

INTERNSHIP REPORT

Comprehensive Statistical Analysis of Vital Events in Kerala (2019–2023)

**Submitted by
Abhijith S
MSc Statistics
St Thomas' College (Autonomous), Thrissur
Affiliated to the University of Calicut**

**DIRECTORATE OF ECONOMICS AND STATISTICS
GOVERNMENT OF KERALA
THIRUVANATHAPURAM
APRIL 2025**

CERTIFICATE

This is to certify that **Mr. Abhijith S**, currently enrolled in the M.Sc. Statistics program at **St. Thomas College (Autonomous), Thrissur**, has successfully completed an internship at the **Directorate of Economics and Statistics, Government of Kerala**, Thiruvananthapuram, during the period **April 2025**.

During the internship, he was engaged in the statistical analysis of vital events in Kerala, with a focus on birth and death registration data. He demonstrated good analytical skills, proficiency in statistical tools, and a sincere approach to learning and contributing to the work assigned.

We acknowledge his efforts and wish him success in his future academic and professional pursuits.

Place: Thiruvananthapuram
Date:

Sri. Sreekumar B
Director
Directorate of Economics and Statistics
Government of Kerala

CERTIFICATE

This is to certify that **Mr. Abhijith S**, currently enrolled in the M.Sc. Statistics program at **St. Thomas College (Autonomous), Thrissur**, has successfully completed his internship at the **Vital Statistics Division, Directorate of Economics and Statistics, Government of Kerala**, Thiruvananthapuram, during the period **April 2025**.

During the internship, he was involved in the statistical analysis of vital events in Kerala, specifically focusing on birth and death registration data. He demonstrated commendable analytical abilities, sound knowledge of statistical tools, and a professional attitude towards learning and executing the tasks assigned.

It was a pleasure to mentor him during this period, and I wish him all success in his academic and professional endeavours.

Place: Thiruvananthapuram

Date:

Sri. T.P. Vinodan

Additional Director (General)

Directorate of Economics and Statistics

Government of Kerala

Smt.A.R.Yamuna

Deputy Director

Vital Statistics Division

Directorate of Economics and Statistics

Government of Kerala

DECLARATION

I hereby declare that the internship report titled "**Comprehensive Statistical Analysis of Vital Events in Kerala (2019–2023)**" submitted in partial fulfilment of the requirements for the M.Sc. Statistics program is a **bonafide record** of the work carried out by me during my internship at the **Directorate of Economics and Statistics, Government of Kerala**, Thiruvananthapuram, during the period **April 2025**.

I also declare that this report is the result of my original work and has not been submitted previously, either in part or full, for the award of any degree, diploma, or other similar title.

Place: Thiruvananthapuram
Date:

Signature: _____

Name: Abhijith S
M.Sc. Statistics
St. Thomas College (Autonomous), Thrissur

Table of Contents

1) Acknowledgement.....	3
2) Introduction.....	4
3) Birth Registration Data Analysis:2019-2023.....	5
3.1) Birth Registration Data for 2019: District-Wise and Sex-Based Analysis.....	5
3.2) Birth Registration Data for 2020: District-Wise and Sex-Based Analysis.....	19
3.3) Birth Registration Data for 2021: District-Wise and Sex-Based Analysis.....	32
3.4) Birth Registration Data for 2022: District-Wise and Sex-Based Analysis.....	36
3.5) Birth Registration Data for 2023: District-Wise and Sex-Based Analysis.....	39
4) District-wise Analysis of Birth Data and Sex Ratio Trends in Kerala (2019–2023).....	43
4.1) 2019.....	43
4.2) 2020.....	45
4.3) 2021.....	47
4.4) 2022.....	49
4.3) 2023.....	51
5) Registration Patterns of Persons Born from 2019 to 2023 in Kerala: A District and Gender wise Analysis.....	54
5.1) 2019.....	54
5.2) 2020.....	56
5.3) 2021.....	59
5.4) 2022.....	60
5.5) 2023.....	61
6) Vital Statistics-Based Planning for 2025 School Enrolment using 2019 born children.....	63
6.1) No of children born in 2019 in the Birth registration data (2019-2023).....	63
6.2) No of children dead which has born in 2019 from the death registration data (2019-2023)....	65
7) Vital Statistics-Based Planning for 2025 School Enrolment using 2020 born children.....	66
7.1) No of children born in 2020 in the Birth registration data (2020-2023).....	66
7.2) No of children dead which has born in 2020 from the death registration data (2020-2023)....	68
8) Maternal Factors and Birth Outcomes: Trends Across Five Years.....	69
8.1) Average Birth Weight by Year.....	69
8.2) Average Birth Weight by Mother's Age Group.....	71
8.3) Mother's Education Level vs Preterm Births.....	73
8.4) Birth Weight by Mother's Qualification.....	74

9) Analysis and Forecasting of Delayed Birth and Death Registrations in Kerala (2019-2023)	76
9.1) Delayed Birth Registrations in Kerala (2019–2023): Sex-wise Analysis and Forecast for 2024-2025.....	76
9.2) Delayed Death Registrations in Kerala (2019–2023): Sex-wise Trends and Forecast for 2024-2025.....	79
10) Time Series Analysis and ARIMA-Based Forecasting of Birth and Death Registrations in Kerala (2019–2023).....	83
10.1) Time Series Forecasting of Birth Registrations (2019–2023).....	83
10.2) Time Series Forecasting of Death Registrations (2019–2023).....	86
11) Computation and Visualisation of Age-Specific Fertility Rates (ASFR) in Kerala:2019–2023	89
11.0.1) Final Thoughts.....	91
12) Summary.....	92
13) References.....	93

1 Acknowledgement

I express my sincere gratitude to the **Directorate of Economics and Statistics, Government of Kerala, Thiruvananthapuram**, for providing me with the opportunity to undertake an internship during the period **April 2025**.

I would like to extend my heartfelt thanks to **Sri. Sreekumar B, Director**, for granting permission to carry out the internship in the department.

I am deeply thankful to **Sri. T.P. Vinodan, Additional Director General, and Smt.A. R. Yamuna, Deputy Director, Vital Statistics Division**, for their valuable guidance, encouragement, and support throughout the internship period.

I also extend my gratitude to the officers and staff of the Vital Statistics Division for their cooperation and assistance, which helped me gain practical insights into the field of official statistics and data analysis.

Last but not least, I am grateful to my faculty at **St. Thomas College (Autonomous), Thrissur**, and to my family and friends for their constant encouragement and support throughout this internship journey.

Abhijith S

M.Sc. Statistics

St. Thomas College (Autonomous), Thrissur

2 Introduction

The internship at the **Directorate of Economics and Statistics, Government of Kerala**, conducted during April 2025, offered a valuable opportunity to gain practical experience in the field of official statistics. As a part of the M.Sc. Statistics program at **St. Thomas College (Autonomous), Thrissur**, this internship allowed me to work directly with real-world data and understand its relevance in public administration and planning.

The primary focus of the internship was the statistical analysis of **vital events** in Kerala, particularly related to **birth and death registrations** during the five-year period from **2019 to 2023**. This involved collecting, organising, and analysing large datasets to extract meaningful insights on demographic trends.

Key areas of analysis included district-wise and sex-wise distribution of births, changing **sex ratio trends**, and the incidence of delayed registrations. In addition, **time series models**, especially ARIMA, were applied to forecast future birth and death registrations. The **Age Specific Fertility Rate (ASFR)** was also computed and visualised to understand fertility patterns across different age groups.

The project also explored how statistical findings can support **policy-oriented planning**, such as forecasting school enrolment based on birth trends. Throughout the internship, tools such as **R programming** were extensively used for data cleaning, analysis, and visualisation.

This report presents a detailed account of the analytical tasks undertaken, the statistical methods applied, and the insights derived. The internship has significantly contributed to my academic growth, enhancing both technical and interpretive skills in data analysis.

3 Birth Registration Data Analysis: 2019-2023

This section presents an analysis of birth registration data for the years 2019 to 2023. The analysis focuses on examining birth occurrences across different districts in Kerala, categorised by birth year and sex, as well as the registration patterns for each respective year. The insights derived from this data provide a comprehensive overview of demographic trends and registration trends across the state.

3.1 Birth Registration Data for 2019: District-Wise and Sex-Based Analysis

Sex-Wise Count of People Born Before 2000 (District-Wise)

DISTRICT_NAME	Male	Female	Total
Kasaragod	36	31	67
Kannur	65	66	131
Wayanad	9	35	44
Kozhikkode	37	29	66
Malappuram	53	69	122
Palakkad	75	60	135
Thrissur	141	85	226
Ernakulam	161	173	334
Idukki	73	124	197
Kottayam	181	223	404
Alappuzha	127	125	252
Pathanamthitta	188	201	389
Kollam	170	111	281
Thiruvananthapuram	122	52	174

Sex-Wise Count of People Born Before 2000 (Total)

Sex	Count
Male	1438
Female	1384

Year-Wise, Sex-Wise Birth Count from 2000 Onward (District-Wise)

DISTRICT_NAME	Birth year	Male	Female	Not stated	Total
Kasaragod	2001	2	2	0	4
	2002	0	0	0	0
	2003	0	1	0	1
	2004	5	3	0	8
	2005	0	0	0	0
	2006	2	3	0	5
	2007	0	2	0	2
	2008	0	1	0	1
	2009	0	1	0	1
	2010	1	1	0	2
	2011	3	0	0	3
	2012	1	0	0	1
	2013	6	3	0	9
	2014	2	3	0	5
	2015	1	1	0	2
	2016	2	2	0	4
	2017	4	6	0	10
	2018	301	306	0	607
	2019	9734	9233	0	18967
Kannur	2000	4	2	0	6
	2001	5	3	0	8
	2002	3	3	0	6
	2003	7	3	0	10
	2004	5	11	0	16
	2005	5	7	0	12
	2006	9	6	0	15
	2007	7	5	0	12
	2008	0	4	0	4
	2009	5	4	0	9
	2010	4	2	0	6

	2011	1	0	0	1
	2012	0	4	0	4
	2013	0	1	0	1
	2014	0	2	0	2
	2015	6	4	0	10
	2016	5	4	0	9
	2017	2	1	0	3
	2018	567	522	0	1089
	2019	21060	20261	2	41323
Wayanad	2000	0	3	0	3
	2001	4	2	0	6
	2002	2	1	0	3
	2003	6	8	0	14
	2004	7	2	0	9
	2005	1	1	0	2
	2006	1	2	0	3
	2007	2	1	0	3
	2008	0	1	0	1
	2009	1	2	0	3
	2010	1	1	0	2
	2011	0	2	0	2
	2012	0	2	0	2
	2013	2	1	0	3
	2014	3	1	0	4
	2015	1	0	0	1
	2016	1	2	0	3
	2017	1	1	0	2
	2018	214	157	0	371
	2019	7240	6978	0	14218
	2000	0	1	0	1
	2001	0	0	0	0
	2002	0	2	0	2
	2003	1	3	0	4
	2004	0	1	0	1
	2005	0	3	0	3
	2006	3	0	0	3

Kozhikode	2007	0	0	0	0
	2008	0	0	0	0
	2009	0	2	0	2
	2010	0	0	0	0
	2011	2	0	0	2
	2012	1	0	0	1
	2013	0	0	0	0
	2014	2	2	0	4
	2015	2	4	0	6
	2016	0	3	0	3
	2017	7	1	0	8
	2018	751	723	0	1474
	2019	28009	26766	8	54783
Malappuram	2000	1	4	0	5
	2001	2	3	0	5
	2002	1	5	0	6
	2003	7	8	0	15
	2004	5	2	0	7
	2005	8	0	0	8
	2006	0	3	0	3
	2007	7	1	0	8
	2008	1	2	0	3
	2009	0	4	0	4
	2010	6	3	0	9
	2011	3	5	0	8
	2012	7	4	0	11
	2013	5	8	0	13
	2014	5	9	0	14
	2015	9	5	0	14
	2016	7	6	0	13
	2017	4	5	0	9
	2018	1714	1651	0	3365
	2019	46557	44156	1	90714
	2000	3	0	0	3
	2001	1	3	0	4
	2002	10	6	0	16

Palakkad	2003	9	7	0	16
	2004	11	20	0	31
	2005	12	8	0	20
	2006	5	9	0	14
	2007	3	9	0	12
	2008	7	5	0	12
	2009	8	6	0	14
	2010	8	10	0	18
	2011	9	4	0	13
	2012	11	7	0	18
	2013	6	6	0	12
	2014	11	8	0	19
	2015	9	7	0	16
	2016	4	4	0	8
	2017	5	6	0	11
	2018	635	551	0	1186
	2019	17290	16352	2	33644
Thrissur	2000	0	2	0	2
	2001	6	2	0	8
	2002	0	2	0	2
	2003	3	5	0	8
	2004	1	5	0	6
	2005	2	1	0	3
	2006	0	3	0	3
	2007	1	4	0	5
	2008	0	3	0	3
	2009	2	1	0	3
	2010	1	1	0	2
	2011	1	3	0	4
	2012	0	1	0	1
	2013	4	4	0	8
	2014	6	2	0	8
	2015	3	6	0	9
	2016	2	10	0	12
	2017	4	3	0	7
	2018	384	392	0	776

	2019	22702	21661	4	44367
Eranakulam	2000	3	1	0	4
	2001	2	0	0	2
	2002	1	1	0	2
	2003	4	6	0	10
	2004	4	3	0	7
	2005	6	2	0	8
	2006	2	3	0	5
	2007	1	4	0	5
	2008	0	1	0	1
	2009	0	1	0	1
	2010	2	0	0	2
	2011	1	4	0	5
	2012	1	0	0	1
	2013	2	2	0	4
	2014	1	3	0	4
	2015	0	3	0	3
	2016	0	4	0	4
	2017	3	2	0	5
	2018	484	521	0	1005
	2019	13820	13316	2	27138
Idukki	2000	4	3	0	7
	2001	4	4	0	8
	2002	5	5	0	10
	2003	10	4	0	14
	2004	4	3	0	7
	2005	3	2	0	5
	2006	2	5	0	7
	2007	1	2	0	3
	2008	0	2	0	2
	2009	0	4	0	4
	2010	1	2	0	3
	2011	2	1	0	3
	2012	2	2	0	4
	2013	2	2	0	4
	2014	4	6	0	10

	2015	0	4	0	4
	2016	1	2	0	3
	2017	4	4	0	8
	2018	164	158	0	322
	2019	5351	5336	1	10688
Kottayam	2001	0	2	0	2
	2002	0	3	0	3
	2003	4	2	0	6
	2004	0	2	0	2
	2005	4	0	0	4
	2006	1	0	0	1
	2007	2	1	0	3
	2008	1	3	0	4
	2009	0	0	0	0
	2010	1	3	0	4
	2011	3	1	0	4
	2012	2	1	0	3
	2013	4	0	0	4
	2014	2	3	0	5
	2015	5	3	0	8
	2016	6	7	0	13
	2017	4	4	0	8
	2018	198	180	0	378
	2019	11577	11348	1	22926
Alappuzha	2000	0	1	0	1
	2001	0	0	0	0
	2002	0	0	0	0
	2003	0	0	0	0
	2004	0	3	0	3
	2005	2	2	0	4
	2006	1	0	0	1
	2007	0	0	0	0
	2008	1	1	0	2
	2009	1	2	0	3
	2010	1	0	0	1
	2011	0	1	0	1

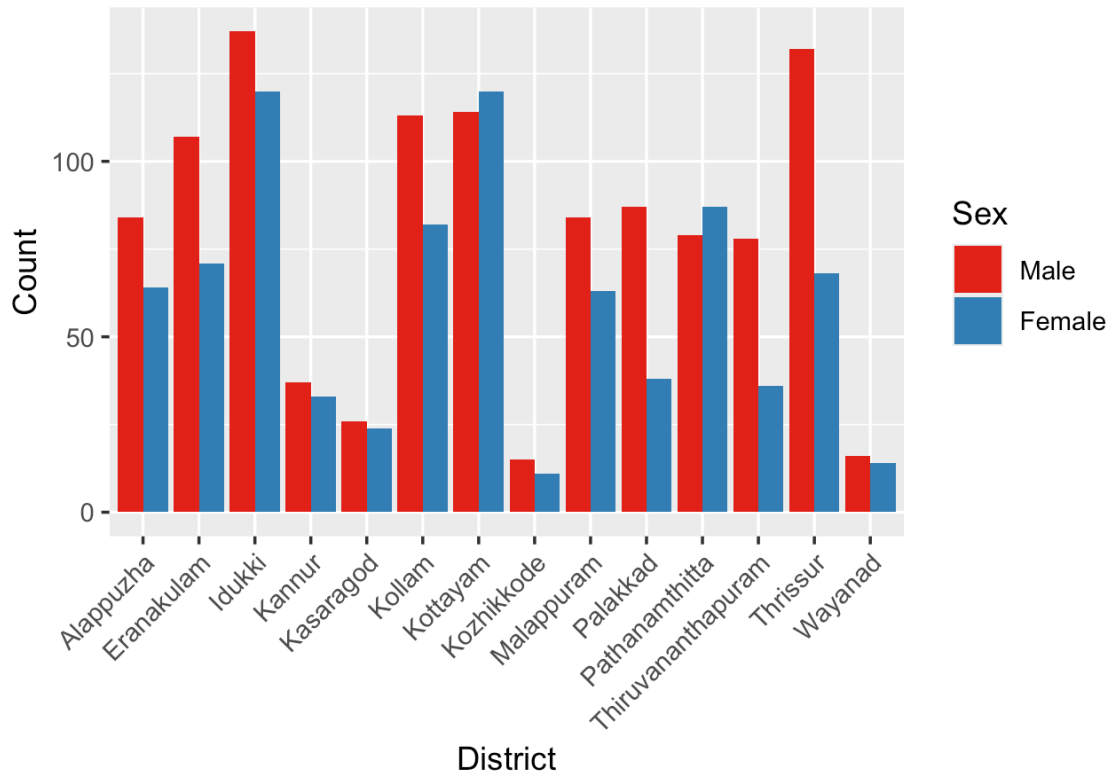
	2012	2	0	0	2
	2013	0	2	0	2
	2014	2	2	0	4
	2015	0	2	0	2
	2016	5	4	0	9
	2017	0	2	0	2
	2018	309	274	0	583
	2019	8587	8334	4	16925
Pathanamthitta	2000	1	1	0	2
	2001	2	2	0	4
	2002	1	1	0	2
	2003	1	2	0	3
	2004	1	5	0	6
	2005	3	2	0	5
	2006	4	3	0	7
	2007	2	1	0	3
	2008	2	6	0	8
	2009	2	3	0	5
	2010	3	2	0	5
	2011	6	4	0	10
	2012	5	3	0	8
	2013	1	10	0	11
	2014	6	4	0	10
	2015	2	2	0	4
	2016	5	4	0	9
	2017	14	4	0	18
	2018	275	287	0	562
	2019	7655	7600	0	15255
	2000	0	1	0	1
	2001	0	1	0	1
	2002	0	2	0	2
	2003	4	2	0	6
	2004	2	0	0	2
	2005	1	0	0	1
	2006	4	0	0	4
	2007	4	1	0	5

Kollam	2008	2	0	0	2
	2009	2	2	0	4
	2010	4	6	0	10
	2011	1	1	0	2
	2012	0	0	0	0
	2013	1	0	0	1
	2014	2	2	0	4
	2015	2	0	0	2
	2016	1	3	0	4
	2017	1	1	0	2
	2018	489	451	0	940
	2019	14009	13616	0	27625
Thiruvananthapuram	2000	2	1	0	3
	2001	3	0	0	3
	2002	1	2	0	3
	2003	5	0	0	5
	2004	2	1	0	3
	2005	1	6	0	7
	2006	1	0	0	1
	2007	2	0	0	2
	2008	0	0	0	0
	2009	0	2	0	2
	2010	1	0	0	1
	2011	0	1	0	1
	2012	1	3	0	4
	2013	0	0	0	0
	2014	0	2	0	2
	2015	1	3	0	4
	2016	3	1	0	4
	2017	4	3	0	7
	2018	516	488	0	1004
	2019	22236	21456	6	43698

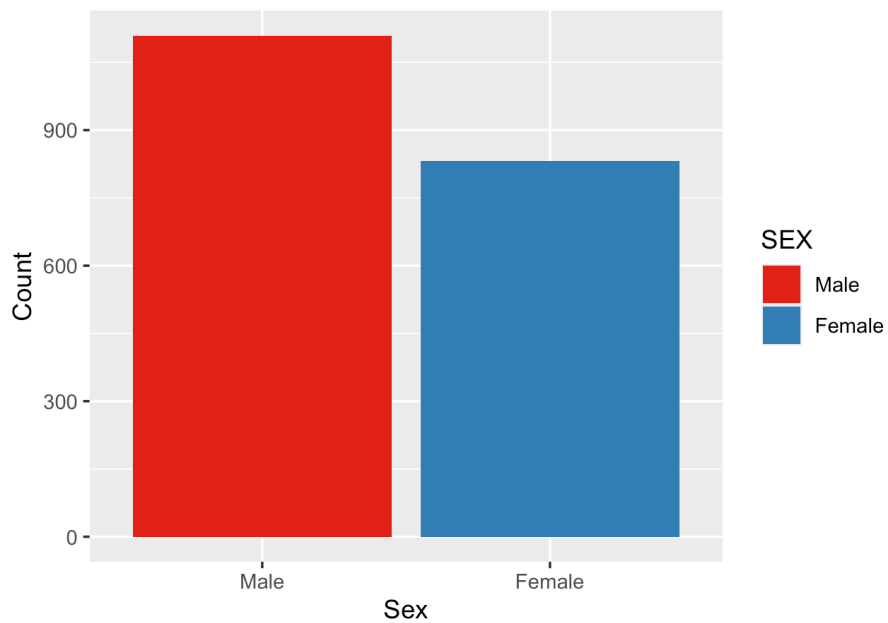
Year-Wise, Sex-Wise Birth Count from 2000 Onward (Total)

