Mapping the Urban Management Risks of Ageing Population: Evidence from Macau SAR, China

Mingjie Dai[1] Huajie Yang[2]

[1,2] *Faculty of Innovation and Design, City University of Macau, Macau SAR, China*
[1] *School of Art and Design, Zhuhai College of Science and Technology, Zhuhai, Guangdong, China*

ABSTRACT

This paper aims to study the evolution of the aging population of the Macau Special Administrative Region (SAR) in the past decade from 2011 to 2021, and consider the impact of the ageing population on Macau society in the context of increasing social ageing population. This research takes Macau Peninsula as the research domain by using literature review, data analysis and GIS map to evaluate the potential risks and challenges confronted by ageing population, providing policy makers with insight to mitigate the challenges of ageing societies in Macau.

Keywords: Macau, Elderly population, Ageing trends, Impacts.

1. INTRODUCTION

Population ageing, as a demographic phenomenon, has a far-researching influence on urban sustainability, which extensively exists in developed countries and regions (Jarzebski, M.P. et al., 2021). In accordance with prior research, there are about 350 to 400 cities with ageing trends, where include the regions such Eastern Europe, the United States and Japan. The findings above suggest that the societies in future may confront with obstacles in terms of economic growth, social welfare, public transport, land use, healthcare and many other societal aspects. In fact, every country in the world is facing ageing challenges and experiencing growth in the number and proportion of older persons in their population, which is a global issue.

Due to these reasons above, this paper aims at not only using literature review, data analysis, but also utilizing GIS map to geographically understand population ageing in an urban setting. Also, these methods can also be applied into researching many other cities around the world regardless of different locations, as well as contributing to better understanding the ageing process as a whole.

2. GLOBAL POPULATION AGEING

2.1 Aging of the Urban Population

According to the Organization for World Economic Cooperation and Development (OECD), among the global trends of the 21st century, population aging is a global phenomenon with significant implications for cities. Among them, the proportion of the population over 65 years old rose from 7.7% in 1950 to 17.8% in 2010 and is expected to climb to 25.1% by 2050. Urban ageing trends in the OECD region, cities account for 43.2% of all older persons (over 65 years of age). Cities can and must complement the efforts of governments to address the consequences of this unprecedented demographic change. Cities are also places of communication across policy departments to address population ageing in urban environments in an integrated manner.

2.2 Population Ageing and Its Perspectives

In essence, the population problem highlights a social problem, and the deep-seated structure behind it and its contradictory causes deserve special attention. In East Asia, various social problems arising from aging reveal the inadequacies and incompleteness of social

institutions. From the perspective of reasons, those responsible for the social welfare of the elderly have increasingly become a social issue and topic of widespread concern. In addition, the gap between public expectations and government welfare policies is difficult to resolve in the short term, but requires the joint efforts of all sectors of society.

However, scholars have also put forward their own views and summarized them as: policy orientation, system characteristics, and institutional interpretation. Specifically, East Asia, which is deeply influenced by Confucian culture well-known, has obvious similarities in the perception of old-age care, and for this reason, relevant scholars point out the proposition of "family style and respect for patriarchal law" (Roberts, 1993). A survey of Hong Kong SAR, China, showed that young people's attitudes towards the elderly are particularly varied. In addition, some scholars believe that Japan, South Korea, Hong Kong and Taiwan have "productivism welfare capitalism", that is, emphasizing growth-oriented and social policies to serve economic goals (Choi, 2012), and a survey of older people in Taiwan shows that 37.3% of respondents hope to be financially independent after retirement (Tsai, 2001). Therefore, in the face of an increasingly severe aging society, limited social resources and welfare will pose a great challenge to the aging process of society.

