COVID-19 in Pregnancy

Technical Report

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# Context

This technical report accompanies the COPS Publication September 2022 publication report and data dictionary. It provides background information on the methods used to produce the estimates of COVID-19 infection and COVID-19 vaccination in pregnant women in Scotland presented in that report.

# Methods

## Overall aim of the analysis

COVID-19 in Pregnancy in Scotland (COPS) is a new national prospective dynamic cohort utilising Scotland’s maternity and health care data. It is unique in that it is a national surveillance platform using routinely available population data to capture nearly all of the pregnancies in Scotland, covering the whole pregnancy from conception to the end of the puerperium for women (41 days postpartum) and the end of the neonatal period (27 days postnatal) for babies.

COPS was created to describe the epidemiology of COVID-19 in pregnancy, the effect of SARS-CoV-2 infection on pregnancy outcomes and investigate the safety of COVID-19 vaccines among pregnant women. COPS includes all women in Scotland who were pregnant on 1st March 2020 or have subsequently become pregnant and thus could be potentially exposed to SARS-2-CoV or COVID-19 vaccination in pregnancy. The dynamic cohort is updated with new pregnancies and pregnancy outcomes monthly.

## Identifying pregnant women

The cohort is generated by linking primary care records to maternity records, national birth and mortality records, other secondary health care data, together with laboratory results of Covid-19 infection, and vaccination information. Combining these data sources allows comprehensive capture of the outcomes of all births and all pregnancy losses in women who attended healthcare services (except very early miscarriages where medical or midwifery advice was not sought). Thus, COPS provides a robust platform for the study of viral effects and pharmacoepidemiologic research.

## Data sources

Data sources to identify the cohort are as follows:

* National Records of Scotland (NRS) statutory live birth registration records
* NHS Scotland health board live births
* Hospital maternity care delivery and abortion discharge records (SMR02)
* Antenatal booking
* GP Data – Albasoft (early losses)
* NRS statutory stillbirth registration records
* Abortion Act Scotland (AAS) records: Statutory termination of pregnancy notification records
* General hospital discharge to identify admission for early miscarriage, molar and ectopic pregnancies (SMR01)
* CHI database – to enhance linkage accuracy and fill in missing demographic information

Additional data sources to identify infections, vaccinations, comorbidities and maternal and baby outcomes:

* Positive COVID-19 test from the Test and Protect database
* Vaccination record from NHS Scotland National Clinical Data Store (NCDS) database
* ICU admission records from SICSAG (for both pregnant women and neonates)
* NRS statutory death registration records for babies aged up to 1 year
* NRS statutory death registration to look for maternal deaths
* Covid-19 Shielding list /highly clinically vulnerable list
* GP comorbidities data
* congenital anomalies from CARDRRISS database
* General hospital discharge (SMR01) records for mothers, stays with certain pregnancy related conditions and COVID-19
* All General hospital discharge (SMR01) records for neonates.

## Who is in the cohort?

COPS is a national dynamic cohort of all women who were pregnant on, or became pregnant after, 1st March 2020 (12). Ongoing pregnancies are identified from antenatal booking records. Completed pregnancies are identified from general and maternity hospital discharge records, GP records, statutory termination of pregnancy records, and statutory live and stillbirth registrations. Hospital and GP records capture women who have early pregnancy losses (miscarriage, molar pregnancy or ectopic pregnancy) and receive care from a healthcare provider. Women who had a very early pregnancy loss and who do not attend or notify their GP or attend hospital for care will not be included. However, we anticipate that these numbers will be small, as, in Scotland: i) the National Health Service (NHS) provides free healthcare to all women; ii) pregnant women are advised to see their GP or attend an early pregnancy unit if they have any signs of a miscarriage; and iii) clinicians and miscarriage support groups have informed us that only a small minority of women have a miscarriage and do not seek care (21-23). As statutory birth records are used, we capture all births including home births (<2% of births in Scotland), although clinical maternity data may be missing for a proportion of home births. There are no private obstetric services in Scotland.

**Identifying different pregnancy outcomes**

**Spontaneous losses**

Spontaneous losses (excl. stillbirth) were grouped into the following subcategories:

1. Early spontaneous pregnancy loss (1st trimester) up to 13+6 (excluding ectopic pregnancies)
2. Ectopic pregnancy
3. Molar pregnancy
4. SMR01 records do not capture gestation. In the absence of any other records providing gestation information (e.g., antenatal booking data), assume 12 weeks' gestation at date of admission.