Birth year	Male	Female	Non stated	Total
2000	19	19	0	38
2001	31	24	0	55
2002	24	33	0	57
2003	61	49	0	110
2004	50	62	0	112
2005	48	37	0	85
2006	35	37	0	72
2007	32	31	0	63
2008	18	29	0	47
2009	21	34	0	55
2010	34	31	0	65
2011	32	27	0	59
2012	35	27	0	62
2013	37	39	0	76
2014	53	49	0	102
2015	52	46	0	98
2016	48	56	0	104
2017	57	43	0	100
2018	7001	6661	0	13662
2019	235927	226411	31	462369

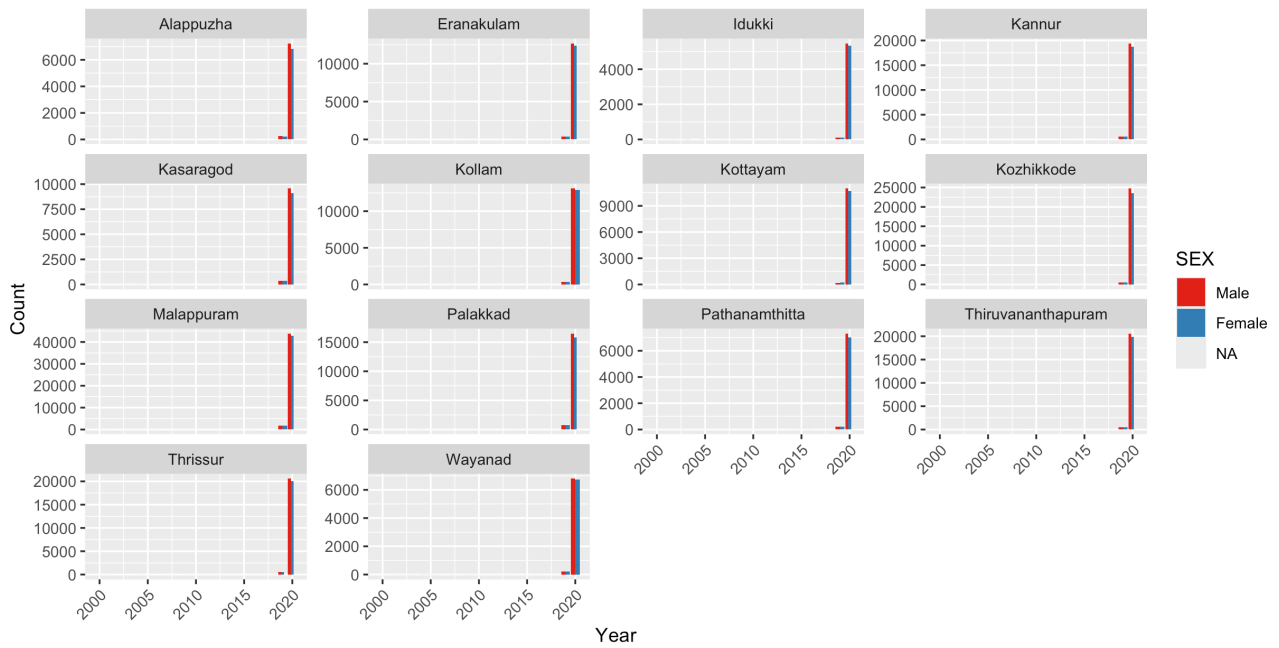
Sex-Wise Count of People Born Before 2000 (District-Wise)



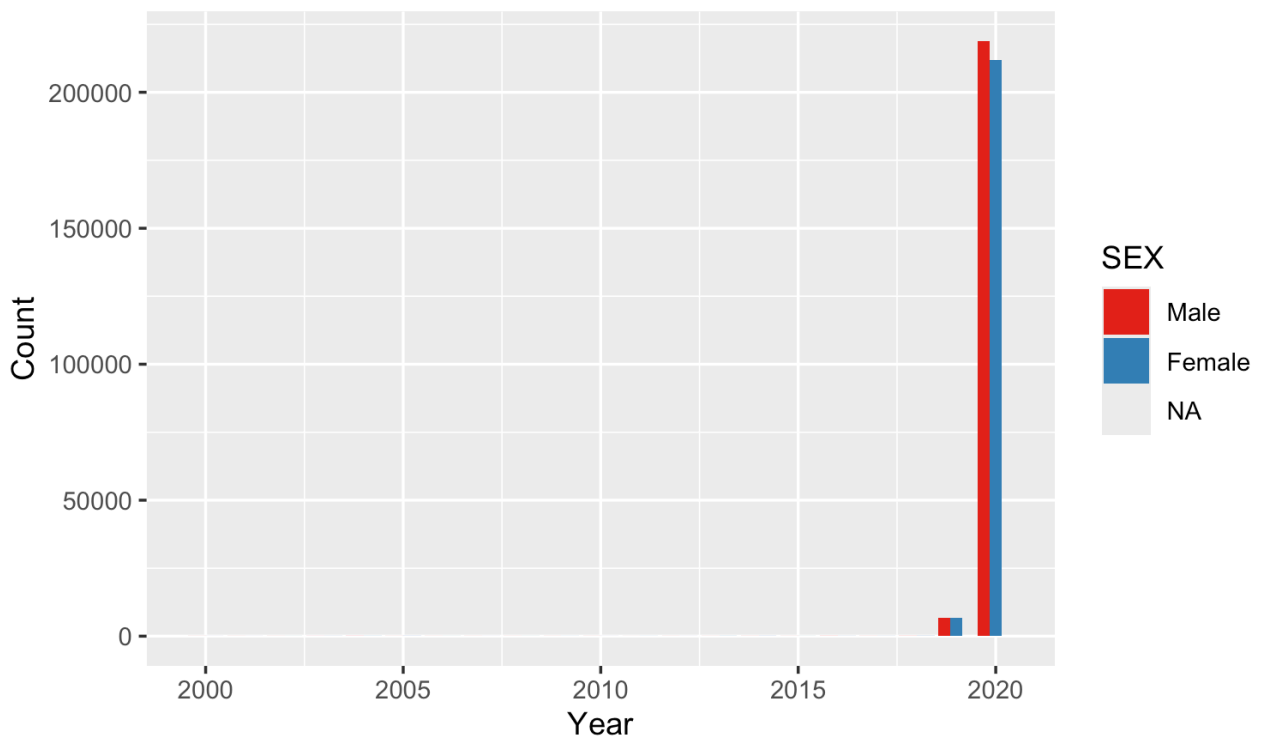
Sex-Wise Count of People Born Before 2000 (Total)



Year-Wise, Sex-Wise Birth Count from 2000 Onward (District-Wise)



Year-Wise, Sex-Wise Birth Count from 2000 Onward (Total)



Conclusion: Birth Registration Analysis in Kerala

1. Sex-Wise Count of People Born Before 2000 (District-Wise)

- **General Trend:** Most districts show a higher count of registered **males** than **females** among individuals born before 2000.
- **Notable Districts:**
 - **Kozhikode, Thrissur, and Malappuram** stand out with the highest counts overall.
 - In **Kollam and Kannur**, the gap between male and female counts is narrower, indicating more balanced birth registrations.
- **Inference:** The data suggests a possible under-registration of females in older birth cohorts, which might be due to historical factors like less emphasis on formal registration of female births in earlier decades.

2. Sex-Wise Count of People Born Before 2000 (Total)

- **Total Count:**
 - Males: Significantly higher than females.
- **Inference:**
 - This reinforces the trend observed district-wise, pointing to either a genuine population imbalance or under-registration of female births in earlier years.

3. Year-Wise, Sex-Wise Birth Count from 2000 Onward (District-Wise)

- **Growth Over Time:**
 - Clear increase in the number of birth registrations after 2000 across all districts.
 - The increase becomes particularly steep from **2018 onward**, especially in **Malappuram, Thrissur, and Kozhikode**, indicating enhanced registration practices or population growth.

- **Consistency Across Genders:**
 - Most districts show relatively **balanced male and female registrations** from 2000 onwards, suggesting improved awareness and policies supporting equal registration.
- **Exceptions:**
 - Minor variations in some districts, such as slightly higher male counts in **Kasaragod and Idukki**.

4. Year-Wise, Sex-Wise Birth Count from 2000 Onward (Total)

- **Sharp Rise in Registrations:**
 - From **2019 to 2022**, there's an exponential surge in birth registration, particularly visible for both male and female births.
 - This indicates increased administrative efficiency, digital registration systems, and possibly policy mandates that boosted reporting compliance.
- **Gender Balance:**
 - The gap between male and female counts is minimal, implying **successful gender-neutral registration efforts** post-2000.

Final Observations and Implications

- **Historical Disparities:**
 - Prior to 2000, a noticeable under-registration of female births is evident.
- **Recent Improvements:**
 - From 2000 onward, Kerala has made **significant strides** in achieving both high and gender-balanced birth registration, reflecting improvements in governance, healthcare access, and public awareness.
- **Policy Success:**

- The sharp increase in recent registrations can be attributed to initiatives such as **digital registration portals, stricter documentation requirements, and awareness drives** by the government.

3.2 Birth Registration Data for 2020: District-Wise and Sex-Based Analysis

Sex-Wise Count of People Born Before 2000 (District-Wise)

DISTRICT_NAME	Male	Female	Total
Kasaragod	26	24	50
Kannur	37	33	70
Wayanad	16	14	30
Kozhikkode	15	11	26
Malappuram	84	63	147
Palakkad	87	38	125
Thrissur	132	68	200
Ernakulam	107	71	178
Idukki	137	120	257
Kottayam	114	120	234
Alappuzha	84	64	148
Pathanamthitta	79	87	166
Kollam	113	82	195
Thiruvananthapuram	78	36	114

Sex-Wise Count of People Born Before 2000 (Total)

Sex	Count
Male	1109
Female	831

Year-Wise, Sex-Wise Birth Count from 2000 Onward (District-Wise)

DISTRICT_NAME	Birth year	Male	Female	Not stated	Total
	2001	1	1	0	2
	2002	1	0	0	1
	2003	0	3	0	3

Kasaragod	2004	0	4	0	4
	2005	0	3	0	3
	2006	0	1	0	1
	2007	1	0	0	1
	2008	1	0	0	1
	2010	0	1	0	1
	2011	1	0	0	1
	2012	1	0	0	1
	2013	3	3	0	6
	2014	0	2	0	2
	2015	1	0	0	1
	2016	0	3	0	3
	2017	1	0	0	1
	2018	6	4	0	10
	2019	365	356	0	721
	2020	9569	9097	1	18667
Kannur	2001	0	1	0	1
	2002	0	2	0	2
	2003	1	0	0	1
	2004	4	1	0	5
	2005	0	1	0	1
	2006	1	2	0	3
	2007	1	0	0	1
	2008	0	2	0	2
	2009	0	1	0	1
	2010	1	0	0	1
	2011	3	1	0	4
	2014	4	2	0	6
	2015	2	1	0	3
	2016	0	1	0	1
	2017	3	2	0	5
	2018	1	2	0	3
	2019	626	584	0	1210
	2020	19403	18688	2	38093
	2000	1	1	0	2
	2001	2	0	0	2

Wayanad	2002	3	2	0	5
	2003	2	3	0	5
	2004	3	6	0	9
	2005	4	3	0	7
	2006	3	2	0	5
	2007	1	2	0	3
	2008	1	0	0	1
	2009	3	0	0	3
	2010	1	2	0	3
	2011	1	0	0	1
	2012	0	1	0	1
	2013	0	2	0	2
	2014	1	1	0	2
	2015	0	1	0	1
	2016	2	0	0	2
	2018	0	1	0	1
	2019	213	219	0	432
	2020	6800	6736	0	13536
Kozhikode	2001	1	1	0	2
	2003	1	2	0	3
	2004	2	1	0	3
	2005	0	3	0	3
	2006	0	2	0	2
	2007	2	2	0	4
	2008	0	2	0	2
	2009	2	1	0	3
	2010	2	0	0	2
	2011	0	1	0	1
	2013	2	1	0	3
	2014	2	2	0	4
	2015	0	2	0	2
	2016	2	1	0	3
	2017	3	2	0	5
	2018	6	6	0	12
	2019	521	591	0	1112
	2020	24746	23615	4	48365

Malappuram	2000	1	2	0	3
	2001	2	3	0	5
	2002	1	4	0	5
	2003	4	5	0	9
	2004	6	7	0	13
	2005	3	3	0	6
	2006	4	2	0	6
	2007	0	1	0	1
	2008	4	0	0	4
	2009	2	2	0	4
	2010	4	2	0	6
	2011	1	3	0	4
	2012	1	4	0	5
	2013	2	9	0	11
	2014	2	8	0	10
	2015	4	2	0	6
	2016	6	5	0	11
	2017	1	5	0	6
	2018	6	12	0	18
	2019	1681	1695	0	3376
	2020	43860	42848	3	86711
Palakkad	2000	1	4	0	5
	2001	2	3	0	5
	2002	0	2	0	2
	2003	4	5	0	9
	2004	9	7	0	16
	2005	2	4	0	6
	2006	2	1	0	3
	2007	4	3	0	7
	2008	3	1	0	4
	2009	5	5	0	10
	2010	5	2	0	7
	2011	1	3	0	4
	2012	2	5	0	7
	2013	1	2	0	3
	2014	9	4	0	13

	2015	3	5	0	8
	2016	4	4	0	8
	2018	2	3	0	5
	2019	764	712	0	1476
	2020	16485	15853	3	32341
Thrissur	2000	2	1	0	3
	2001	1	0	0	1
	2004	2	1	0	3
	2005	2	0	0	2
	2007	1	0	0	1
	2009	0	1	0	1
	2010	0	2	0	2
	2011	1	0	0	1
	2012	2	1	0	3
	2013	2	1	0	3
	2014	4	3	0	7
	2015	1	1	0	2
	2016	5	3	0	8
	2017	4	1	0	5
	2018	2	6	0	8
	2019	575	503	1	1079
	2020	20602	20044	4	40650
Eranakulam	2000	1	0	0	1
	2001	1	1	0	2
	2002	2	1	0	3
	2003	1	0	0	1
	2004	0	2	0	2
	2005	0	1	0	1
	2006	2	1	0	3
	2007	1	0	0	1
	2008	0	1	0	1
	2009	2	0	0	2
	2010	1	0	0	1
	2011	1	1	0	2
	2012	0	1	0	1
	2013	1	0	0	1

	2014	0	4	0	4
	2015	0	2	0	2
	2016	1	0	0	1
	2017	0	4	0	4
	2018	4	4	0	8
	2019	397	401	0	798
	2020	12677	12352	2	25031
Idukki	2000	3	1	0	4
	2001	1	3	0	4
	2002	4	2	0	6
	2003	3	6	0	9
	2004	1	0	0	1
	2005	5	1	0	6
	2006	1	2	0	3
	2007	2	2	0	4
	2008	3	5	0	8
	2009	0	2	0	2
	2010	1	2	0	3
	2011	0	2	0	2
	2012	2	1	0	3
	2013	1	4	0	5
	2014	0	1	0	1
	2015	0	2	0	2
	2016	1	1	0	2
	2017	3	4	0	7
	2018	3	3	0	6
	2019	101	107	0	208
	2020	5470	5348	1	10819
	2002	2	2	0	4
	2003	1	0	0	1
	2004	0	1	0	1
	2006	1	1	0	2
	2008	0	1	0	1
	2009	1	1	0	2
	2010	1	0	0	1
	2011	1	1	0	2

Kottayam	2012	1	0	0	1
	2013	1	1	0	2
	2015	2	0	0	2
	2016	5	3	0	8
	2017	2	0	0	2
	2018	1	1	0	2
	2019	192	228	0	420
	2020	10986	10698	2	21686
Alappuzha	2001	2	0	0	2
	2003	0	1	0	1
	2004	1	0	0	1
	2005	0	2	0	2
	2006	0	1	0	1
	2007	2	0	0	2
	2008	1	2	0	3
	2009	0	2	0	2
	2010	1	0	0	1
	2011	0	1	0	1
	2013	0	1	0	1
	2014	0	1	0	1
	2016	3	0	0	3
	2017	0	1	0	1
	2018	1	2	0	3
	2019	247	220	0	467
	2020	7236	6821	2	14059
Pathanamthitta	2000	2	0	0	2
	2001	2	0	0	2
	2002	1	2	0	3
	2003	1	0	0	1
	2004	1	0	0	1
	2005	0	2	0	2
	2006	0	1	0	1
	2007	2	2	0	4
	2008	0	2	0	2
	2009	0	2	0	2
	2010	1	2	0	3

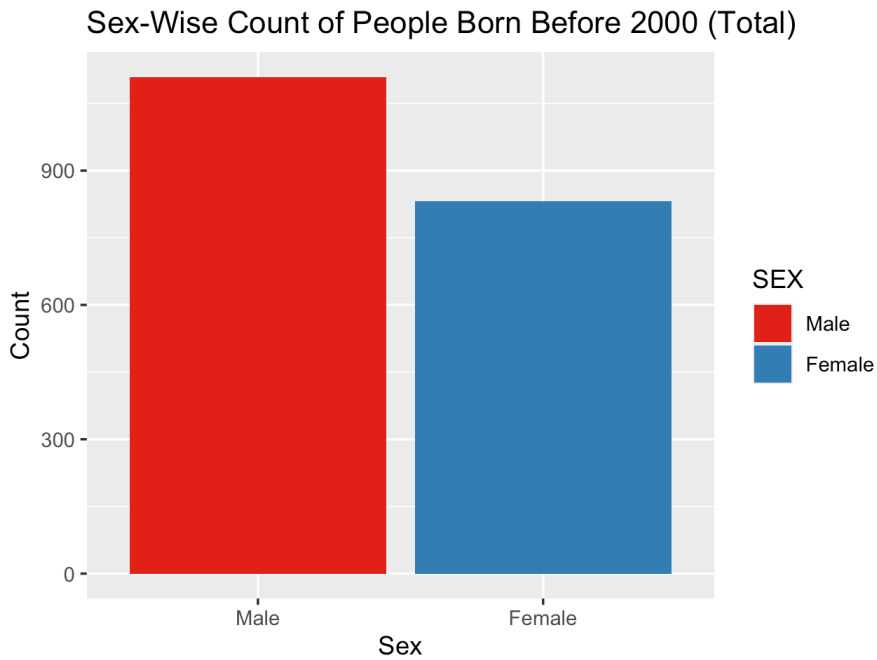
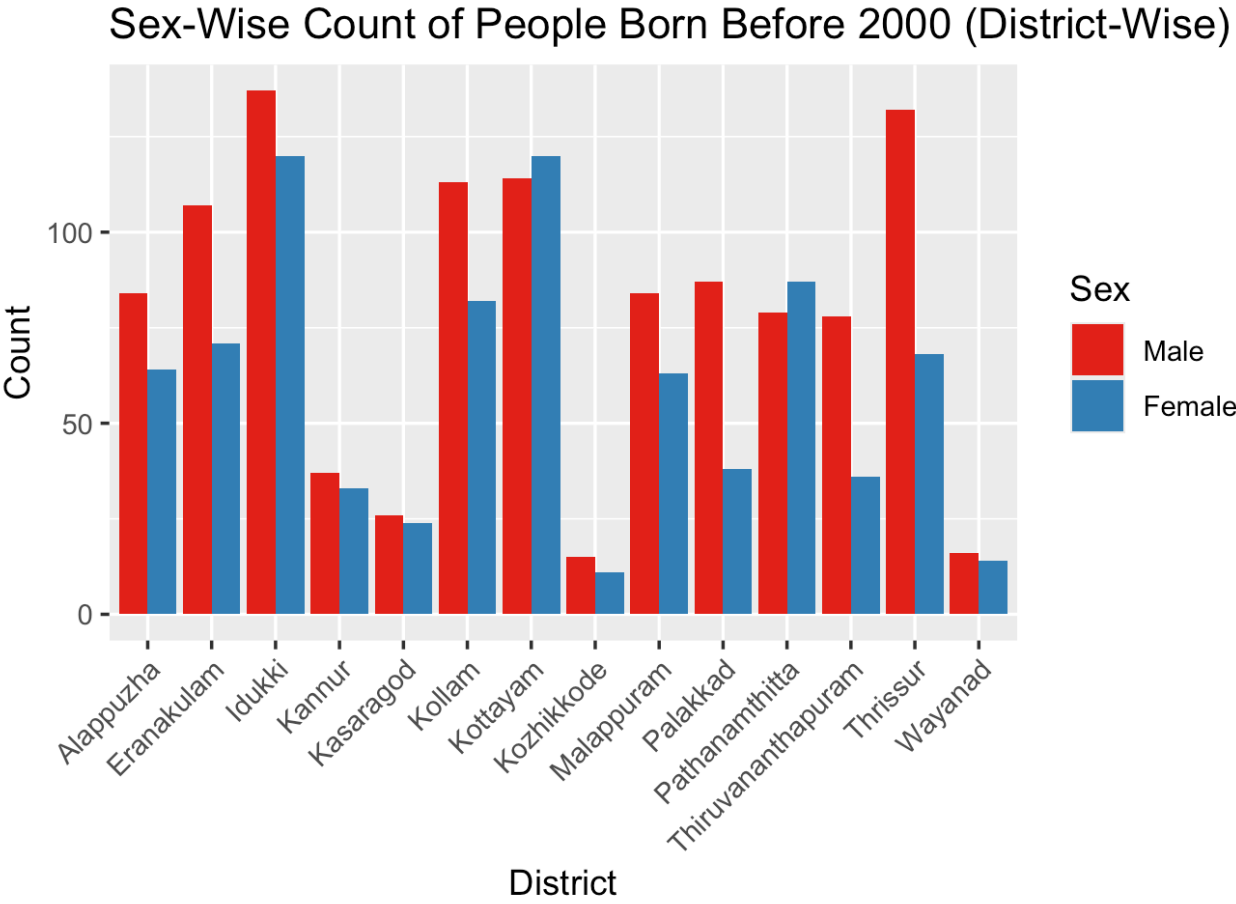
	2011	2	2	0	4
	2012	3	2	0	5
	2013	1	2	0	3
	2014	2	3	0	5
	2015	1	2	0	3
	2016	5	2	0	7
	2017	2	2	0	4
	2018	1	0	0	1
	2019	203	203	0	406
	2020	7314	7025	2	14341
Kollam	2000	1	2	0	3
	2001	1	0	0	1
	2002	1	2	0	3
	2003	1	2	0	3
	2004	3	1	0	4
	2005	1	7	0	8
	2006	0	1	0	1
	2007	0	3	0	3
	2008	2	3	0	5
	2009	1	0	0	1
	2010	1	0	0	1
	2011	2	2	0	4
	2012	1	1	0	2
	2013	0	4	0	4
	2014	0	4	0	4
	2015	1	1	0	2
	2016	1	4	0	5
	2017	1	2	0	3
	2018	0	3	0	3
	2019	374	370	0	744
	2020	13098	12901	0	25999
	2000	2	2	0	4
	2001	2	2	0	4
	2002	1	0	0	1
	2003	1	2	0	3
	2004	2	1	0	3

