

# Vitality Unveiled

An interactive data visualisation on  
Gender Inequality

Canace CHEN

- *Table of Content:*
- *P1: Cover Page*
- *P2: Abstract*
- *P3: Research & Concept*
- *P4: Processing Data*
- *P5: Analyse Data*
- *P6: Data Visualisation (p5.js)*
- *P7: Data Visualisation (p5.js)*
- *P8: Final Result*
- *P9: Evaluation*
- *P10: References*

(Codex Anatomicus, no date)

# Abstract

“Vitality Unveiled” delves into the pervasive issue of gender inequality through a data visualization approach. Utilizing the comprehensive dataset of the World Data of Gender Inequality Index 2021, the project aims to shed light on various aspects of inequality between women and men across 195 countries. The dataset encompasses key indicators such as the Gender Inequality Index, maternal mortality ratio, adolescent birth rate, share of seats in parliament, population with secondary education, and Labor force participation.

The visualization is implemented using p5.js and comprises five scenes, each representing one of the aforementioned indicators. The central visual element is a symbolic representation of a uterus adorned with flowers, encapsulating the essence of femininity, beauty, and vitality. The colour of the uterus dynamically changes based on the underlying data, providing a visually compelling representation of gender disparities.

Analysis of the data reveals a correlation between higher levels of development and lower rates of maternal mortality and adolescent birth rates. Additionally, countries with greater development tend to exhibit a higher proportion of women occupying parliamentary seats and a more balanced gender ratio in secondary education attainment. However, a persistent global trend indicates that the percentage of women in the labour force lags behind that of men, albeit with more pronounced disparities in countries with mid-level human development.

The project also acknowledges the significance of feminism as a social movement advocating for gender equality. Recognizing the diverse roles women undertake, both paid and unpaid, including caregiving and maintaining a healthy home environment, the project seeks to foster a deeper understanding of the multifaceted contributions of women in society (Lorber, 2010).

Through its visual representation of gender inequality data, this project aims to raise awareness, inspire dialogue, and encourage actions towards a more equitable future for all genders.

# Research & Concept

## Research:

Feminism, a social movement advocating for gender equality, has historically sought to improve the social standing of women and marginalized men, recognizing their equal capabilities (Lorber, 2010).

Gender bias in healthcare distribution and societal norms surrounding motherhood have contributed to the needless deaths of women during pregnancy, particularly in Africa and regions like Afghanistan where access to safe delivery services is limited (Chirowa, et al., 2013).

The cultural belief that motherhood is a woman's primary role, coupled with limited educational and employment opportunities, creates an environment where adolescent pregnancy is accepted and, in some cases, desired (Braverman-Bronstein, et al., 2023).

Conversely, democratic institutions and access to education foster gender equality by providing opportunities for the development of an educated middle class. However, in countries with limited democracy, rulers may prioritize political entrenchment over the development of an educated population, leading to discrimination against girls and perpetuating gender inequality (Cooray and Potrafke, 2011).

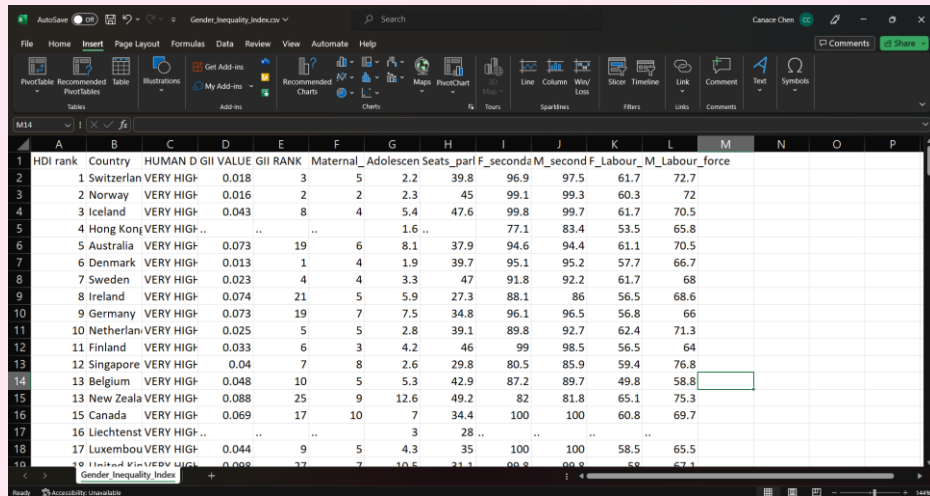
## Concept:

