

IS428 Visual Analytics for Business Intelligence

How can we make Singaporeans happier?

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Abstract - Enshrined in the principles of the United Nations (UN) is the idea that “the pursuit of happiness is a fundamental human goal” - what this tells us is that happiness is universally important, even to large international organisations like the UN. The World Happiness Report (WHR) ranks 156 countries by how happy their citizens perceive themselves to be. These rankings are based on levels of GDP, life expectancy, generosity, social support, freedom, and corruption which are believed to be sufficient indicators of happiness. However, our paper argues that the rankings in the WHR are not able to sufficiently represent happiness as it does not take into account other important factors which can contribute to happiness, specifically that of Singaporeans. Our paper focuses on providing the government, organisations and companies with a tool that they can use to determine how Singaporeans can be made happier through using Tableau and D3.js as visualisation tools. In analysing our findings from the WHR and additional factors which can contribute to happiness, we found that while Singapore is the happiest country in Southeast Asia, its ranking is relatively low compared to other countries. We identified that, in order to become a happier society, Singapore might want to focus particularly on sleep, working hours, and mental health as these factors were highlighted as areas where Singapore is lacking.

1. Introduction

Enshrined in the principles of the United Nations (UN) is the idea that “the pursuit of happiness is a fundamental human goal” [1] - what this tells us is that happiness is universally important, even to large international organisations like the UN. While happiness is intangible, one way that it has been measured by countries across the world is through The World Happiness Report (WHR). The WHR ranks 156 countries by how happy their citizens perceive themselves to be [2]. These rankings are based on levels of GDP, life expectancy, generosity, social support, freedom, and corruption which are believed to be sufficient indicators of happiness.

Our team argues that happiness can be predicated on other factors which have not been included in the WHR, especially ones which are important to Singaporeans. Hence, in exploring and analysing existing trends in the WHR and by looking at other factors outside of those used in the WHR, our report seeks to determine how Singaporeans can be made happier. Our report will provide a visual representation of the above problem statement and expound on how our findings can be useful to organisations and institutions in making Singaporeans happier.

1.1 Critique of the WHR

While the WHR is widely used by countries as a reference point when critiquing their own well-being-oriented policies, it is limited in a few ways. In referring to other literature, we recognise that happiness can be measured in several ways but methods need to be holistic in acknowledging the various factors that contribute to happiness. In a paper written by Tambyah and Tan [3], the findings of a 2016 Quality of Life (QOL) survey on Singapore were analysed. We believe that this QOL survey sufficiently represents Singaporeans’ concerns around happiness and it argues that Singaporeans desire a well-rounded approach to happiness - they aspire to have a strong sense of belonging to their community, be able to revel in fun and enjoyment especially for destressing, and are inclined towards self-fulfilment. With this understanding, we realise that the WHR is limited in showcasing how Singaporeans specifically can be made happier due to the following reasons:

1. Does not include measures that reflect important aspects to happiness such as fun and enjoyment
2. Self-reporting nature of the Cantril ladder survey makes it subjective

Hence, we seek to include external factors and data that can address these limitations as well.

2. Motivation and Objectives

As Singaporeans, we have a stake in creating a happier society given its universality. We recognise that happier people are more creative, better equipped to develop personal resources, and are more resilient [4]. However, it is not just individuals who benefit from a happier society; governments and organisations also have a stake and responsibility in developing a happy society, given that it is fundamental to optimal human development [3]. Hence, our visualisation approach seeks to support the following analysis requirements:

1. Identify trends and correlations among the happiest countries in the world and in South-East Asia according to WHR.
2. Explore additional factors not included in the WHR which can contribute to happiness.
3. Compare Singapore's statistics across the different WHR factors and additional factors and identify areas in which we can improve to create a happier society.'

Thus, in creating this report, our objective is to provide organisations and institutions involved in policy making and individuals with the power to influence company principles with relevant information on how Singaporeans can be made happier.

3. Related Works

There are multiple works that use the World Happiness Report as a base for their research.