*Datasets used to identify losses:*

* SMR01 Latest extract on 30th August 2022 n=21,002 relevant admissions, grouped into 19,668 separate events).
  + Includes all SMR01 records with relevant coding (see appendix 2) from 01/01/2015 (admission date).
  + Records grouped into the following categories:
    - Spontaneous pregnancy loss ICD-10 codes: O02, O03.5-O03.9, O05.5-O05.9, O06.5-O06.9
    - Ectopic pregnancy
      * ICD-10 code: O00
    - Molar pregnancy: O01
  + Group stays where admission date is up to 83 days after index discharge as the same event. Index discharge = the last discharge date of the first continuous inpatient stay of interest.
* SMR02 Latest extract on August 2022 n=387,442 relevant admissions, pertaining to 392,944 babies with defined outcome, representing 389,157 events (3787 duplicates excluded).
  + Read in SMR02 records from 01/01/2015
  + Group records into the following categories:
    - Spontaneous pregnancy loss
      * Condition on discharge = 2 (aborted)
      * Type of abortion = 1, 2, 8, 9 (spontaneous excluding ectopic, molar)
      * Gestation ≤ 23 weeks (later than this and it is classed as a stillbirth)
    - Ectopic pregnancy
      * Condition on discharge = 2 (aborted)
      * Type of abortion = 6 (ectopic)
      * Any gestation
    - Molar pregnancy
      * Condition on discharge = 2 (aborted)
      * Type of abortion = 3 (molar)
      * Any gestation
  + Group stays where admission date is up to 83 days after index discharge as the same event. Index discharge = the last discharge date of the first episode of interest.
* GP data (latest extract taken 30/08/22 – 83,190 valid records after cleaning below)
  + Data requires cleaning before use
    - Removal of any missing/invalid CHI number (currently n=261)
    - Unexpected event dates removed: Event dates before 2015 or after date of extraction removed (n=55).
    - Restrict to women (remove n=127) of reproductive age (10-55 inclusive) (currently remove n=164)
    - Exclude irrelevant codes (n=60) (see appendix 2 for list of read codes included).
  + Multiple spontaneous losses with the same mother UPI that are within 83 days of each other were grouped and counted as a single event.

**Stillbirths**

*Datasets used to identify stillbirths:*

* SMR02
  + All SMR02 records coded as follows (check all 3 outcome of pregnancy fields):
    - Condition on discharge=3 (delivered)
    - Outcome of pregnancy=2 (stillbirth)
* NRS stillbirth registrations
  + Registrations where the ICD-10 code P96.4 (termination of pregnancy, affecting fetus and newborn) is NOT recorded
    - A termination may result in a stillbirth if it is carried out at a gestation where the fetus is delivered after 24 completed weeks of pregnancy. These cases will be recorded as terminations, not stillbirths

Multiple stillbirth registrations with the same mother UPI that are within 30 days of each other should be grouped and counted as a single event. SMR02 records admission and discharge dates and not the specific date of delivery so this will allow us to group stillbirth registrations & SMR02 records that belong to the same event but don’t have matching dates.

**Termination of pregnancy**

All terminations carried out between 01 Jan 2015 and 27th August 2022. N= 102,323 combined into 101,862 events on the basis of date. Terminations are carried out for a range of different reason and fall into 2 broad categories.

* Legal at <24w under Grounds C and D of the Abortion Act 1967
* Legal at any gestation under Grounds A, B, E, F, G

Note: The grounds for termination will allow us to check and clean the gestation recorded for each case. Information on grounds for termination is only available from the AAS dataset.

*Grounds for termination of pregnancy*

1. The continuance of the pregnancy would involve risk to the life of the pregnant woman greater than if the pregnancy were terminated
2. The termination is necessary to prevent grave permanent injury to the physical or mental health of the pregnant woman
3. The pregnancy has not exceeded its 24th week and the continuance of the pregnancy would involve risk, greater than if the pregnancy were terminated, of injury to the physical or mental health of the pregnant woman
4. The pregnancy has not exceeded its 24th week and the continuance of the pregnancy would involve risk, greater than if the pregnancy were terminated, of injury to the physical or mental health of any existing child(ren) of the family of the pregnant woman
5. There is a substantial risk that if the child were born it would suffer from such physical or mental abnormalities as to be seriously handicapped
6. To save the life of the pregnant woman
7. To prevent grave permanent injury to the physical or mental health of the pregnant woman

*Datasets used to identify terminations:*

* AAS
  + All records in the time period of interest
* SMR02
  + All SMR02 records coded as follows:
    - Condition on discharge=2 (aborted)
    - Type of abortion=4 (therapeutic abortion)
* NRS stillbirth registrations
  + Registrations where the ICD-10 code P96.4 (termination of pregnancy, affecting fetus and newborn) is recorded
    - A termination may result in a stillbirth if it is carried out at a gestation where the fetus is delivered after 24 completed weeks of pregnancy

Multiple termination registrations with the same mother UPI that are within 30 days of each other should be grouped and counted as a single event. SMR02 records admission and discharge dates and not the specific date of termination so this will allow us to group AAS / stillbirth registrations & SMR02 records that belong to the same event but don’t have matching dates.

**Live births**

*Datasets used to identify live births:*

* NRS live birth registrations
* NHS live birth registrations
* SMR02
  + All SMR02 records coded as follows (check all 3 outcome of pregnancy fields):
    - Condition on discharge=3 (delivered)
    - Outcome of pregnancy=1, 3, 4, 5 (live birth)
  + SMR02 is a mother record so for multiple pregnancies where we have data on more than one baby, we need to pivot the data to take it to baby level. Live births should be identified using the conditions above and all other pregnancy outcomes can be removed at this point.
* NRS deaths - If a death record exists for an infant, the outcome in the COPS data is recorded as a live birth regardless of other information, as the baby must be born alive for a death record to be generated.