“Vitality Unveiled” focuses on data visualization to explore gender inequality using the WORLD DATA OF Gender Inequality Index 2021. The visualization, has five scenes visually represent five key indicators: maternal mortality, adolescent birth rate, share of seats in parliament, population with at least some secondary education, and the labour force. A symbolic representation of a uterus adorned with flowers is employed to convey the beauty and vitality of women, with its colour dynamically changing based on the data.

The analysis of the data reveals that countries with higher levels of development exhibit lower rates of maternal mortality and adolescent birth rates. Additionally, these countries tend to have a slightly higher representation of women in parliamentary seats, and a closer parity between female and male populations in terms of secondary education. However, a global trend persists where the percentage of women in the labour force is lower than that of men. Notably, countries with mid-level human development exhibit wider gender gaps in labour force participation.

This project emphasizes the urgency of addressing gender bias in healthcare, improving educational and work opportunities for women, and promoting democratic institutions to achieve global gender equality. By challenging societal norms, empowering women through education and equal rights, and advocating for inclusive policies, societies can strive towards a more equitable future for all.

# Processing Data



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	HDI rank	Country	HUMAN D GII VALUE	GII RANK	Maternal_Adolescen	Seats_parli	F_second	F_Labour	M_Labour	force						
2	1	Switzerland	VERY HIGH	0.018	3	5	2.2	39.8	96.9	97.5	61.7	72.7				
3	2	Norway	VERY HIGH	0.016	2	2	2.3	45	99.1	99.3	60.3	72				
4	3	Iceland	VERY HIGH	0.043	8	4	5.4	47.6	99.8	99.7	61.7	70.5				
5	4	Hong Kong	VERY HIGH	..	..	..	1.6	..	77.1	83.4	53.5	65.8				
6	5	Australia	VERY HIGH	0.073	19	6	8.1	37.9	94.6	94.4	61.1	70.5				
7	6	Denmark	VERY HIGH	0.013	1	4	1.9	39.7	95.1	95.2	57.7	66.7				
8	7	Sweden	VERY HIGH	0.023	4	4	3.3	47	91.8	92.2	61.7	68				
9	8	Ireland	VERY HIGH	0.074	21	5	5.9	27.3	88.1	86	56.5	68.6				
10	9	Germany	VERY HIGH	0.073	19	7	7.5	34.8	96.1	96.5	56.8	66				
11	10	Netherlands	VERY HIGH	0.025	5	5	2.8	39.1	89.8	92.7	62.4	71.3				
12	11	Finland	VERY HIGH	0.033	6	3	4.2	46	99	98.5	56.5	64				
13	12	Singapore	VERY HIGH	0.04	7	8	2.6	29.8	80.5	85.9	59.4	76.8				
14	13	Belgium	VERY HIGH	0.048	10	5	5.3	42.9	87.2	89.7	49.8	58.8				
15	15	New Zealand	VERY HIGH	0.088	25	9	12.6	49.2	82	81.8	65.1	75.3				
16	15	Canada	VERY HIGH	0.069	17	10	7	34.4	100	100	60.8	69.7				
17	16	Liechtenstein	VERY HIGH	..	..	..	3	28	..	..	..	..				
18	17	Luxembourg	VERY HIGH	0.044	9	5	4.3	35	100	100	58.5	65.5				
19	18	United Kingdom	VERY HIGH	0.098	27	7	10.5	21.1	89.8	89.8	58	67.1				

The data set was found on Kaggle. It is a csv file of the World Data of Gender Inequality Index 2021. The columns are: Gender Inequality Index:

A measure of inequality between women and men in reproductive health, empowerment, and the labour market.

