

# Microheart: A Visual Analytics Tool for Analyzing Singapore's Growing Ageing Population and its Implications

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**Abstract** – It is a well-known fact that Singapore's population is ageing rapidly, and the nation has been hampered by falling birth rates. Despite the government's efforts to counter this, measures still have to be taken to cater for the needs of the increasing number of aged citizens and retirees amongst the population. This research project aims to provide an insight into how fast the ageing population is growing. It also aims to raise awareness regarding the availability and accessibility of healthcare facilities catered to the aged living in Singapore.

## I. INTRODUCTION

By 2030, the elderly and retired population in Singapore is expected to be approximately 900,000<sup>1</sup>. One in every three Singaporeans is projected to require eldercare services<sup>2</sup> by 2030 as well. The ratio between the number of elderly to working population is close to 1.0 this year. There is a growing number of elderly and retirees who live either alone or with spouses in a similar age group.

The government has been ramping up its efforts to beef up the quality, availability and accessibility of healthcare for the elderly and retired. Eldercare facilities are gradually being shifted from conventional hospitals to locations within the heartland of residential areas (e.g. more dialysis and physiotherapy centres are now built in planning areas).

## II. MOTIVATION

This research is motivated by the need to be aware of how well-equipped each

planning area is in coping with the needs of the aged population. This particular group of citizens have special needs that includes healthcare, and personal caregiving -- especially those living without their children. By identifying these needs and zooming in on the ones that are most sought-after, our research aims at highlighting the planning areas that require improvement.

## III. RELATED WORKS

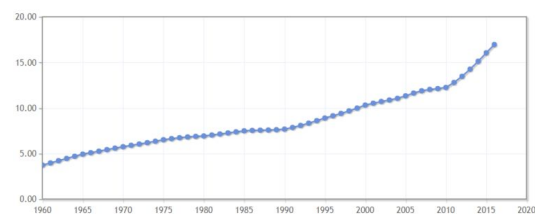


Figure 1.0

Figure 1.0 above depicts how the dependency ratio in Singapore has an ever-increasing trend and has even taken a sharp spike lately. This time-based trendline speaks of how the current working population is facing a growing burden in terms of supporting those not in the nation's workforce. This past work is one of the motivating factors for this research and has spurred us to probe and study what the future prospects are like for our expanding elderly population.

<sup>1</sup> Tai, J. (2016). Growing old: Should you be worried? Retrieved from <https://www.straitstimes.com/singapore/growing-old-should-you-be-worried>

<sup>2</sup> Tai, J. (2016). Growing old: Should you be worried? Retrieved from <https://www.straitstimes.com/singapore/growing-old-should-you-be-worried>

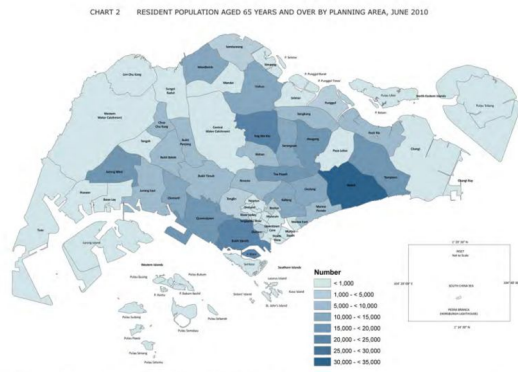


Figure 2.0

This visualisation helps users quickly identify which areas in Singapore are relatively more densely populated with the elder generation and thus are more exposed to the effects of an increased ageing population. However, it does not depict which planning areas are eldercare deficient and was also non-interactive. In addition, it does not reveal the trend of population in the recent years or any gender information for each of the planning area.

#### IV. VISUALISATION APPROACH

##### ***Phase 1 - Sourcing, Data Transformation and First Iteration***

This project obtained the population demographics data from Singapore's Department of Statistics i.e. the distribution of Singapore residents by planning area as well as age group and sex. Data obtained were in CSV format. It provided us an insight into the number of Singapore residents staying at the various planning areas and subzones, from the year 2000 - 2018.

With this data, we mapped out the distribution of the population onto an interactive map - somewhat reproducing a past visualisation, only this time, making it interactive with filters for the different years and adding additional information such as gender breakdown and population

trends of recent years. Also in the form of a map, we drew out the aged dependency ratios for each subzone and planning area. Note that for this research, we focus on the *aged dependency ratio* i.e. number of aged residents (65 years and older) per working resident (15 - 64 years old). Tableau was used for this mapping process.

