Visualisation of Singapore's Fertility Rate and Analysis

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1 INTRODUCTION

The declining birth rate in Singapore is an issue of critical concern with profound implications for the nation's future. Singapore's total fertility rate, which measures the average number of children born to a woman over her lifetime, has consistently fallen below the replacement rate of 2.1 (OECD, n.d.) [6]. In 2023, the total fertility rate reached a "historic low of 0.97", far from what is needed to sustain the population (Ganesan,2024) [5]. This trend is alarming as a persistently low birth rate, coupled with an aging population, will likely strain Singapore's economy, healthcare, and social services, potentially slowing down economic growth and diminishing the workforce. Therefore, we aim to achieve 3 objectives:

(1) Evaluate the different factors that contribute to Singapore's birth rate.
(2) Compare Singapore with other countries to find potential solutions.
(3) Evaluate past government policies on birth rate. After which, we will come up with a dashboard.

Our Story Dashboard serves as a one-stop platform for these insights, presenting a clear and accessible analysis of the key factors the government can address to support Singapore's goal of raising birth rates. The dashboard goes beyond merely presenting data; it also challenges existing policies, prompting policymakers to reassess and refine their approach. By comparing Singapore with neighbouring and similarly developed countries, the dashboard provides valuable insights into successful strategies that Singapore could consider implementing. This combination of local analysis and global comparison will offer a holistic view to inform future policy decisions aimed at reversing the declining birth rate trend.

2 MOTIVATION

The rapidly ageing population in Singapore is set to place unprecedented pressure on the nation's healthcare, economic, and social systems. Currently, 1 in 5 Singaporeans are 65 years or older, but this proportion is expected to increase to 1 in 4 by 2030 (Chin, 2022) [3]. As life expectancy rises and birth rates continue to decline, the balance between working-age adults and the elderly will shift dramatically, creating a heavier dependency ratio. This shift not only places financial strain on the workforce to support an ageing population but also intensifies the demand for healthcare services. For example, with a growing elderly population, healthcare expenditures are projected to increase significantly as more resources are needed to manage age-related health conditions, such as chronic illnesses, disabilities, and long-term care requirements. "Some studies have found that population ageing is associated with an increase in healthcare spending, with approximately 20% of healthcare spending growth predicted to be attributed to ageing by 2025" (NIH,2023) [2]. As such, "Singapore's National Health Expenditure could increase from $22 billion in 2018 to $59 billion in 2030 as our population ages" (MOH,2022) [4]. Beyond healthcare, the societal impact of an aging population encompasses potential labor shortages and reduced productivity. With fewer working-age adults relative to retirees, Singapore's labor force may shrink, potentially leading to slower economic growth, increased tax burdens on younger generations, and a possible reevaluation of retirement age policies. Furthermore, the need for increased eldercare services and infrastructure, including nursing homes, specialized housing, and elderly-friendly public spaces, will demand additional government resources and careful planning. By understanding these root causes, we aim to suggest targeted strategies that could help strengthen our local workforce and reduce some of this growing pressure on our systems.

3 RELATED WORKS

When examining Singapore's declining birth rate, we decided to focus on the population below 35 years old, a demographic with the highest likelihood of having children and thus pivotal to reversing current trends. This age group, encompassing young adults and early-career professionals, represents the core of the childbearing population. "A woman in her early to mid-20s has a 25–30% chance of getting pregnant every month. Fertility generally starts to slowly decline when a woman is in her early 30s, and after the age of 35 the decline speeds up. By age 40, the chance of getting pregnant in any monthly cycle is around 5%" (Betterhealth, n.d.) [1]. Aside from biological factors, other factors such as high living costs, career pressures, and work-life balance concerns also play a part. According to a study done by the National Youth Council (NYC) and the Institute of Policy Studies (IPS) Social Lab, "young people prioritise their careers and financial security over goals like getting married" [7]. This emphasis on career and financial stability among young adults significantly impacts their readiness to start families, often leading to delayed marriage and family planning. In light of these findings, it becomes clear that addressing Singapore's declining birth rate requires a comprehensive approach that goes beyond biological factors.

4 DATASETS

4.1 Dynamic Datasets

Dynamic datasets are utilised in two of our dashboards: the Social and Cultural dashboard, and the Health and Psychological dashboard. By leveraging API endpoints provided by the Department of Statistics Singapore, our visual analytics platform delivers real-time insights into fertility and demographic trends. These dynamic datasets enable continuous tracking, equipping policymakers with timely information to support immediate actions aimed at improving Singapore's birth rate.

- **Birth and Fertility Rate Annual**
  This dataset tracks birth and fertility rates annually, enabling us to observe both fluctuations and long-term trends. It also includes data on birth and fertility rates by race and the number of births per 1,000 females across different age groups.

- **Median Age of Mothers at First Birth**
  This dataset tracks the median age of resident and citizen mothers at first birth, as well as the median age of mothers for all resident and citizen births.

- **Resident Ever-Married Females Aged 15 Years and Older**
  This dataset tracks the number of children born to residents and citizens, categorized by different age groups. This breakdown enables us to analyze the number of babies born to citizens and residents across various age groups.