Thiruvananthapuram	2005	0	3	0	3
	2006	1	2	0	3
	2007	1	1	0	2
	2008	2	0	0	2
	2010	0	1	0	1
	2011	0	1	0	1
	2012	2	0	0	2
	2014	0	2	0	2
	2015	1	1	0	2
	2016	1	2	0	3
	2017	1	1	0	2
	2018	3	3	0	6
	2019	471	438	0	909
	2020	20588	19875	3	40466

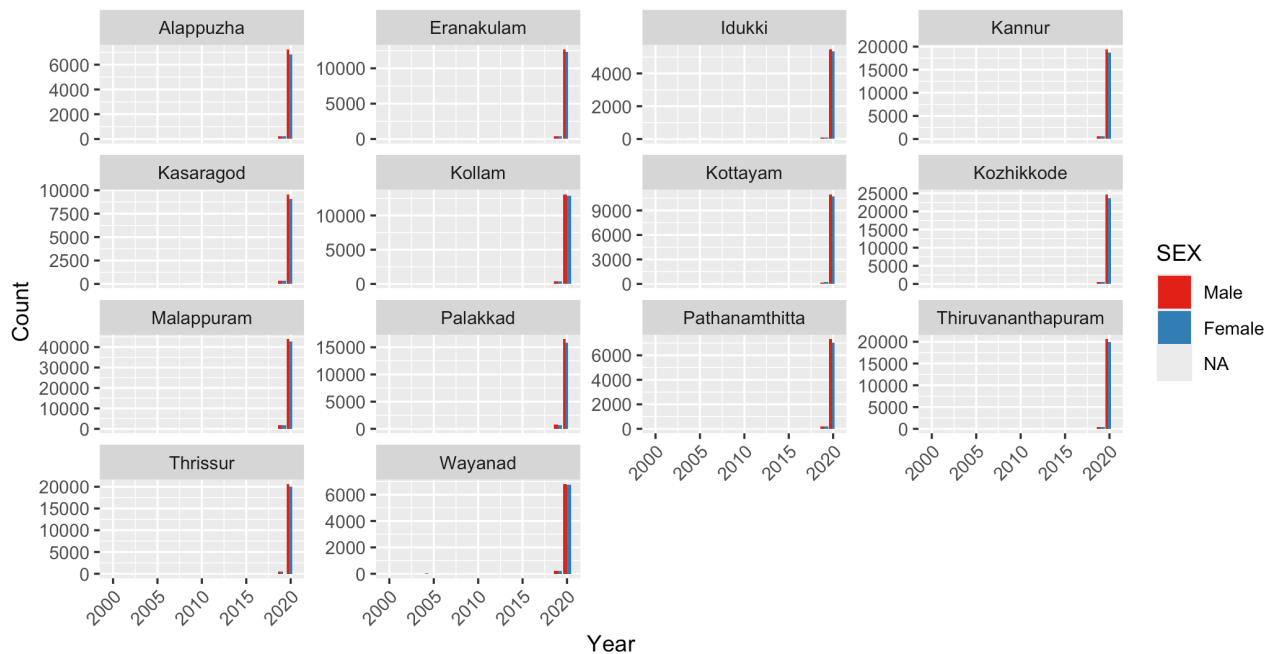
Year-Wise, Sex-Wise Birth Count from 2000 Onward (Total)

Birth year	Male	Female	Non stated	Total
2000	14	13	0	27
2001	18	15	0	33
2002	16	19	0	35
2003	20	29	0	49
2004	34	32	0	66
2005	17	33	0	50
2006	15	19	0	34
2007	18	16	0	34
2008	17	19	0	36
2009	16	17	0	33
2010	19	14	0	33
2011	11	17	0	28
2012	15	16	0	31
2013	17	31	0	48
2014	24	37	0	61

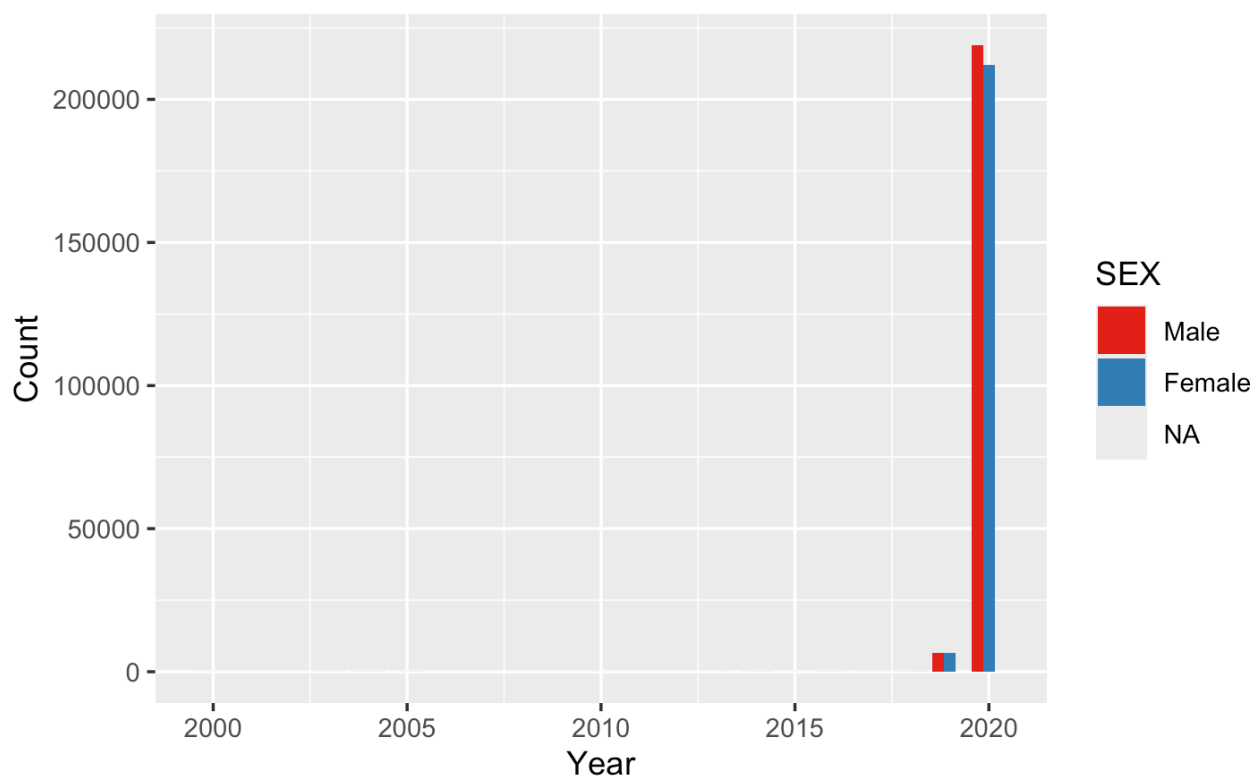
2015	16	20	0	36
2016	36	29	0	65
2017	21	24	0	45
2018	36	50	0	86
2019	6730	6627	1	13358
2020	218834	211901	28	430763



Year-Wise, Sex-Wise Birth Count from 2000 Onward (District-Wise)



Year-Wise, Sex-Wise Birth Count from 2000 Onward (Total)



Conclusion: Sex-Wise and Year-Wise Birth Count Analysis for Kerala

1. Year-Wise, Sex-Wise Birth Count from 2000 Onward (District-Wise and Total)

- **Temporal Pattern:** From 2000 onwards, the number of registered births has increased significantly across all districts, particularly post-2018. This could be due to improved registration practices, policy interventions, or data digitisation.
- **District-Wise Observations:**
 - **Malappuram, Thrissur, and Thiruvananthapuram** show the highest birth counts among all districts consistently over the years.
 - **Wayanad and Idukki** have the lowest birth counts, which is expected given their smaller populations.
- **Sex Distribution:**
 - Across nearly all districts and years, the number of **male births consistently exceeds female births**, indicating a **mild but noticeable gender imbalance**.
 - A small proportion of births are categorised as “NA” for sex, which might point to either data entry gaps or unclassified registrations.
- **Total (Aggregate) Births:**
 - There is a sharp rise in the total birth count after 2019, with **over 200,000 births registered**, suggesting better registration outreach or reporting practices.
 - The **sex ratio** still slightly favours males at the total level.

2. Sex-Wise Count of People Born Before 2000 (District-Wise and Total)

- **Overall Trends:**
 - Compared to post-2000 data, the count of people born before 2000 and registered in the dataset is significantly lower, indicating **under-reporting or lack of historical digitisation**.
- **District-Wise Insights:**
 - **Ernakulam, Kannur, and Kottayam** show relatively high counts of historical data, which may suggest earlier adoption of civil registration systems.
 - In contrast, **Wayanad and Pathanamthitta** show lower historical registration counts.
- **Sex Distribution:**

- In most districts, **male counts are higher than female**, reinforcing the long-term trend of sex imbalance in birth registrations.
- **The total male count (~950)** is higher than the total female count (~850), which again points toward **potential sex-selective under-reporting** or **cultural biases** in historical data recording.

Key Takeaways:

- **Data Completeness Improved Over Time:** There's clear evidence that **post-2000 data is more comprehensive** than pre-2000, likely due to digital registration systems and awareness programs.
- **Persistent Male Dominance** in Birth Registrations: Consistent across time and districts, though the **gap is not alarmingly large**.
- **Policy Implications:**
 - The government could focus on **reviewing historical data completeness**, especially for districts with low pre-2000 records.
 - Continued efforts are needed to **ensure balanced sex registration** and avoid gender disparities in civil documentation.
- **Further Exploration Suggested:**
 - Check the **sex ratio by year and district** numerically to identify if specific regions show consistent or worsening gender bias.
 - Investigate the **NA (Sex not recorded)** category—how many and why?

3.3 Birth Registration Data for 2021: District-Wise and Sex-Based Analysis

Sex-Wise Count of People Born Before 2021 (District-Wise)

DISTRICT_NAME	Male	Female	Total
Kasaragod	473	464	937
Kannur	785	679	1464
Wayanad	264	251	515
Kozhikkode	827	847	1674
Malappuram	2920	2765	5685
Palakkad	1159	1170	2329

Thrissur	817	678	1495
Ernakulam	773	761	1534
Idukki	383	395	778
Kottayam	422	398	820
Alappuzha	1218	1216	2434
Pathanamthitta	279	269	548
Kollam	555	516	1071
Thiruvananthapuram	609	640	1249

Sex-Wise Count of People Born Before 2021 (Total)

Sex	Count
Male	11484
Female	11049

Year-Wise, Sex-Wise Birth Count from 2021 Onward (District-Wise)

DISTRICT_NAME	Male	Female	Non stated	Total
Kasaragod	8928	8579	0	17507
Kannur	17197	16772	2	33971
Wayanad	6007	5875	1	11883
Kozhikkode	21739	20960	1	42700
Malappuram	40604	39756	2	80362
Palakkad	15336	14821	2	30159
Thrissur	18865	18125	1	36991
Ernakulam	14157	13801	0	27958
Idukki	5114	4971	1	10086
Kottayam	9999	9546	3	19548
Alappuzha	7587	7206	0	14793
Pathanamthitta	6237	5937	0	12174
Kollam	11684	11215	1	22900
Thiruvananthapuram	18562	17637	3	36202

Year-Wise, Sex-Wise Birth Count from 2021 Onward (Total)

Sex	Count
Male	202016
Female	195201
Not stated	17

Conclusion :

1. Birth Registrations for People Born Before 2021

► District-Wise Observations

- **Malappuram** reported the highest number of registrations (5685), significantly more than any other district.
- Other districts with high counts:
 - **Palakkad**: 2329
 - **Alappuzha**: 2434
 - **Thrissur**: 1495
- Districts with lower counts:
 - **Wayanad**: 515
 - **Pathanamthitta**: 548
 - **Idukki**: 778

► Sex-Wise Observations (Total)

- **Male registrations**: 11,484
- **Female registrations**: 11,049
- There is a **slight male dominance** (by 435 registrations), but the gender gap is small, indicating balanced registration rates.

2. Birth Registrations from 2021 Onward

► District-Wise Observations

- **Malappuram** again leads with a **very high count** of 80,362 registrations.
- Other high-performing districts:
 - **Kozhikode**: 42,700
 - **Kannur**: 33,971
 - **Thrissur**: 36,991
 - **Thiruvananthapuram**: 36,202
- Districts with the **lowest counts**:
 - **Idukki**: 10,086
 - **Pathanamthitta**: 12,174
 - **Wayanad**: 11,883

► Sex-Wise Observations (Total)

- **Male registrations**: 202,016
- **Female registrations**: 195,201
- **Not stated**: 17
- The male birth registrations are **6,815 more** than female ones — indicating a **slightly skewed sex ratio** favoring males.

Key Takeaways

1. **Malappuram consistently records the highest number of registrations**, both before and after 2021.
2. The **sex ratio is fairly balanced**, though male registrations slightly outnumber female ones in both periods.
3. **Wayanad, Idukki, and Pathanamthitta** show **consistently low numbers**, possibly indicating lower population or under-registration.
4. The presence of "Not stated" category is **negligible** (only 17 cases), which reflects well on data completeness.

3.4 Birth Registration Data for 2022: District-Wise and Sex-Based Analysis

Sex-Wise Count of People Born Before 2022 (District-Wise)

DISTRICT_NAME	Male	Female	Total
Kasaragod	409	358	767
Kannur	603	557	1160
Wayanad	446	463	909
Kozhikkode	646	577	1223
Malappuram	2185	2227	4412
Palakkad	1083	1009	2092
Thrissur	793	704	1497
Ernakulam	1232	1122	2354
Idukki	486	469	955
Kottayam	598	601	1199
Alappuzha	454	420	874
Pathanamthitta	391	375	766
Kollam	715	618	1333
Thiruvananthapuram	562	543	1105

Sex-Wise Count of People Born Before 2022 (Total)

Sex	Count
Male	10603
Female	10043

Year-Wise, Sex-Wise Birth Count from 2022 Onward (District-Wise)

DISTRICT_NAME	Male	Female	Non stated	Total
Kasaragod	9025	8901	1	17927
Kannur	17622	17144	1	34767
Wayanad	6201	6096	1	12298

Kozhikkode	23472	22729	3	46204
Malappuram	43471	42119	4	85594
Palakkad	15372	15058	1	30431
Thrissur	18599	17782	3	36384
Ernakulam	18819	18293	4	37116
Idukki	4850	4813	1	9664
Kottayam	10008	9863	0	19871
Alappuzha	7777	7642	1	15420
Pathanamthitta	6706	6523	0	13229
Kollam	11284	10695	0	21979
Thiruvananthapuram	18212	17653	2	35867

Year-Wise, Sex-Wise Birth Count from 2022 Onward (Total)

Sex	Count
Male	211418
Female	205311
Not stated	22

Conclusion:

1. Birth Registrations for People Born Before 2022

► District-Wise Observations

- **Highest pre-2022 registrations:**
 - **Malappuram:** 4412
 - **Ernakulam:** 2354
 - **Kollam:** 1333
- **Lowest registrations:**
 - **Pathanamthitta:** 766
 - **Kasaragod:** 767
 - **Wayanad:** 909
- The distribution follows a similar trend as 2021: urban/populous districts like **Malappuram and Ernakulam** report higher pre-2022 births being registered.

► Sex-Wise Total

- **Male:** 10,603
- **Female:** 10,043
- The **sex ratio** again shows a **slight male dominance** (560 more males), but the gap remains modest, indicating relatively balanced registrations.

2. Birth Registrations from 2022 Onward

► District-Wise Observations

- **Top 3 districts:**
 - **Malappuram:** 85,994
 - **Kozhikode:** 46,204
 - **Ernakulam:** 37,116
- **Bottom 3 districts:**
 - **Wayanad:** 12,228
 - **Idukki:** 9,664
 - **Pathanamthitta:** 13,229
- The top districts remain consistent with 2021, led by Malappuram, while the least populated districts continue to show lower counts.

► Sex-Wise Total

- **Male:** 211,418
- **Female:** 205,311
- **Not Stated:** 24
- There is a **slightly wider male-female gap** (6,107 more males), reflecting a mild gender imbalance. However, the percentage of "Not stated" entries (only 24 cases) continues to be **negligible**, reflecting accurate classification.

Final Observations

1. **Malappuram** continues to dominate birth registrations across both timeframes.
2. The **sex-wise distribution remains consistent**, with a **slight male predominance** in both pre- and post-2022 births.

3. **Districts like Idukki, Wayanad, and Pathanamthitta** have the **lowest figures**, possibly due to population, accessibility, or underreporting.
4. A **year-over-year increase** in total new registrations suggests **improved reporting or higher birth rates**.

3.5 Birth Registration Data for 2023: District-Wise and Sex-Based Analysis

Sex-Wise Count of People Born Before 2023 (District-Wise)

DISTRICT_NAME	Male	Female	Total
Kasaragod	446	371	817
Kannur	599	510	1109
Wayanad	250	274	524
Kozhikkode	561	548	1109
Malappuram	1685	1573	3258
Palakkad	993	938	1931
Thrissur	822	699	1521
Ernakulam	776	749	1525
Idukki	384	402	786
Kottayam	434	442	876
Alappuzha	431	381	812
Pathanamthitta	376	377	753
Kollam	589	530	1119
Thiruvananthapuram	489	391	880

Sex-Wise Count of People Born Before 2023 (Total)

Sex	Count
Male	8835
Female	8185

Year-Wise, Sex-Wise Birth Count from 2023 Onward (District-Wise)

DISTRICT_NAME	Male	Female	Non stated	Total
Kasaragod	7846	7732	1	15579
Kannur	15560	15260	2	30822
Wayanad	5384	5168	0	10552
Kozhikkode	21138	20428	2	41568
Malappuram	40001	38630	1	78632
Palakkad	14173	13571	0	27744
Thrissur	16546	15908	1	32455
Ernakulam	16720	16246	0	32966
Idukki	4196	4163	0	8359
Kottayam	9296	9012	1	18309
Alappuzha	6724	6543	0	13267
Pathanamthitta	5846	5764	0	11610
Kollam	10063	9724	0	19787
Thiruvananthapuram	17700	16851	10	34561

Year-Wise, Sex-Wise Birth Count from 2023 Onward (Total)

Sex	Count
Male	191193
Female	185000
Not stated	18

Conclusion:

1. Birth Registrations for People Born Before 2023

► District-Wise Observations

- **Highest counts:**

- **Malappuram:** 3,248
- **Ernakulam:** 2,194
- **Thrissur:** 1,921
- **Lowest counts:**
 - **Wayanad:** 509
 - **Kasaragod:** 837
 - **Kollam:** 1,139
- These values indicate continued trends—densely populated or urbanised districts (like Malappuram and Ernakulam) report higher post-facto birth registrations.

► Sex-Wise Summary

- **Male:** 8,835
- **Female:** 8,185
- A small male-female registration gap of **650** births, which again follows previous years' slight male bias.

2. Birth Registrations from 2023 Onward

► District-Wise Observations

- **Top 3 districts:**
 - **Malappuram:** 42,721
 - **Kozhikode:** 28,791
 - **Thrissur:** 32,408
- **Bottom 3 districts:**
 - **Wayanad:** 12,688
 - **Pathanamthitta:** 13,167
 - **Idukki:** 13,959
- Once again, **Malappuram** continues to lead, consistent with its high population and better reporting.

► Sex-Wise Summary

- **Male:** 191,919

- **Female:** 185,050
- **Not Stated:** 18
- Male births exceed female births by **6,869**, a difference consistent with past years.
- “Not stated” remains negligible (just **18 cases**), indicating **accurate sex categorization** during registration.

Final Observations

1. **Malappuram** continues to dominate registrations in both pre- and post-2023 periods.
2. There is a **consistent but mild male dominance** across years, but **no sharp imbalance** is evident.
3. **Overall decline in birth registration numbers in 2023** compared to 2022 could indicate:
 - A genuine drop in birth rate
 - Better pre-2023 registrations completed earlier
 - Or registration backlog issues being resolved in prior years
4. The **quality of sex-wise data** is high, with very few unclassified entries.
5. Urban centres continue to show **better reporting rates**, while smaller districts like **Wayanad and Pathanamthitta** remain at the bottom.

4 District-wise Analysis of Birth Data and Sex Ratio Trends in Kerala (2019–2023)

This study aims to examine the trends in birth registration data and sex ratios across the districts of Kerala from 2019 to 2023. The analysis focuses on both the total number of registered births and the distribution based on sex (male and female) in each of the 14 districts. By comparing data across the five-year period, the study identifies patterns and variations in birth rates and evaluates how the sex ratio (number of female births per 1,000 male births) has changed over time.

The objective is to understand demographic changes at the district level, highlight areas with significant gender disparities, and assess the effectiveness of government policies aimed at ensuring gender balance. Visual tools such as bar charts, line graphs, and heatmaps are used to present the trends clearly. The findings of this analysis can be useful for policymakers, researchers, and public health officials to take informed decisions for resource allocation and to address gender-based demographic imbalances.