3. THE LITERATURE ON CAUSES AND CHARACTERISTICS

3.1 The Declined Birth Rate

Studies have proposed that global population aging is directly related to the decline in birth rate to some extent, and it is also the key to discover the causes and characteristics of population aging and analyzing population aging. Specifically, the decline in the birth rate has led to a decrease in the proportion of adolescents in the total population, and the reduction in mortality has led to an increase in the proportion of the elderly population, which together contribute to the aging of the population (Miladinov, 2021). In addition, population aging is also an inevitable consequence of the population age gradient in the demographic transition (Donald et al., 2011). From the trend point of view, if the proportion of infants in the total population of a country or region is decreasing, and the proportion of elderly people is increasing, it indicates that the

country has begun or has entered the stage of population aging.

3.2 The Level of Industrialization

In addition, previous research implies that industrialization is related to the level of social development and the rate of aging, especially the "Shock of Gray" problem in the post-industrial era. The higher the degree of industrialization, the more concentrated the level of development of countries or regions, the more serious the proportion of aging population, such as Japan, South Korea, Singapore and so on in East Asia.

At the same time, an ageing population is exacerbating disease patterns and creating more challenging public health issues. From a global perspective, even though the development of industrialization will promote people's health awareness and the development of medical technology to a certain extent, thereby extending the average life expectancy in terms of population age structure, it will also correspondingly promote the increase of aging population, such as developed countries Japan.

3.3 Labor Supply

In terms of labor supply, an abundant supply of labor in some developing countries will greatly promote economic development indeed. From the perspective of economic factors, when the age structure of the population is at its most productive, sufficient labor supply and high savings rate provide an additional source of economic growth, which is called the demographic dividend. Correspondingly, once the demographic transition exceeds this stage and the age structure of the population ceases to be generally productive due to ageing, the usual demographic dividend is lost.

Since changes in the stages of demographic transition can be most comprehensively reflected in terms of total fertility, we can theoretically anticipate the relationship between such a demographic transition and economic growth: when total fertility is at a very high level, the economic growth rate is correspondingly at a very low (assuming no demographic transition and technological progress) steady-state level; with the decline in fertility and the consequent formation of a productive age structure of the population, the rate of economic growth accelerates, thus reaping the demographic dividend; and as fertility continues to fall to lower levels, economic growth gradually

falls back to a lower steady-state level (no longer the demographic transition we recognize, but technological progress is at the forefront of innovation) as fertility continues to decline. Correspondingly, the so-called "demographic window of opportunity" is formed at specific stages of demographic transition when fertility declines and thus creates a productive age structure of the population.

4. DEMOGRAPHIC CHARACTERISTICS AND THE TRENDS

Generally speaking, research shows that the population of the Macau SAR has been affected by various factors such as economic development, social change and immigration and other factors,

and has certain fluctuation factors and changing characteristics ("Table 1"). According to the statistics and census data of Macau in previous years, the overall population development of the Macau SAR has tended to age since the 1990s. In 1981, the proportion of the elderly (aged 65 and above) population in the Macau SAR reached 7.7%, but due to the large number of young people Chinese mainland the 20th century and the 80s, the age structure of the population of the Macau SAR has changed significantly, and the proportion of the elderly population has continued to decline, falling back to 6.6% in 1991, avoiding the Macau SAR from entering an "aging society". Since then, the proportion of the elderly population has continued to rise, and the proportion of the elderly population has remained above 7% for a long time.

Table 1. Population ageing process in different countries and regions

Country/Region The process of population ageing	The year in which the proportion of elderly people reached the relevant indicator		From 7% to 14% Time required (years)	Years when the proportion of elderly people reaches 21% (ultra-aging society)	From 14% to 21% Time required (years)
	7% (Aging society)	14% (Society for the Elderly)			
Macau SAR	1981	2021	40	2031	10
Hong Kong SAR	1983	2013	30	2023	10
Japan	1970	1994	24	2005	11
South Korea	2000	2017	17	2026	9
UK	1930	1975	45	2026	51
France	1864	1979	115	2020	41

Data source: Statistics and census service of Macau, United nations population division