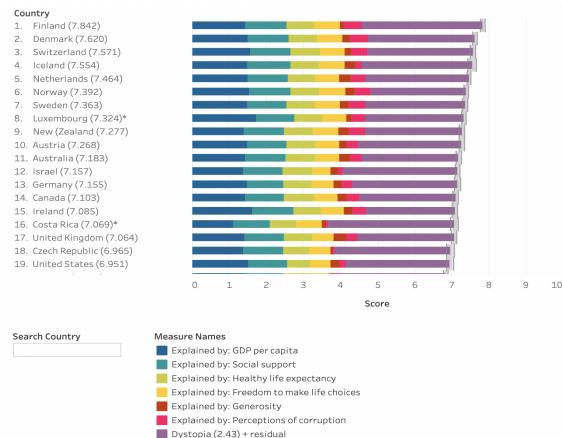


Fig 1. World Happiness Report Dashboard for 2021

Fig. 1 is an interactive chart done by the World Happiness Report [5] that displays a sorted bar chart based on overall happiness index and is made up of 7

components. The creator of the chart has added tool-tips such as a search bar and filter through attributes to easily identify and rearrange the chart according to the user's preferences. Even though the World Happiness Report provides a comprehensive view of the year 2021, users might want to know more in-depth details of changes over the years on top of knowing the country's happiness for that year. Hence the team went out to find dashboards that showed more information within a single screen.

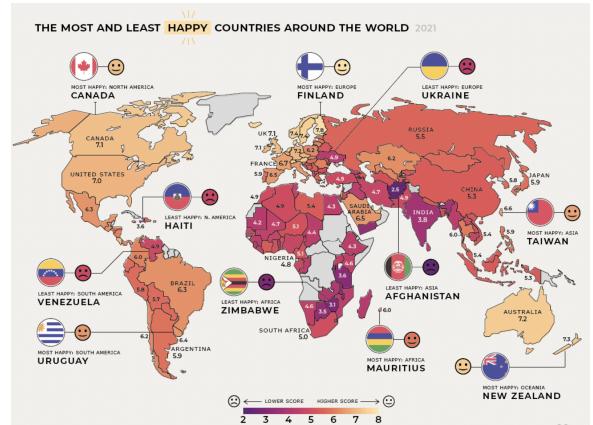


Fig 2. Global Happiness Levels in 2021

Fig. 2 displays the happiness index of selected countries [4]. Within the map, there are countries that have both labels and values, only labels, and no values. While the map provided a view that would draw the user's attention to the specific countries, it would be better if the data is displayed interactively by providing a drop-down filter to select the top countries or a specific country so as to facilitate the user's search for particular countries.

Happiness Score by Country

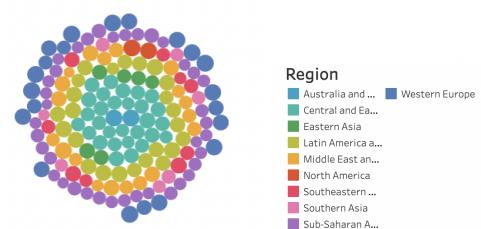


Fig 3. Happiness Score by Country

Fig. 3 is part of a dashboard [5] that includes a packed bubble chart, placing focus on regions and their happiness index. At a glance, it is easy to tell how many countries belong to a region by the colours, but the size of the bubbles are not relative which can be misleading. In order for users to retrieve

more information, they would have to hover over the individual bubbles. The intent of creating such a chart could be to stand out as this is the only chart that utilised colours. Something the creator could have done is to incorporate a line chart with circle sizes as details.

In examining existing visualisations of the WHR, our group has gained a deeper understanding of the current visualisations in terms of their measures and how they have thus far displayed the data.