- **Average Number Of Children Born To Resident Ever-Married Females Aged 40-49 Years By Highest Qualification Attained**
  This dataset tracks the number of children born to residents that are married, from age 40-49 by the highest qualification attained. This provides us insights into how women of different qualifications view giving birth over time.

4.2 Static Datasets

These static datasets were sourced from various websites, with some data created and consolidated by our team after gathering relevant information online. To explore potential strategies for improving Singapore's birth rate, we compared data from two other developed countries: the United Kingdom, which has a higher birth rate than Singapore, and Japan, which is also facing a rapidly declining birthrate similar to Singapore. The UK datasets are obtained from the Office for National Statistics (ONS), providing valuable comparisons to policies and factors that may contribute to higher fertility rates. The Japan datasets are obtained from the Statistics Bureau, Ministry of Internal Affairs and Communications.

- **Median Household Income, Consumer Price Index, Unemployment**
  This dataset consists of 3 smaller datasets which are joined together by the years, allowing us to plot out how the different factors affect one another and also, provides insight into why it might affect the birth rate.

- **Mental Health Survey**
  This dataset provides data on mental health across both sexes and various age groups, showing the proportion of individuals with poor mental health. It enables us to examine the percentage of females with poor mental health in specific age ranges, offering insights into potential factors affecting birth rates.

- **World Fertility Rate**
  This dataset consists of the fertility rate of countries all over the world, which is used in our comparison to other countries view where it is displayed as a tooltip over the map.

- **Average Work Hours in Singapore, UK and Japan**
  This dataset consists of the average working hours in the 3 countries over the years, which can provide us insight as to why birth rates are declining.

- **Average Expenses of Raising a Child in Singapore, UK and Japan**
  This dataset consists of the average expenses required to raise a child in the 3 countries at different stages in their lives. This provides us with insight as to which country is cheaper and we can relate it to the birth rates.

- **Number of PRs and SCs Granted in Singapore**
  This dataset shows the number of PRs and SCs granted in Singapore over the years, categorized by age group. It provides insights into the distribution of PRs and SCs by age, enabling us to make informed recommendations.

- **Baby Bonus Institutions and Payout**
  This dataset consists of the locations of the baby bonus institutions in Singapore and the different payout amounts based on how many childrens are birthed. This allows us to provide recommendations as to where the Government can approve more of such institutions for the ease of parents.

4.3 JSON Object Dataset

- **JSON Object Dataset**
  This dataset contains data on the costs of raising a child to adulthood across specific age ranges. The data was compiled into an Excel sheet, converted into a JSON object, and uploaded to GitHub along with the code to create a hyperbolic tree diagram

5 TOOLS AND RESOURCES

5.1 Code

- **JSON (Javascript Object Notation)**
  Used for storing data from the SingStat API, and also for the hyperbolic tree diagram which provides dynamic datasets in JSON format.

- **API Endpoint**
  Requests library handles HTTP requests to API URLs.

- **Singstat API**
  Provides datasets with end-points where JSON data can be retrieved via GET requests.

- **Javascript**
  For the creation of the hyperbolic tree diagram

- **Github**
  Used for storing data related to the hyperbolic tree diagram to link it to Tableau Dashboard.

5.2 Tableau

- **Tableau**
  Tableau is ideal for visualizing data with a wide variety of graphs and maps. It combines powerful features with an intuitive interface, making it effective for quickly turning data into insights.

- **Web Data Connector**
  A tool to connect API endpoints to Tableau, enabling real-time data synchronisation. This helps keep the data up-to-date as it's updated at the source, streamlining data retrieval and visualization.

- **Tableau Public**
  Used to upload our completed dashboards and story online for the dissemination of our Google Forms

5.3 User Testing

- **Google Forms**
  Used to create User Feedback forms for areas of improvement and changes.

6 TASKS

6.1 Project Planning and Development Process

In our initial meeting, we discussed Singapore's declining birth rate and explored possible directions for our analysis. During our next meeting, each team member presented the datasets they had prepared, and we brainstormed how to integrate these sheets into a cohesive dashboard. This collaboration led to the creation of our first dashboard, the Social and Cultural Dashboard, where we refined insights and made adjustments. Building on this, we decided to develop four additional dashboards: Economic, Health and Psychological, Comparison with Other Countries, and Existing Policy and Simulation, to provide a comprehensive analysis.

6.2 Data Integration and Tableau Public

After completing our individual dashboards, we collaborated to integrate them and uploaded the final version to Tableau Public : How to Improve Singapore Fertility Rate.

6.3 User Testing and Form Creation

We created a Google Forms feedback form to gather user feedback on our dashboard. The form primarily used a 5-point Likert scale for users to rate various aspects, along with an open-ended section for additional comments. After collecting 20 responses, we analyzed the feedback, made adjustments to the dashboard, and developed a **User Guide** for easier navigation. Users can access the **User Guide** to better understand how to use filters and the purpose of each dashboard.