4.1 Population Aging Index

The population aging index, also known as the ratio of old to young, refers to the relative ratio of the elderly population (65 years old and above) to the number of children and adolescents (0 to 14 years old) in the same population, used to reflect the trend of relative changes at both ends of the population age structure. A higher index indicates deeper ageing. Over the past decade, the population ageing index of the Macau has been on the rise, from 62% in 2011 to about 84% in 2021 in the past decade, of which 2011-2013 was the two years with a faster increase ("Figure 1"). The proportion of children and adolescents is much lower than that of

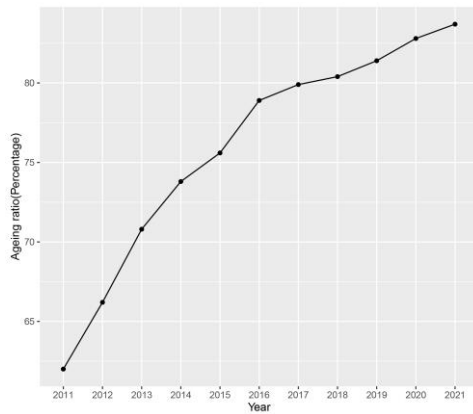the elderly population, and the trend of population ageing is increasing.

Figure 1 The decade trend of population ageing (%).

Data source: Statistics and census service of Macau (Output by authors using R)

4.2 The Dependency Ratio

The old-age dependency ratio, also known as the dependency coefficient of the elderly population, refers to the ratio of the number of non-working-age middle-aged and elderly people in a certain population to the working-age population. To put it simple, the official definition in accordance with the United Nations population division is that the dependency ratio relates the number of children (0-14 years old) and older persons (65 years or over) to the working-age population (15-64 years old), and this indicator is recommended to undertake population censuses every ten years.

Overall, the past decade has witnessed the dependency ratio of the elderly population in the Macau SAR has increased from about 9% in 2011 to about 17% in 2021, in accordance with an average annual growth rate of about 1% ("Figure 2"). It can be seen that the proportion of social aging population has increased, the difficulty of social support has increased, the social urban public resources required by the elderly have further increased, and the aging of the urban population is facing further pressure. According to the relevant indicators of the United Nations population aging, the aging society (7% and above) has been transformed into an aging society (14% and above).
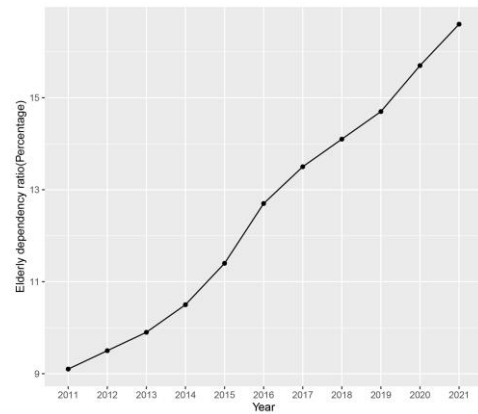

Figure 2 The decade trend of elderly dependency ratio (%).

Data source: Statistics and census service of Macau (Output by authors using R)

4.3 Ratio of Working Population Aged 65 and Above

During the past decade, the proportion of the working population aged 65 and above in the Macau SAR has continued to rise, from about 5% in 2011 to about 13% in 2021, especially from 2018 to 2020 for two consecutive years of rapid growth, in which the average annual growth rate over the decade was 0.6 per cent ("Figure 3"). Factors such as the cost of living and housing prices may cause the elderly in the younger age to work, while the insufficient number of young and middle-aged working people may also lead to the work of the elderly in the younger age group. Elderly workers among the younger elderly population of the Macau may become a new feature of the development of the urban population in the next decade. In addition, in the most recent research by the World Bank in 2021, population aged 65 and above (% of the total population) in Macau SAR accounts for 12.32%, which is slightly lower than that of the mainland China (13%), but relatively lower than that in Hong Kong SAR (19.6%).
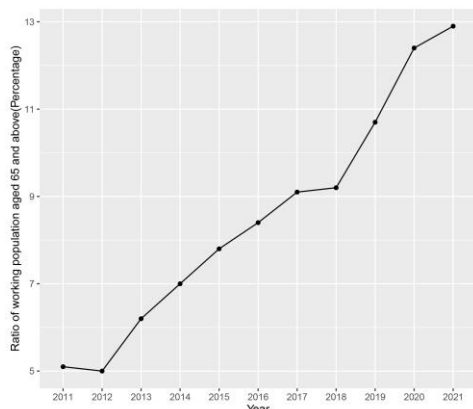
Figure 3 The decade trend of working population aged 65 and above (%).