4. Datasets, Tools & Resources

The following datasets are used for this project:

- **World Happiness Report data from 2015-2020** [6]. These can be found on the online World Happiness Report archives under each year. The data has been compiled on Kaggle under the "World Happiness Report 2015-2021" dataset which contains the Happiness rank, the Happiness Score and other data for different countries.
- **Amount of time spent on sleep from 2017**. This dataset is part of the Time Use database from Our World in Data by Ortiz-Ospina, Giattino and Roser [7]. It only contains data from 33 countries and details how much time is spent on particular activities in the average day of an individual living in specific countries. Singapore's data was acquired from Statista by Richter (2021) [8].
- **Annual Working Hours Per Worker**. This was acquired from Our World in Data by Huberman & Minns and PWT 9.1 [9]. It presents the annual working hours per worker in 66 countries.
- **Minimal annual leave by country**. This dataset presents the number of vacation days an individual is entitled to. It combines data of paid vacation days and paid public holidays from Wikimedia Foundation [10].
- **Global Peace Index from 2015-2020**. The Vision of Humanity website provides the Global Peace Index (GPI) for 163 countries across years. The GPI ranks 163 states and territories according to their level of peacefulness [11].
- **Unemployment Rate from 2015-2020**. The World Bank website provides data on the percentage of the total labour force that are unemployed for different countries [12].
- **Percentage of the population using the Internet from 2015-2020**. The percentage of individuals using the Internet in different countries is provided by The World Bank [13].

- **Percentage of the population that are aged 15-64**. The World Bank also provides data on the percentage of the population that are aged 15-64 across the years [14].
- **Percentage of population with mental health disorders**. This dataset was provided by Dattani, Ritchie and Roser (2018) on Our World in Data [15]. It provides statistics on the percentage of a country's population with mental health disorders. Singapore's data was acquired from a CNA article [16] - we averaged the data across all ages to get the population average.
- **Size of population**. This data was acquired from The World Bank which combines data from various sources to compute the total population of countries [17]. Where data was missing, the figures were acquired through manually searching for them online.

The intention of including the additional datasets is to explore other important factors which contribute to happiness such as enjoyment and fun, sleep, mental health, size of population, the level of peace [18], the level of unemployment [19] and factors that relate to it, and the level of technological advancement in the form of access to the Internet [20].

To analyse and visualise the data, we utilised: **Microsoft Excel, Tableau, D3.js**. The use and implementation of these tools will be further elaborated in later sections.

5. Methods

In order to develop the visualisations, we undertook three steps: (1) Exploratory Data Analysis (EDA), (2) Ideating and planning for dashboard, (3) Data preprocessing and creating the visualisations, each of which will be expounded in the following sections.

5.1. Exploratory Data Analysis

For our preliminary results, we would like to highlight some interesting insights from our initial exploratory data analysis on the WHR data and additional data. We realised that certain continents have countries with higher happiness scores. Countries in South and North America tend to be happier while those in Africa and Asia tend to be less happy. The prevalence of internet use and GDP levels also have a strong positive correlation. Countries that have high GDP levels and high internet use tend to be happier with the exception of some countries such as Greece, Azerbaijan and Lebanon where people find

themselves less happy than average despite the high internet use and levels of GDP.

The preliminary findings have shown trends and that there may be some correlation between certain factors that predicate happiness. These correlations prove to be interesting and may be useful for policymakers and companies. Hence, we will attempt to explore more variables in relation to each other and how they affect a country's level of happiness.

5.2. Ideating and planning for dashboard

In designing the dashboard, our primary goals were to:

1. Create a user interface that is easy to navigate and intuitively use.
2. Allow users to compare Singapore's statistics for all the relevant datasets (WHR and additional factors) and against different regions (Worldwide and SEA).

With these considerations in mind, we made sure to segment the dashboard pages according to the different comparisons that a user would need to make - this was a key driver of our design considerations. Additionally, for ease of comparison, we included filters and colour schemes that would allow the user to easily identify Singapore among the other countries. Hence, our dashboard will focus primarily on creating visualisations that provide the user with an opportunity to compare and contrast Singapore's statistics with other countries.

5.3. Data preprocessing and creating the visualisations

The datasets were prepared by standardising the name of countries across all datasets, converting certain values to whole numbers or changing decimal points to make it uniform across all values, and where Singapore's data is missing, imputing values found from other credible sources to allow for comparison between Singapore and other countries. These were conducted using Microsoft Excel.