Multiple live birth registrations with the same baby UPI that are within 30 days of each other should be grouped and counted as a single event (in the case of a singleton birth only). For babies with no recorded UPI, duplicate records could be linked through mother UPI in the case of singleton pregnancies.

For live births on SMR02 or NHS live births, it is recorded how many babies were born, this information can be used to resolve multiple records in the case where baby UPI is recorded inconsistently – the number of records that there should be (1 per baby) is known and the number of records in COPS can be reduced to that number in the case of duplicated records.

**Ongoing pregnancies**

*Datasets used to identify ongoing pregnancies:*

* Antenatal booking data (n=179,207 bookings equating to 178,793 pregnancies 414 duplicates excluded. )
* Terminations cohort
  + Remove records we know ended in a termination
* Stillbirths cohort
  + Remove records we know ended in a stillbirth
* Spontaneous losses cohort
  + Remove records we know ended in a spontaneous loss
* Live births cohort
  + Remove records we know ended in a live birth

## Reconciling discrepancies across data sources in recorded pregnancy outcome

### Outcome of pregnancy

As it is possible that some cases may be classified differently in different datasets, checks and de-duplication procedures were carried out between the above groups of cases as follows.

TOPFA and spontaneous fetal deaths (late fetal losses and stillbirths) were added together and records that identified the same case were grouped to avoid double counting. If a termination record existed anywhere then the case was reclassified as a termination, even if it was recorded as a spontaneous fetal death elsewhere.

The combined list of terminations and spontaneous fetal deaths was then split into two files; one containing all singleton pregnancies and one containing all multiple pregnancies. The file containing singleton pregnancies was added to a list of all singleton live births and records that identified the same event were grouped to avoid double counting. A small number of live birth cases were grouped with a termination record. This is because a very small number of late termination cases may result in a live birth if the mother does not receive an injection to stop the fetal heartbeat (feticide) prior to delivery. These cases were reclassified as a termination of pregnancy.

These checks could only be carried out on singleton pregnancies as termination and spontaneous fetal death cases do not have a baby CHI number and it is valid that a mother may have multiple records with different outcomes if she has had a multiple pregnancy.

### Date of outcome

Where there are multiple records of the pregnancy outcome, with multiple possible end dates, a hierarchy is followed, selecting the date from the first data source available, as follows:

NHS Live births > NRS live births > NRS stillbirths > SMR02 > AAS > SMR01 > GP losses

So, for example: the date of pregnancy end for a pregnancy ending in any live birth will be the date on NHS live birth record, unless this is unavailable, in which case NRS live births is used. In the case of a termination recorded in both SMR02 and AAS, the SMR02 pregnancy end date would be prioritised over the AAS date (if the former was available).

Records of events within 83 days of each other are initially grouped and assumed to be from the same pregnancy, as some pregnancies will have multiple records with differing end dates from different sources. There are some cases where two records within 83 days do appear to belong to different pregnancies; corrections to grouping of records are applied later to deal with these cases, see the [definitions section.](bookmark://_Definitions_and_calculations)

In a small proportion of cases (6% in the current cohort update), the outcome of the pregnancy is not recorded in any data source. The majority of these are recently ended pregnancies, where the outcomes have not accumulated in records yet, other cases will be due to the mother moving out of Scotland prior to the birth or errors in CHI/UPI recording resulting in no linkage. These pregnancies are known through antenatal booking record only and have passed the point where the pregnancy could feasibly still be continuing, the end date for these pregnancies is imputed as conception date + 44 weeks.

Further reconciliation is required for some cases where pregnancies appear to be overlapping. This is mostly due to one pregnancy having a missing end date (as above). Another pregnancy has occurred, but because we've set the conception date for the previous pregnancy to conception date + 44 weeks, it appears the pregnancies are concurrent. In these cases, where there is no other means of determining the end date of the previous pregnancy, it is imputed to end 4 weeks prior to the conception date of the following pregnancy.

### Gestation at outcome

Gestation at outcome is taken from gestation on the end of pregnancy record where available, from antenatal booking records if not and finally, [imputed](#_Imputed_gestations). For Live births and stillbirths, gestation on NHS live birth/NRS stillbirth records takes priority over gestation on SMR02. For terminations recorded on SMR02 and AAS, SMR02 gestation takes priority. If recorded gestation is not [feasible](#_Feasible_gestation_ranges) for the outcome of pregnancy, it is discarded, and the gestation taken from the next priority record, or imputed.

## Demographic data

### Maternal NHS Board area of residence

Where possible, the mother’s postcode of residence at the end of the pregnancy was taken from NRS live and stillbirth records. For cases where there was no live or stillbirth record (e.g. a termination) or no available postcode information on the NRS record, postcode was taken from SMR02 or AAS record(s) relating to that pregnancy. Postcode was then used to derive maternal NHS Health Board[[1]](#footnote-2) of residence. Healthboard boundaries were last updated in 2019, so this is the version used in COPS.