5. THE AGEING TREND OF ELDERLY POPULATION IN THE PENINSULA OF MACAU

5.1 Setting

Macau, formerly used to a Portuguese colony for centuries, internationally is a port city and also known as a special administrative region in China, where has an area of 32.9 km^2, with a population of about 680,000. Located in the west bank of Pearl River closed to Zhuhai, and connected with Hong Kong via the Hong Kong-Zhuhai-Macau Bridge, the whole territory consists of Macau peninsula, Cotai, part of artificial island and the campus of University of Macau in Hengqin, Zhuhai.

In order to prove the ageing trend in an urbanized area, this study puts a focus on the peninsula area of Macau SAR, where it has a high density of population as opposed to Cotai and other parts of the city. This means that a few of census tracts in the region are researched during 2011 and 2021. ("Figure 4")
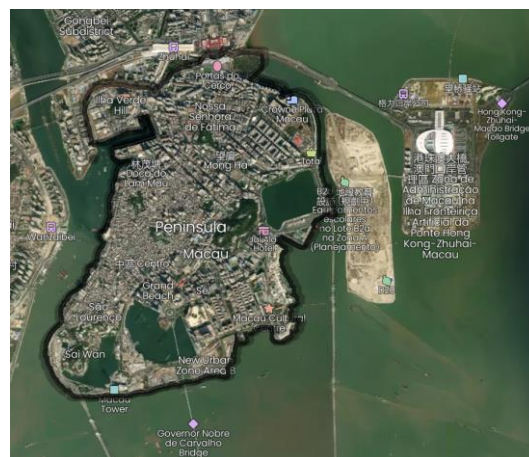

Figure 4 The peninsula of Macau.

5.2 Data and Analysis

The research data elderly population in use originates from Government of Macau Special Administrative Region Division of Statistics and Census Service, which officially has a statistical claim and speech and makes it to the public via Web-GIS platform. The official data contributes to give the authors to conduct the research and find the possible final outcome.

The analysis process generally pays attention to the trend of each demographic census tract between 2011 and 2021, which sixteen tracts in the Macau Peninsula area are analyzed at a longitudinal time, so that each census tract reflects a comparative analysis. Hence, the gap in growth for amount of ageing population is capable to be visualized by the output data. By doing so, each demographic census tract can be able to easily read in amount, also resulting in suggesting the top four census tracts with the most growth.

Therefore, to realize, R program, data analysis tool with necessary codes designed, is technically conducted to be in support of visualizing and rendering the possible outcome in analysis. Before the process taken, given the long name of the demographic census tracts in Portuguese in Macau, it is necessary to format in abbreviation and used in CSV (comma) file column as variable ("Table2", "Figure 5").

Table 2. List of demographic census tract

census_tract	Abbr.
Guia	-
Conselheiro Ferreira de Almeida	C.F.A.
Horta e Costa e Ouvidor Arriaga	H.C.O.A.
Baixa de Macau	B.M.
Barca	-
Praia Grande e Penha	P.G.P.
Patane e São Paulo	P.S.P.
Barra e Manduco	B.M.
Doca do Lamau	D.L.
Fai Chi Kei	F.C.K.
Tamagnini Barbosa	T.B.
Móng Háe Reservatório	M.H.R.
Areia Preta e Iao Hon	A.P.I.H.
Novos Aterros da Areia Preta	N.A.A.P.
Zona de Aterros do Porto Exterior	Z.A.P.E.
Novos Aterros do Porto Exterior e Aterros da Baia da Praia Grande	N.A.P.E.A.B.P.G.
Ilha Verde	I.V.