We have 3 separate datasets - one for Tableau and two for D3.js. The Tableau dataset, named 'WorldHappinessReport_Ext.xlsx', has a total of 13 sheets which correspond to all of the data mentioned in **Section 4. Datasets, Tools, & Resources**.

D3.js has two datasets as the two dashboards made with D3.js each require a separate dataset. The bubble

chart dataset, named 'bubblechart.csv', contains the columns from WHR alongside an additional column 'Region'. The dataset for the linear bubble, named 'linearbubblechart.csv', contains columns from our Tableau dataset which have been scaled from 0 to 1. This was done by taking the maximum of each column as 1. For rows that the team could not gather data for, null values were replaced with 0 to prevent disruption to the visualisations.

The visualisations were produced via Tableau and D3.js. As will be mentioned later, we referenced the work of other designers when using D3.js and after sufficiently making changes to their work to better suit our needs, we connected our D3.js dashboards to our Tableau dashboards. The result is a large Tableau dashboard which we then uploaded onto Tableau Public.

6. Data Visualisation Walkthrough

There are 7 main dashboards available in our application. The dashboards are accessible through this [link](#). The full link is also provided in **Section 12. Dashboard Link**.

6.1. Overview of WHR

The homepage provides an overall overview of the WHR, a breakdown of WHR attributes by countries and the correlation between happiness and the various attributes. The dashboard allows the user to view data based on the years from 2016 to 2020, with the default option being 2020, and the filtering of countries.

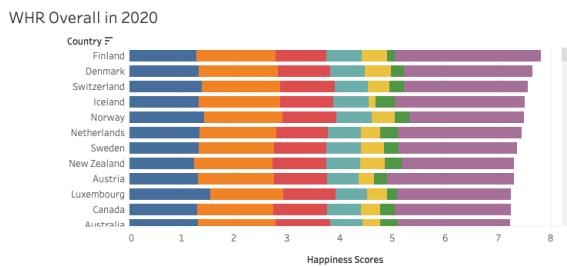


Fig. 4. Happiness Rankings of Countries with Attributes Breakdown

The bar chart in Figure 4 is useful in showing the countries sorted by the happiest countries at the top. Colours are added to represent the different attributes provided by the WHR to visualise how the different attributes affect a country's happiness score. When users hover over a country's attribute, a tooltip

showing the country's name, happiness ranking, happiness score and the attribute score.

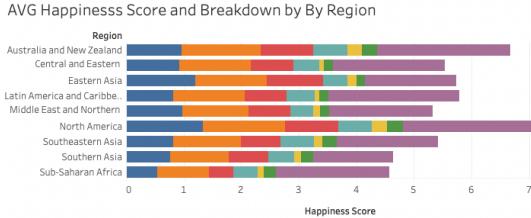


Fig. 5. Happiness Rankings of Regions with Breakdown of Attributes

The bar chart in Figure 5 is useful to show the average happiness score of the regions in the world. Colours are added to represent the different WHR attributes and share the same colour scheme as Fig 4. Hovering over a region's attribute will show a tooltip with the region's name, average happiness score and average score of the highlighted attribute.



Fig. 6. World Map of Countries with Happiness Score visualised

A world map is used to visualise the country's happiness as a hue, allowing users to more easily visualise the happiness score of the countries.

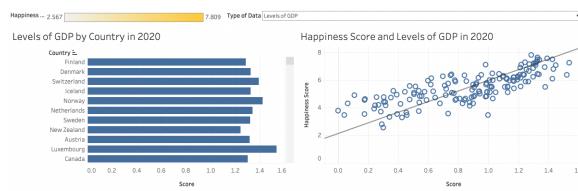


Fig. 7. Happiness Score and WHR Attributes

The bar chart in Figure 7 allows users to compare the individual WHR attribute score by countries. Hovering over the bar will show a tooltip containing

the country's name, attribute score and happiness ranking.