Simultaneously, the team searched for the distribution of specific eldercare facilities across the island. We focused on dialysis centres as well as physiotherapy centres -- which based on research, are two of the in-demand healthcare facilities amongst the aged population.

##### ***Phase 2 - Completion of first two distribution charts and development of medical facilities chart***

A visualisation was plotted to depict the trend of the *aged dependency ratio* in Singapore. Data for this phase would be extracted from our visualisations in Phase 1.

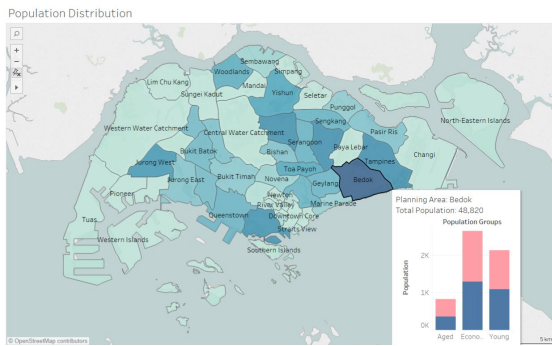
For our chart on medical facilities, we spent a larger amount of time as the data involved manual work of extracting the data from an official healthcare website.

##### ***Phase 3 - Web-based implementation and Analysis***

In this final stage, we embedded the tableau designed charts onto wix website development platform. We focused on completing the final web-based product for showcase. In addition, we focused on analyses and obtaining valuable insights that would help our users. Projections and predictions would be made to meet the objectives of this research.

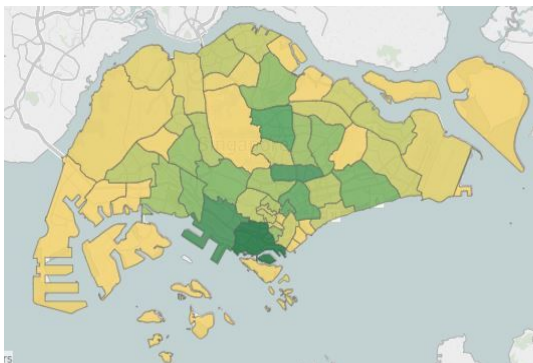
#### V. VISUALISATIONS SELECTED

##### ***Visualisation 1: Population Map***



The first visualization is a general overview of the ageing population distributed across Singapore according to the planning areas. The color intensity was set to indicate the volume of ageing population for each area. As we hover over each planning area, more details are shown such as the breakdown of the population category by gender and the trend lines.

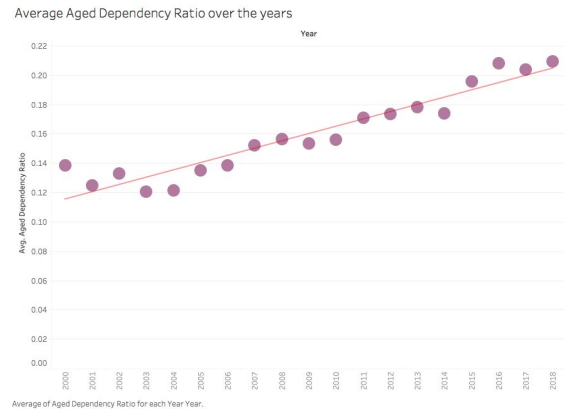
### Visualisation 2: Aged Dependency Ratio Map



We created calculated fields from our raw data set in Tableau. Number of residents from ages 0 - 14 were grouped in the Young category; 15 - 64 year olds were in the Working category; while the remaining fell under the Aged category. From this, we created another calculated field  $\text{Aged Dependency Ratio} = \text{Aged} / \text{Working}$ .