7 METHODOLOGY

7.1 Data Processing

- **Dynamic Data**
  We utilised data from the Singapore Department of Statistics (SingStat) by accessing their API endpoints to retrieve data in JSON format. Following the guidelines in the SingStat API documentation, we identified the corresponding resourceID for each dataset and sent API requests to extract the data, as illustrated in Figure 1. To seamlessly integrate these JSON datasets into Tableau, we used a free and authorised Web Data Connector developed by a member of the Tableau community, which enabled us to import and work with the data directly in Tableau.

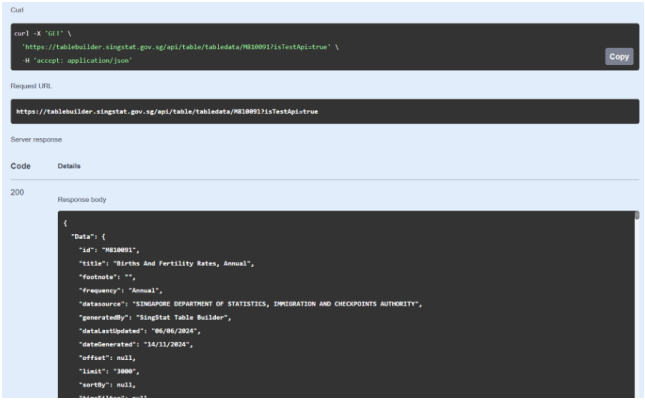

Figure 1: Example of Data Table in JSON Format – Annual Fertility Rate (Resource ID: M810091)

- **Static Data**
  Data was imported from Excel files obtained from various sources, including global data for cross-country comparisons of policies and factors that contribute to changes in birth rates. Additionally, to provide a comprehensive view of the different factors affecting Singapore's birth rate, we gathered scattered datasets, such as CPI, median household income, and unemployment rates. To simplify the analysis process, I manually created a consolidated Excel sheet, combining these datasets into a single sheet. This approach streamlines the data integration in Tableau and reduces unnecessary data loading, making the analysis more efficient.

- **Hierarchical JSON Object**
  Data was collected and organised into an Excel file for storage and then transformed into a hierarchical JSON object. This JSON object represents the total cost breakdown associated with raising a child across various life stages. Each

stage (e.g., "Pregnancy-related," "1st Year," "1 to 6 Years") contains child nodes with specific items and associated costs, structured in a parent-child format, as illustrated in Figure 2.

```
const data = {
    "name": "Total Cost",
    "children": [
        {
            "name": "Pregnancy-related",
            "children": [
                { "name": "Delivery", "price": 10000.0 },
                { "name": "Pre-pregnancy Checkup", "price": 820.0 },
                { "name": "Doctor's consultation", "price": 1062.0 },
                { "name": "Pre-natal Packages", "price": 600.0 },
                { "name": "Pregnancy-related Costs", "price": 15000.0 },
                { "name": "Confinement Nanny", "price": 3350.0 }
            ]
        },
        {
            "name": "1st Year",
            "children": [
                { "name": "Diapers", "price": 780.0 },
                { "name": "Formula Milk", "price": 900.0 },
                { "name": "Baby Gear", "price": 1806.5 },
                { "name": "Cleaning Products", "price": 607.0 },
                { "name": "Clothing and Toys", "price": 750.0 },
                { "name": "Vaccination", "price": 1133.6 },
                { "name": "Micellaneous", "price": 500.0 }
            ]
        },
        {
            "name": "1 to 6 Years",
            "children": [
                { "name": "Infant Care/Nanny", "price": 10500.0 },
                { "name": "Childcare (from month 19)", "price": 105600.0 },
                { "name": "Food and Nutrition", "price": 21600.0 },
                { "name": "Regular Checkups", "price": 4500.0 },
                { "name": "Enrichment Classes (Optional)", "price": 6000.0 },
                { "name": "Micellaneous", "price": 7500.0 }
            ]
        },
        {
            "name": "7 to 18 Years",
            "children": [
                { "name": "School Essentials", "price": 12000.0 },
                { "name": "Pocket Money", "price": 25200.0 },
                { "name": "Personal Learning Device", "price": 1250.0 },
                { "name": "Tuition and Enrichment Classes", "price": 46800.0 },
                { "name": "Family Travel and Leisure", "price": 15000.0 }
            ]
        },
        {
            "name": "Tertiary Education",
            "children": [
                { "name": "Tiertiary Education", "price": 86000.0 },
                { "name": "Tuition Fees", "price": 40400.0 },
                { "name": "Living Expenses", "price": 45600.0 }
            ]
        }
    ]
};
```

Figure 2: Baby-Related Cost Data in JSON Format

7.2 Challenges

We initially aimed to find a comprehensive dataset covering most of the factors influencing birth rates. However, since the factors affecting birth rates are multifaceted, we needed to source various datasets to support each section of our dashboard. For example, in the economic view, we made an extra effort to consolidate data from multiple sources, including CPI, median household income, and unemployment rates, into a single Excel sheet. This sheet is then linked with our average housing price data using the year as a common key, allowing us to create a cohesive economic dashboard that illustrates the factors influencing Singapore's birth rate.