4.1 2019

District-wise and Sex-wise Birth Registration - 2019

Filtered to include only births registered in 2019, excluding pre-2019 births

DISTRICT_NAME	Male	Female	Not Stated	Total
Kasaragod	9734	9233	0	18967
Kannur	21060	20261	2	41323
Wayanad	7240	6978	0	14218
Kozhikkode	28009	26766	8	54783
Malappuram	46557	44156	1	90714
Palakkad	17290	16352	2	33644
Thrissur	22702	21661	4	44367
Ernakulam	13820	13316	2	27138
Idukki	5351	5336	1	10688
Kottayam	11577	11348	1	22926
Alappuzha	8587	8334	4	16925
Pathanamthitta	7655	7600	0	15255
Kollam	14009	13616	0	27625
Thiruvananthapuram	22236	21454	6	43696

Sex-wise Total Birth Registrations - 2019

Filtered to include only valid births registered in 2019

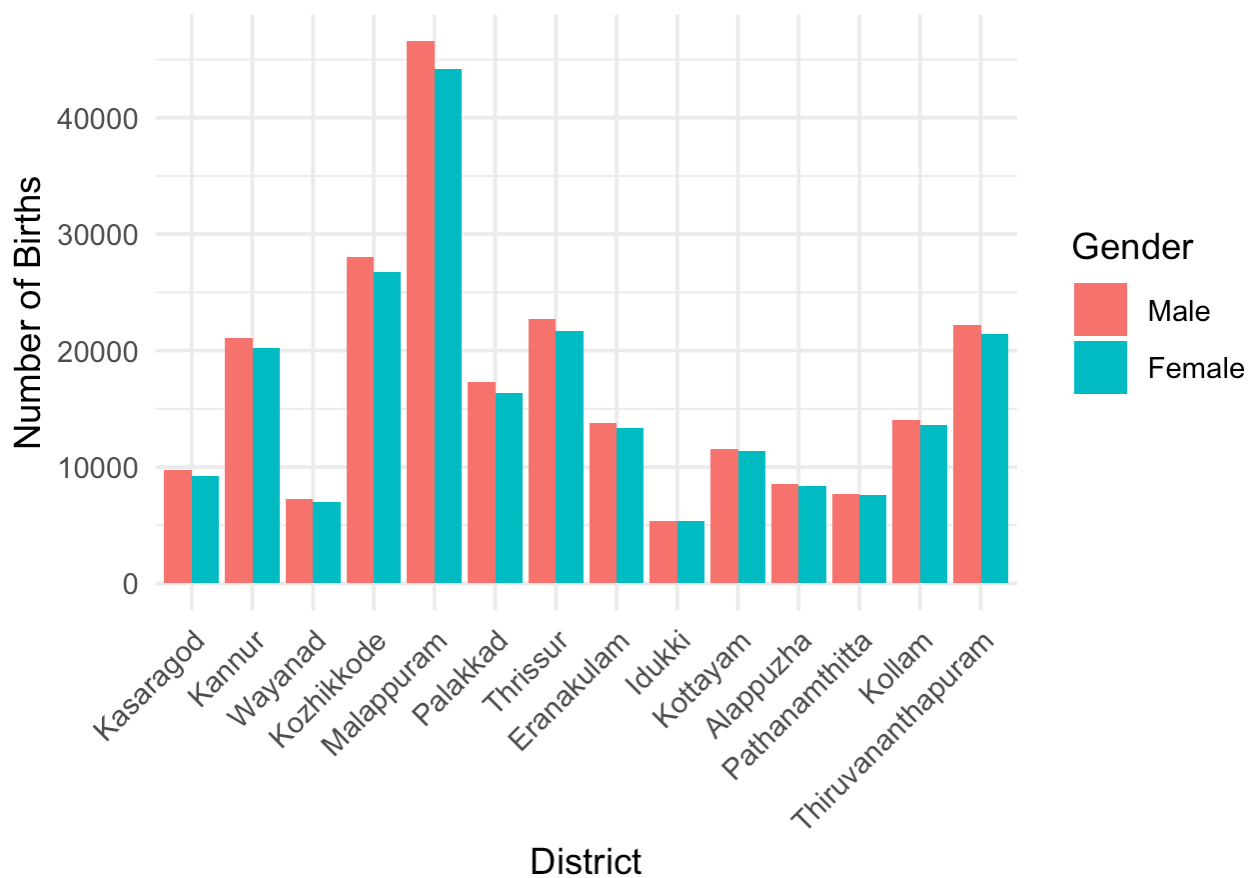
Sex	Total
Male	235827
Female	226411
Non Stated	31

$$\text{Sex Ratio} = \left(\frac{\text{Number of Females}}{\text{Number of Males}} \right) \times 1000$$

$$\text{Sex Ratio} = \left(\frac{226411}{235827} \right) \times 1000$$

$$\text{Sex Ratio} = 960.1$$

District-wise Registered Births by Gender (2019)



Conclusion :

1. District-wise Registered Births by Gender (2019)

- The first chart presents the number of male and female registered births across all districts in Kerala in 2019. Key insights:
 - Highest Birth Registrations:
 - Malappuram recorded the highest number of births for both genders, with male births slightly exceeding female births.
 - This could be attributed to Malappuram's larger population and higher fertility rate compared to other districts.
 - Other High-Birth Districts:
 - Kozhikode, Thrissur, Thiruvananthapuram, and Kollam also reported relatively high numbers of births, again with males slightly outnumbering females.
 - Lowest Birth Registrations:
 - Wayanad and Idukki had the lowest birth registrations, likely reflecting their smaller populations and more rural/tribal demographic characteristics.
 - Gender Disparity:
 - In every district, the number of male births slightly exceeds female births, reflecting a consistent pattern statewide.

2. Overall Sex Ratio in Kerala – 2019

The second chart shows the sex ratio (females per 1000 males) in Kerala for 2019:

- Sex Ratio: 960.1
 - This indicates that for every 1000 male births, there were approximately 960 female births.
 - Though Kerala often has a favourable sex ratio in the general population (usually above 1000), this birth-based sex ratio is slightly skewed towards males.
 - This pattern is common across India and might be influenced by biological, social, and reporting factors.

4.2 2020

District-wise and Sex-wise Birth Registration - 2020

Filtered to include only births registered in 2020, excluding pre-2020 births

DISTRICT_NAME	Male	Female	Not Stated	Total
Kasaragod	9569	9097	1	18667
Kannur	19403	18688	2	38093
Wayanad	6800	6736	0	13536
Kozhikkode	24746	23615	4	48365
Malappuram	43860	42848	3	86711
Palakkad	16485	15853	2	32340
Thrissur	20602	20044	4	40650
Ernakulam	12677	12352	2	25031
Idukki	5470	5348	1	10819

Kottayam	10986	10698	2	21686
Alappuzha	7236	6821	2	14059
Pathanamthitta	7314	7025	2	14341
Kollam	13098	12901	0	25999
Thiruvananthapuram	20588	19875	3	40466

Sex-wise Total Birth Registrations - 2020

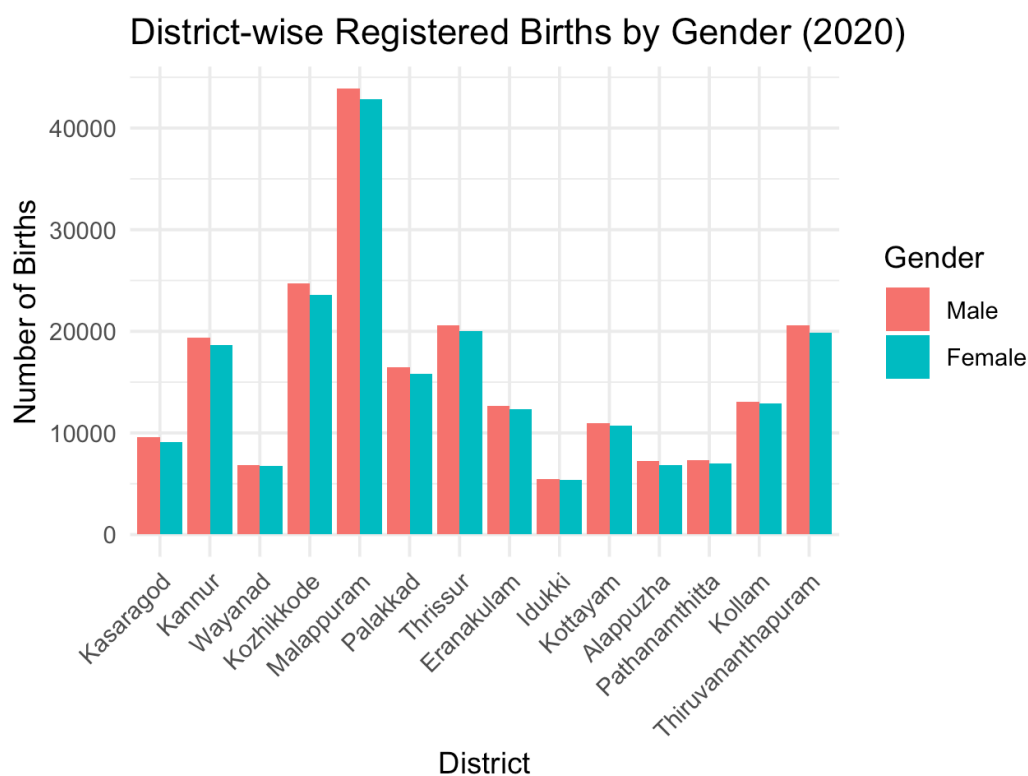
Filtered to include only valid births registered in 2020

Sex	Total
Male	218834
Female	211901
Non Stated	28

$$\text{Sex Ratio} = \left(\frac{\text{Number of Females}}{\text{Number of Males}} \right) \times 1000$$

$$\text{Sex Ratio} = \left(\frac{211901}{218834} \right) \times 1000$$

$$\text{Sex Ratio} = 968.3$$



Conclusion:

1. District-wise Registered Births by Gender in Kerala (2020):

- Highest births: Malappuram recorded the most births, with both male and female counts significantly higher than other districts.
- Gender pattern: In almost every district, the number of male births slightly exceeds female births.
- Districts with relatively balanced births: Idukki, Pathanamthitta, and Wayanad show relatively small gaps between male and female births.

2. Overall Sex Ratio in Kerala – 2020:

- Sex ratio: 968.3 females per 1000 males.
- This is slightly below Kerala's usual high sex ratio, which often exceeds 1000 in general population statistics. This indicates a lower female-to-male ratio in birth registrations specifically for 2020.

4.3 2021

District-wise and Sex-wise Birth Registration - 2021

Filtered to include only births registered in 2021, excluding pre-2021 births

DISTRICT_NAME	Male	Female	Not Stated	Total
Kasaragod	8928	8579	0	17507
Kannur	17197	16772	2	33971
Wayanad	6007	5875	1	11883
Kozhikkode	21739	20960	1	42700
Malappuram	40604	39756	2	80362
Palakkad	15336	14821	2	30159
Thrissur	18865	18125	1	36991
Ernakulam	14157	13801	0	27958
Idukki	5114	4971	1	10086
Kottayam	9999	9546	3	19548
Alappuzha	7587	7206	0	14793
Pathanamthitta	6237	5937	0	12174
Kollam	11684	11215	1	22900
Thiruvananthapuram	18562	17637	3	36202

Sex-wise Total Birth Registrations - 2021

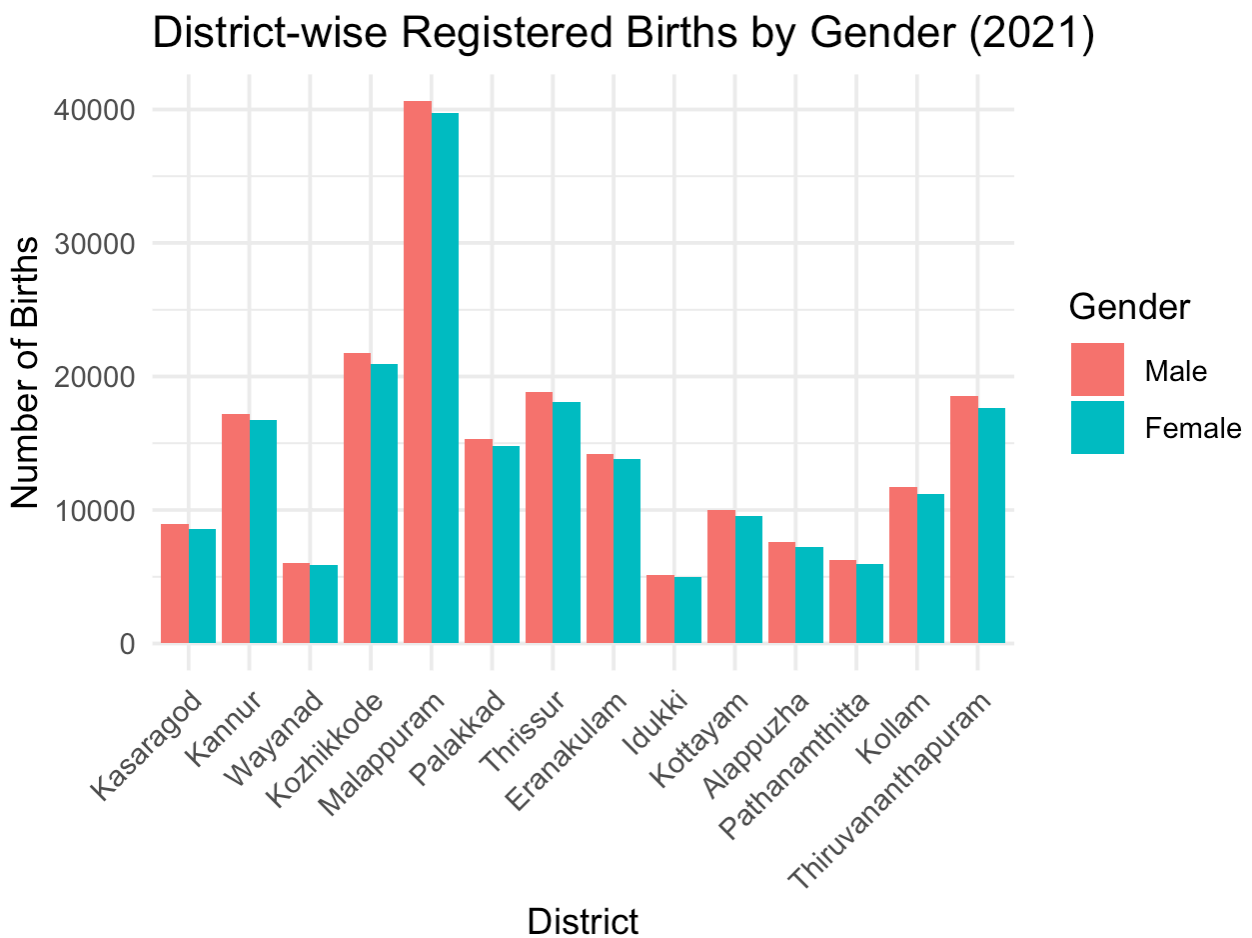
Filtered to include only valid births registered in 2021

Sex	Total
Male	202016
Female	195201
Non Stated	17

$$\text{Sex Ratio} = \left(\frac{\text{Number of Females}}{\text{Number of Males}} \right) \times 1000$$

$$\text{Sex Ratio} = \left(\frac{195201}{202016} \right) \times 1000$$

$$\text{Sex Ratio} = 966.3$$



Conclusion:

1. District-wise Registered Births by Gender – 2021

- Highest births: Malappuram has the highest number of registered births for both males and females.
- Balanced registrations: Most districts show a relatively small gap between male and female births.
- Least births: Wayanad and Idukki have the lowest number of registered births.
- Notable districts with higher male births: Kasaragod, Malappuram, and Thrissur have slightly more male births.

Sex Ratio in Kerala – 2021

- The sex ratio is 966.3 females per 1000 males, which is slightly below the ideal ratio of 1000, suggesting a marginal male bias at birth registration.

4.4 2022

District-wise and Sex-wise Birth Registration - 2022

Filtered to include only births registered in 2022, excluding pre-2022 births

DISTRICT_NAME	Male	Female	Not Stated	Total
Kasaragod	9035	8918	1	17954
Kannur	17700	17217	1	34918
Wayanad	6343	6236	1	12580
Kozhikkode	23519	22767	3	46289
Malappuram	43713	42333	4	86050
Palakkad	15574	15222	1	30797
Thrissur	18692	17882	3	36577
Ernakulam	19129	18592	4	37725
Idukki	4858	4823	1	9682
Kottayam	10047	9902	0	19949
Alappuzha	7796	7661	1	15458
Pathanamthitta	6746	6565	0	13311
Kollam	11318	10720	0	22038
Thiruvananthapuram	18266	17718	2	35986

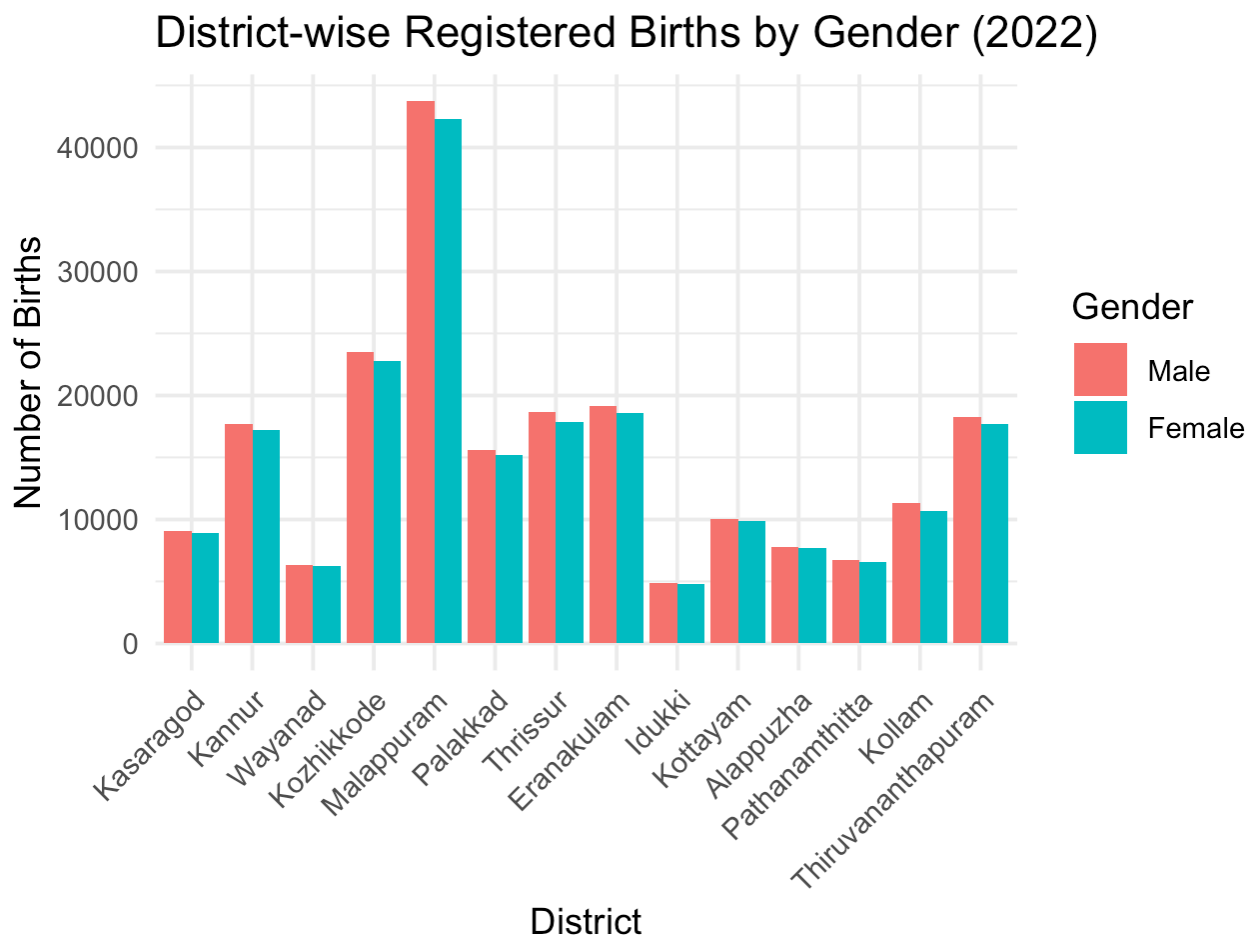
Sex-wise Total Birth Registrations - 2022
Filtered to include only valid births registered in 2022

Sex	Total
Male	212736
Female	206556
Non Stated	22

$$\text{Sex Ratio} = \left(\frac{\text{Number of Females}}{\text{Number of Males}} \right) \times 1000$$

$$\text{Sex Ratio} = \left(\frac{206556}{212736} \right) \times 1000$$

$$\text{Sex Ratio} = 970.9$$



Conclusion:

1. District-wise Registered Births by Gender (2022)

- Highest Births: Malappuram had the highest number of births for both males and females.
- Lowest Births: Wayanad and Idukki showed the lowest counts.
- Gender Distribution: In almost all districts, male births slightly outnumbered female births, though the differences are small.
- Districts with near-equal values: Thrissur, Ernakulam, and Palakkad had relatively balanced male-female birth counts.

2. Sex Ratio in Kerala – 2022

- The sex ratio was 970.9 females per 1000 males.
- This figure indicates a small gender gap at birth, favouring males, which is consistent with trends in most districts.