EAVE cohort healthboard (valid March 2020) was used if no other source was available.

### Maternal age

Maternal date of birth is not available to PHS on NRS records, but was available from all other data sources (SMR02 record, NHSLB, AAS, SMR01, antenatal booking, GP losses). CHI was used as the primary source of DOB, with any gaps (mothers with invalid CHI), filled from other sources. This allowed for the calculation of maternal age at the pregnancy end date.

### Maternal deprivation and urban rural index

The mother’s postcode of residence at the end of the affected pregnancy was used to derive maternal deprivation level (Scottish Index of Multiple Deprivation (SIMD) quintile) and urban rural index (URI). The latest version of SIMD was released in 2020, the latest version of URI in 2016.

Where multiple postcodes were present on different records, the priority order was:

NRS lb > SMR02 > AAS > NRSSB > SMR01

### Maternal ethnicity

Maternal ethnicity was determined from several sources, in the following order of priority

SMR02 > SMR01 > AN booking > file from vaccine team

The file COPS receives from the vaccine team is ethnicity status based on last healthcare contact at which it was recorded, *excluding vaccination appointment*.

Ethnicity is poorly recorded in most sources, with a high level of unknowns. 26.7% of pregnancies in the final dataset have unknown maternal ethnicity, including where ethnicity was recorded as “refused”. Missing ethnicity varies by outcome, it is highest in ongoing pregnancies (82%) and unknown outcomes (55%), and lowest amongst ectopic pregnancies (12%) and live births (14%).

### Infant sex

The baby’s sex is often not known or not recorded for pregnancies that end in a spontaneous fetal death or termination of pregnancy. Infant sex should be recorded for all live births and for outcomes where it is recorded infant sex was taken from NRS live birth records.

### Singleton / multiple status

The baby’s singleton/multiple status is often not known or not recorded for pregnancies that end in a spontaneous fetal death or termination of pregnancy, so all analyses involving infant multiplicity status were based on live births only. This information was taken from NRS live birth records.

### Comorbidity

*From SMR02 records*

Pregnancies with an outcome recorded in SMR02 should have a record of the diabetes status, smoking status at booking, and height and weight (from which we calculate BMI) of the mother at time of admission. In practice, of the pregnancies in the cohort that have an SMR02 record, 95% have diabetes information, 96% have a smoking status and 94% have a valid BMI. Smoking status is also available from antenatal booking records: in total, 71% of the cohort have a booking smoking status, whether recorded on SMR02, or on antenatal booking records.

*Comorbidities from GP data*

Comorbidities that have been identified as predictors for higher risk of death or severe illness (collectively known as QCOVID comorbidities)[[2]](#footnote-3), were available for the COPS cohort from GP data. This includes any record of a person having one of the conditions in the list recorded on their record within the previous 5 years. Everyone registered with a GP in Scotland at the time of data extraction should have any QCOVID comorbidities recorded. This will include the vast majority of the cohort.

BMI and smoking status are also available from GP records (baselined at 2020); the GP data has a high level of missingness and inconsistency, however, even for those registered at March 2020, so it is only used when no other source of information is available for these comorbidities.

*Clinical vulnerability/shielding list.*

The shielding list is the list of people identified by who were initially advised to shield (<https://www.gov.scot/publications/covid-highest-risk/>). This list was dynamic throughout the pandemic. Latterly, shielding advice was dropped and the shielding list was replaced with the clinical vulnerability list. This list includes people with 7 categories of conditions that make them highly vulnerable to severe illness from COVID-19. Compared to the GP QCOVID list, this is more restricted list of conditions, representing the most severe conditions, and it was updated monthly until [May 2022](https://www.gov.scot/publications/covid-highest-risk/).

## Covid-19 infection data

Covid infection data was taken from the Covid-19 test & protect database. The definitions of an infection was a positive PCR test (from March 2020- end cohort). From 6th January 2022, the Scottish definition of a case was expanded to include a positive lateral flow test (LFD), without the need for a confirming PCR test. However, if a person has a positive LFD test followed by a negative PCR, the LFD is assumed to be a false positive, and the case is not counted. The COPS definition of a positive covid-19 case follows this expanded definition from this date onwards and so includes cases identified by positive LFD tests as well as positive PCR tests.

### Deduplication rules

Cases were deduplicated on 90 days, that is, from the first positive test a person has, subsequent positive tests within a 90-day window do not count as a separate case, but a positive test > 90 days from the date of the first case would count as a second Covid-19 case.

### Case in pregnancy

A covid-19 case was counted as a case in pregnancy if the positive test was obtained 2+0 weeks gestation to end of pregnancy.

### Additional information about the infection

Additional information about the positive test was used for some studies. The following was extracted for PCR tests from the test and protect database:

* S-gene status (as a proxy for variant)
* flag\_covid\_symptomatic,
* test\_reason,

For the minority of RT-PCR tests that were sequenced, the information on the assigned variant of concern (VOC) or variant under investigation (VUI), was extracted from the whole genome sequencing database.