Maternal mortality ratio:

Number of pregnancy-related deaths per 100,000 live births.

Adolescent birth rate:

Number of births to women aged 15–19 per 1,000 women aged 15–19.

Share of seats in parliament:

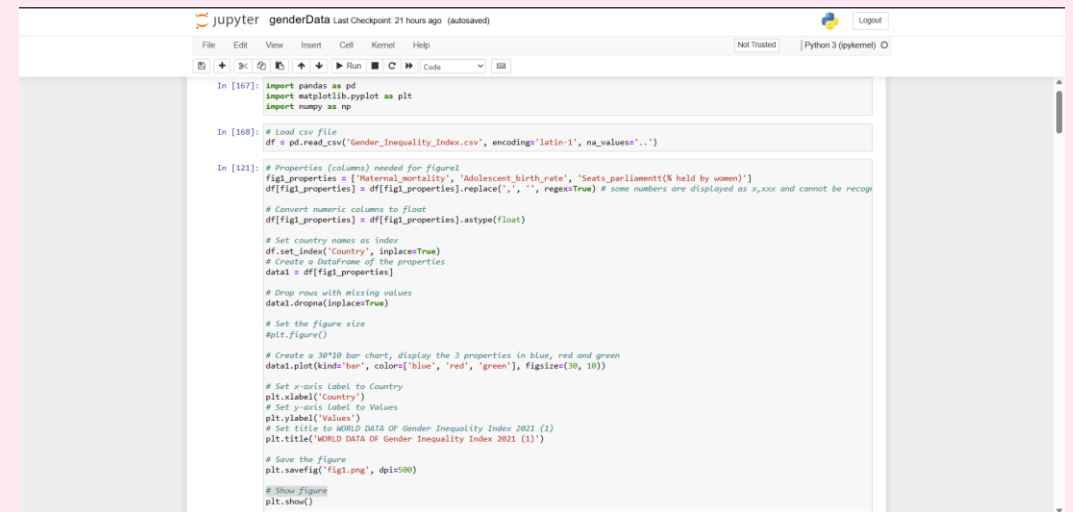
Percentage of seats in the national parliament held by women.

Population with at least some secondary education:

Percentage of the population aged 25 and older with at least a secondary level of education.

Labour force:

Percentage of the population who are employed or seeking employment. (Pandey, 2023)



```
In [167]: import pandas as pd
import matplotlib.pyplot as plt
import numpy as np

In [168]: # Load csv file
df = pd.read_csv('Gender_Inequality_Index.csv', encoding='latin-1', na_values='..')

In [121]: # Properties (columns) needed for figure1
fig1_properties = ['Maternal_mortality', 'Adolescent_birth_rate', 'Seats_parliament(% held by women)']
df[fig1_properties] = df[fig1_properties].replace('..', np.nan, regex=True) # some numbers are displayed as x,xxx and cannot be recog

# Convert numeric columns to float
df[fig1_properties] = df[fig1_properties].astype(float)

# Set country names as index
df.set_index('Country', inplace=True)
# Create a DataFrame of the properties
data1 = df[fig1_properties]

# Drop rows with missing values
data1.dropna(inplace=True)

# Set the figure size
plt.figure()

# Create a 30*10 bar chart, display the 3 properties in blue, red and green
data1.plot(kind='bar', color=['blue', 'red', 'green'], figsize=(30, 10))

# Set x-axis label to Country
plt.xlabel('Country')
# Set y-axis label to Values
plt.ylabel('Values')
# Set title to WORLD DATA OF Gender Inequality Index 2021 (1)
plt.title('WORLD DATA OF Gender Inequality Index 2021 (1)')

# Save the figure
plt.savefig('fig1.png', dpi=500)

# Show figure
plt.show()
```

The code begins by loading the CSV file using the `pd.read\_csv()` function. To handle missing data represented as `..` in the CSV, these values are specified as `na\_values` to be treated as missing values later on.

