: 25.7 ≥11 months: 7.3 | <11 months: 3.60 (3.07, 4.24)  ≥11 months: Reference | --- | <11 months: +1.84 (1.45, 2.23)  ≥11 months: Reference | |
| Regan *et al*., 2019 | Stillbirth | | <6 months: 17.6  6-11 months: 13.5  12-23 months: 14.3  >24 months: 16.9 | <6 months: 1.11 (0.68, 1.79)  6-11 months: 0.79 (0.42, 1.50)  12-23 months: 0.85 (0.45, 1.64)  ≥24 months: Reference | <6 months: 1.09 (0.62, 1.91)  6-11 months: 0.90 (0.47, 1.71)  12-23 months: 0.88 (0.46, 1.70)  ≥24 months: Reference | <6 months: +0.07 (-0.54, 0.68)  6-11 months: -0.34 (-0.28, 0.96)  12-23 months: -0.26 (-0.41, 0.93)  ≥24 months: Reference | |
| Smith *et al*, 2003 | Live birth | | 1-5 months: 2.1  6-11 months: 1.1  12-17 months: 1.6  18-23 months: 1.3  24-59 months: 1.7 | 1-5 months: 1.6 (0.6, 3.8)  6-11 months: 0.8 (0.4, 1.8)  12-17 months: 1.2 (0.6, 2.3)  18-23 months: Reference  24-59 months: 1.2 (0.7, 2.2) | 1-5 months: 1.2 (0.5, 3.0)  6-11 months: 0.7 (0.3, 1.7)  12-17 months: 1.2 (0.6, 2.3)  18-23 months: Reference  24-59 months: 1.2 (0.7, 2.1) | 1-5 months: +0.08 (-0.09, 0.25)  6-11 months: -0.02 (-0.07, 0.11)  12-17 months: +0.03 (-0.07, 0.13)  18-23 months: Reference  24-59 months: +0.04 (-0.04, 0.12) | |
| Smith *et al*, 2007 | Live birth | | <6 months: 2.9  6-11 months: 2.1  12-23 months: 2.5  24-59 months:2.6  60-120 months: 3.7  >120 months: 5.4 | <6 months: 1.09 (0.64, 1.86)  6-11 months: 0.80 (0.54, 1.19)  12-23 months: 0.95 (0.73, 1.22)  24-59 months: Reference  60-120 months: 1.41 (1.04, 1.90)  >120 months: 2.06 (0.97, 4.41) | ---†† | <6 months: +0.03 (-0.12, 0.18)  6-11 months: -0.05 (-0.04, 0.14)  12-23 months: -0.01 (-0.05, 0.07)  24-59 months: Reference  60-120 months: +0.11 (0.01, 0.21)  >120 months: +0.28 (-0.12, 0.68) | |
| Stephansson *et al,* 2003 | Any outcome\*\* | | 0-3 months: 4.5 4-7 months: 2.4  8-11 months: 2.3  12-35 months: 2.4 36-71 months: 3.0 ≥72 months: 4.4 | <3 months: 1.9 (1.3, 2.7) 4-7 months: 1.0 (0.8, 1.3) 8-11 months: 0.9 (0.8, 1.1) 12-35 months: Reference 36-71 months: 1.2 (1.1, 1.5) ≥72 months: 1.8 (1.4, 2.4) | 0-3 months: 1.3 (0.8, 2.1) 4-7 months: 1.0 (0.7, 1.3) 8-11 months: 1.0 (0.8, 1.2) 12-35 months: Reference 36-71 months: 1.2 (1.0, 1.4) ≥ 72 months: 1.5 (1.1, 2.1) | 0-3 months: +0.21 (0.05, 0.37)  4-7 months: 0 (-0.06, 0.06)  8-11 months: -0.01 (-0.04, 0.06)  12-35 months: Reference  36-71 months: +0.06 (0.01, 0.11)  ≥72 months: +0.20 (0.09, 0.31) | |

Abbreviations: OR, odds ratio; CI, confidence interval

\*Adjustment variables can be found in Table S3.

†Reference group was defined as 27-50 months after a live birth

§ Examined only stillbirths occurring at gestational age 20-25 weeks

¶Adjusted estimate provided was a hazard ratio

\*\*Excluding previous spontaneous abortions and medical terminations

††Adjusted estimate provided was risk difference

1. Wells GA, Shea B, O'Connell D, et al. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Available from: http://www.ohri.ca/programs/clinical\_epidemiology/oxford.asp. Accessed 1 December 2018. [↑](#footnote-ref-1)