### Data quality and completeness

The level of testing available, and testing practices in healthcare, varied a lot of the course of the time period covered by the data, and the test positive rates should be interpreted accordingly. A timeline including information on changes in testing policy can be [found on the Scottish Parliment Information Centre](https://spice-spotlight.scot/2022/08/19/timeline-of-coronavirus-covid-19-in-scotland/). The level of CHI completeness in the testing data was generally good, 96.8%, for PCR tests and 99.0% for LFD tests.

## Vaccination data

Vaccination data comes from the NHS Scotland National Clinical Data Store (NCDS). The NCDS draws data from the NHS Scotland Vaccine Management Tool (VMT) and any GP practices that are recording delivery of vaccinations directly into GP system. Vaccination data is received into COPS in a pre-processed file from the vaccinations team (**email here**) .

### Data quality and completeness

The vaccines file only contains vaccinations with Pfizer, Moderna and AstraZeneca from 8th December 2020.It thus excludes anyone vaccinated with another vaccine as part of a clinical trial. *(excludes all clinical trial vaccines?),* it only contains vaccinations given in Scotland, so anyone vaccinated abroad or elsewhere in the UK will not have their vaccination status recorded correctly.

## Maternal outcomes

### Admissions to hospital/intensive care

* Admissions to ICU/HDU are extracted from the SICSAG database. This includes data on all adult ICU admissions including those who have not been discharged yet. Cause(s) of admission are recorded. Incidental covid positive test should not be recorded on SICSAG prior to April 2022; from the beginning of April 2022it can be recorded specifically as incidental covid positive.
* Hospital admission was determined from linking SMR01 and SMR02 records.
  + Covid diagnosis codes were not used from SMR, as presence of covid diagnosis on SMR01 or SMR02 records could indicate either an incidental positive test (without clinically significant disease) or covid as a significant morbidity. See Scottish clinical coding standards no. 30(<https://www.isdscotland.org/products-and-services/terminology-services/clinical-coding-guidelines/Docs/Scottish-clinical-coding-standards-no30-July-2021.pdf>) for coding rules in SMR01,and note the exceptions for pregnancy.
  + Admissions with Certain Complications of pregnancy – VTE, bleeding, haemorrhage, are flagged and added to the cohort. See [Appendix 2](#_Appendix_2_–) for details of the conditions included.

### Deaths

* Pregnancy records were linked to NRS death records. A maternal death is defined as a death in pregnancy or up to 41 days after end of pregnancy. Date and causes of death for any women dying in this period were extracted from the database.

## Neonatal outcomes

### Neonatal infection

Neonatal infections were identified from the test and protect database in the same way as maternal infections. Only babies with valid CHI could be linked to test data.

### Neonatal death

Neonatal deaths were identified through linkage with the NRS statutory death registration records for babies aged up to 1 year. Linkage was possible either by CHI number or by NRS triplicate (birth) ID for those babies with no CHI recorded.

Neonatal death is defined as death at 0-27 days. Early neonatal death as death at 0 -6 days.

### Neonatal admissions

Neonate acute hospital admissions were identified through linkage with SMR01. ICU admissions through SICSAG. Diagnosis information was also linked. Only babies with valid CHI could be linked to hospital/ICU admissions data.

### Congenital anomalies

Congenital anomalies were identified by linking to the [CARDRISS data.](https://beta.isdscotland.org/topics/maternity-and-births/congenital-anomalies-rare-diseases-and-cardriss/)

## Definitions and calculations used

### Trimester

First trimester - 14 days to 13+6 weeks

Second trimester 14 weeks to 27+6 weeks

Third trimester 28 weeks +

### Impacts of infections

The main focus of reporting is on “associated” impacts (occurring within 28 days of +ve covid test, or for neonate outcomes following a birth that occurred within 28 days of +ve maternal test). Subsequent impacts – that is, the above outcomes occurring in/at the end of a pregnancy that was affected by covid at any point in the pregnancyare also reported on.

We report on the following impacts associated with positive covid test in pregnancy (not all are published).

* ICU admission, hospital admission (determined from SICSAG/SMR01 records, respectively)
* Birth outcomes for births occurring within 28 days of infection
  + Live birth
  + Stillbirth
  + Preterm/very preterm <37 / < 32 weeks
* Low APGAR scores (score < 7, term births only)
* Neonatal deaths: Neonatal death is defined as death at 0-27 days. Early neonatal death as death at 0 -6 days.
* Neonatal infections: infections occurring at 0-27 days
* Maternal deaths : death of mother in pregnancy or up to 41 days after end of pregnancy.

### Grouping outcomes

Missing or inaccurate date and UPI information can result in multiple records with apparently conflicting dates or outcomes for the same pregnancy. It is not always possible to be 100% certain of the actual outcome, so we apply grouping rules that work for most cases. Initially we group records that belong to the same woman and occur within 83 days of each other as belonging to the same pregnancy (as it is rare that one pregnancy would end, and another have an outcome within this time period, and this rule helps to resolve inconsistencies in estimated conception date between records).