Secondly, we intended to analyse the relationship between baby bonus increments and the percentage change in the Consumer Price Index (CPI), hypothesising that baby bonus increases may be too small relative to rising costs, potentially contributing to declining birth rates. However, due to limited historical data on baby bonus adjustments, the analysis remained inconclusive. As an alternative, we developed a D3 hyperbolic tree diagram to visualise the costs of raising a child across different life stages. By comparing these costs with the current year's baby bonus, we aim to assess the bonus's effectiveness in offsetting the financial burden of parenthood in Singapore.

8 VISUAL ANALYSIS

8.1 Social and Cultural Analysis

Singapore's annual fertility rate has been declining rapidly and is projected to drop further to 0.806 by 2034, according to forecast indicators. Notably, some temporary increases are observed in years of the Dragon in the Chinese Zodiac, as shown in Figure 3.

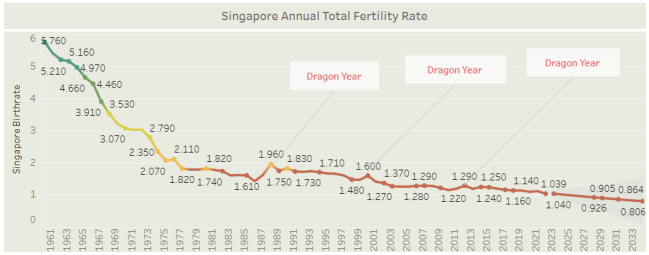

Figure 3: Singapore Annual Total Fertility Rate

When examining birth rates by ethnicity, we observe that the Malay community had a higher birth rate of 1.65 in 2023, significantly above that of the Indian and Chinese communities, which had rates of 0.95 and 0.86, respectively. Birth rates across all ethnic groups have gradually declined, with the Indian community experiencing the steepest drop between 1960 and 1977. The Chinese community has consistently shown the lowest birth rate over the years (see Figure 4).

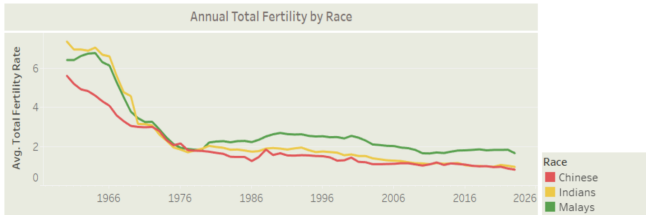

Figure 4: Annual Total Fertility by Race

Additionally, the Female Age Distribution histogram of our Social and Cultural dashboard shows that the 25-29 age group historically had the highest birth frequency, peaking at 136.3 births per 1,000 females. However, by filtering for recent years (2017, 2019, and 2021), we observe a shift, with the 30-34 age group becoming more dominant, indicating a growing preference among young women to have children at a slightly older age.

The horizontal bar chart of educational qualifications among women aged 40-49 shows a clear trend: the higher the educational level, the fewer children are born to these mothers. Interestingly, among mothers with university degrees, the average number of children declined from 1.7 in 2018 to 1.59 in 2022, before unexpectedly rising to 1.64 in 2023, as illustrated in Figure 5. This recent increase in 2023 presents an opportunity for the government to investigate the underlying factors, which could potentially be leveraged to encourage higher birth rates among highly educated women if deemed effective.