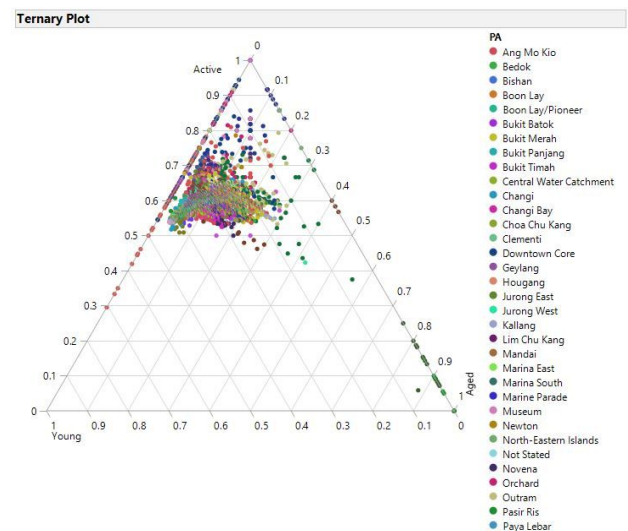
This new ratio was then plotted onto the map and dragged into the Color segment of Tableau.

### Visualisation 3: Aged Dependency Ratio Trend Line



The average Aged Dependency Ratio would then be plotted against the years 2000 - 2018 to obtain the point plot. Using Tableau, the best fit line was drawn through these points. The R-squared value of this best fit line is 0.905 (more than 90% of the variation of the average aged dependency ratios can be accounted for using the best fit line), indicating that the line is a good indication of the rising trend of the average Aged Dependency Ratio.

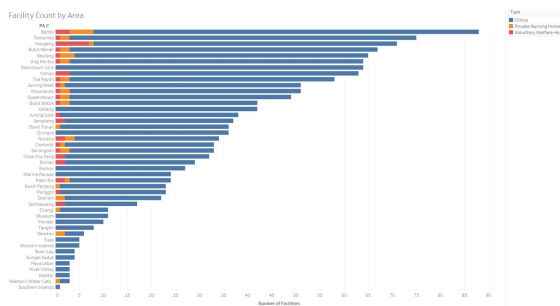
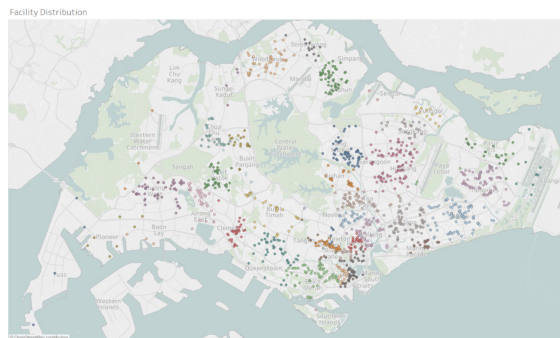
### Visualisation 4: Ternary Plot



The population data in CSV format was imported into JMP Pro. The Ternary Plot option was chosen. "Young", "Economically Active" and "Aged" were added to "X, Plotting". Select PA

(Planning Area) to be the Row Legend. Marker Size was set to medium for better visibility.

**Visualisation 5: Social & Healthcare Accessibility**



Bedok, although dense in its number of clinics, has very little voluntary welfare homes and nursing homes, meaning that the aged population in this area are highly likely to be underserved. It might have a high number of clinics. However, the elderly in general have a more urgent need for long-term services what nursing and welfare homes can provide.

Also, from Visualization 1, Jurong East can be seen to be a planning area with a relatively higher number of older people living in it. However, in comparison with the bar chart showing the count of clinics and homes for each planning area, Jurong East does not have a high count of clinics or homes, lying outside the top 10 areas with the highest number of clinics or homes. However, this is also based on the assumption that a higher number of clinics is necessary to provide service for a larger number of old people. Our team acknowledge that we did not take capacity of the clinics or homes into account which is crucial factor to take into account.

**VI. KEY FINDINGS & INSIGHTS**

**Visualisation 1 and 5**

This visualisation uncovered the planning areas with a relatively higher population of aged/elderly residents. Bedok, Ang Mo Kio and Bukit Merah (the darker regions on the map) indicate the highest number of aged residents. All three are considered to be mature estates in Singapore<sup>3</sup>.

Further research was also conducted to map out the distribution of healthcare facilities across the island. In this research, healthcare facilities refer to clinics, voluntary welfare homes and nursing homes. Clinics refer to general practitioner centres and polyclinics. We found that

Visualisation 2

We have observed that the Central and Southeastern regions in Singapore face a much higher Aged Dependency Ratio as compared to other regions. The team observes that many of these regions are home to private residential areas e.g. Nassim, Boulevard and Siglap. In fact, Pearl’s Hill subzone has more aged residents in comparison to working residents. In these affluent subzones, the aged population would normally reside with their children i.e. their caregivers. Therefore, although these areas might be more sparse in terms of accessible eldercare facilities, these residents would not be without helpers to transport them.