The bubble chart helps to preview the correlation of the WHR attribute to countries happiness score. Hovering over a bubble will show a tooltip containing the country's name, attribute score and happiness ranking.

Users will be able to change the attribute in the Type of Data dropdown and highlight a country by inputting in the highlight country filter.

6.2. WHR Comparison - World

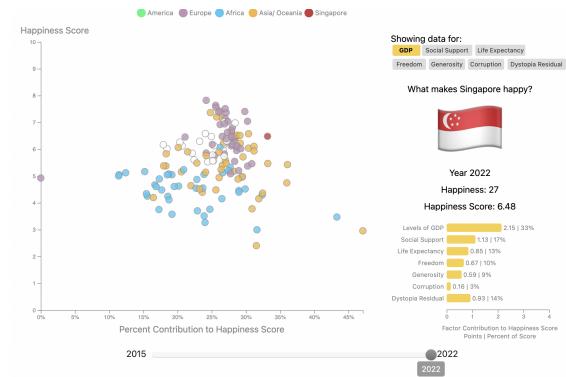


Fig 8. Bubble Chart with breakdown WHR Happiness category

Fig 8. displays a chart that was developed using D3 with reference from Alejandrina Patrón's work [21] - it combines the use of a scatter plot and an information section that allows users to go in-depth with the details of a country's contributing factors in a specific year. It also colour codes countries according to their region. This scatterplot shows how much each factor contributes to the happiness score. Since Singapore is key to our project, we coloured it a red to help it stand out against the other countries.

6.3. WHR Comparison - SEA (1)

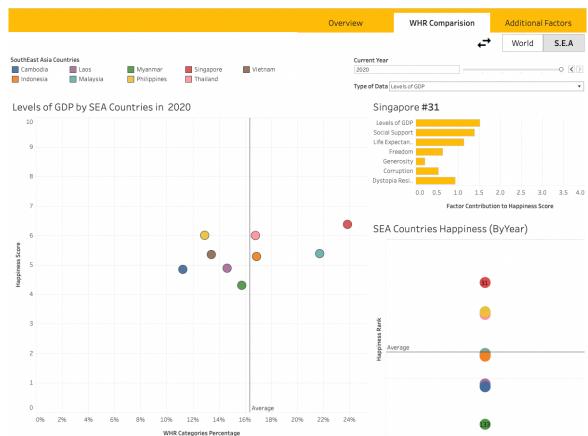


Fig. 9. Bubble Chart of SEA countries with breakdown WHR Happiness category

Figure 9 displays a bubble chart, showing Levels by GDP by South East Asia (SEA) Countries, to show how much each WHR factor contributes to the happiness score. A bar chart acts as an information section to allow users to preview in-depth details of a country's contributing factors in a specific year. Users can hover over a factor to preview the score of that factor, and click on a country in the bubble chart to update the bar chart data to the country's data.

A bubble chart, showing SEA Countries' Happiness, is included to show SEA countries happiness ranking for that year. Singapore has been consistently ranked happiest country in SEA from 2015 to 2020.

Since Singapore is the focal point of our project, we coloured it red due to the colour association with Singapore's national colours to distinguish it from other SEA countries. Clicking the two-arrows button will swap the view to the next dashboard.

6.4. WHR Comparison - SEA (2)

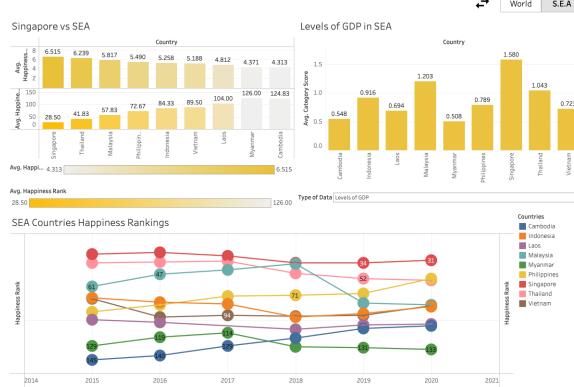


Fig. 10. Overview of WHR data in SEA

Figure 10 shows an overview of the WHR data for countries in the SEA. The bar chart, Singapore vs SEA, compares SEA's average happiness ranking and score over 2015-2020. A hue colour of yellow is used to visualise a country's happiness.