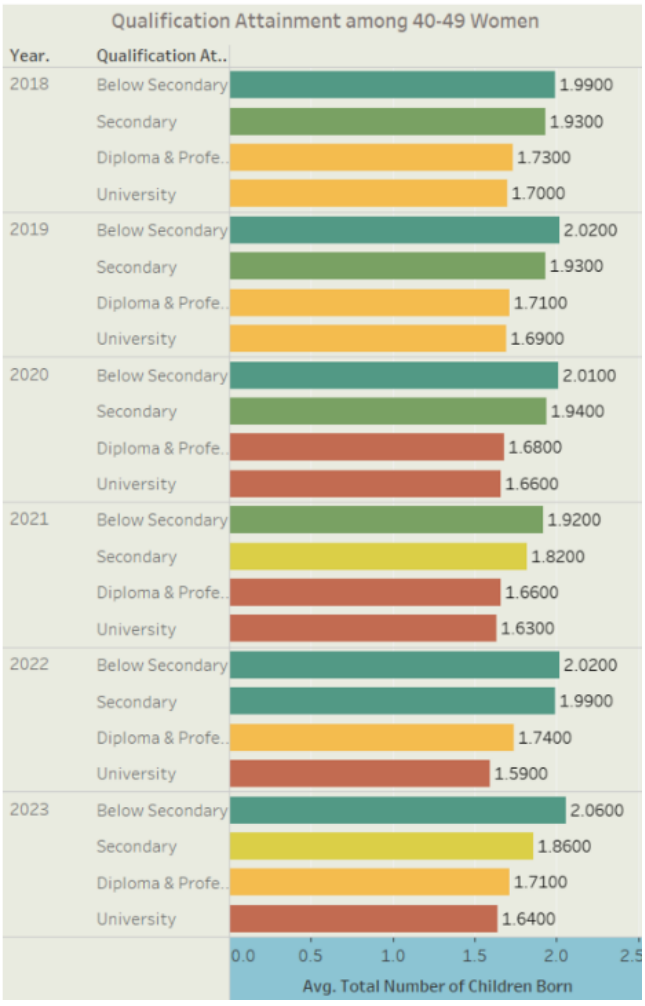

Figure 5: Vertical Bar Chart of Qualification Attainment among 40-49 women

8.2 Economic Analysis

In most years, the percentage increase in the Consumer Price Index (CPI) has been slower than the percentage increase in Household Median Income. However, in 2022, this trend reversed, as shown in Figure 6, with the CPI rising by 6.121% compared to a smaller 4.81% increase in Household Median Income. This discrepancy suggests that when the cost of living (as indicated by the CPI) rises faster than household income, financial strain increases, which can discourage family planning and reduce birth rates. This relationship is evident in the decline in birth rate from 1.120 in 2021 to 1.040 in 2022, as seen in Figure 3.

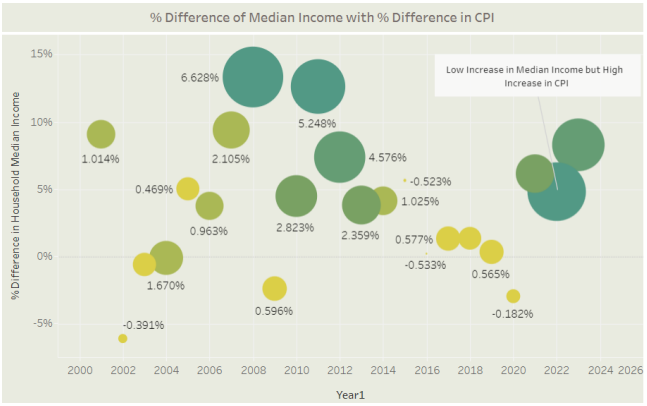

Figure 6: % Difference in Household Median Income with % Difference in CPI

By using the filter feature to select only the data points for 2006 and 2007, we observe a significant decline in the unemployment rate across all age groups, particularly among the 15-24 and 25-29 age groups. During this period, the percentage increase in Household Median Income was also notably higher than the increase in CPI, indicating improved purchasing power. These factors suggest a possible correlation between lower unemployment rates and higher fertility rates, especially among younger adults. This period of economic stability corresponds with a modest increase in the birth rate, from 1.280 in 2006 to 1.290 in 2007.

For the last sheet in this dashboard, the analysis indicates that housing prices in the Central Area (yellow) and Bukit Timah (mustard yellow) remain consistently high (Figure 7a), limiting affordable options for young families. This financial barrier can delay family planning, as couples may feel compelled to wait for more stable, affordable housing. Additionally, significant price volatility in Pasir Ris for 2- and 3-room flats (Figure 7b) introduces further uncertainty for those looking at more budget-friendly areas. Together, these housing challenges create financial hesitation around homeownership and family expansion, contributing to Singapore's declining birth rate as families defer starting a family.

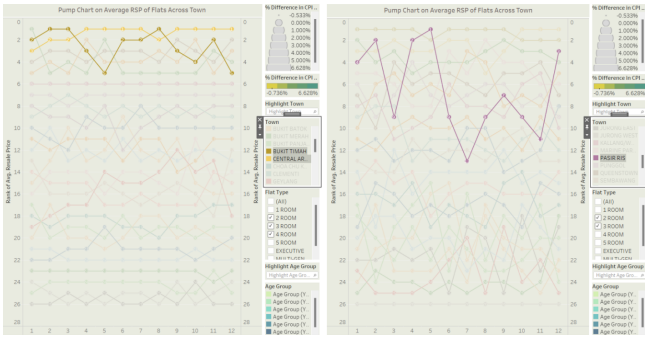

Figure 7: Ranking of Average RSP of Flats Across Town

8.3 Health and Psychological Analysis

The median age of mothers has shown an upward trend over the years, now exceeding 30. To explore the ideal age for having a first child, we referred to an article from Parents (2024) [8], which identifies 25 to 32 as the optimal age range based on health and lifestyle factors. The article highlights that fertility begins to decline at 32, with a sharper drop after 37, emphasising the need for caution when conceiving later. Using this information, we set the ideal maximum age at 32.

Tableau allows us to forecast that the median age of mothers will surpass this ideal range after 2028 as shown in Figure 8. This trend poses significant health risks for women, including increased pregnancy complications, and may lead to lower fertility rates as age impacts the likelihood of having more children. To address these concerns, the government should encourage earlier childbirth to promote maternal health and support the nation's fertility rate. This analysis underscores the relationship between maternal age, individual health, and broader societal implications.

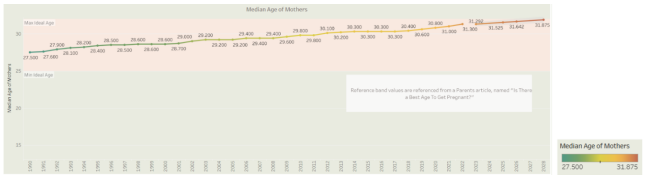

Figure 8: Median Age of Mothers

In Figure 9, we can see that in the age group 25 to 29, most females have no children and in the age group 30 to 34, 34631 females have no children. In both age groups, there is a high concentration of females without children, which is a concern as this plays a huge role in the low fertility rate in Singapore. It is also a concern to the health of these females if they do wish to have children at a later age as there would be greater harm to the body for late pregnancies.