After loading the data, a list of desired properties (columns) for the chart is created. Since some numeric values contain commas (e.g., `1,150`), these commas and empty spaces are removed to convert the values to floating-point numbers. The 'Country' column is set as the index.

Next, a DataFrame named `data` is created by selecting the desired properties (columns) from the original DataFrame. Rows with missing values are dropped from `data` to ensure valid data for plotting.

The bar chart is created using `.plot()`, specifying the chart type as 'bar' and setting colors for each property. The x-axis of the chart is labelled as 'Country', and the y-axis represents the property names and their corresponding values.

Finally, the chart is displayed using `plt.show()`.



# Analyse Data

All figures:

<https://drive.google.com/drive/u/0/folders/1pIKuFPGRFuciiPrUwIJJQ2Luce8n3szCW>

Figure 1:

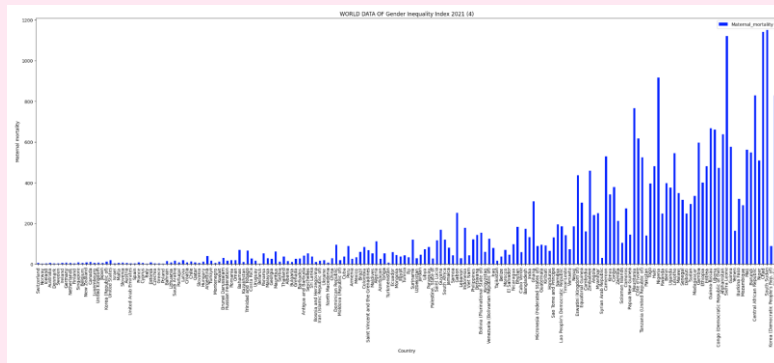


Figure 2:

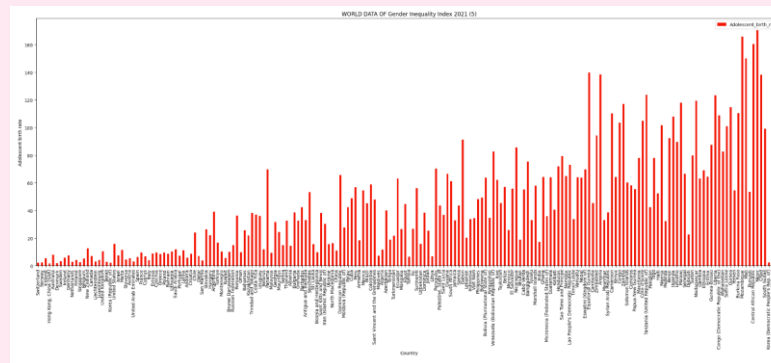
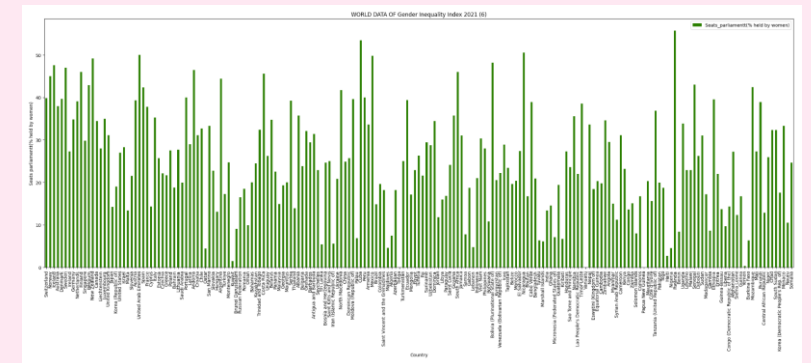


Figure 3:



This indicates a significant growth in pregnancy-related deaths as the human development level in the country decreases. This could be due to Socioeconomic Factors (eg: healthcare).

This indicates a significant growth in births to adolescent women as the human development level in the country decreases. This could be due to the lack of Sex Education.

This indicates a minor decline in women's share of seats in parliament as the human development level in the country decreases. This could be due to the Lack of Gender Quotas or Affirmative Action.

