



Sense-making Public Perceptions of Falls, Bone Health, and Caregiving



Lloyd's Register Foundation
Institute for the Public
Understanding of Risk

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EXECUTIVE SUMMARY

The Singapore healthcare system was ranked the world's most efficient in 2014 by Bloomberg, with one of the lowest healthcare costs per capita. Singapore's multi-ethnic population is also one of the most rapidly ageing in Asia with increasing life expectancy, growing chronic disease burden and a shrinking workforce. Singapore reached a demographic milestone in 2018 where the number of older adults aged 65 years and above equalled that of youths 15 years and below. In addition, recent projections show that disability prevalence will grow by five-fold in 40 years.

Falls are an important area of study in Singapore given the high prevalence of over 20% among older adults. The consequence of a fall is of serious public health concern, making up a staggering 80% of cases presented at emergency departments across public hospitals. Victims of traffic accidents are a distant second, almost 20%. Injuries sustained from a fall were also more severe in older adults (above 65 years) where over 60% required hospital admission. While, the physical consequences are well understood, the perceptions of falls and bone health among older adults and caregivers have been under-researched. Studying perceptions can help understand the attitudes and practices that are linked to serious falls and lay the groundwork to formulate upstream bone health messages that are targeted and effective.

We blended traditional survey tools and cutting-edge big data analytics to achieve the following insights on bone health, osteoporosis, falls and caregiving:

1. In Asia, bone health narratives are often medicalised and conflated with osteoporosis. In contrast, such narratives in Australia and the United States tend to be more positive and preventive. We recommend an awareness campaign around prevention in Asia to counteract the incessant medicalisation of bone health. This would empower older adults and nudge them and their caregivers towards a preventative approach.
2. Bone health narratives are most negative and pessimistic in Asia, and most positive in Oceania and North America. The negative baggage is detrimental to early conversations about bone health. We recommend that public campaigns debunk the deterministic and pessimistic nature of bone health, and reframe it with positive and preventative narratives.
3. At the individual level, knowledge of bone health and osteoporosis may not lead to practices that promote bone health. Older adults and their caregivers need to be nudged towards positive behaviours. However, a one-size-fits-all approach cannot achieve this last-mile behavioural change. We found four risk profiles among older adults and recommend customised messaging and nudges towards practices that promote bone health and decrease incidence of falls.
4. Our big data analytics found that caregiver burden, strain and mental health are hardly discussed in Singapore. Instead, caregivers are flooded with information about schemes and subsidies. We advocate for more online and offline spaces to

discuss the daily grind of caregiving, and the need for more resources to promote resilience and mental health support.

5. In essence our study points to a need for a comprehensive and up-to-date study of caregiving in Singapore. The important insights could be used to create customised caregiver toolkits for better resilience and coping with physical and emotional strain.

Longevity provides individuals with prolonged time and opportunities in life; however, older age also comes with certain risks such as diseases, frailty, and mental disorders. The key to ensure quality of life depends on how well we as a society manage ageing risks.

One of the most common ageing risks is falling. Globally, one in three elderlies aged 65 years or above fall at least once a year ¹. Fall incidents among the community-dwelling population could result in serious injuries or even death. According to US Centres for Diseases Control and Prevention, more than 25% of elderlies aged 65 and older experience falls each year. Falls are costly to both the health care system as well as individuals and families. Scholars in the U.S. have calculated the cost of fall accidents to be \$50 billion a year. Research has also found a significant portion of healthcare costs to be falls-



¹ Health Promotion Board, *Falls Prevention Among Older Adults Living in the Community*, 2015

related.² National Institute for Health and Care Excellence reported that more than 3 million people in the UK have osteoporosis, and 500,000 fragility fractures occur each year. 50% of women aged 50 and above will break a bone due to osteoporosis, and the rate is 20% for men of the same age group.³

In Asia, hip fracture cases are expected to grow more than two-fold to 2.56 million in 2050 from 1.12 million in 2018.⁴ The study attributed the ageing demographics in Asia, particularly in China and India, to be critical drivers of such a staggering increase. In Hong Kong, the latest osteoporosis and hip fracture medical costs for patients and local government were estimated at HK \$ 660 million and projected to HK \$ 1.9 billion by 2050.⁵ For Singapore, studies have shown that fall incident rate increase significantly with age and majority of falls occur at home. One estimate shows the crude incident rate of unintentional falls in Singapore is 277.7 per 100,000 for those aged 60 and above.⁶ Moreover, hip fracture cases have increased to 2729 fractures per year in 2017 from 1487 cases in 2000.⁷

8.9 million
hip fractures caused by
osteoporosis annually

Source: International Osteoporosis Foundation

2.56 million
Hip fracture cases in Asia by
2050

Source: Cheung, C. L., et al. (2018). An updated hip fracture projection in Asia: The Asian Federation of Osteoporosis Societies study. *Osteoporosis and sarcopenia*, 4(1), 16–21.