This analysis also provides insights for the government to target efforts to boost fertility rates. For ages 25 to 29, strategies should focus on encouraging childbirth to reduce the proportion of females with no children and promote having at least one child. In the 30 to 34 age group, the goal is to reduce the number of females with zero or one child and increase those with two children. Shifting these trends can significantly improve Singapore's fertility rate by encouraging childbirth during prime reproductive years.

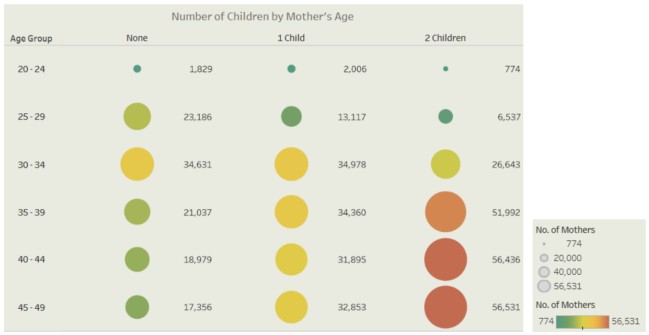

Figure 9: Number of Children by Age of Mothers

The data comes from the 2023 National Population Health Survey, which provided percentages of each age group. Using the total survey participants, we calculated the actual numbers for each age group to create a donut chart. The largest group, 60 to 74 years old, accounts for 31.4% of participants as illustrated in Figure 10. For the pie charts on mental health by gender, tooltips display the number of males and females with poor mental health in each age group.

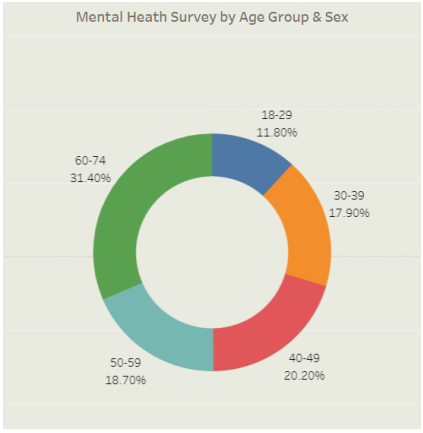

Figure 10: Mental Health Survey by Age

The age groups with the highest reported poor mental health are 18 to 29 and 30 to 39, with 234 and 235 cases, respectively. Figure 11 shows that among 18 to 29-year-old, 31.7% of females and 20.4% of males reported poor mental health — the highest proportions across all age groups. In the 30 to 39 age group, 20.2% of females and 14% of males reported poor mental health. Overall, females tend to have poorer mental health than males across all age groups.

Mental health significantly impacts life decisions such as starting a family, career stability, and financial planning, making it a crucial

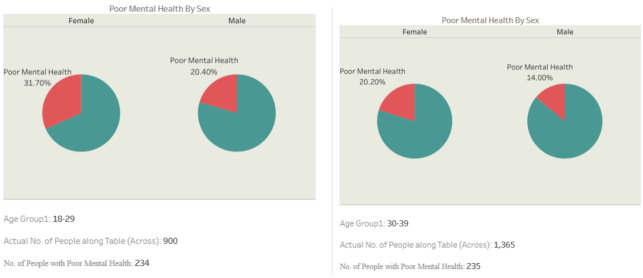

Figure 11: Poor mental health by Sex

factor that we need to consider to promote higher fertility rates in Singapore. These insights can help the government understand the importance and prevalence of mental health issues in key age groups. Addressing poor mental health could play a vital role in improving fertility rates by enhancing overall well-being.

8.4 Comparison with other countries

In our analysis, we will be focusing on Japan and the UK in comparison with Singapore since these two countries are also developed countries yet all have low fertility rates as seen from their respective map colors falling in the green range (Figure 12).

Figure 12: Map of Fertility Rate in Different Countries

We examined the relationship between the average working hours per week and the fertility rate for the three countries. Figure 13 shows that the declining work hours have generally not led to a sustained increase in fertility rates. This indicates that work hours alone have little impact, with other factors also influencing fertility.

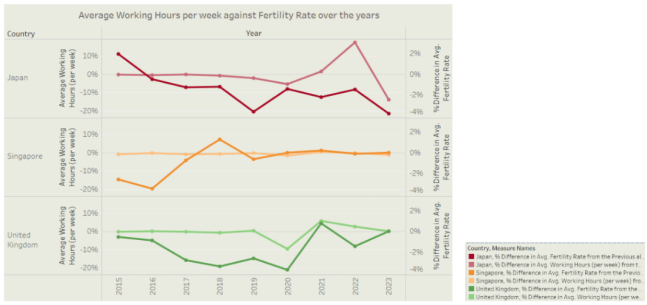

Figure 13: Average Working Hours against Fertility Rate

We then delved into comparing the UK and Singapore. Despite a declining trend, the UK's fertility rate of 1.560 in 2023 remains significantly higher than Singapore's fertility rate of 0.943 in 2023. A closer look at maternity and paternity leave policies revealed that UK mothers receive 39 weeks of maternity leave, while in Singapore, maternity leave is 16 weeks (Figure 14). This indicates that UK mothers have more time for early childcare, which may provide greater stability for new parents, thereby making it easier to consider having children.