However, there are certain situations where we can be reasonably certain that events within 83 days of each other *do* belong to separate pregnancies, and we reclassify these accordingly: occasionally a termination or early loss can occur shortly after another pregnancy ending. In the case when an AAS record or Ectopic or Molar pregnancy is recorded after a live or stillbirth, we can be relatively certain that the date of the birth is correct on the records, and therefore a subsequent early loss or termination will refer to a different pregnancy. If a live or stillbirth is followed by a termination or early loss within 30 days, these are classed as separate pregnancies. This is an exception to the 83 day rule.

### Feasible gestation ranges

| **Dataset** | **Feasible Gestation Range** |
| --- | --- |
| Antenatal Booking | 4 to 43 weeks |
| AAS Records | Ground A, B, E, F, G: 4 to 43 weeks Ground C, D: 4 to 23 weeks |
| SMR02 | Live Birth: 20 to 43 weeks Stillbirth: 24 to 43 weeks Spontaneous Loss: 4 to 23 weeks Termination: 4 to 43 weeks |
| NRS Stillbirths | 24 to 43 weeks |
| NHS Live Births | 20 to 43 weeks |

### Imputed gestations

For outcomes where gestation is not present, or not feasible, the gestation is imputed as follows

| **Dataset** | **Assumed Gestation** |
| --- | --- |
| SMR01 | 12 weeks |
| SMR02 | Live Birth: 40 weeks Spontaneous Loss: 12 weeks Termination: 16 weeks Stillbirth: 32 weeks |
| NRS Stillbirths | 32 weeks |
| NRS Live Births | 40 weeks |
| NHS Live Births | 40 weeks |
| AAS Records | 10 weeks |

### Vaccine calculations:

Vaccination does not take effect immediately, so people were classed as vaccinated only after a certain time after the date of vaccination, as follows:

* 1st dose – counts as vaccinated with one dose from 21 days post vaccination
* 2nd dose – counts as vaccinated with second dose from 14 days post vaccination
* 3rd and subsequent doses - counts as vaccinated with third/subsequent dose from 14 days post vaccination

## Comparability with other Scottish statistics

## Accuracy and reliability

This is the most complete record of who is pregnant when in Scotland. The estimates of covid infection and covid vaccination in pregnant women are the best currently available in Scotland and are fit for purpose to monitor the impact of covid on pregnancy outcomes and for monitoring vaccine safety in pregnant women.

Many of the data sources used to determine pregnancy are legal/statutory requirements – live births, stillbirths and terminations must all be recorded. Records of pregnancies ending in these outcomes are reliably recorded with a very high level of completeness. There will be some early spontaneous losses that are not recorded in any dataset, additionally, we do not have end of pregnancy records for women who move out of Scotland before their pregnancy ends.

# Glossary

|  |  |
| --- | --- |
|  |  |
| AAS | Abortion Act Scotland |
| CHI | Community Health Index. A number that uniquely identifies a patient within the NHS in Scotland. |
| Ectopic pregnancy | A condition in which a fertilized egg grows outside of the uterus, usually in one of the fallopian tubes |
| Gestation | The time between conception and the end of a pregnancy. |
| HDU | High dependency unit |
| ICD10 | International Classification of Diseases and Related Health Problems 10th Revision. |
| ICU | Intensive care unit |
| Live birth | Delivery of a live born baby at any gestation. |
| Molar pregnancy (hydatidiform mole) | Abnormal growth of tissue, due to an abnormally fertilised egg |
| Multiple pregnancy | A pregnancy of two (twins) or more (triplets, etc) babies. |
| NRS | National Records of Scotland. |
| PHS | Public Health Scotland |
| Preterm (birth) | Live birth occurring before 37 weeks’ gestation  Very preterm is defined as <32 weeks’ gestation |
|  |  |
| SICSAG | Scottish Intensive Care Society Audit Group <https://www.sicsag.scot.nhs.uk/index.html> |
| SIMD | Scottish Index of Multiple Deprivation. A measure of deprivation based on postcode. |
| Singleton | A pregnancy of one baby. |
| SMR01 | Scottish Morbidity Record 1: Acute General Inpatient and daycase. - <https://www.ndc.scot.nhs.uk/Data-Dictionary/SMR-Datasets/SMR01-General-Acute-Inpatient-and-Day-Case/> |
| SMR02 | Scottish Morbidity Record 2: Maternity inpatient and daycase. <https://www.ndc.scot.nhs.uk/Data-Dictionary/SMR-Datasets/SMR02-Maternity-Inpatient-and-Day-Case/> |
| Spontaneous early pregnancy loss | Early spontaneous pregnancy loss (1st trimester) up to 13+6 (excluding ectopic pregnancies) |
| (Spontaneous) late fetal loss | Miscarriage of a dead fetus between 20+0 and 23+6 weeks gestation (not as the result of a termination of pregnancy procedure). |
| (Spontaneous) stillbirth | Delivery of a dead fetus from 24+0 weeks gestation onwards (not as the result of a termination of pregnancy procedure). |
| Therapeutic abortion | Termination of pregnancy, i.e. a procedure carried out to intentionally end a pregnancy. |
| Total Births | The combined number of live births and stillbirths. |