The good news is that most falls are preventable if modifiable risks are well managed. Some of the risk factors for falls include low bone density, visual impairment, medication, impaired balance or gait, and psychological factors such as depression and fear of falling.⁸ While physical risk factors are well-understood among medical practitioners and policymakers, the psychological, social, and behavioural aspects of falls remain under-studied. This report aims to uncover individual and public

² Allen K, "Older Adults Falls Cost About \$50 Billion a Year", AARP, 2018

³ National Institute for Health and Care Excellence, *NICE impact falls and fragility fractures*, 2018

⁴ Ching-Lung Cheung et al, "An updated hip fracture projection in Asia: The Asian Federation of Osteoporosis Societies study", *Osteoporosis and Sarcopenia*, 2018

⁵ Cheung E, "Number of hip fractures from osteoporosis in Hong Kong expected to triple in 30 years", *South China Morning Post*, 2018

⁶ Health Promotion Board, *Falls Prevention Among Older Adults Living in the Community*, 2015

⁷ Ching-Lung Cheung et al, "An updated hip fracture projection in Asia: The Asian Federation of Osteoporosis Societies study", *Osteoporosis and Sarcopenia*, 2018

⁸ Dai, W., Tham, Y., Chee, M. et al., "Falls and Recurrent Falls among Adults in A Multi-ethnic Asian Population: The Singapore Epidemiology of Eye Diseases Study", *Scientific Reports*, 2018

perceptions around falls, bone health, and osteoporosis to help the public understand the risk better.

It is well-established that individual perception of risk is correlated with their decision, and public perception and narratives are influential in public consensus and policy formulation. Understanding how the public understands falls and bone health will enable medical professionals and policymakers to design targeted interventions and policies. This study also aims to identify characteristics of community dwelling older adults in Singapore and initiate discussion and conversation on how society could provide customized care catering to their actual needs.

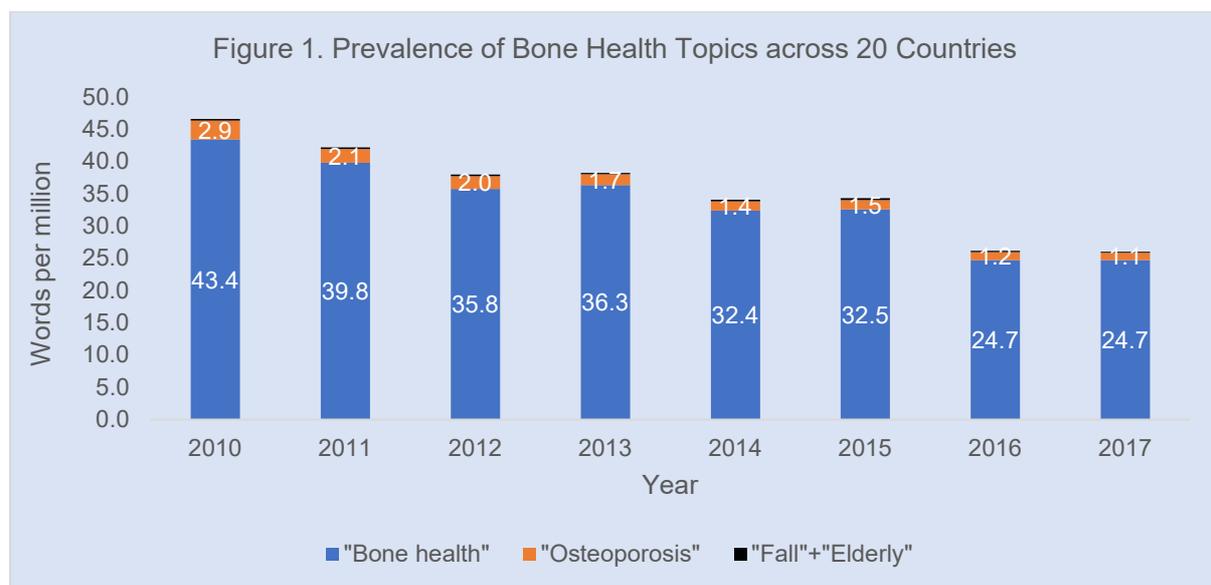
As the ageing population grows worldwide, we can expect the cases of osteoporosis and falls and medical and social costs to increase in the coming decades. Therefore, it becomes imperative to investigate in the issue to design strategies and policies that ensure quality of life among elderlies.