Figure 4:

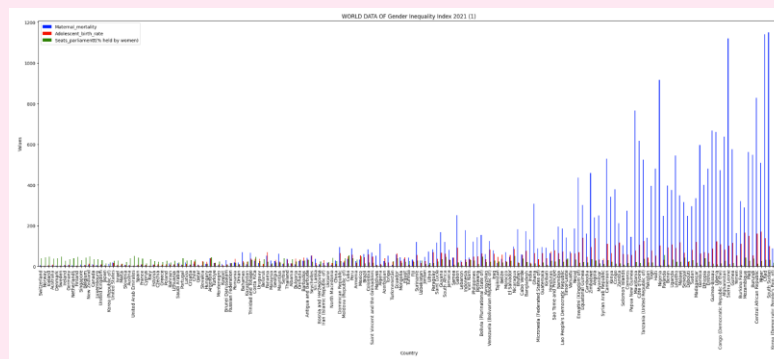


Figure 5:

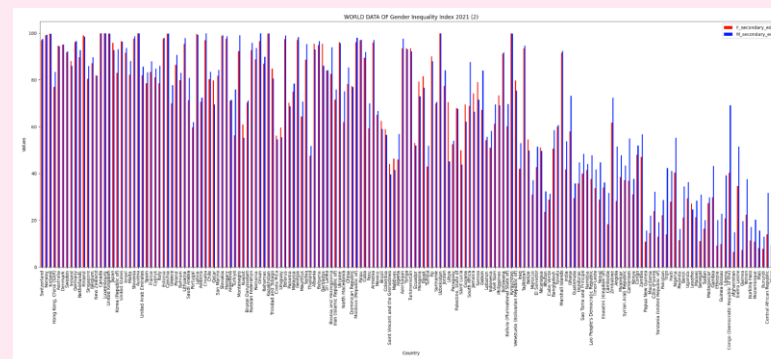
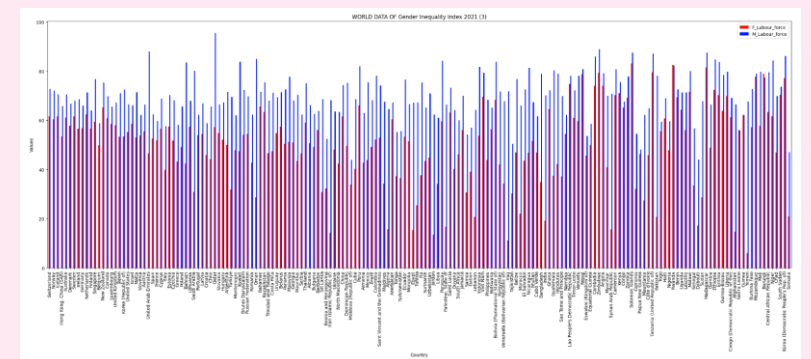


Figure 6:



This combines figure1-3 and shows when a country has a higher number of pregnancy-related deaths, it is also more likely to have a higher number of births to adolescent women and a lower number of seats in parliament held by women, or vice versa.

This demonstrates a substantial decline in percentage of the population with at least a secondary education, especially for women. Another notable trend is as the human development level in the country decreases, the gap between male and female gets larger. The reason could be limited access to Education and cultural and social norms.

The gap between female and male labour force reveals gender inequality in the labour force is present in almost every country, with a more significant issue in countries with mid-level human development. This can be attributed to varying levels of focus on gender equality and the economic necessity for widespread labour force participation in lower development countries.

# Data Visualisation (p5.js)

As there are 195 countries in the dataset, the bar charts generated have too many bars. Although they are still good for finding out the trend, it becomes difficult when the viewer tries to read data for individual country. Therefore, p5.js was used to further visualise the data to make it both easily readable and aesthetically appealing.

## Load and use data:

```
1 let data; // Array to store CSV data
7 function preload() {
8   // Load data
9   data = loadTable('Gender_Inequality_Index.csv', 'csv', 'header');
10 }
```

Declare a variable data to store CSV data. Then use loadTable() to load csv data to data.