# Appendices

## Appendix 1 – Background information

### Data Completeness

*CHI completeness for last cohort update*

|  |  |
| --- | --- |
| **Dataset** | **CHI completeness (%)** |
| Vaccine | 100% |
| Test and protect | 97.3% |
| GP losses | 99.7% |
| SMR02 (babies) | 99.5% |
| SMR02 (mothers) | 100% |
| NHS live births (babies) | 100% |
| NHS live births (mothers) | 94.3% |
| NRS live births (babies) | 99.5% |
| NRS live births (mothers) | 74.7% |

## Appendix 2 – Coding of outcomes

### Identifying pregnancy outcomes – coding rules

|  |  |  |
| --- | --- | --- |
| **Outcome** | **Dataset** | **Criteria** |
| Live births | SMR02 | condition on discharge == 3 outcome of pregnancy == 1, 3, 4, or 5 |
| NHS Live Births | All records |
| NRS Live Births | All records |
| Stillbirth | SMR02 | condition on discharge == 3 outcome of pregnancy == 2 |
| NRS Stillbirth records | primary cause of death != P964 secondary cause of death 0 != P964 secondary cause of death 1 != P964 secondary cause of death 2 != P964 secondary cause of death 3 != P964 |
| Spontaneous Losses  (miscarriage) | SMR01 | ICD10 codes: O02, O03.5-O03.9, O05.5-O05.9; O06.5-O06.9 |
| SMR02 | condition on discharge == 2 type of abortion == 1, 2, 3, 8, or 9 |
|  | GP records | Spontaneous, other, and unspecified abortion: L0... ; L04.. ; L040.; L042.; L043.; L045.; L04z.; L07..; L070.;L072.; L07z. , L0y.. , L0z.. , Lyu02  Other abnormal product of conception (including missed abortion)  L01.., L02… , Lyu01, 7E088 |
| Molar pregnancy | GP records | READ CODES: L00.., BBR0., BBR5., BBR7., BBR8. |
|  | SMR01 | ICD10 codes: O01 |
| Ectopic pregnancy | SMR01 | O00 |
| SMR02 | condition on discharge == 2 type of abortion == 6 |
| GP records | L03..; Lyu00; 584E.; 7E131; 7E133; 7E190 |
| Terminations | AAS records | All records |
| SMR02 records | condition on discharge == 2 type of abortion == 4 |

### SMR01 flagged admissions

Admissions with certain complications of pregnancy are included in the COPS data. Admissions with a diagnosis of covid or a covid related condition are also included. The ICD10 codes of the conditions included are listed in the table below.

|  |  |
| --- | --- |
| **Condition** | **ICD10 codes** |
| Hypertensive complications of pregnancy | O11, O13, O14.0, O14.1, O14.2, O14.9,O15.0, O15.1, O15.2, O15.9 |
| VTE | I26.0, I26.9, I80.1, I80.2, I80.3, O08.2, O22.3, O87.1, O88.2, I80.8, I80.9, I81, I82.0, I82.1, I82.2, I82.3, I82.8, I82.9, O22.9, O87.9, G08, I63.6, I67.6, O22.5, O87.3, O03.2, O03.7, O04.2, O04.7, O05.2, O05.7, O06.2, O06.7, O07.2, O07.7 |
| Early pregnancy bleeding | O03.1, O03.6, O04.1, O04.6, O05.1, O05.6, O06.1, O06.6, O07.1, O07.6, O08.1, O20.0, O20.8, O20.9 |
| Obstetric haemorrhage | O44.1, O45.0, O45.8, O45.9, O46.0, O46.8, O46.9, O67.0, O67.8, O67.9, O69.4, O72.0, O72.1, O72.2, O72.3 |
| Disseminated intravascular coagulation | D65 |
| Acute covid infection | U07.1, U07.2, U07.5 |
| History of covid infection | U07.3, U07.4 |
| Adverse reaction to covid vaccine | U07.7 |

### Scottish Index of Multiple Deprivation

Deprivation for individuals is estimated from aggregate data derived from the census and other routine sources. These are used to estimate the deprivation of individuals in small geographical areas. The Scottish Index of Multiple Deprivation has seven domains (income, employment, education, housing, health, crime, and geographical access), which have been combined into an overall index to pick out area concentrations of multiple deprivation. The SIMD postcode mappings do not attempt to identify individuals who are deprived.

A small percentage of records could not be mapped to a SIMD quintile due to missing postcode information. The sum of the individual quintiles therefore may not match the total figures at Scotland level.