Chapter 2: Sense-making Public Perception of Falls and Bone Health Around the World



Bone health and osteoporosis conversations across regions

Globally, conversations around bone health have declined between 2010 to 2017. Specifically, the occurrence of 'bone health' was at 43 words per million in 2010, and its prevalence rate gradually decreased to 25 words per million in 2017 (**Figure 1.**). Meanwhile, conversations about 'osteoporosis' and 'elderly falls' were insignificant throughout the entire period, as shown in the figure below. Despite being an urgent health issue, especially among the elderly population, falls and health risks of osteoporosis are under-reported by the media. As societies worldwide are undergoing demographic ageing, it is imperative to raise public awareness around bone health and fall prevention-related topics.

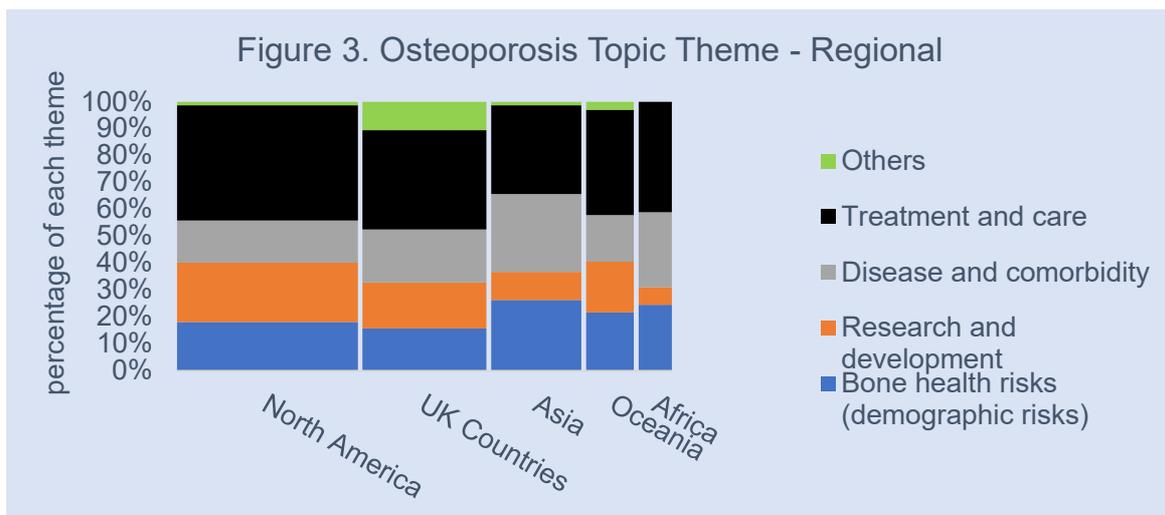
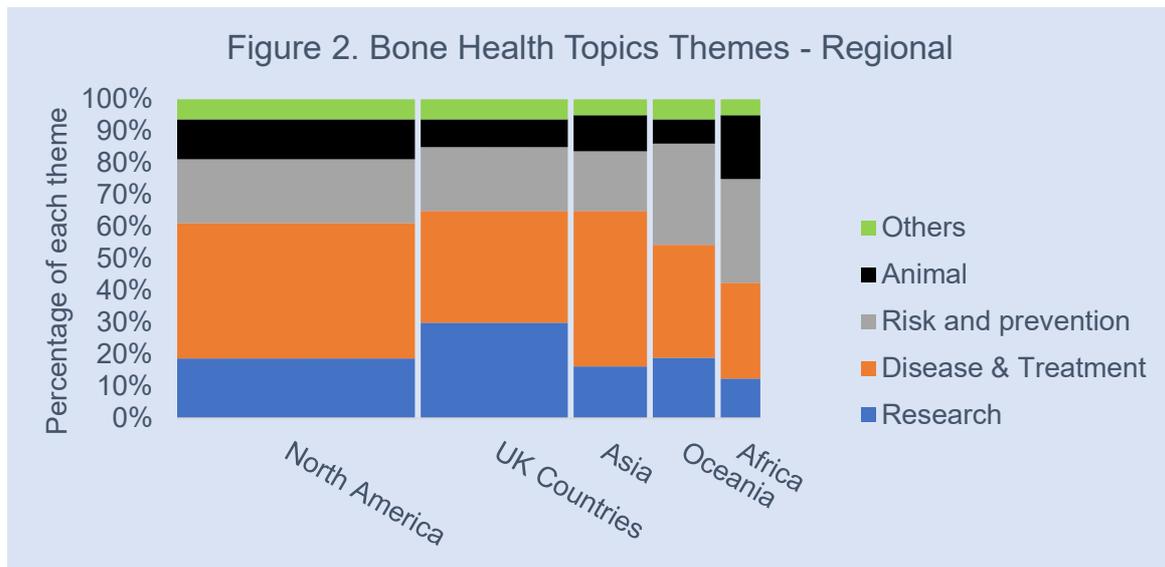