## Country slider:

```
2 let slider; // Slider to change the displayed country
3 let currentCountryIndex = 0; // Index of the currently displayed country
47 // Create the slider
48 slider = createSlider(0, data.getRowCount() - 1,
49   currentCountryIndex);
50 slider.position((windowWidth-windowHeight)/2+15, height - 45);
51 slider.style('width', (height-50) + 'px');
52 // Add an event listener to update the displayed country when the
53 // slider value changes
54 slider.input(updateCountry);
55 // Call the initial visualization
56 updateCountry();
210 function updateCountry() {
211   // Get the index of the selected country from the slider value
212   currentCountryIndex = slider.value();
213   // Redraw the visualization
214   redraw();
215 }
216 }
```

Declare variable slider to hold the slider object and currentCountryIndex to hold the index of current country. Then create a slider of all countries. Create a function updateCountry(). After assigning currentCountryIndex to the slider value, redraw the canvas. Use .input() to update the displayed country according to slide value. Call updateCountry() to initialise the visualisation.

## Scene switch buttons:

```
4 let currentScene = 0; // Index of the current scene
15 // Create buttons for each scene
16 let button1 = createButton('Scene 1');
17 button1.position((windowWidth-windowHeight)/2+15, 20);
18 button1.style('color', 'rgb(250,121,222)');
19 button1.style('border-color', 'rgb(250,121,222)');
20 button1.mousePressed(() => changeScene(0));
21
59 function draw() {
60   // Draw different scenes based on the currentScene value
61   if (currentScene === 0) {
62     drawScene1();
63   } else if (currentScene === 1) {
64     drawScene2();
65   } else if (currentScene === 2) {
66     drawScene3();
67   } else if (currentScene === 3) {
68     drawScene4();
69   } else if (currentScene === 4) {
70     drawScene5();
71   }
72   // Reset tint to avoid affecting
73   noTint();
74 }
75
76 function changeScene(sceneIndex) {
77   currentScene = sceneIndex;
78 }
79 }
```

Declare variable currentScene to hold the index of current scene. Create a buttons for each scene and enable interaction (change sceneIndex) with .mousePressed(() => changeScene()). Create a function changeScene(sceneIndex) to assign sceneIndex to currentScene. In function draw(), use if else statements to check the value of currentScene and switch to the corresponding scene.

# Data Visualisation (p5.js)

## Scene 1-3:

```
81 function drawScene1() {
82   background(255);
83   // Get the country name and data
84   let country = data.get(currentCountryIndex, 'Country');
85   let mm = parseFloat(data.get(currentCountryIndex,
'Maternal_mortality')); //convert data to floating point numbers
86   // Map data mm from 0, 1150 to 0, 255 and set as opacity value
87   let opacity = map(mm, 0, 1150, 0, 255);
88   // Let textColor be black
89   let textColor = 0;
90
91   // Draw image
92   image(img, width*0.15, height*0.15, width*0.7, height*0.7);
93
94   // Mask canvas with back, opacity according to mm value
95   fill(0, 0, 0, opacity)
96   rect(0, 0, width, height)
97
98   // If canvas gets to dark, change textColor to white
99   if(opacity>=200){
100     textColor = 255;
101   }
102   fill(textColor);
103   textAlign(LEFT);
104   textSize(16);
105   // Country name
106   text(country, width/20, height-55);
107   textSize(16);
108   // Data
109   text('Maternal mortality: ' + mm, width-200, height-55);
110 }
```

Scene 1-3 are about Maternal mortality, Adolescent birth rate and Seats parliament(% held by women).

Get data from data with .get() and convert property data to floating point numbers by using parseFloat(). Map the number to 0, 255 and set it as the opacity. Set textColor to black. After drawing the image, a canvas-size square was drawn to mask the canvas. The opacity of square depends on the property value. When the canvas gets too dark, textColor will be set to white. The country name and data are displayed at the bottom. When move the slider, the opacity, country name and data will change accordingly.