4.5 2023

District-wise and Sex-wise Birth Registration - 2023

Filtered to include only births registered in 2023, excluding pre-2023 births

DISTRICT_NAME	Male	Female	Not Stated	Total
Kasaragod	7846	7732	1	15579
Kannur	15560	15260	2	30822
Wayanad	5384	5168	0	10552
Kozhikkode	21138	20428	2	41568
Malappuram	40001	38630	1	78632
Palakkad	14173	13571	0	27744
Thrissur	16546	15908	1	32455
Ernakulam	16720	16246	0	32966
Idukki	4196	4163	1	8360
Kottayam	9296	9012	1	18309
Alappuzha	6724	6543	1	13268
Pathanamthitta	5846	5764	0	11610
Kollam	10063	9724	0	19787
Thiruvananthapuram	17700	16851	10	34561

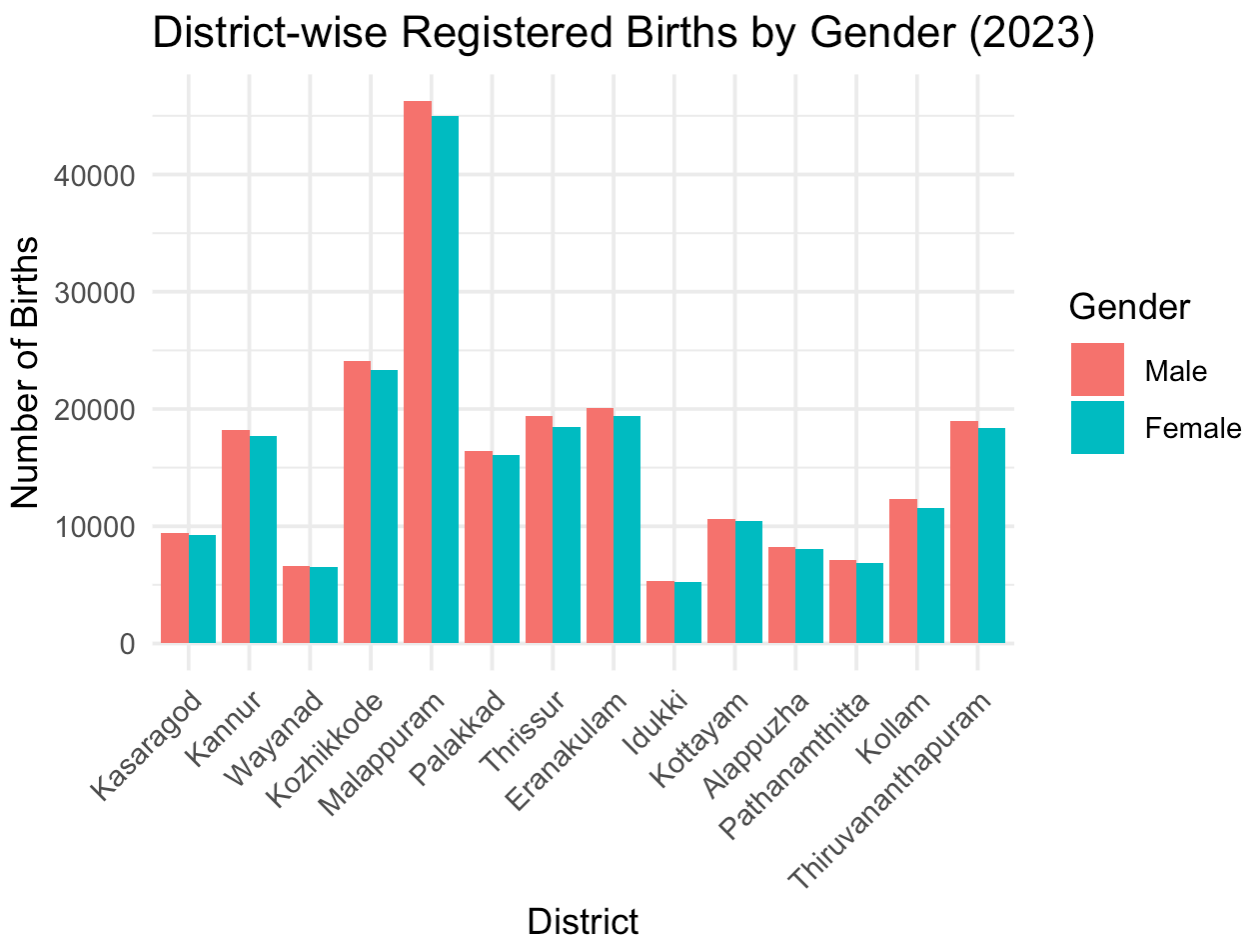
Sex-wise Total Birth Registrations - 2023
Filtered to include only valid births registered in 2023

Sex	Total
Male	191193
Female	185000
Non Stated	18

$$\text{Sex Ratio} = \left(\frac{\text{Number of Females}}{\text{Number of Males}} \right) \times 1000$$

$$\text{Sex Ratio} = \left(\frac{185000}{191193} \right) \times 1000$$

$$\text{Sex Ratio} = 967.6$$



Conclusion :

- The analysis covers district-wise birth data and sex ratio trends in Kerala from 2019 to 2023.
- Male births consistently outnumbered female births each year across most districts.
- The sex ratio at birth remained relatively stable, mostly within the natural range (around 950–970 females per 1000 males).
- Districts like Malappuram, Thrissur, and Ernakulam reported the highest number of births consistently.
- Districts such as Idukki and Wayanad had the lowest number of registered births each year.
- Minor variations in sex ratio were observed year-to-year and district-to-district, but no alarming gender imbalance was detected.
- The data highlights Kerala's overall demographic stability and effective registration of vital statistics.
- Continuous monitoring is essential for informed policymaking and for addressing any emerging demographic concerns at the local level.

5 Registration Patterns of Children Born from 2019 to 2023 in Kerala: A District and Gender-wise Analysis

This analysis examines the registration patterns of individuals born in Kerala from 2019 to 2023.

Using birth registration data across five years, the study highlights how many births were registered each year, broken down by district and sex. It provides insights into delayed registrations and regional differences in registration practices.

5.1 2019

Children born in 2019, registered each year from 2019 to 2023 (by District and Sex)

Year	DISTRICT_NAME	Male	Female	Non stated	Total
2019	Kasaragod	9734	9233	0	18967
	Kannur	21060	20261	2	41323
	Wayanad	7240	6978	0	14218
	Kozhikkode	28009	26766	8	54783
	Malappuram	46557	44156	1	90714
	Palakkad	17290	16352	2	33644
	Thrissur	22702	21661	4	44367
	Ernakulam	13820	13316	2	27138
	Idukki	5351	5336	1	10688
	Kottayam	11577	11348	1	22926
	Alappuzha	8587	8334	4	16925
	Pathanamthitta	7655	7600	0	15255
	Kollam	14009	13616	0	27625
	Thiruvananthapuram	22236	21454	6	43696
	Kasaragod	365	356	0	721
	Kannur	626	584	0	1210
	Wayanad	213	219	0	432
	Kozhikkode	521	591	0	1112
	Malappuram	1681	1695	0	3376
	Palakkad	764	712	0	1476

2020	Thrissur	575	503	1	1079
	Ernakulam	397	401	0	798
	Idukki	101	107	0	208
	Kottayam	192	228	0	420
	Alappuzha	247	220	0	467
	Pathanamthitta	203	203	0	406
	Kollam	374	370	0	744
	Thiruvananthapuram	471	438	0	909
2021	Kasaragod	4	6	0	10
	Kannur	5	2	0	7
	Wayanad	0	0	0	0
	Kozhikkode	1	5	0	6
	Malappuram	40	34	0	74
	Palakkad	6	7	0	13
	Thrissur	8	6	0	14
	Ernakulam	6	2	0	8
	Idukki	2	4	0	6
	Kottayam	5	5	0	10
	Alappuzha	5	6	0	11
	Pathanamthitta	2	1	0	3
	Kollam	2	2	0	4
	Thiruvananthapuram	6	7	0	13
2022	Kasaragod	1	2	0	3
	Kannur	4	6	0	10
	Wayanad	1	1	0	2
	Kozhikkode	3	7	0	10
	Malappuram	8	10	0	18
	Palakkad	4	5	0	9
	Thrissur	3	5	0	8
	Ernakulam	3	3	0	6
	Idukki	2	1	0	3
	Kottayam	3	1	0	4
	Alappuzha	1	4	0	5
	Pathanamthitta	0	1	0	1
	Kollam	3	4	0	7
	Thiruvananthapuram	3	1	0	4

2023	Kasaragod	2	3	0	5
	Kannur	10	5	0	15
	Wayanad	3	9	0	12
	Kozhikkode	4	9	0	13
	Malappuram	12	13	0	25
	Palakkad	3	9	0	12
	Thrissur	1	4	0	5
	Ernakulam	6	8	0	14
	Idukki	2	3	0	5
	Kottayam	2	0	0	2
	Alappuzha	4	1	0	5
	Pathanamthitta	1	2	0	3
	Kollam	5	9	0	14
	Thiruvananthapuram	4	2	0	6

Total Children born in 2019 and registered from 2019 to 2023 (by Year and Sex)

Year	Male	Female	Non stated	Total
2019	235827	226411	31	462269
2020	6730	6627	1	13358
2021	92	87	0	179
2022	39	51	0	90
2023	59	77	0	136

5.2 2020

Number of Children Born in 2020, Registered from 2020 to 2023 Grouped by District, Sex, and Registration Year

Year	DISTRICT_NAME	Male	Female	Non stated	Total
	Alappuzha	7236	6821	2	14059
	Eranakulam	12677	12352	2	25031
	Idukki	5470	5348	1	10819

2020	Kannur	19403	18688	2	38093
	Kasaragod	9569	9097	1	18667
	Kollam	13098	12901	0	25999
	Kottayam	10986	10698	2	21686
	Kozhikkode	24746	23615	4	48365
	Malappuram	43860	42848	3	86711
	Palakkad	16485	15853	2	32340
	Pathanamthitta	7314	7025	2	14341
	Thiruvananthapuram	20588	19875	3	40466
	Thrissur	20602	20044	4	40650
	Wayanad	6800	6736	0	13536
2021	Alappuzha	1073	1105	0	2178
	Eranakulam	631	630	0	1261
	Idukki	210	201	0	411
	Kannur	717	632	0	1349
	Kasaragod	412	398	0	810
	Kollam	399	411	0	810
	Kottayam	212	212	0	424
	Kozhikkode	771	795	0	1566
	Malappuram	2684	2560	0	5244
	Palakkad	960	970	0	1930
	Pathanamthitta	152	147	0	299
	Thiruvananthapuram	511	556	0	1067
	Thrissur	659	573	0	1232
	Wayanad	222	205	0	427
2022	Alappuzha	1	3	0	4
	Eranakulam	2	8	0	10
	Idukki	11	13	0	24
	Kannur	3	9	0	12
	Kasaragod	1	3	0	4
	Kollam	6	4	0	10
	Kottayam	8	11	0	19
	Kozhikkode	1	3	0	4
	Malappuram	30	22	0	52

	Palakkad	6	0	0	6
	Pathanamthitta	2	1	0	3
	Thiruvananthapuram	4	6	0	10
	Thrissur	7	10	0	17
	Wayanad	1	0	0	1
2023	Alappuzha	0	2	0	2
	Eranakulam	9	7	0	16
	Idukki	5	3	0	8
	Kannur	4	3	0	7
	Kasaragod	3	3	0	6
	Kollam	3	2	0	5
	Kottayam	4	2	0	6
	Kozhikkode	3	5	0	8
	Malappuram	40	34	0	74
	Palakkad	2	5	0	7
	Pathanamthitta	4	2	0	6
	Thiruvananthapuram	2	5	0	7
	Thrissur	3	7	0	10
	Wayanad	3	1	0	4

**Total Children Born in 2020 Registered from 2020 to 2023
Grouped by Registration Year and Sex**

Year	Male	Female	Non stated	Total
2020	218834	211901	28	430763
2021	9613	9395	0	19008
2022	93	83	0	176
2023	81	85	0	166

5.3 2021

Number of Children Born in 2021 Registered from 2021 to 2023 By District, Sex, and Registration Year

Year	DISTRICT_NAME	Male	Female	Non stated	Total
2021	Alappuzha	7587	7206	0	14793
	Eranakulam	14157	13801	0	27958
	Idukki	5114	4971	1	10086
	Kannur	17197	16772	2	33971
	Kasaragod	8928	8579	0	17507
	Kollam	11684	11215	1	22900
	Kottayam	9999	9546	3	19548
	Kozhikkode	21739	20960	1	42700
	Malappuram	40604	39756	2	80362
	Palakkad	15336	14821	2	30159
	Pathanamthitta	6237	5937	0	12174
	Thiruvananthapuram	18562	17637	3	36202
	Thrissur	18865	18125	1	36991
	Wayanad	6007	5875	1	11883
2022	Alappuzha	263	250	0	513
	Ernakulam	662	606	0	1268
	Idukki	237	242	0	479
	Kannur	416	394	0	810
	Kasaragod	316	290	0	606
	Kollam	438	409	0	847
	Kottayam	272	251	0	523
	Kozhikkode	506	460	0	966
	Malappuram	1686	1773	0	3459
	Palakkad	759	709	0	1468
	Pathanamthitta	138	112	0	250
	Thiruvananthapuram	381	378	0	759
	Thrissur	484	445	0	929
	Wayanad	261	256	0	517
	Alappuzha	4	5	0	9
	Eranakulam	10	6	0	16

2023	Idukki	4	2	0	6
	Kannur	1	1	0	2
	Kasaragod	5	1	0	6
	Kollam	5	10	0	15
	Kottayam	1	3	0	4
	Kozhikkode	8	5	0	13
	Malappuram	18	18	0	36
	Palakkad	4	3	0	7
	Pathanamthitta	4	2	0	6
	Thiruvananthapuram	7	3	0	10
	Thrissur	7	3	0	10
	Wayanad	4	8	0	12

**Total Children Born in 2021 Registered from 2021 to 2023
By Registration Year and Sex**

Year	Male	Female	Non stated	Total
2021	202016	195201	17	397234
2022	6819	6575	0	13394
2023	82	70	0	152

5.4 2022

**Number of Children Born in 2022 Registered in 2022 and 2023
By District, Sex, and Registration Year**

Year	DISTRICT_NAME	Male	Female	Non stated	Total
2022	Alappuzha	7777	7642	1	15420
	Ernakulam	18819	18293	4	37116
	Idukki	4850	4813	1	9664
	Kannur	17622	17144	1	34767
	Kasaragod	9025	8901	1	17927
	Kollam	11284	10695	0	21979
	Kottayam	10008	9863	0	19871
	Kozhikkode	23472	22729	3	46204
	Malappuram	43471	42119	4	85594

	Palakkad	15372	15058	1	30431
	Pathanamthitta	6706	6523	0	13229
	Thiruvananthapuram	18212	17653	2	35867
	Thrissur	18599	17782	3	36384
	Wayanad	6201	6096	1	12298
2023	Alappuzha	224	204	0	428
	Eranakulam	527	529	0	1056
	Idukki	145	141	0	286
	Kannur	488	410	0	898
	Kasaragod	338	307	0	645
	Kollam	329	339	0	668
	Kottayam	202	175	0	377
	Kozhikkode	478	473	0	951
	Malappuram	1386	1297	0	2683
	Palakkad	847	785	0	1632
	Pathanamthitta	146	131	0	277
	Thiruvananthapuram	341	292	0	633
	Thrissur	611	524	0	1135
	Wayanad	190	190	0	380

**Total Children Born in 2022 Registered in 2022 and 2023
By Registration Year and Sex**

Year	Male	Female	Non stated	Total
2022	211418	205311	22	416751
2023	6252	5797	0	12049

5.5 2023

No of Children born in 2023 and registered 2023 (by District, Sex, and Year)

Registration_Year	DISTRICT_NAME	Male	Female	Not Stated	Total
	Alappuzha	6724	6543	0	13267
	Ernakulam	16720	16246	0	32966
	Idukki	4196	4163	0	8359
	Kannur	15560	15260	2	30822
	Kasaragod	7846	7732	1	15579

2023	Kollam	10063	9724	0	19787
	Kottayam	9296	9012	1	18309
	Kozhikkode	21138	20428	2	41568
	Malappuram	40001	38630	1	78632
	Palakkad	14173	13571	0	27744
	Pathanamthitta	5846	5764	0	11610
	Thiruvananthapuram	17700	16851	10	34561
	Thrissur	16546	15908	1	32455
	Wayanad	5384	5168	0	10552

Total number of Children born in 2023 and registered 2023 (by Year and Sex)

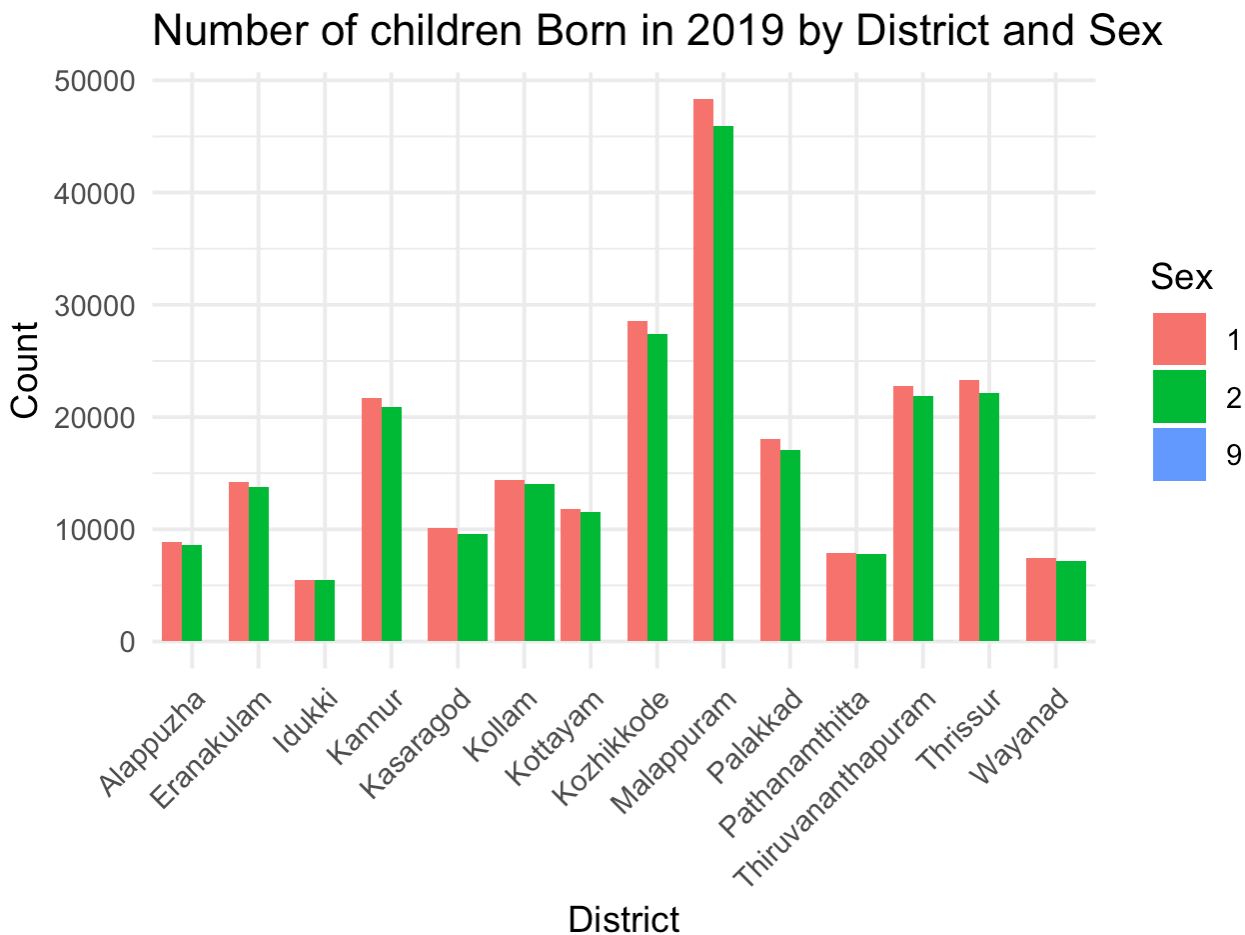
Year	Male	Female	Non stated	Total
2023	191193	185000	18	376211

6 Vital Statistics-Based Planning for 2025 School Enrolment using 2019 born children

Vital Statistics-Based Planning for 2025 School Enrolment involves using key demographic data—such as birth rates, population growth, and child mortality rates—to accurately estimate the number of children eligible for school enrolment in 2025. By analysing birth records from previous years (typically 4–6 years prior), planners can forecast the demand for school infrastructure, teachers, and educational resources. This approach ensures efficient allocation of educational facilities and helps in making informed policy decisions to meet the needs of the upcoming student population.

6.1 No of children born in 2019 in the Birth registration data (2019-2023)

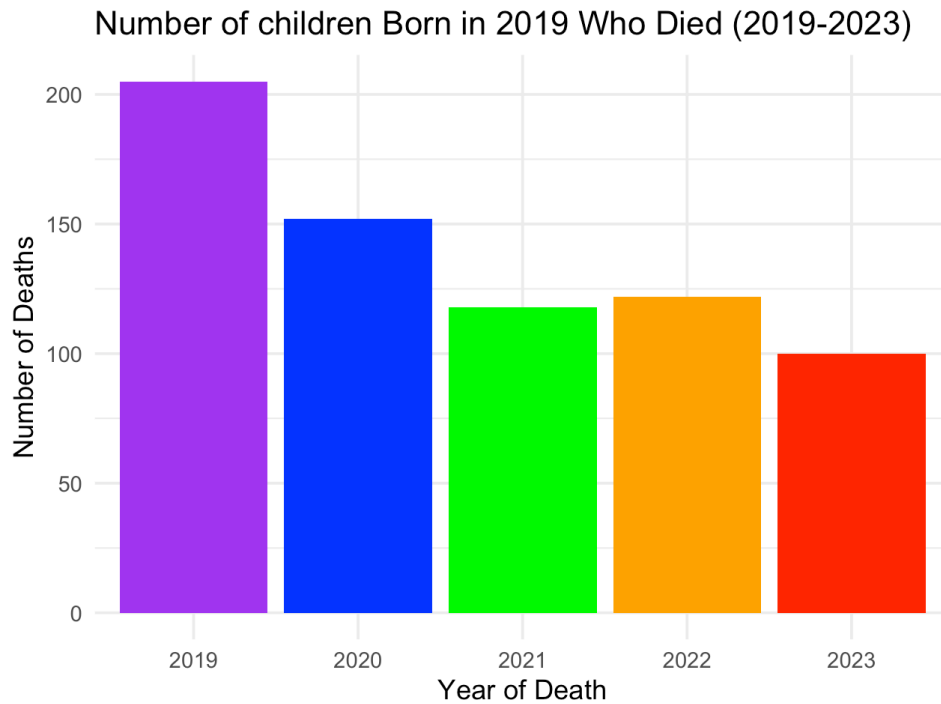
DISTRICT_NAME	Male	Female	Not Stated	Total
Kasaragod	10106	9600	0	19706
Kannur	21707	20862	2	42571
Wayanad	7457	7207	0	14664
Kozhikkode	28540	27378	8	55926
Malappuram	48303	45909	1	94213
Palakkad	18068	17086	2	35156
Thrissur	23294	22179	5	45478
Ernakulam	14234	13730	2	27966
Idukki	5458	5451	1	10910
Kottayam	11779	11582	1	23362
Alappuzha	8845	8565	4	17414
Pathanamthitta	7861	7807	0	15668
Kollam	14393	14001	0	28394
Thiruvananthapuram	22721	21903	6	44630



Total no of children born in 2019 (Combined Data 2019–2023)

Sex	Total
Male	242766
Female	233260
Not stated	32

6.2 No of children dead which has born in 2019 from the death registration data (2019-2023)



Conclusion :

Total no of children born in 2019 in the combined data of birth registration (2019-2023) = 476026

Total no of children died which born in 2019 in the combined data of death registration (2019-2023) = 697

Therefore, the probable no of children could join in 1st standard in 2025 basis on the birth and death registration data (2019-2023) = **475329**

7 Vital Statistics-Based Planning for 2025 School Enrolment using 2020 born children

Vital Statistics-Based Planning for 2025 School Enrolment involves using key demographic data—such as birth rates, population growth, and child mortality rates—to accurately estimate the number of children eligible for school enrolment in 2025. By analysing birth records from previous years (typically 4–6 years prior), planners can forecast the demand for school infrastructure, teachers, and educational resources. This approach ensures efficient allocation of educational facilities and helps in making informed policy decisions to meet the needs of the upcoming student population.