Regional breakdown of bone health and osteoporosis conversation topics

Below (Figure 2.) is a Mekko chart⁹ demonstrating 8-year average corpus size of each region and the percentage breakdown of bone health conversation's topics. As shown in the figure, North America, namely the United States and Canada, comprise 38% of the 'bone health' corpus – making it the largest among the regions. Meanwhile, Africa, despite comprises of 5 of the 20 countries, its corpus size only accounts for 7% of the whole. This regional disparity is likely due to differences in economic development, media capacities, and language limitation of the corpus database. Nevertheless, this

⁹ A Mekko chart or marimekko chart is a two-dimensional stacked chart. In addition to the varying segment heights of a regular stacked chart, a Mekko chart also has varying column widths. Column widths are scaled such that the total width matches the desired chart width.

finding should spur local and regional efforts to raise public awareness of bone health risks in the African region.



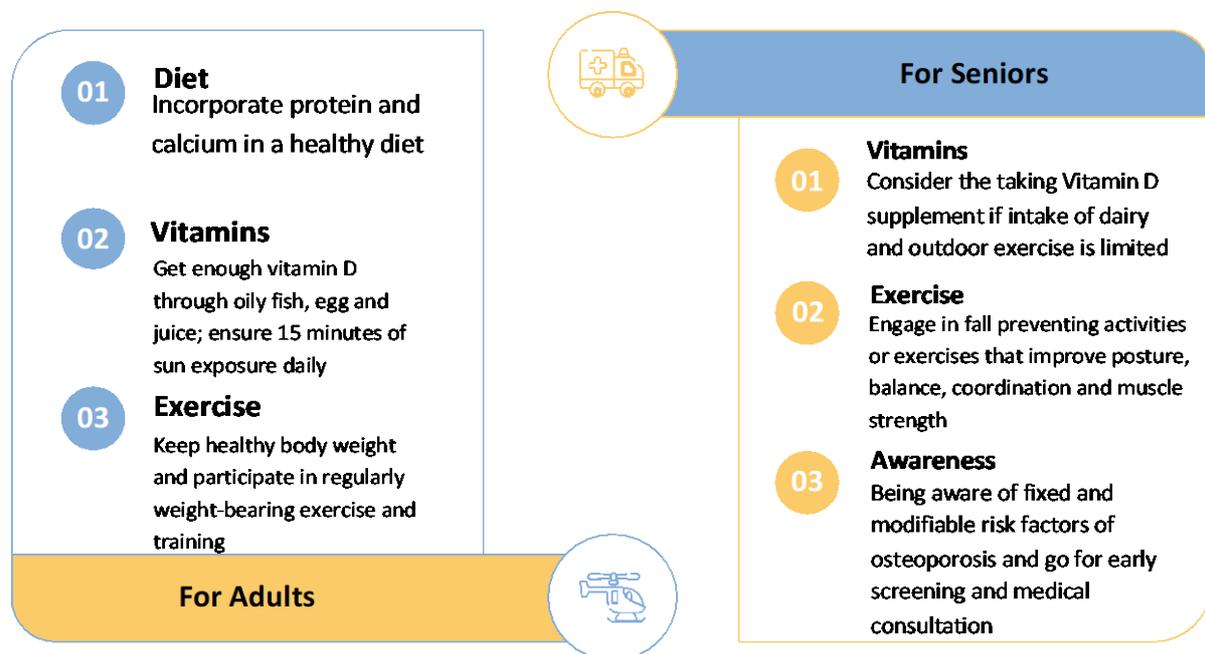
Among the five most salient bone health topics in online media, ‘disease and treatment’ appeared a prominent one across all regions and cultures. This finding is not surprising as studies from countries with different cultural and socio-economics dynamics and genetic predispositions have all shown a rise in bone health disease.^{10,11} Meanwhile, societal conversations in bone health research and risk and prevention appear to be less prominent than ‘disease and treatment’.