## Scene 4-5:

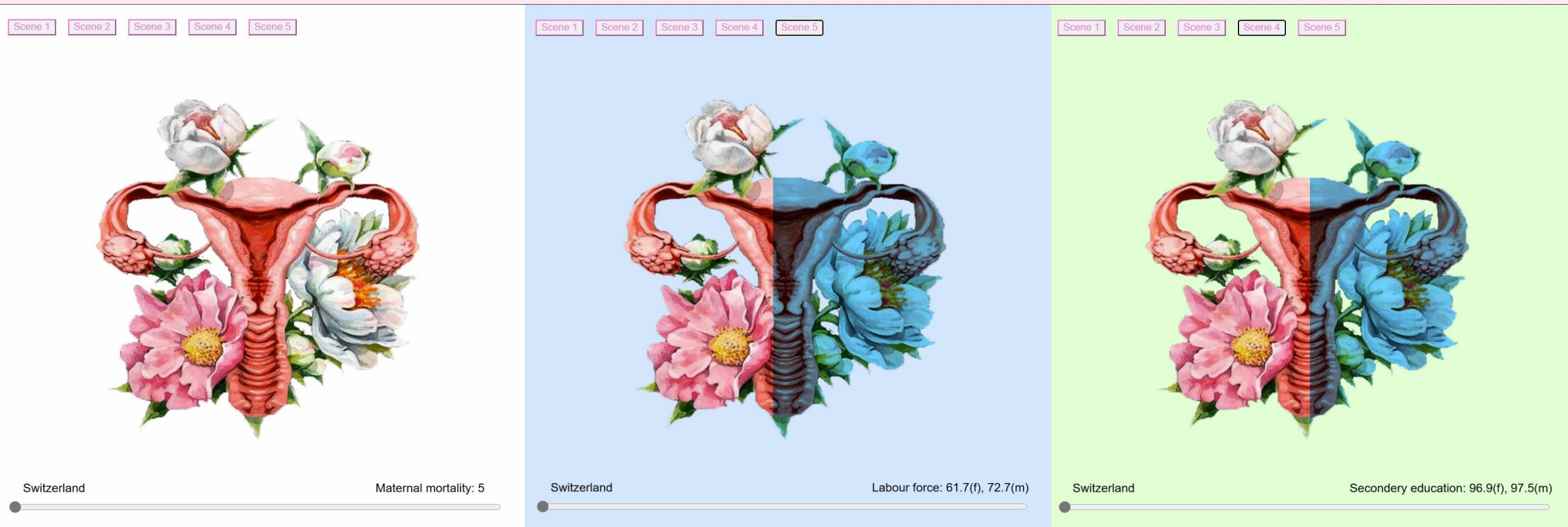
```
164 function drawScene4() {
165   background(222, 255, 214);
166   // Get the country name and data
167   let country = data.get(currentCountryIndex, 'Country');
168   let fse = parseFloat(data.get(currentCountryIndex,
'F_secondary_educ')); //convert data to floating point numbers
169   let mse = parseFloat(data.get(currentCountryIndex,
'M_secondary_educ')); //convert data to floating point numbers
170   // Calculate female male ratio
171   var rate = mse/(fse+mse)-0.5;
172   //console.log(rate);
173   let textColor = 0;
174
175   // Draw image
176   image(img, width*0.15, height*0.15, width*0.7, height*0.7);
177
178   // Set tint colour
179   tint(86, 210, 255);
180   image(img, width*(0.5-rate*0.7), height*0.15, width*0.7,
height*0.7, img.width*(0.5-rate), 0, img.width, img.height);
181
182   fill(textColor);
183   textAlign(LEFT);
184   textSize(16);
185   // Country name
186   text(country, width/20, height-55);
187   textSize(16);
188   // Data
189   text('Secondary education: ' + fse+ '(f), ' + mse + '(m)', width-
300, height-55);
190 }
```

Scene 4-5 are about percentages of female : male with secondary education and percentages of female : male in labour force.

After getting data and converting property data to floating point numbers, calculate the ratio between female and male data. Set textColor to black. After drawing the image, add a tinted image on the right half of the canvas. The tinted (blue) image represents male ratio. The areas of image in original colour and in tinted colour shows female : male. The country name and data are displayed at the bottom. When move the slider, the tinted area, country name and data will change accordingly.