Further information about SIMD can be found at:

<http://www.isdscotland.org/Products-and-Services/GPD-Support//Deprivation/SIMD>

A more detailed explanation about the application of SIMD, its advantages and disadvantages is available at:

<http://www.isdscotland.org/Products-and-Services/GPD-Support/Deprivation/SIMD/_docs/PHI-Deprivation-Guidance.pdf>

## Appendix 3 – Publication Metadata

|  |  |
| --- | --- |
| Metadata Indicator | Description |
| **Publication title** | Covid-19 In pregnancy: technical report |
| **Description** | This publication presents the methodology used to create the COPS cohort released in September 2022 |
| **Theme** | Health and Social Care |
| **Topic** | Maternity and Births |
| **Format** | PDF publication full report, technical report, and publication summary with accompanying Excel workbooks. |
| **Data source(s)** | NRS Live Birth Registrations, NHS live birth registrations, NRS Stillbirth Registrations, Scottish Birth Record, SMR02, SMR01, Notification of Abortion Statistics, GP records, NRS Death Registrations, SICSAG, Test and protect, Vaccinations |
| **Date that data are acquired** | August 2022 |
| **Release date** | xx September 2022 |
| **Frequency** | Once |
| **Timeframe of data and timeliness** | All known pregnancies & births overlapping the time period March 2020 – August 2022. Births data estimated complete till ?? June 2022. |
| **Continuity of data** | All datasets were available for the full time period |
| **Revisions statement** | N/A – this is a new publication |
| **Revisions relevant to this publication** | N/A – this is a new publication |
| **Concepts and definitions** | See [Methods](#_Methods) and [Appendix A1](#_Appendix_1_–). |
| **Relevance and key uses of the statistics** | Providing estimates of covid infection in pregnancy and outcomes for affected mothers and babies. Providing information on Covid-19 vaccination uptake in pregnancy. |
| **Accuracy** | Although this is the first publication of its kind, the data sources used are long standing population based datasets that are completed to a high standard. |
| **Completeness** |  |
| **Comparability** |  |
| **Accessibility** | It is the policy of ISD Scotland to make its web sites and products accessible according to [published guidelines.](http://www.isdscotland.org/About-ISD/Accessibility/) |
| **Coherence and clarity** | Tables and charts of published data are accessible via the PHS website <https://publichealthscotland.scot/publications/show-all-releases?id=20580> The final version of the dataset is archived and held in the EDRIS safe haven |
| **Value type and unit of measurement** |  |
| **Disclosure** | The [ISD protocol on Statistical Disclosure Protocol](https://www.isdscotland.org/About-ISD/Confidentiality/disclosure_protocol_v3.pdf) is followed. |
| **Official Statistics designation** | Official Statistics |
| **UK Statistics Authority Assessment** | These statistics have not been submitted for assessment by the UK statistics Authority. |
| **Last published** | N/A |
| **Next published** | NA |
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| **Help email** | phs.COPS@phs.scot |
| **Date form completed** |  |

## Appendix 4 – ISD and Official Statistics

**About ISD**

Scotland has some of the best health service data in the world combining high quality, consistency, national coverage and the ability to link data to allow patient based analysis and follow up.

Information Services Division (ISD) is a business operating unit of NHS National Services Scotland and has been in existence for over 40 years. We are an essential support service to NHS Scotland and the Scottish Government and others, responsive to the needs of NHS Scotland as the delivery of health and social care evolves.

Purpose: To deliver effective national and specialist intelligence services to improve the health and wellbeing of people in Scotland.

Mission: Better Information, Better Decisions, Better Health

Vision: To be a valued partner in improving health and wellbeing in Scotland by providing a world class intelligence service.

**Official Statistics**

Information Services Division (ISD) is the principal and authoritative source of statistics on health and care services in Scotland. ISD is designated by legislation as a producer of ‘Official Statistics’. Our official statistics publications are produced to a high professional standard and comply with the Code of Practice for Official Statistics. The Code of Practice is produced and monitored by the UK Statistics Authority which is independent of Government. Under the Code of Practice, the format, content and timing of statistics publications are the responsibility of professional staff working within ISD.

ISD’s statistical publications are currently classified as one of the following:

* National Statistics (i.e. assessed by the UK Statistics Authority as complying with the Code of Practice)
* National Statistics (i.e. legacy, still to be assessed by the UK Statistics Authority)
* Official Statistics (i.e. still to be assessed by the UK Statistics Authority)
* Other (not Official Statistics)

Further information on ISD’s statistics, including compliance with the Code of Practice for Official Statistics, and on the UK Statistics Authority, is available on the [ISD website](http://www.isdscotland.org/About-ISD/About-Our-Statistics/).

1. The 2019 NHS Scotland Health Board configuration was used. [↑](#footnote-ref-2)
2. Clift A K, Coupland C A C, Keogh R H, Diaz-Ordaz K, Williamson E, Harrison E M et al. Living risk prediction algorithm (QCOVID) for risk of hospital admission and mortality from coronavirus 19 in adults: national derivation and validation cohort study *BMJ* 2020; 371 :m3731 doi:10.1136/bmj.m3731 [↑](#footnote-ref-3)