However, older age osteoporosis is preventable, and International Osteoporosis Foundation suggests that the public adopts a bone disease preventative lifestyle

¹⁰ International Osteoporosis Foundation, *Epidemiology, costs and burden of osteoporosis in Asia 2009*, 2009

¹¹ Jeremiah MP et al, “Diagnosis and Management of Osteoporosis”, *American Family Physician*, 2015

starting from childhood. Rather than focusing on treating the disease, health care campaigns should educate the public to be proactive in preventing the onset of bone disease.



Source: International Osteoporosis Foundation

Moreover, the above analyses also demonstrate regions sharing similar concerns over bone health, showing the globalization of bone health topics. This convergence is likely due to the global-wide ageing populations. This trend provides a perfect opportunity for cross-country collaboration to highlight and promote best practices.

For 'osteoporosis' related topics, 'treatment and care' was the most prevalent theme from 2010-2017, followed by 'disease and comorbidity' (Figure 3.)

One study analysing forty-four qualitative research in osteoporosis found three significant themes around the topic: lived experiences of osteoporosis patients, prevention and treatment of the disease, and the broader implications for patients and the general public.¹² Other than topic on the disease's treatment, the current study did not find significant discussions around osteoporosis patients' lived experience. It shows a gap between osteoporosis patients' perspective and what the media are representing in their content.

Physical disease is indeed not a light matter, and we should continue to find the best treatment for the patients. However, the condition is also personal, and it is a lived experience of the patients and their families day-to-day. Therefore, it is essential to reframe the societal narratives of the disease with a balanced tone and contents.

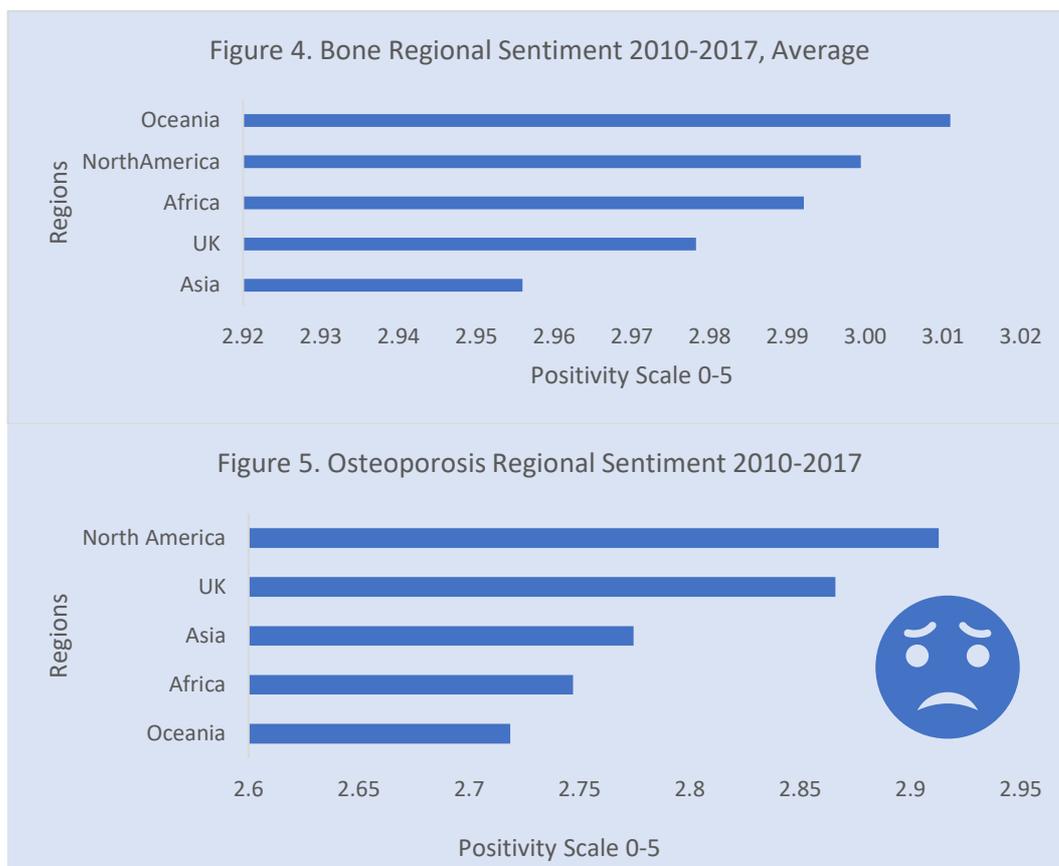
¹² Bombak, A. E., & Hanson, H. M., "Qualitative Insights from the Osteoporosis Research: A Narrative Review of the Literature", Journal of osteoporosis, 2016