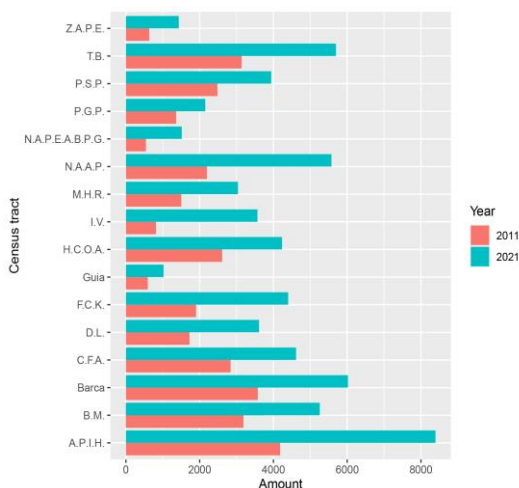Data source: Statistics and census service of Macau

Figure 5 Comparing elderly population increase between 2011 and 2021.

Data source: Statistics and census service of Macau (Output by authors using R)

5.3 Results and GIS Map

In terms of the analysis results dependent upon the output ("Figure 5"), it is the fact that there are four demographic census tracts with high increases on elderly population increase between 2011 and 2021, and geographically speaking, the north part of the Peninsula area of Macau SAR shows the potential risk of ageing population, including Areia Preta e Iao Hon (A.P.I.H.), Novos Aterros da Areia Preta (N.A.A.P.) Tamagnini Barbosa (T.B.), Ilha Verde (I.V.). ("Figure 6")

Figure 6 The four census tracts with the most growth in ageing population.

(Output by authors using Web-GIS)

6. CONCLUSION

In conclusion, this paper aims at understanding the effect on the evolution of ageing population. It contributes to the literature in two ways. On one hand, it contributes to understand the elderly population not just from the text on literature but a further knowledge on statistics based on urban demographic census tract. On the other hand, it dedicates to mapping out the urban ageing region in terms of preparing for the ageing challenges and thus alleviates the risks. Further research may link social or urban factors with specific research questions to explain the mechanism in the specific urban context.

REFERENCES

[1] Jarzebski, M.P., Elmqvist, T., Gasparatos, A. et al. (2021). Ageing and population shrinking: implications for sustainability in the urban century. *npj Urban Sustain* 1, 17. https://doi.org/10.1038/s42949-021-00023-z

[2] Roberts, Dorothy E., "Racism and Patriarchy in the Meaning of Motherhood" (1993). Faculty Scholarship at Penn Law. 595. https://scholarship.law.upenn.edu/faculty_scholarship/595

[3] Choi, Y. J. (2012). End of the Era of Productivist Welfare Capitalism? Diverging Welfare Regimes in East Asia. Asian Journal of Social Science, 40(3), 275–294. http://www.jstor.org/stable/43498840

[4] Tsai, W. (2001). The Management of Later Life: How Elderly in Contemporary Taiwan Manage Their Time. American Journal of

Chinese Studies, 8(2), 115–131. http://www.jstor.org/stable/44288670

[5] Miladinov G. (2021). The mechanism between mortality, population growth and ageing of the population in the European lower and upper middle income countries. PloS one, 16(10), e0259169.
https://doi.org/10.1371/journal.pone.0259169

[6] Donald D. Lee, David S. Reher. (2011). Demographic Transition and Its Consequences. Population and Development Review. https://www.popcouncil.org/uploads/pdfs/2011_PDRSupp_DemTranConseq.pdf