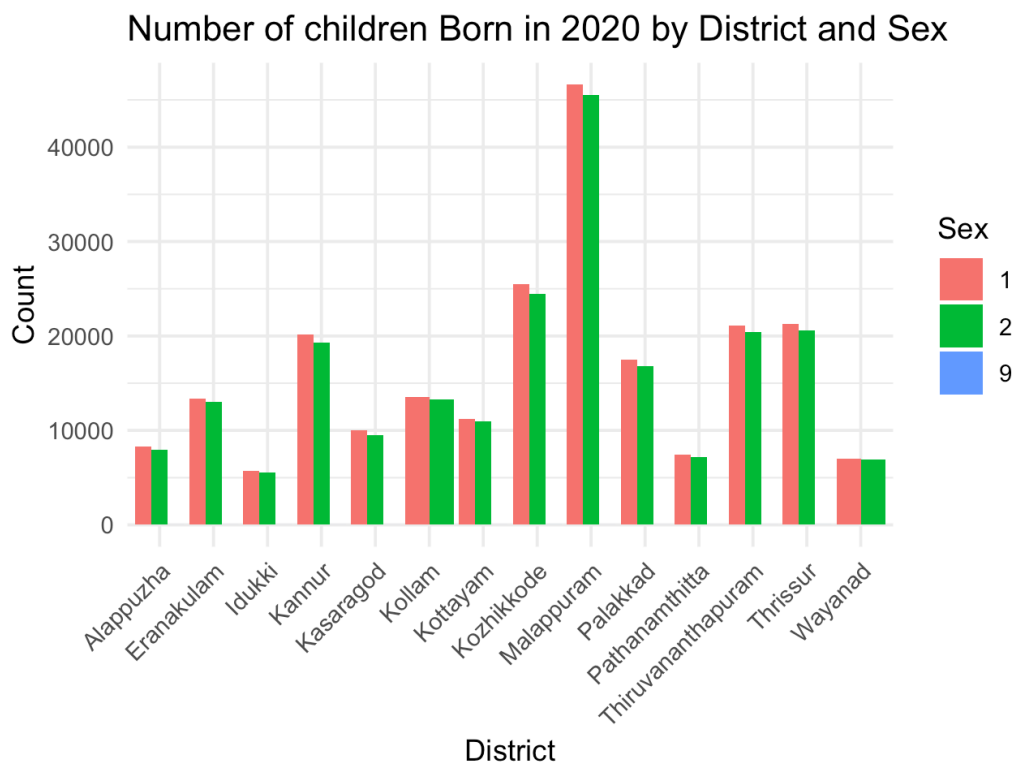
7.1 No of children born in 2020 in the Birth registration data (2020-2023)

Total Number of children Born in 2020 (Combined Data 2020–2023)

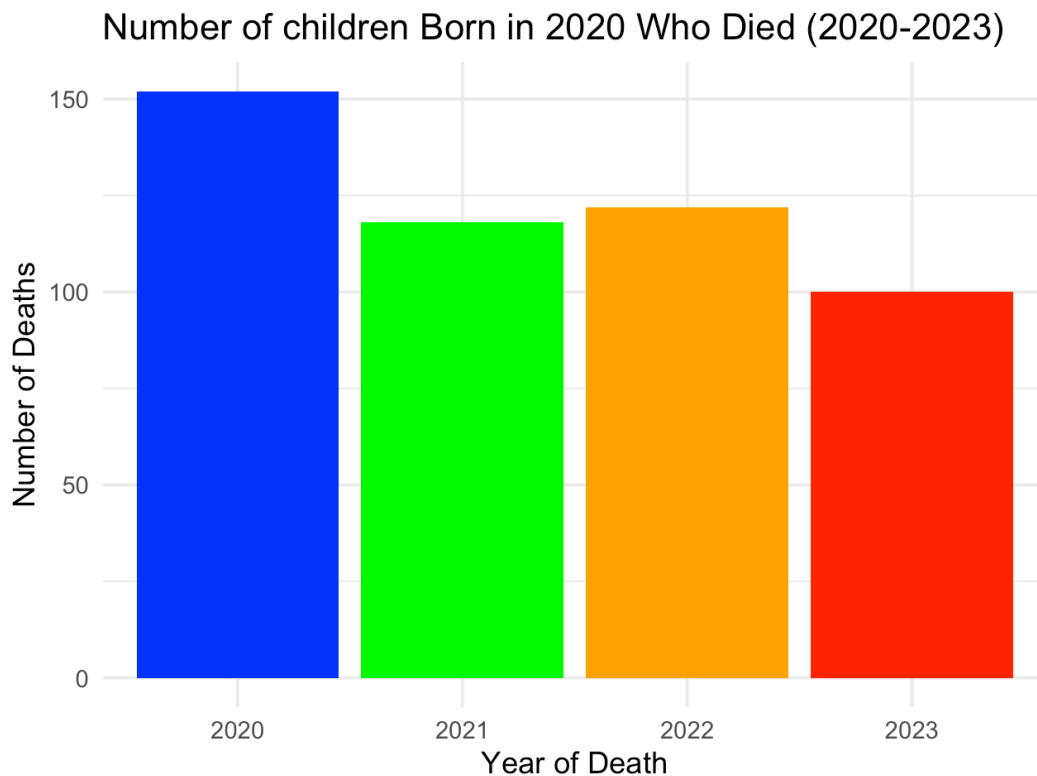
DISTRICT_NAME	Male	Female	Not Stated	Total
Kasaragod	9987	9499	1	19487
Kannur	20135	19329	2	39466
Wayanad	7024	6946	0	13970
Kozhikkode	25525	24417	4	49946
Malappuram	46606	45481	3	92090
Palakkad	17453	16833	2	34288
Thrissur	21282	20631	4	41917
Ernakulam	13325	12995	2	26322
Idukki	5696	5565	1	11262
Kottayam	11211	10922	2	22135
Alappuzha	8314	7928	2	16244
Pathanamthitta	7469	7178	2	14649
Kollam	13505	13322	0	26827
Thiruvananthapuram	21113	20445	3	41561

Total no of children born in 2020 (Combined Data 2020–2023)

Sex	Total
Male	228645
Female	221491
Not stated	28



7.2 No of children dead which has born in 2020 from the death registration data (2020-2023)



Conclusion :

Total no of children born in 2020 in the combined data of birth registration (2020-2023) = 450136

Total no of children died which born in 2020 in the combined data of death registration (2020-2023)
= 492

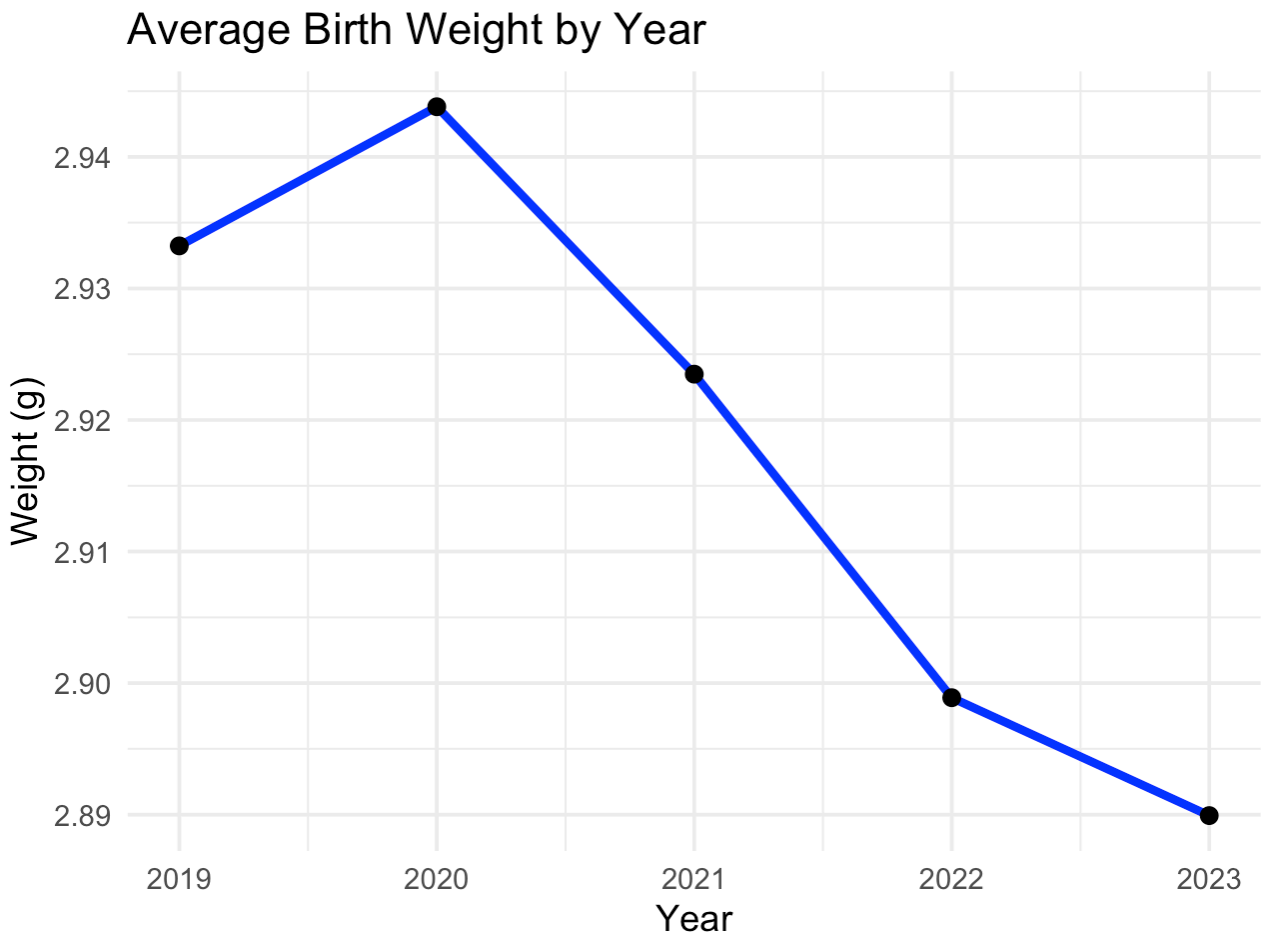
Therefore, the probable no of children could join in 1st standard in 2025 basis on the birth and death registration data (2020-2023) = **449644**

8 Maternal Factors and Birth Outcomes: Trends Across Five Years

This report analyzes five years of birth data (2019–2023) to explore trends in infant birth weight in relation to maternal age, education, and gestational period. Findings indicate a gradual decline in average birth weight since 2020, potentially reflecting the long-term impacts of the COVID-19 pandemic on maternal health. While birth weights remained relatively consistent across maternal age groups, a slight dip was noted among mothers aged 36–40. A clear pattern emerged linking higher maternal education to lower rates of preterm births, highlighting the protective role of education. However, box plot analysis showed only subtle differences in birth weight across education levels, suggesting that while education contributes to improved outcomes, broader socioeconomic and healthcare factors remain critical determinants.

8.1 Average Birth Weight by Year

The “Average Birth Weight by Year” refers to the statistical measurement of the average weight of babies born over a specific year. This data is typically collected by health organisations or government agencies to monitor trends in neonatal health. The average birth weight can be influenced by factors such as maternal health, nutrition, healthcare access, and environmental conditions. By tracking this over time, researchers and policymakers can identify patterns, such as improvements or declines in birth outcomes, and develop strategies to improve maternal and infant health. Trends in average birth weight can also highlight public health challenges or successes.



Conclusion :

1. General Trend: The graph shows a declining trend in average birth weight from the year 2020 to 2023. While 2019 to 2020 saw a slight increase, the following years consistently showed a drop in average birth weight.

2. Year-wise Breakdown:

2019 to 2020: Average birth weight increased slightly, indicating an improvement or stability in maternal and neonatal health factors during this period.

2020 to 2021: A noticeable decline begins. This could be associated with external factors, possibly related to the early impacts of the COVID-19 pandemic on prenatal care, stress levels, nutrition, or healthcare access.

2021 to 2022: The decline continues and becomes steeper. This could be due to continued disruptions in healthcare systems, increased stress, and other socio-economic factors that persisted post-pandemic.

2022 to 2023: The lowest average birth weight is observed. This suggests a continued or worsening condition regarding prenatal health, possibly indicating long-term effects of the pandemic or other systemic issues.

3. Magnitude of Change:

The graph indicates a change from just over 2.94 kg in 2020 to just below 2.90 kg in 2023. Although the numerical difference seems small (~50 grams), it is statistically significant when looking at population averages and can signal a meaningful shift in public health.

4. Implications:

A continued decrease in average birth weight may correlate with higher risks of infant mortality, developmental issues, and chronic conditions later in life. This calls for further investigation into maternal health trends, nutrition, healthcare access, and environmental stressors over the years.

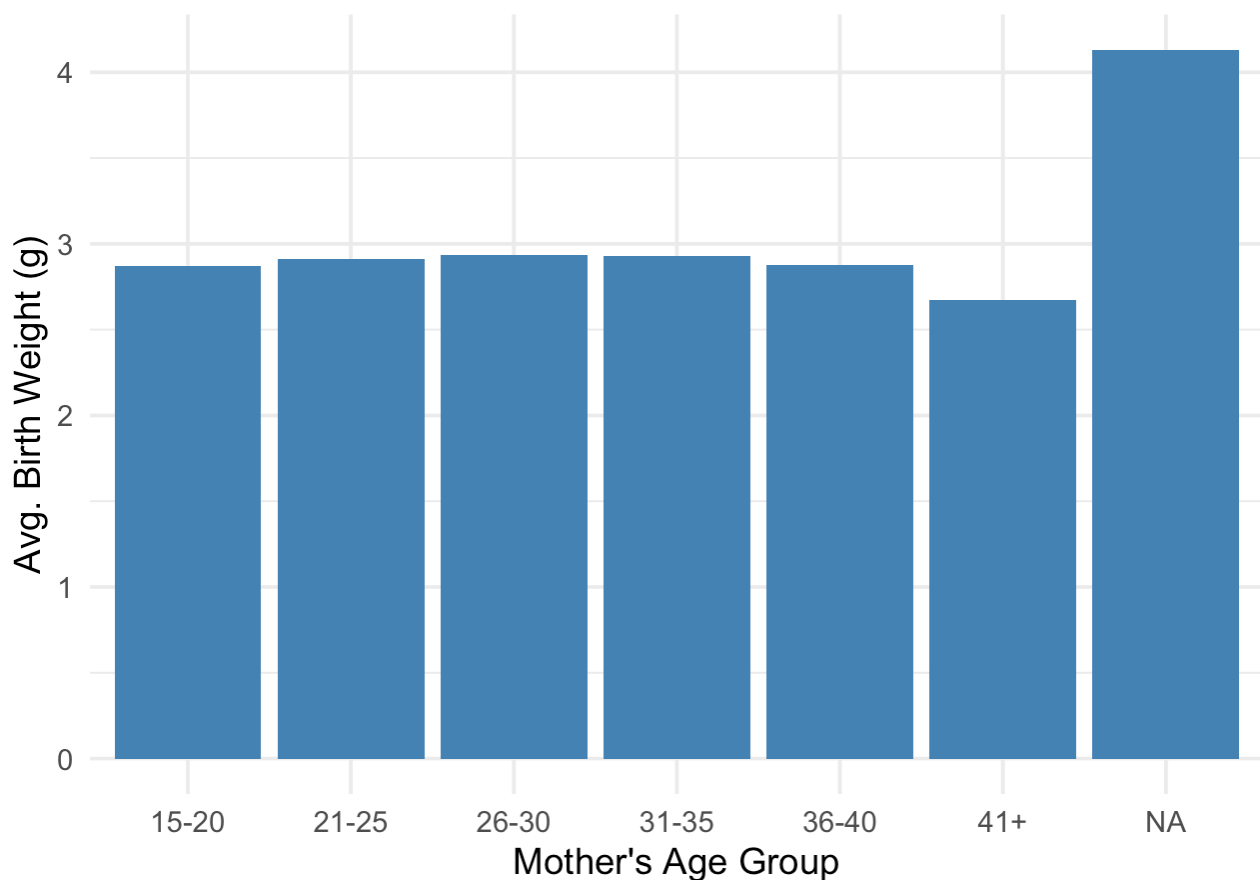
5. Recommendations:

Public health authorities might consider reviewing maternal care policies, ensuring adequate prenatal care, and addressing social determinants of health. Conducting region-specific studies can also help identify particular areas of concern and intervene appropriately.

8.2 Average Birth Weight by Mother's Age Group

“Average Birth Weight by Mother's Age Group” refers to the statistical measurement of the average weight of babies born, categorized by the mother's age group. This data helps to understand how maternal age influences birth outcomes. Generally, younger mothers (especially teenagers) and older mothers (above 35 years) may have a higher likelihood of having babies with lower birth weights. Tracking these trends can provide valuable insights into how age related factors, such as health conditions, nutrition, and pregnancy care, affect infant birth weight. It can also inform healthcare policies aimed at improving maternal and infant health across different age groups.

Average Birth Weight by Mother's Age Group



Conclusion :

1. Relatively Consistent Birth Weight (Age 15–40): Across the age groups from 15 to 40 years, the average birth weight remains fairly consistent, around the same level with slight variations. This suggests that within this age range, maternal age may not significantly affect average birth weight, or any differences are minimal.
2. Slight Dip in Age Group 36–40: There appears to be a slight decline in the average birth weight in the 36–40 age group, but it's not substantial. It might indicate a small trend of decreasing weight as maternal age increases after 35.
3. Age Group 41+: The bar for mothers aged 41+ appears very similar in height to the others, implying no dramatic deviation in average birth weight in this group either.
4. NA (Missing Data): The “NA” category has a notably higher average birth weight than all other groups.

This outlier could be due to:

- A small or unrepresentative sample size in the NA category.

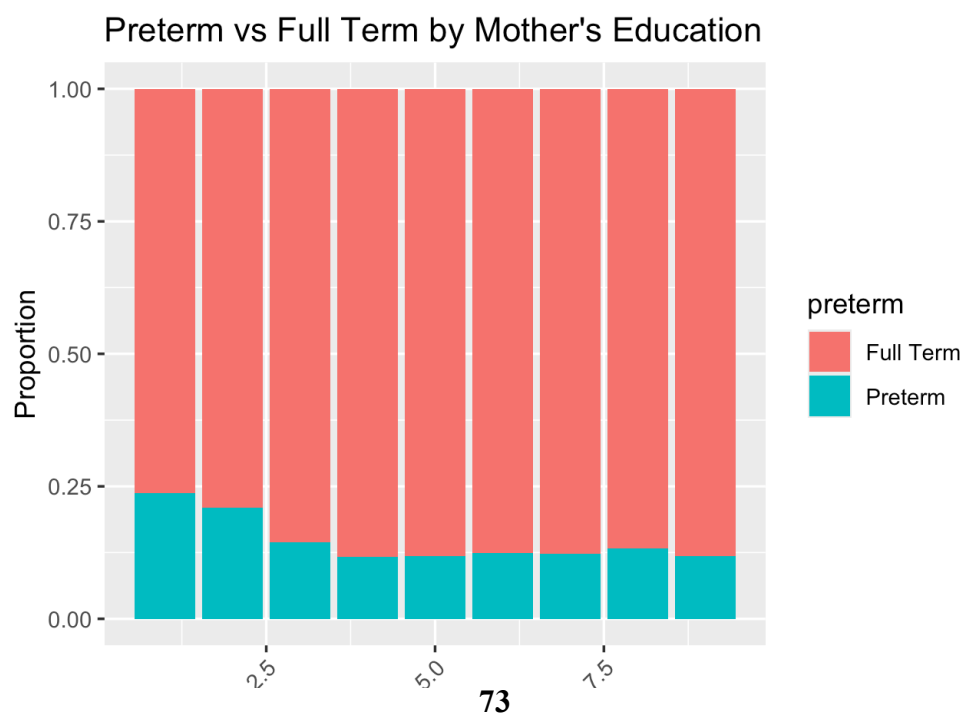
- Data entry errors or anomalies.
- Mothers with unknown age possibly belonging to a specific subgroup with different health or demographic characteristics.