While visualization 1 reveals that areas with higher volume of older people tend

<sup>3</sup> Anonymous. (n.d.). The Ultimate Guide To Resale Flat Prices In Singapore 2016/17. Retrieved from <https://stackedhomes.com/hdb-estates.html>

towards the eastern region of the country, the Aged Dependency Ratio chart (visualization 2) reveals that areas with higher ratios tend towards the southern region of country. This shows that while an area may have a larger number of old people living in it, it is not necessary a greater area of concern as there might be a sizeable population of active working population to support them. As such, our team has learnt that in reviewing the ageing population of the country, it is important to be clear of the metric on which we are measuring the problem by.

### Visualisation 3

The average aged dependency ratio has been steadily increasing over the years. Using the best fit line, it is predicted that by the year 2025, the ratio is expected to hit 0.325 i.e. one elderly/aged resident is expected to be supported by only three working residents. By 2050, the ratio is expected to hit 1:1<sup>4</sup>.

### Visualisation 4

Based on our observation from ternary chart, we found that in most of the planning area, about 70 percent of the population are economically active and the other 30 percent is shared between aged and young.

## VII. AREAS OF IMPROVEMENT

Our team has identified the following challenges and areas of improvements we could have had:

(i) Lack of usable medical and social service facilities data

Our team faced a challenge of obtaining usable geographic data of the medical facilities and nursing homes. We had to manually extract the data from [www.healthhub.sg](http://www.healthhub.sg). From the website, we were able to retrieve just the zip code. In order to visualize by planning area, we used OneMap API to retrieve the latitudes and longitudes from which planning areas of the facilities were obtained. With the updated data, we were able to plot out these facilities onto a tableau open source map. Below is the JavaScript code used to extract the planning area of the facilities.

```
function printTable(file) {
    var reader = new FileReader();
    reader.readAsText(file);
    reader.onload = function(event) {
        var csv = event.target.result;
        var data = $.csv.toArrays(csv);
        var html = '';
        var i = 1;
        var url = '';
        var paArray = [];
        for(i = 1; i < data.length; i++) {
            var lat = data[i][0];
            var long = data[i][1];
            url = "https://developers.onemap.sg/privateapi/zipapi/getPlanningArea?lat=" + lat + "&long=" + long;
            $.ajax({
                type: "GET",
                async: false,
                url: url,
                success: function(response) {
                    paArray[i-1] = response[0].pin_area_n;
                }
            });
        }
        var j = 0;
        for (j = 0; j < paArray.length; j++) {
            html += '<tr>\n';
            html += '<td>' + paArray[j] + '</td>\n';
            html += '</tr>\n';
        }
        $('#contents').html(html);
    };
    reader.onerror = function() { alert('Unable to read ' + file.fileName); };
}
</script>
```

(ii) Specialised Medical Facilities

We would like to be able to further deep dive into specialised medical facilities such as dialysis centres, renal centres and psychiatrists and plot out their geographic distribution on the map to showcase their reach to patients. To date, we were unsuccessful in sourcing out the data for such clinics where locations were readily available for us to use.

(iii) Missing Population Data

Our population data from singstats had missing population data from several planning areas, such as Boon Lay. These

<sup>4</sup> Siau, M.E. (2017). Elderly to make up almost half of S'pore population by 2050: United Nations. Retrieved from <https://www.todayonline.com/singapore/elderly-make-almost-half-spore-population-2050-united-nations>

areas could have notable ageing population information that we are unaware about.

#### (iv) Other Factors

While our project is heavily emphasised on showcasing the geographic distribution of the ageing population and healthcare/social facilities, our team understands that the problem of ageing population is more than just the distribution of facilities. Other factors such as the impact of social policies targeted at helping the older citizens are also notable areas of analyses to manage the problem of ageing in a country.

### VIII. CONCLUSION

The rise of ageing population in Singapore is an unavoidable trend, indicating that management of the ageing trend is the most feasible and effective solution for the country to date.

In the government's efforts to increase our younger population, more attention has to be channel towards ensuring that the aged population are well taken care of too. Understanding how our aged population are spread across the island and also how the healthcare facilities are distributed leads to the awareness that healthcare infrastructure could be streamlined to be better aligned with eldercare. Our project may have revealed several findings where gaps exist between the distribution of the two, implying a possible area for the government to look into and consider in their future area planning.