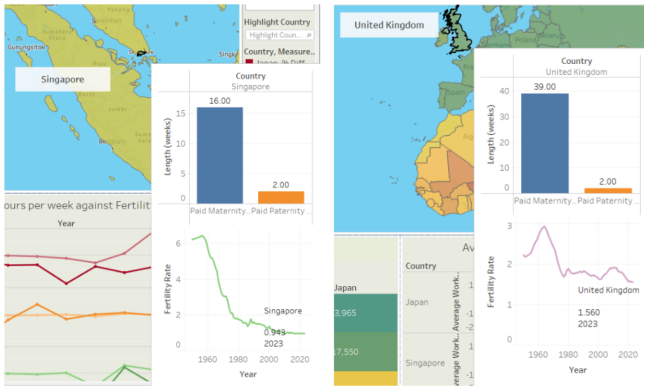

Figure 14: Parental Leaves and Fertility Rate Comparison between Singapore and UK

Furthermore, the average cost of raising a child in the UK is estimated at USD $288,000, which is higher than Singapore's estimated USD $191,588. However, the UK sustains a higher fertility rate, likely due to supportive family policies that help offset these costs, emphasizing the importance of enhancing family support in Singapore (refer to Figure 15). Additionally, the initial cost of childbirth in Singapore is significantly higher, at around USD $12,021 compared to the UK's USD $5,252, which could add financial strain during early family planning. Introducing stronger child-raising support and addressing these initial costs could encourage family growth in Singapore, aligning its policies more closely with those of countries like the UK to promote a higher fertility rate.

In our comparison of Japan and Singapore as shown in Figure 16, we found that although Japan still has a higher fertility rate of 1.208 than Singapore's 0.9443 in 2023, it has been declining faster than Singapore's in recent years. From 2015 to 2023, Japan's fertility rate decreased by 14.6% while Singapore's fertility rate decreased by 3.48%. When taking a look at maternity and paternity leave policies, we see that Singapore currently offers 16 weeks of maternity leave, slightly more than Japan's 14 weeks. This suggests that Japan's shorter maternity leave may be a factor in contributing to its faster fertility decline due to lesser parental support being given. This further highlights the potential role of more robust parental leave policies that may aid in increasing fertility rates.

Stages	Singapore	United Kingdom
Pregnancy & ChildBirth	12,021	5,252
Infant & Toddler	71,804	91,644
Primary School	51,406	81,811
Secondary School	37,700	35,658
Pre-University	18,657	73,636

Figure 15: Cost of having Children in Singapore and UK at Different Life Stages

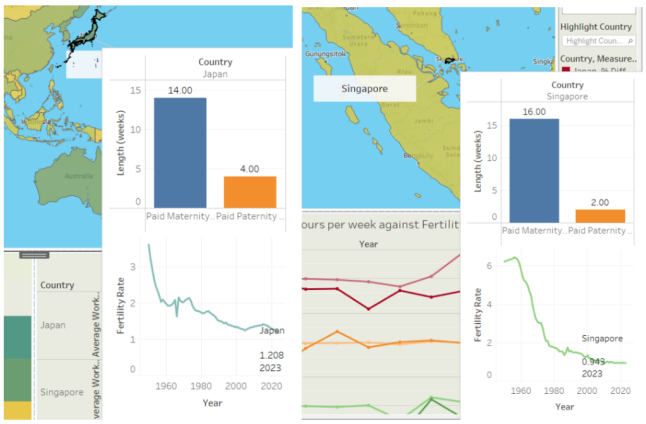

Figure 16: Parental Leaves and Fertility Rate Comparison between Singapore and Japan

8.5 Singapore's Existing Policies

In this analysis, we examine Singapore's existing policies. Figure 17 displays a map showing the distribution of institutions where parents can claim their baby bonus. Notably, the North and East regions have the highest number of baby bonus institutions, while the South has the fewest. This disparity may suggest that families in the South face greater inconvenience or longer travel distances to access these institutions compared to other regions.

Taking a closer look at Figure 18 on Singapore's baby bonus, currently it provides up to $11,000 for the first two children and $13,000 for third and subsequent children. However, an estimated price of around $155,700 is needed to raise a child from 1 to 6 years old. As such, the existing Baby Bonus only covers a small portion

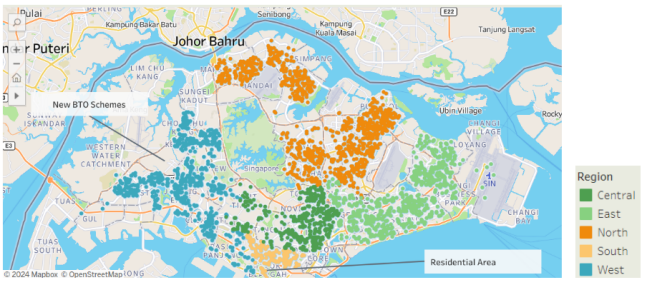

Figure 17: Map of Baby Bonus Institutions

of the expenses parents face, making it challenging for parents to manage the substantial financial responsibilities with raising children.