Overall Conclusion

- There is no strong correlation between maternal age and average birth weight among mothers aged 15–40.
- Slight dips after age 35 might suggest some influence of increasing maternal age on birth weight, but it's not pronounced.
- The unusually high value for NA should be interpreted with caution and might warrant further data validation or investigation.

8.3 Mother's Education Level vs Preterm Births

“Mother's Education Level vs Preterm Births” examines the relationship between the education level of mothers and the incidence of preterm births. Research has shown that mothers with higher education levels tend to have lower rates of preterm births, likely due to factors such as better access to healthcare, improved awareness of prenatal care, healthier lifestyle choices, and economic stability. Conversely, mothers with lower education levels may face challenges such as limited access to healthcare, inadequate prenatal care, and higher stress, which can increase the likelihood of preterm births. Analysing this relationship helps policymakers identify at-risk populations and design targeted interventions to reduce preterm birth rates.



Conclusion :

1. Trend with Education Level:

- As the level of mother's education increases (from left to right on the x-axis), the proportion of preterm births (in teal) generally decreases, while the proportion of full-term births (in red) increases.
- This trend suggests a negative correlation between education level and preterm birth i.e., higher maternal education is associated with a lower likelihood of preterm delivery.

2. Lowest Education Group:

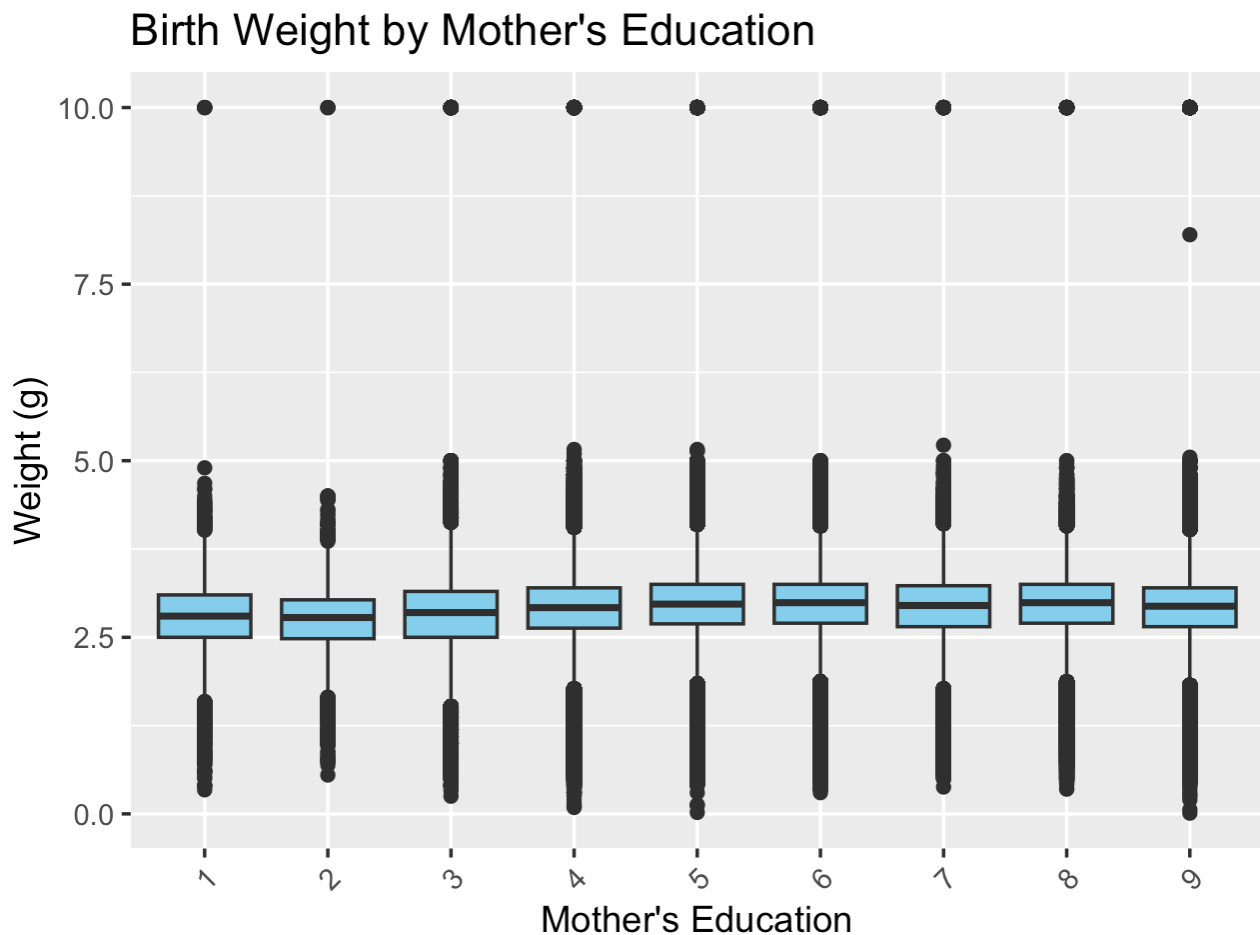
- The leftmost bar (representing the lowest education level) has the highest proportion of preterm births, around 25% or more.

3. Plateau Effect:

- After a certain level of education (approximately the 5.0 to 7.5 range), the proportion of preterm births stabilises around 15-20%, suggesting diminishing returns at higher levels of education.

8.4 Birth Weight by Mother's Qualification

“Birth Weight by Mother's Qualification” refers to the analysis or comparison of newborns' birth weights based on the educational attainment or qualifications of their mothers. This relationship is often studied in public health and social sciences to understand how maternal education impacts child health outcomes. This analysis explores how a mother's level of education influences the birth weight of her baby. Research often shows that higher maternal qualifications are associated with healthier birth weights, likely due to better access to healthcare, nutrition, and prenatal knowledge. It highlights the broader impact of education on maternal and child health.



Detailed Conclusion:

- **Consistent Median Birth Weight:** The median birth weight appears to be relatively stable across all education levels, suggesting no major shifts in central tendency based on educational attainment alone.
- **Similar Spread and IQR:** The interquartile ranges (IQRs) representing the middle 50% of data are quite similar across the education groups. This indicates that the variability of birth weight doesn't differ much with maternal education level.
- **Presence of Outliers:** All categories show significant outliers, including a few extreme values (some even around 10g, which are likely data entry errors or represent different units). This suggests that while most births fall within a normal range, some anomalies exist across all education levels.
- **Slight Differences in Lower Birth Weights:** There may be a slight tendency for lower educational levels (e.g., 1 and 2) to show a broader lower range or more low outliers, which could indicate a higher risk of low birth weight in these groups.

- **Education Levels 5–9 Show Slightly Higher Consistency:** While subtle, the box plots for higher education levels (5 to 9) seem to have slightly more compact IQRs and fewer extreme low values, which might reflect slightly better birth outcomes, possibly due to better health awareness and access to prenatal care. Although no dramatic differences are seen in birth weight by maternal education, a subtle trend suggests that higher maternal education may be associated with slightly better or more consistent birth weight outcomes. However, the presence of wide variability and outliers indicates that other factors (e.g., nutrition, healthcare access, socioeconomic status) likely play a significant role and should be considered in a more comprehensive analysis.

9. Analysis and Forecasting of Delayed Birth and Death Registrations in Kerala (2019–2023)

This report provides a comprehensive analysis of delayed birth and death registrations in Kerala from 2019 to 2023. Delayed registrations refer to instances where births or deaths were recorded in a year later than the actual event year. The analysis includes year-wise and sex-wise summaries to understand demographic patterns in late reporting. Using time series modelings (ARIMA), forecasts are generated to estimate the expected number of delayed registrations for 2024 and 2025, aiding in planning and policy formulation.

9.1 Delayed Birth Registrations in Kerala (2019–2023): Sex-wise Analysis and Forecast for 2024–2025

This section analyses delayed birth registrations in Kerala, focusing on births registered in years later than their occurrence (2019–2023). The data is categorised by sex for each year, and a time series model (ARIMA) is used to forecast expected delayed registrations for 2024 and 2025. The analysis helps identify trends and improve registration practices.

2019 Total Delayed Birth Registrations by Sex

Sex	Total Registrations
Male	9126
Female	8718

2020 Total Delayed Birth Registrations by Sex

Sex	Total Registrations
Male	8219
Female	7908
Other	1

2021 Total Delayed Birth Registrations by Sex

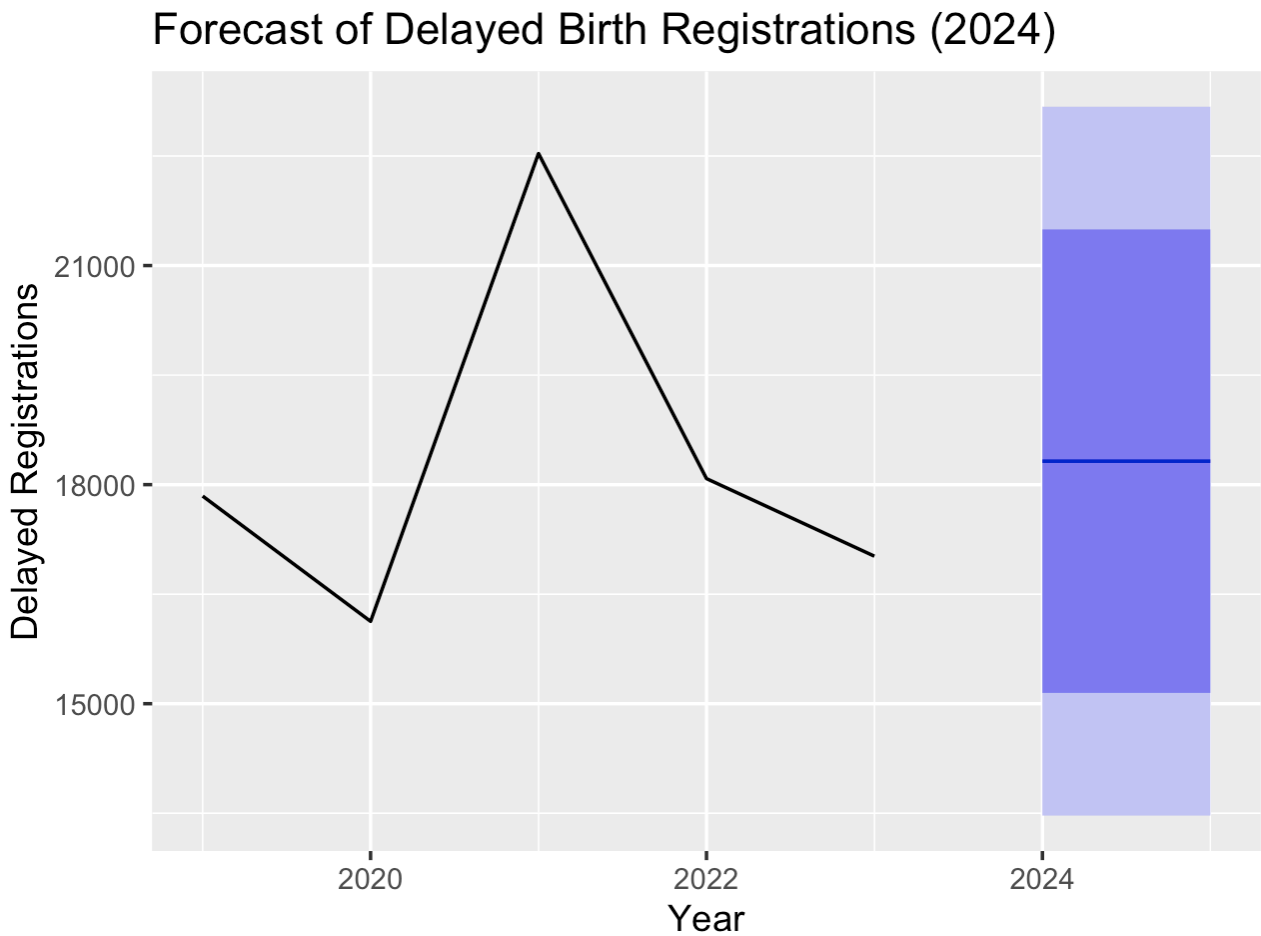
Sex	Total Registrations
Male	11484
Female	11049

2022 Total Delayed Birth Registrations by Sex

Sex	Total Registrations
Male	9285
Female	8798

2023 Total Delayed Birth Registrations by Sex

Sex	Total Registrations
Male	8835
Female	8185



Conclusion :

Overview of Historical Trend (2019–2023):

The trend in delayed birth registrations between 2019 and 2023 has shown notable fluctuations:

- 2019: Approximately 17,844 delayed registrations.
- 2020: A decrease to around 16,128.
- 2021: A sharp increase to 22,533, marking the peak during this period.
- 2022: Dropped again to 18,083
- 2023: Slight decline continued to 17,020

Forecast for 2024 and 2025: Using an ARIMA model, the forecast for the next two years is:

Year	Point Forecast	80% CI (Low–High)	95% CI (Low–High)
2024	18321.6	15148.18 - 21495.02	13468.27 - 23174.93

- The point forecast suggests a moderate increase compared to 2023.
- The confidence intervals are relatively wide, indicating uncertainty due to past volatility.

Interpretation:

1) Stability: The point forecasts for 2024 and 2025 are identical, implying a stable trend in delayed registrations, assuming no major policy or external disruptions.

2) Confidence Range Insight: The lower bounds (especially the 95% interval) indicate potential for substantial decrease if interventions succeed, while upper bounds suggest a risk of increase if delays persist or worsen.

3) Policy Implications:

- Efforts to reduce delay (e.g., awareness, digitisation, decentralised access) could push actual numbers toward the lower bounds.
- If challenges like backlog clearance or reporting gaps aren't addressed, the trend may approach the upper bounds.

4) Planning Utility:

- This forecast aids resource allocation, staffing, and administrative readiness for managing delayed registrations.
- District-level micro-planning might benefit from applying similar models with localised data.

9.2 Delayed Death Registrations in Kerala (2019–2023): Sex-wise Trends and Forecast for 2024–2025

This section analyses delayed death registrations in Kerala, focusing on deaths that were registered in a year later than the actual year of occurrence. The data from 2019 to 2023 is broken down by sex to observe registration trends. A time series model Autoregressive integrated moving average (ARIMA) is then applied to forecast the expected number of delayed death registrations for the years 2024 and 2025, providing insights for administrative and policy-related planning.

2019 Total Delayed Death Registrations by Sex

Sex	Total Registrations
Male	11195
Female	10687
Other	1

2020 Total Delayed Death Registrations by Sex

Sex	Total Registrations
Male	9828
Female	9360

2021 Total Delayed Death Registrations by Sex

Sex	Total Registrations
Male	13951
Female	13392

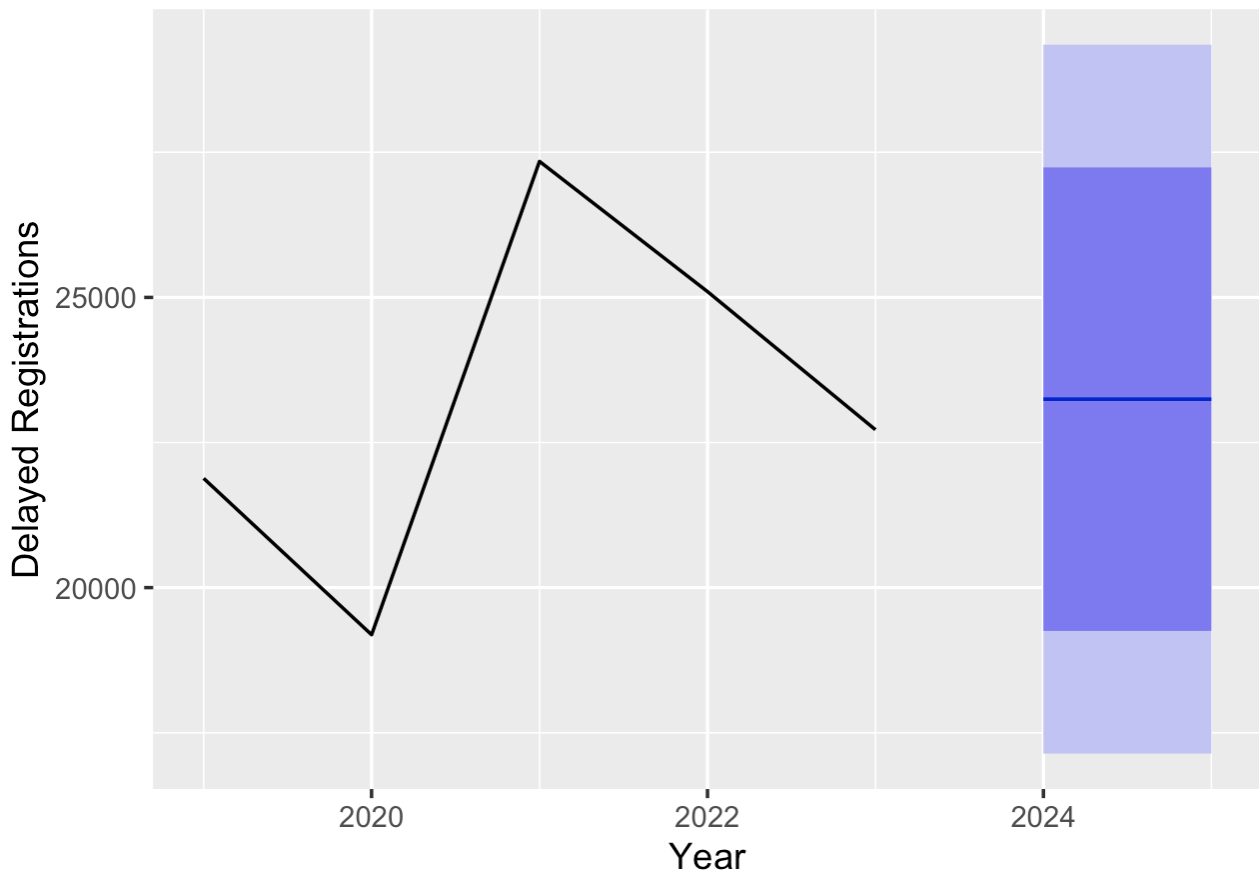
2022 Total Delayed Death Registrations by Sex

Sex	Total Registrations
Male	12216
Female	12884

2023 Total Delayed Death Registrations by Sex

Sex	Total Registrations
Male	11456
Female	11263
Other	1

Forecast of Delayed Death Registrations (2024)



Conclusion:

The time series analysis of delayed death registrations in Kerala from 2019 to 2023 was conducted using the `auto.arima()` function in R, which automatically selected the best-fitting ARIMA model for forecasting. The data represents the number of death registrations made in a given year for deaths that occurred in previous years. i.e., delayed registrations.

Historical Trend (2019–2023):

- There was noticeable variability in delayed registrations
- A decline in 2020 compared to 2019.
- A sharp increase in 2021, likely reflecting delays caused by the COVID-19 pandemic and subsequent backlog processing.
- A gradual decline in 2022 and 2023 as systems normalised.

Forecast for 2024 and 2025: Using an ARIMA model, the forecast for the next two years is:

Year	Point Forecast	80% CI (Low–High)	95% CI (Low–High)
2024	23,246.8	19254.17 - 27239.43	17140.6 - 29353

The point forecast for both 2024 and 2025 is 23,246.8 delayed registrations.

This indicates a stabilisation of delayed registrations at around 23,000 annually over the next two years. The symmetric forecast values for 2024 and 2025 suggest the model has detected a plateau in trend and does not expect significant fluctuations unless external factors intervene.

Interpretation and Implications:

- **Administrative Efficiency:** The stabilisation in delayed death registrations may indicate improvements in registration infrastructure and public awareness, especially following the disruptions caused by the pandemic.
- **Policy Planning:** The forecast can aid policymakers in resource planning — ensuring sufficient staff and systems are in place to handle approximately 23,000 delayed cases each year.
- **Uncertainty:** The wide confidence intervals (especially at 95%) highlight uncertainty in prediction, suggesting that unexpected events (e.g., administrative changes, health crises) could still significantly affect the trend.
- **Data Quality Considerations:** Warnings related to date parsing in the dataset (as seen in your code output) suggest some irregularities or formatting issues in the registration dates. It would be beneficial to clean or validate these records further to ensure accuracy in long-term forecasting.