The bar chart on the right is used to compare the average scores of the different WHR factors in SEA. The factors can be changed by changing the dropdown list value.

The bubble line chart at the bottom is used to visualise how the rankings of the countries changed

over the years. Users can hover over the lines or the nodes to preview the happiness score and ranking of a country for that year with the tooltip. Singapore has been consistently the happiest country in SEA for all the years.

6.5. Additional Factors - World (1)

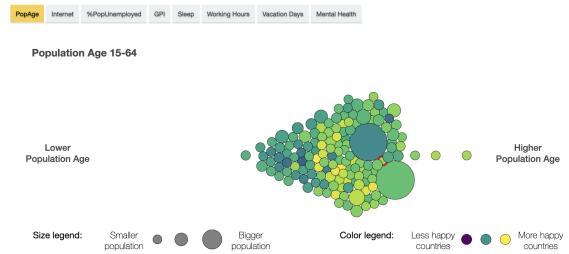
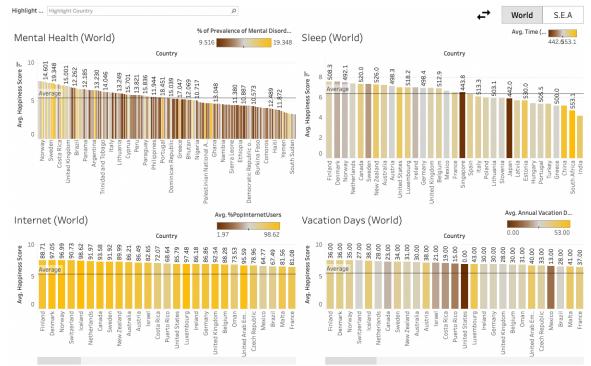


Fig 11. Linear Bubble Chart with new attributes

Fig 11. too, was created using D3 and we referenced Rebecca Barter's work [22] in creating these bubble charts. Users are able to switch between the new factors that they want to explore such as PopAge (percentage of the population who are aged 15-64), Internet (percentage of the population who have access to the Internet), %PopUnemployed (percentage of population who are unemployed), GPI (Global Peace Index), Sleep (Average amount of sleep in a day), Working Hours (Total annual working hours per person), Vacation Days (Total paid vacation days), and Mental Health (percentage of population with mental health disorders).

The size of the bubbles represent the population size, while the colours represent how happy they are. Yellow is representative of happiness and as the happiness decreases, it turns into purple which was chosen as it is a contrasting colour to yellow.

6.6. Additional Factors - World (2)



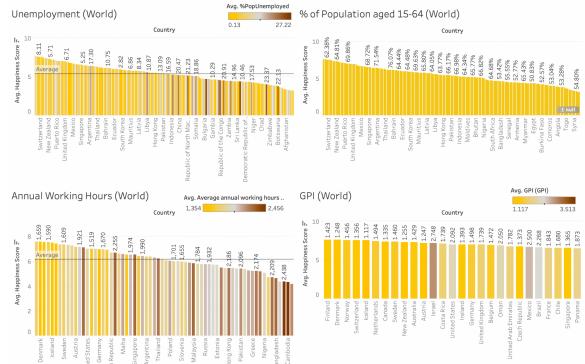


Fig 12. Additional Factors as a Bar Chart

Fig 12. consists of a series of bar charts representing the new factors. Users can observe the overall trend for these factors and see how they correlate to the average happiness score. The team decided to calculate the average happiness score as many of these factors do not have annual data, and include a highlight filter at the top left of the dashboard to allow users to highlight the country of interest and an average line to compare how well a country fairs in average for that factor.