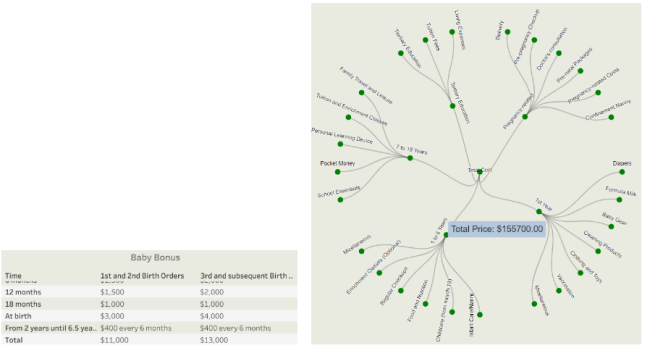

Figure 18: Baby Bonus Payouts VS Treemap of Cost for Raising a Child

Additionally, our analysis of Permanent Residencies (PRs) and Singapore Citizenships (SCs) granted over time reveals a distinct trend based on age. Between 2012 to 2023, the number of PRs granted to individuals under 30 generally declined from 20,565 to 18,591 while the SCs granted to this age group generally decreased from 11,485 to 11,196 as shown in Figure 19. However, the total PRs and SCs granted to people above 30 have generally increased over the years. This shift suggests a decreasing influx of younger residents who are statistically more likely to have children are not contributing to the fertility rate, resulting in the declining fertility rate.

9 CONCLUSIONS

Our analysis provides valuable insights into addressing Singapore's birth rate challenge from multiple perspectives. In this project, we examined economic, health, and social factors that contribute to low birth rates, assessed existing policies, and compared Singapore's approach with that of other countries for a broader perspective. By adopting successful strategies from other nations and remaining open to policy adaptation, Singapore can implement meaningful solutions to address its fertility challenges.

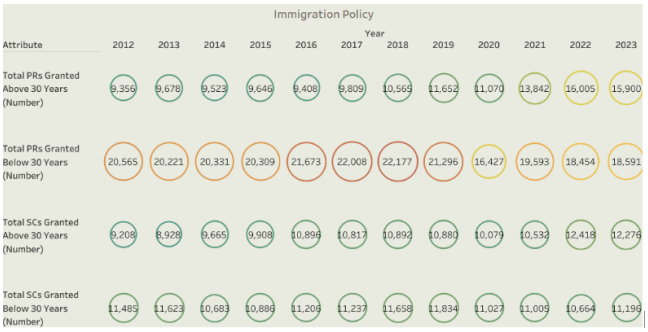

Figure 19: Bubble Chart on PRs and Citizens Granted

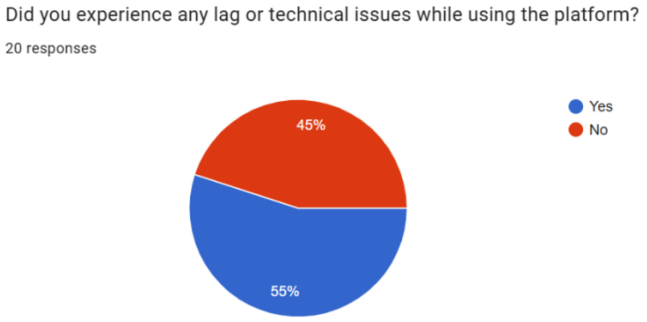

Figure 20: User Feedback Issues with the Dashboard

Critically evaluating current policies through simulations helps identify which measures are truly impactful and which may need reevaluation. Given the urgency of this issue, it is essential for the Singapore government to consider our visual analysis to address the alarming decline in birth rates, ensuring Singapore's continued presence on the world map for generations to come. In conclusion, our analysis serves as a foundation for understanding the root causes of Singapore's low fertility rate and provides actionable insights for the government to make meaningful changes to improve this pressing issue in our society.

9.1 Current Limitation and Future Works

Firstly, participants from survey expressed feeling lost when navigating our dashboards, as they lacked a specific goal. Initially, we provided only a brief instruction to view the dashboards in a set order, which led to some confusion and potentially missed out key insights. To address this, we developed a more detailed **User Guide** to help direct viewers through the intended flow and provide context for understanding our visualisations.

Another primary issue our viewers faced was significant lag when loading the dashboards on Tableau Public as shown in Figure 20, making navigation and interaction challenging. This lag is largely due to multiple data sources requiring extensive processing time. Given more time, we would centralise all data in a single SQL database, such as MySQL, to streamline data management and improve performance. A centralised SQL database would allow us to standardise storage, simplify updates, and reduce data complexity by pre-processing and aggregating data before Tableau pulls it, ultimately reducing loading times and enhancing user experience.

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