# Final Result



*P5.js:*

<https://editor.p5js.org/n55iwi271003/full/qUhP7Alwk>

*Video:*

<https://drive.google.com/file/d/1WuOjmUW6VHKCKf8JOYhEKhgIVGtjOjdN/view?usp=sharing>

*Full code:*

[https://git.arts.ac.uk/21020295/Vitality\\_Unveiled](https://git.arts.ac.uk/21020295/Vitality_Unveiled)



# Evaluation

## Self-evaluation:

This project on gender inequality data visualization has been a thought-provoking and enlightening experience. By immersing myself in the WORLD DATA OF Gender Inequality Index 2021, I gained a deeper understanding of the multifaceted aspects of gender disparities worldwide. Creating the visualizations using p5.js allowed me to transform abstract data into compelling visual representations that convey the urgency and complexity of the issue.

Analysing the data highlighted both progress and persistent challenges in achieving gender equality. It reinforced the importance of addressing gender biases in healthcare, education, and workforce participation. This project served as a reminder of the power of visual storytelling and the potential to evoke empathy and inspire action. It has motivated me to advocate for gender equality and work towards creating a more equitable and inclusive society.

## Possible improvement:

1. Incorporate more interactive elements into the data visualization, allowing users to actively engage with the data. This could include tooltips providing additional information when hovering over data points, interactive filters to explore specific regions or countries, or the ability to compare multiple indicators simultaneously.
2. Introduce a comparative analysis feature that enables users to compare countries or regions side by side. This would provide a clearer understanding of the variations in gender inequality and identify trends or patterns across different socio-economic contexts.
3. Include historical data to enable longitudinal analysis of gender inequality trends. This would provide insights into the progress made over time and help identify areas where interventions have been successful or need further attention.

By implementing these improvements, the project can evolve into a more comprehensive, engaging, and impactful tool for understanding and addressing gender inequality.

# References

1. Braverman-Bronstein, A. et al. (2023). *Gender inequality, women's empowerment, and adolescent birth rates in 363 Latin American cities*. Available at: [Gender inequality, women's empowerment, and adolescent birth rates in 363 Latin American cities – ScienceDirect](#) (Accessed: 20 May 2023).
2. Chirowa, F. et al. (2013). *Gender inequality, health expenditure and maternal mortality in sub-Saharan Africa: A secondary data analysis*. Available at: [Gender inequality, health expenditure and maternal mortality in sub-Saharan Africa: A secondary data analysis - PMC \(nih.gov\)](#) (Accessed: 17 May 2023).
3. Codex Anatomicus (no date). *UTERUS ANATOMY - FLORAL – BLACK*. Available at: [Floral uterus anatomy art print - Codex Anatomicus \(codexanatomy.com\)](#) (Accessed: 20 May 2023).
4. Cooray, A. and Potrafke, N. (2011). *Gender inequality in education: Political institutions or culture and religion?* Available at: [Gender inequality in education: Political institutions or culture and religion? – ScienceDirect](#) (Accessed: 3 Jun 2023)
5. Lorber, J. (2010). *GENDER INEQUALITY: Feminist Theories and Politics*. Available at: [lorber feminisms 2010-libre.pdf \(d1wqtxts1xzle7.cloudfront.net\)](#) (Accessed: 7 May 2023).
6. Pandey, R. K. (2023). *WORLD DATA OF Gender Inequality Index*. Available at: [WORLD DATA OF Gender Inequality Index | Kaggle](#) (Accessed: 3 Jun 2023).
7. Sayantanm19 (2020). *p5.js | tint() Function*. Available at: [p5.js | tint\(\) Function – GeeksforGeeks](#) (Accessed: 7 Jun2023).
8. The Coding Train (2016). *8.5: Interacting with the DOM using Sliders, Buttons and Text Inputs - p5.js Tutorial*. Available at: [8.5: Interacting with the DOM using Sliders, Buttons and Text Inputs - p5.js Tutorial – YouTube](#) (Accessed: 6 Jun 2023).