The bar charts are ordered based on their average happiness score, and shaded in a continuous variation based on the country's factors. A darker brown implies a negative impact while a brighter yellow indicates that the factors are positive.

6.7. Additional Factors - SEA

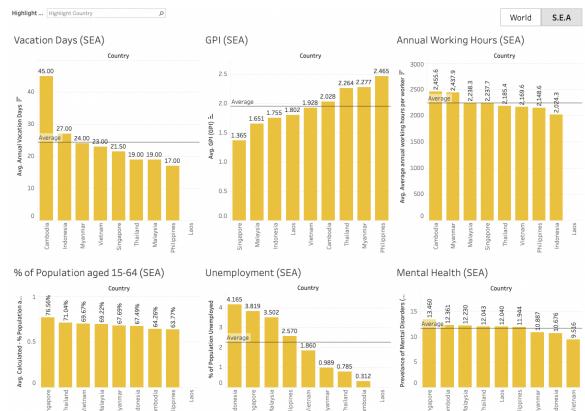


Fig 13. Additional Factors (SEA) as a Bar Chart

Fig. 13 shows scores for additional factors for all SEA countries. Users can compare the scores for each country and use the average line to gauge how well the country is doing in a particular factor. The team decided to include a highlight filter at the top left of the dashboard to allow users to highlight the country of interest.

7. Key Findings & Insights

From our analyses, we discovered that the top countries were often Norway, Finland, Denmark, Sweden, Netherlands, New Zealand, Australia, Canada, Switzerland and Iceland. Singapore's overall ranking averages at 28.5 with an average happiness score of 6.515, thus it is not very highly ranked internationally.

In comparing Singapore against other countries worldwide in Fig. 12 we derived the following insights:

- Starting from **PopAge**, Singapore has a higher percentage of the population (**74%**) from the ages 15-64, showing that it has a large working population but also an ageing population.
- Percentage of the population that has access to the **internet**, accounts for only about **76%** of the population having access to the internet, which is surprising as Singapore prides itself in being a technologically advanced country. Interestingly, we can see that happier countries tend to have a greater portion of their population having access to the internet
- **Percentage of Population Unemployed** indicates that Singapore has a low unemployment rate at **4.1%** which when scaled, is relatively lower than the other African and European countries. And unemployment is correlated to higher happiness.
- For the global peace index (**GPI**), Singapore has a low GPI of **1.3** which means society is relatively peaceful and free of violence. Low GPIs are correlated with higher happiness.
- As there are only 34 data points for **Sleep**, it shows a limited view of the world's sleep time. However, consistent with other surveys that look at how much sleep countries get, we can see from the linear bubble chart that Singaporeans get very little sleep (average 444 minutes/ day).
- Conversely, Singapore has very high **working hours** (2,238 hrs/ year). Yet, we can see that lower working hours is correlated with higher happiness.
- For **vacation days**, Singaporeans also have a relatively lower number of vacation days (22) in comparison to happier countries, especially Iran (53) and other African and European countries.
- As for mental health, the population of Singapore that has mental health disorders is at 14%. It is placed in the middle in comparison to other countries.

The WHR ranks Singapore as the happiest in SEA where it surpasses its neighbours in level of GDP, life expectancy, and lower levels of corruption. Conversely, Singapore is lagging behind in terms of social support, freedom and generosity. As for additional factors, from Figure 13, we further observed that Singapore fairs quite well against other SEA countries, scoring average or above in most factors.

- For **vacation days**, Singapore seems to have fewer vacation days, with a scoring below average. However, Cambodia's vacation days (45) seems to be an anomaly due to which the average is skewed to the right.
- Looking at the **unemployment rates** for each SEA country, the team found that Singapore has a high unemployment rate of 3.8%. This factor has a direct correlation to the happiness score.

Hence, when looking at the additional factors we decided to include, we realised that Singapore is lacking in several areas, namely internet use, sleep, working hours, vacation days and mental health, unemployment. However, from our earlier investigations on how Singaporeans think they can achieve happiness, we decided to focus on creating suggestions for the following factors: **sleep, working hours, mental health.**

Hence, we would like to make the following suggestions.