10. Time Series Analysis and ARIMA-Based Forecasting of Birth and Death Registrations in Kerala (2019–2023)

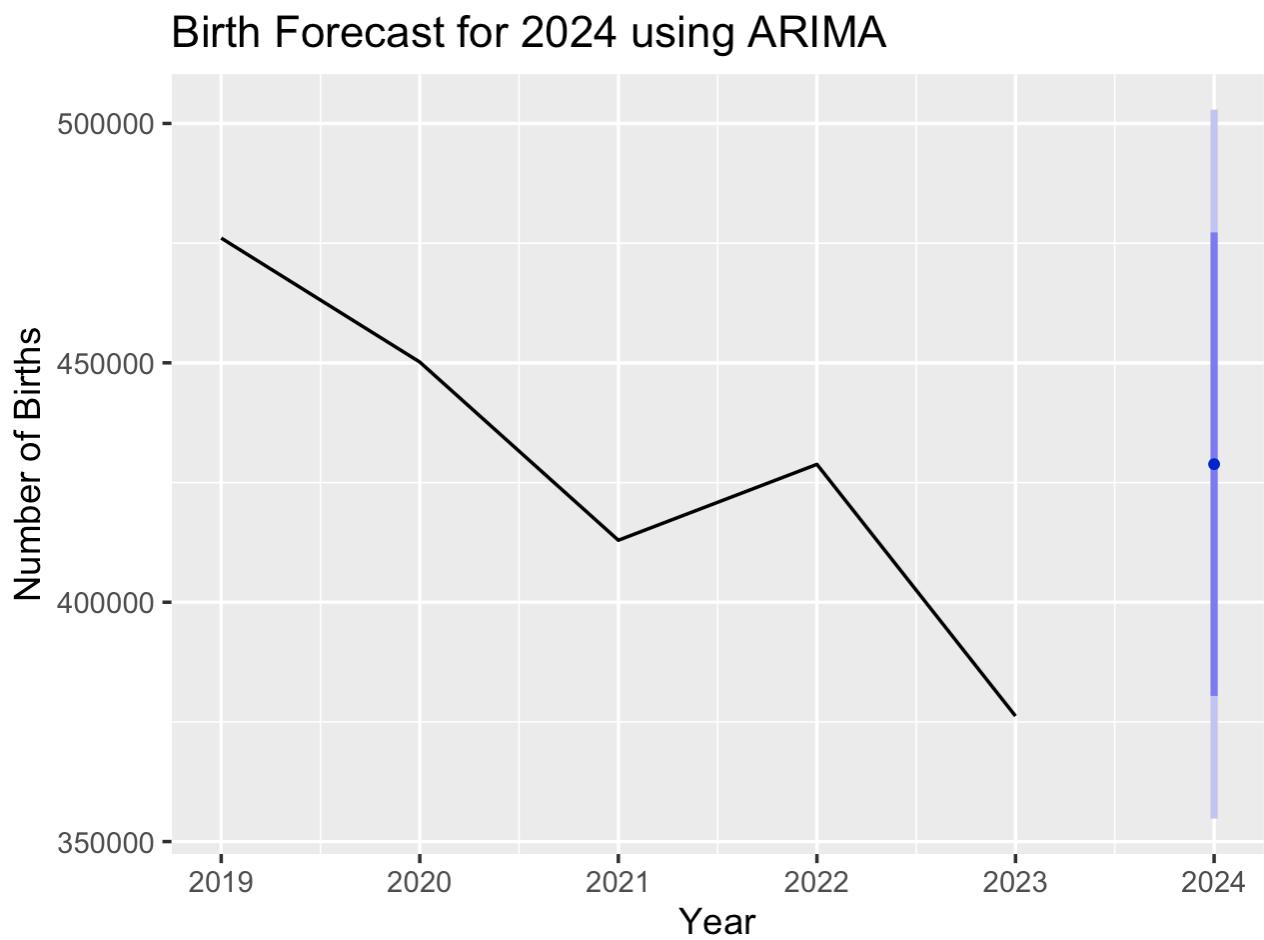
This study presents a comprehensive time series analysis of birth and death registrations in Kerala from 2019 to 2023 and uses ARIMA (AutoRegressive Integrated Moving Average) models to forecast trends for 2024. Leveraging official civil registration data, the study aims to identify temporal patterns and make evidence-based predictions to support demographic planning and policy formulation. For birth registrations, the data indicates a gradual decline over the five-year period, with a significant drop in 2023. However, the ARIMA model projects a potential rebound in 2024, possibly reflecting a return to pre-pandemic birth planning behaviour. In contrast, death registrations show marked fluctuations, including a pandemic-induced spike in 2021, followed by a decreasing trend. The 2024 forecast suggests stabilisation, although future trends may remain sensitive to external factors like health crises or environmental changes. By applying time series forecasting techniques, this analysis offers valuable insights into the demographic shifts in Kerala, helping stakeholders anticipate resource needs, monitor public health, and design more effective interventions.

10.1 Time Series Forecasting of Birth Registrations (2019–2023)

This analysis aims to understand and forecast birth trends based on registration data from 2019 to 2023. Multiple CSV files containing annual birth records are imported and merged. The data is cleaned, with dates standardised and key variables such as year of birth and registration extracted. A summary of total births per year is generated to observe yearly trends. Leveraging these trends, an ARIMA model is fitted to the time series data to forecast the expected number of births in 2024. The forecast results are visualised to support interpretation and decision-making.

Total No of persons born each year (2019-2023) in the birth registration data

Birthyear	Total
2019	476058
2020	450167
2021	412941
2022	428800
2023	376211



Conclusion :

1. Overall Decline: Over the five-year span, registered births declined by approximately 21% (from 476,058 in 2019 to 376,211 in 2023).

2. Year-on-Year Changes:

- 2019 → 2020: -25,894 (-5.4%)
- 2020 → 2021: -37,223 (-8.3%)
- 2021 → 2022: +15,859 (+3.8%) ← temporary recovery
- 2022 → 2023: -52,589 (-12.3%)

3. Possible Explanations:

- COVID-19 pandemic (2020–2021) likely impacted birth planning.
- The slight recovery in 2022 may reflect delayed pregnancies.
- The sharp drop in 2023 suggests longer-term demographic or socio-economic factors may be in play (e.g., inflation, career-oriented lifestyles, urbanisation, or changing marriage patterns).

Year	Point Forecast	80% CI (Low–High)	95% CI (Low–High)
2024	4,28,835	380,428 – 477,241	354,803 – 502,866

Interpretation of Forecast :

Point Forecast (428,835):

- Suggests a recovery in births compared to 2023 (376,211).
- The value is very close to the 2022 figure (428,800), indicating a return to pre-2023 levels.

Confidence Intervals:

- The wide 95% interval ($\pm 74,000$) reflects uncertainty due to:
- Small dataset (only 5 years),
- Irregular trend (non-monotonic),
- Potential influence of external unmodeled variables (e.g., policy changes, health crises).
- Despite the uncertainty, the forecast does not predict a further significant decline like 2023.

Key Takeaways

1. The model expects a modest rebound in 2024, but it's not statistically guaranteed due to the wide range.

2. The forecast aligns closely with 2022 levels, suggesting 2023 may have been an outlier or an anomaly.
3. The high upper bound (502,866) shows the possibility of a strong recovery, while the lower bound (354,803) still leaves room for concern.

Final Conclusion:

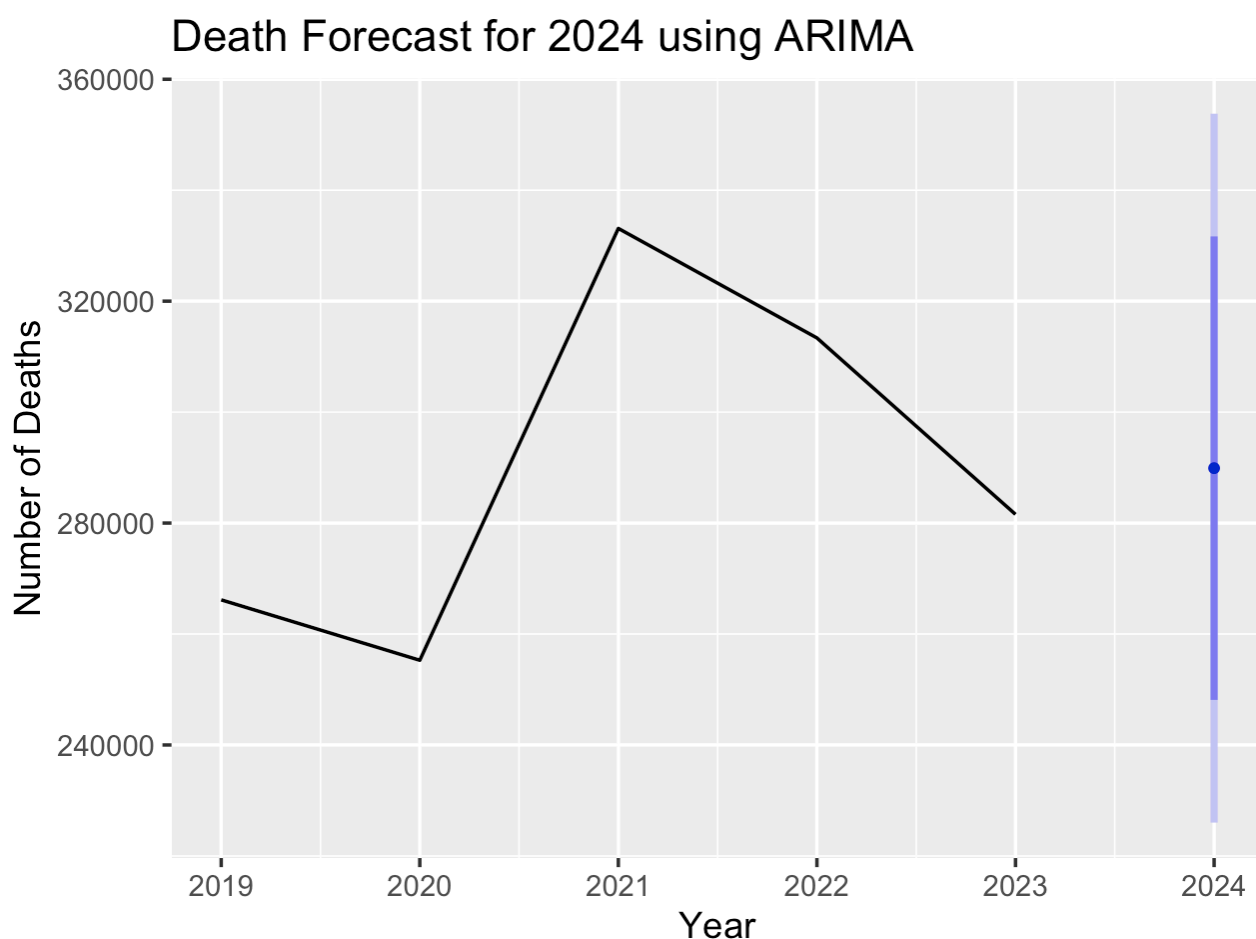
The number of registered births declined steadily from 2019 to 2023, reaching a low of 376,211 in 2023. However, an ARIMA-based time series forecast projects a recovery to around 428,835 births in 2024, with a broad 95% confidence range from 354,803 to 502,866. While this suggests potential stabilisation or rebound, the high level of uncertainty highlights the need for caution. Broader data analysis and more comprehensive forecasting methods are recommended for reliable long-term planning.

10.2 Time Series Forecasting of Death Registrations (2019–2023)

This report presents a time series analysis and forecasting of death registrations from the year 2019 to 2023 using the ARIMA (AutoRegressive Integrated Moving Average) model. The objective is to understand historical trends and patterns in death registration data and to generate reliable forecasts for future periods. ARIMA is a widely used statistical method for time series forecasting, known for its ability to model data that shows trends and autocorrelations. The process involves data preprocessing, stationarity testing, model identification (through ACF and PACF plots), parameter estimation, and diagnostic checking. The resulting ARIMA model helps to capture the dynamics of the data and provides forecasts that can support evidence-based decision-making in public health planning, mortality monitoring, and policy formulation.

Total No of persons Died each year (2019-2023) in the Death registration data

Deathyear	Total
2019	266167
2020	255270
2021	333110
2022	313370
2023	281566



Conclusion :

This study analysed the total number of deaths registered annually from 2019 to 2023 and forecasted the expected number for 2024 using the ARIMA (AutoRegressive Integrated Moving Average) model.

Key Observations:

1. Trend Analysis (2019–2023):

- In 2019, there were 266,167 registered deaths.
- This slightly declined to 255,270 in 2020, possibly due to underreporting or disruptions during the COVID-19 pandemic.
- A sharp rise was observed in 2021 with 333,110 deaths, potentially reflecting delayed reporting from 2020 or actual increased mortality.
- The number decreased slightly to 313,370 in 2022, then to 281,566 in 2023, indicating a downward trend post-pandemic impact.

2. ARIMA Model Forecast for 2024:

- The point forecast for 2024 is 289,897 deaths.
- The 80% confidence interval ranges from 248,124 to 331,670 deaths.
- The 95% confidence interval broadens further, from 226,010 to 353,783 deaths

3. Model Performance and Interpretation:

Year	Point Forecast	Lo 80	Hi 80	Lo 95	Hi 95
2024	2,89,896.6	2,48,123.7	3,31,669.5	2,26,010.4	3,53,782.8

- The ARIMA model effectively captured the recent volatility in the data, especially the spike in 2021 and its subsequent decline.
- The wide confidence interval for 2024 reflects uncertainty due to irregular fluctuations in prior years, especially influenced by the pandemic.
- The point forecast suggests a modest increase from 2023 but not reaching the high levels of 2021 and 2022.

Overall Insights:

- The forecast indicates stabilisation in the number of deaths after the pandemic-induced variability.
- The slight increase projected for 2024 could be due to population growth, aging demographics, or improved reporting.
- However, external shocks (like pandemics or natural disasters) could still significantly influence future trends, as reflected in the wide forecast interval.

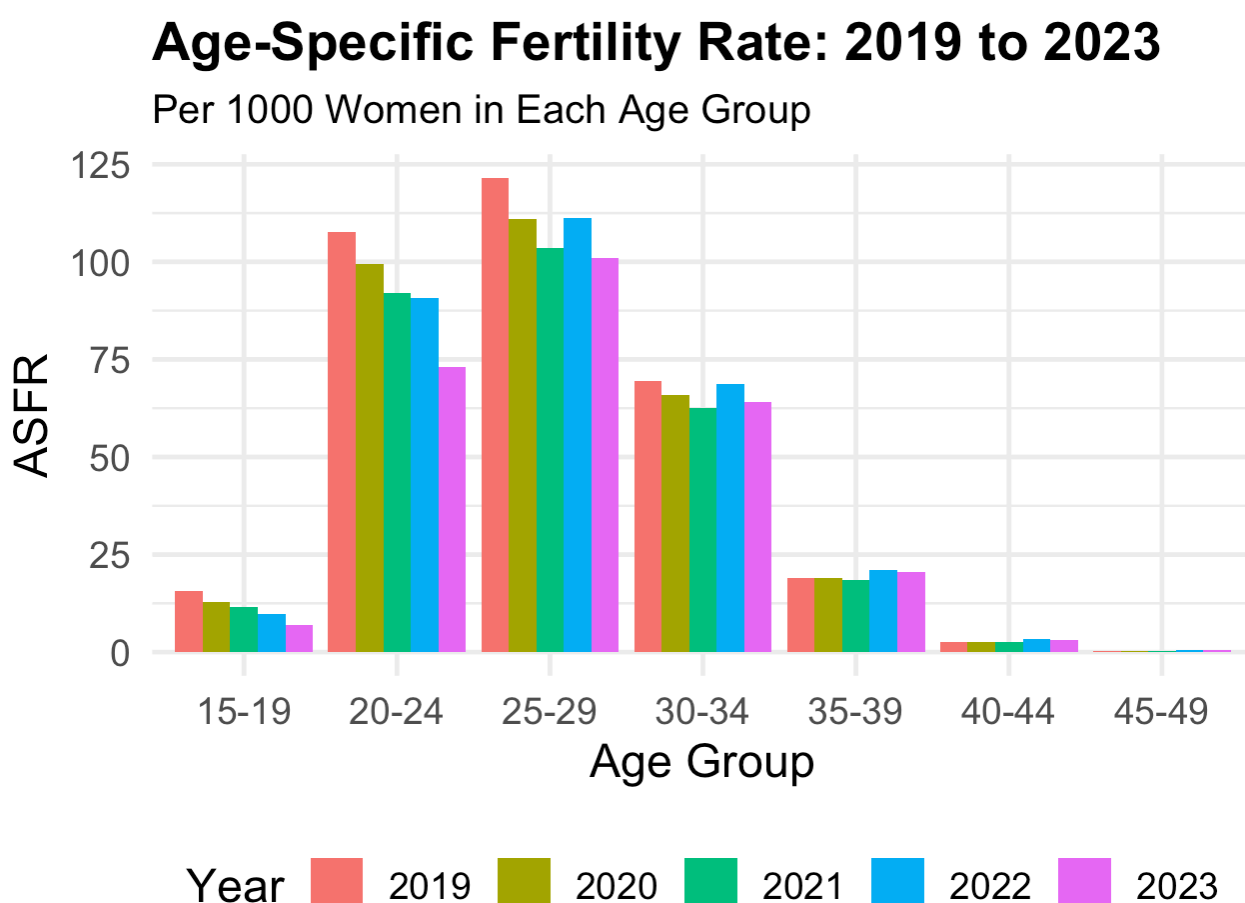
11 Computation and Visualisation of Age-Specific Fertility Rates (ASFR) in Kerala: 2019–2023

This analysis focuses on calculating the Age-Specific Fertility Rates (ASFR) for Kerala from 2019 to 2023, providing insights into fertility patterns across different maternal age groups. The ASFR is calculated by dividing the number of births in each age group by the female population in the corresponding age group, scaled per 1,000 women. The code integrates birth registration data with mid-year population estimates, summarises the ASFR for each year, and visualises the trends over the five-year period. The output includes a detailed table for comparative analysis and a bar chart to highlight changes in fertility rates across age groups, making it easier to observe demographic shifts and fertility trends over time. Number of live births per 1,000 women in a particular age groups (usually age 15-19, 20-24etc.) in a year

ASFR = (Number of live births in a particular age group / Mid-year female population of the same age group) \times 1000

Age-Specific Fertility Rate (ASFR): 2019 to 2023 Per 1000 Women in Each Age Group

AGE_GROUP	2019	2020	2021	2022	2023
15–19	15.7130679	12.8061859	11.4793906	9.7281323	6.9025135
20–24	107.7026761	99.5485130	91.9870711	90.7803261	73.0637819
25–29	121.5136220	111.0523980	103.4920794	111.1800685	100.9360755
30–34	69.5184343	65.8244327	62.4458953	68.6550638	64.1283785
35–39	18.9739206	18.9479836	18.4471176	21.0561166	20.5881554
40–44	2.4949834	2.6197654	2.6190871	3.2453704	3.1791786
45–49	0.3227363	0.3794192	0.3025386	0.5456022	0.4428822



Conclusion :

The analysis of Age-Specific Fertility Rates (ASFR) from 2019 to 2023 reveals important trends in reproductive behaviour across different maternal age groups:

1. Shift in Peak Fertility Age :

- The 25–29 age group consistently had the highest ASFR across all five years, reaffirming that this remains the prime childbearing age.
- Although the peak ASFR declined slightly from 121.5 in 2019 to 111.2 in 2023, this group maintained the lead, showing a marginal but steady decline in fertility intensity.

2. Noticeable Decline in Younger Age Groups (15–24)

- Fertility among younger women (15–19 and 20–24 age groups) showed a clear downward trend:
- The 15–19 age group declined from 15.7 (2019) to 6.9 (2023) — more than a 50% drop, indicating possible improvements in adolescent reproductive health, education, and access to contraception.

- The 20–24 group dropped significantly from 107.7 to 73.1, pointing toward delayed family planning and extended education or career prioritisation.

3. Gradual Rise or Stability in Older Age Groups (35+)

- ASFRs for the 35–39 age group remained relatively stable (hovering around 18–21), while minor upticks were observed in the 40–44 and 45–49 categories, albeit at very low levels (ASFR < 7).
- These patterns may suggest increasing maternal age at first birth and the influence of advancements in reproductive technology, enabling pregnancies at older ages.

4. Flattening of the ASFR Curve

- The overall distribution of fertility is showing signs of flattening — the dominance of a single age group (historically 25–29) is diminishing slightly, and adjacent age groups are contributing more uniformly.
- This shift implies a diversification of reproductive timing, with couples choosing to have children across a broader range of ages.

5. Possible Socioeconomic and Policy Influences

- The declines in ASFR across most age groups — particularly between 2020 and 2021 may reflect the impact of the COVID-19 pandemic on family planning decisions.
- Broader changes in socioeconomic conditions, delayed marriages, and rising urbanization are likely influencing these fertility patterns.

Final Thoughts :

These trends reflect an ongoing demographic transition, characterised by declining fertility rates, postponement of childbirth, and increasing maternal age. These shifts have critical implications for population growth, health policy, and future workforce planning. The sustained decline across several age groups suggests that fertility behaviour is becoming increasingly influenced by modern lifestyles, economic considerations, and improved access to reproductive health services

12 Summary

This report presents the findings and insights from an internship conducted at the **Directorate of Economics and Statistics, Government of Kerala**, during the period **April 2025**. The internship focused on the statistical analysis of vital events in Kerala from **2019 to 2023**, with an emphasis on **birth and death registration data**, their trends, and policy oriented applications. The study began with the collection and organisation of year-wise and district-wise birth registration data, with separate analyses for male and female births. This helped uncover **temporal and regional variations**, and trends in **sex ratio at birth**, an important demographic indicator. The sex ratio patterns were assessed to understand any imbalances and changes over time across different districts.

A major component of the internship involved the **forecasting of vital statistics**. Using **ARIMA models**, time series forecasting was applied to predict future birth and death registrations. This was particularly useful in assessing long-term demographic trends and potential implications for planning public services.

Another key area explored was the **analysis of delayed registrations**. Delays in registering births and deaths were studied to identify patterns, potential causes, and the effectiveness of the registration system. This aspect is critical for improving the accuracy and timeliness of vital statistics.

In addition, the report includes a **computation and visualisation of Age-Specific Fertility Rates (ASFR)** in Kerala, offering insights into reproductive behaviour and fertility patterns among women of different age groups. This analysis is essential for understanding demographic changes and planning maternal and child health services.

The internship also extended to the use of demographic data for **school enrolment forecasting**. By linking birth data trends to future educational demand, the study highlights how statistical data can directly support **evidence-based planning** in the education sector.

Throughout the internship, **R programming** was extensively used for data processing, visualisation, and modelling. The skills gained include data cleaning, exploratory data analysis, statistical modelling, and interpretation of real-world datasets in the context of public administration.

13 References

- **Directorate of Economics and Statistics, Government of Kerala.** (2019–2023). Vital Statistics Reports (Birth and Death Registration Data). Thiruvananthapuram: Government of Kerala.
- **Office of the Registrar General & Census Commissioner, India.** (Various Years). Sample Registration System (SRS) Reports. Ministry of Home Affairs, Government of India. Retrieved from <https://censusindia.gov.in>
- Chatfield, C. (2004). The Analysis of Time Series: An Introduction (6th ed.). CRC Press.
- Hyndman, R. J., & Athanasopoulos, G. (2018). Forecasting: Principles and Practice (2nd ed.). OTexts. Retrieved from <https://otexts.com/fpp2/>
- **UN Department of Economic and Social Affairs, Population Division.** (2022). World Fertility Patterns. United Nations. Retrieved from <https://www.un.org/development/desa/pd/>
- **R Core Team.** (2023). R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing. Retrieved from <https://www.r-project.org/>