1. Allow Singaporeans more time outside of work to enjoy activities they like by reducing the number of official working days. The pandemic has generated greater appreciation for the four-day work week arrangement [23] and Singapore has not been impartial to this - a study conducted by Indeed [24] showed that 88% of Singaporeans prefer to have 4-day work weeks with the same pay (in "4 of 5 Singapore employees want four-day workweek and flexibility"). Additionally, 4-day work weeks have their benefits: worker productivity and satisfaction may increase, business costs can be reduced, and employee work-life balance can improve (Bartel, 2021). Hence, we hope that like Belgium, where 4-day work weeks have recently been given nation-wide support by

the Belgian government (Kelly, 2022), the Singapore government and companies can support a 4-day work week arrangement for employees.

2. In supporting a 4-day work week, Singaporeans may be able to have longer sleep. According to HealthHub Singapore [25], lack of sleep results in slower reaction times, poor focus, attention span, and judgement, and can cause health risks. These could severely impair a person's ability to function on a daily basis, hence ensuring that Singaporeans get more sleep is important.
3. Greater support for mental health can make Singaporeans happier as well. A paper written by Harandi, Taghinasab, & Nayeri [26] states that social support is key in improving a population's mental health. According to Porter [27], apart from greater government spending on mental health, increasing citizen's ability to spend time on leisure and personal care also leads to greater support for mental health. Hence, one way the government and companies can improve mental health is to allow citizens more time and avenues for de-stressing and leisurely activities.

Hence, the government and companies should focus on the above-mentioned areas to create a happier Singapore.

8. Limitations

Although the team wanted to conduct a full exploration on how to increase the happiness of Singapore, there are limitations to our dashboards:

- **Limited data.** Given that we had to source for data from different sources, we were unable to acquire data for all relevant countries and years. This resulted in some gaps in our visualisations, and hence affected the accuracy of our analyses.
- **Limited ability to produce interactive dashboards.** Additionally, we were unable to utilise more dynamic platforms and code for developing more interactive dashboards due to our limited knowledge of using platforms apart from Tableau and PowerBI.

With these limitations in mind, we will talk about Future Works in the following section to see how we

can address the limitations in future revisions of the project.

9. Future Works

In considering our current limitations, we would like to conduct the following in our future works:

1. **Interactivity of dashboards.** Most charts that are presented through the report are mostly static. The team would like to explore the use of D3 loop to present an overview of WHR index. This would give users a better understanding of where we were in the past and the present while also maintaining sliders and areas for users to interact with
2. Explore how we can **reconfigure the happiness score by the WHR to include the additional factors** we've explored. This would help to create a more holistic and accurate representation of happiness across the different countries, and hence make the WHR a greater tool for governments and institutions alike to refer to when generating policies.

10. Conclusion

To conclude, Singapore is not one of the happiest countries in the world according to WHR, with an average rank of 28.5. While it is the happiest country in Southeast Asia, Singapore can afford to improve in many areas to create a happier society. However, the team recognises the limitations of the WHR in its definition of happiness and hence ranking of countries - it does not take into account factors such as time spent on leisure activities which are important to Singaporeans and can be subjective due to the self-reporting nature of the Cantril ladder survey. Hence, the team decided to look at other factors which contribute to happiness.

In analysing both WHR factors and additional factors, the team identified areas in which Singapore can create improvements to make Singaporeans happier, namely by increasing the amount of time Singaporeans have outside of work to spend on personal activities, increase the amount of sleep Singaporeans get and provide greater support for mental health.

Through our dashboard, analyses and suggestions, we hope to provide governments, institutions and companies with relevant tools and ideas to promote

greater happiness in society and at work. The pursuit of happiness is a fundamental human goal, hence it is important that Singaporeans receive support from both public and private sectors to equip themselves with the skills and resources to strive for their own happiness.

11. References

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12. Dashboard Link

Please access the link below for our dashboard:
https://public.tableau.com/views/WHR_Dashboard/Overview