Specifically in Asia, ‘disease and morbidity’ has the highest prevalence rate (29%) compared with other regions. Although osteoporosis is a bone disease and medical treatment is required, public discussions around the topic should have a balanced take on prevention and treatment. Regional efforts are necessary to reframe osteoporosis as a preventative disease instead of the destined suffering in older age.

Sentiment analysis of bone and osteoporosis conversations

Given the problems mentioned above in bone health narratives, it is not surprising that regional level sentiment of ‘bone’ related conversations is mostly negative (**Fig.4**). Specifically, the sentiment of bone conversation in Oceania and North America is in the neutral zone, with 3 points on the positivity scale. The rest of the regions are all below the neutral line with the Asian region being the most negative. Moreover, sentiment analysis result reveals an overall pessimistic attitude in osteoporosis societal narrative (**Fig.5**). Specifically, all areas show scores lower than 3.

These results call for urgent actions to reframe bone health and osteoporosis conversation with a more positive attitude around prevention.

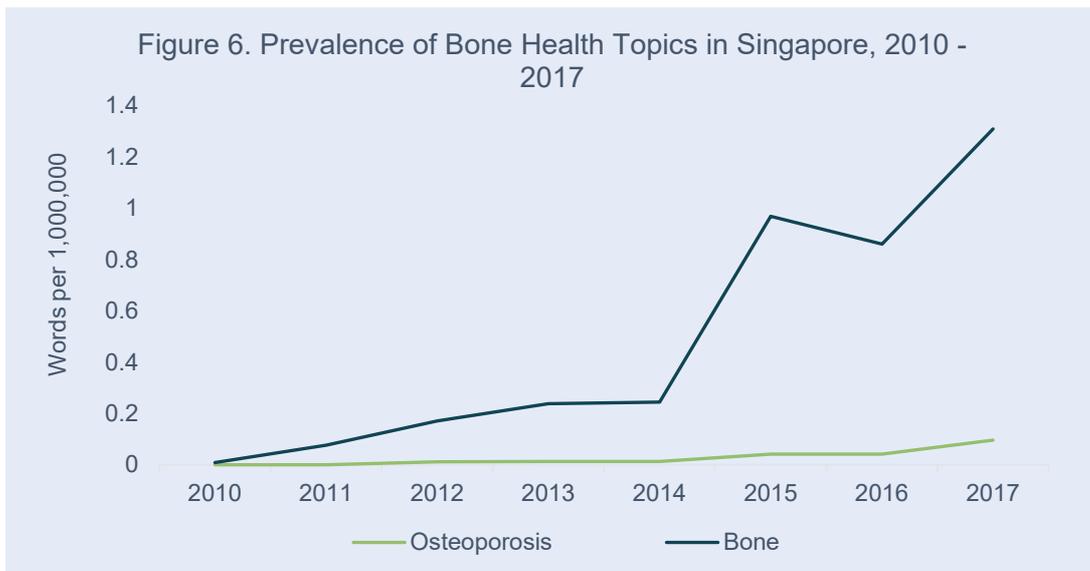




Bone health societal narratives in Singapore

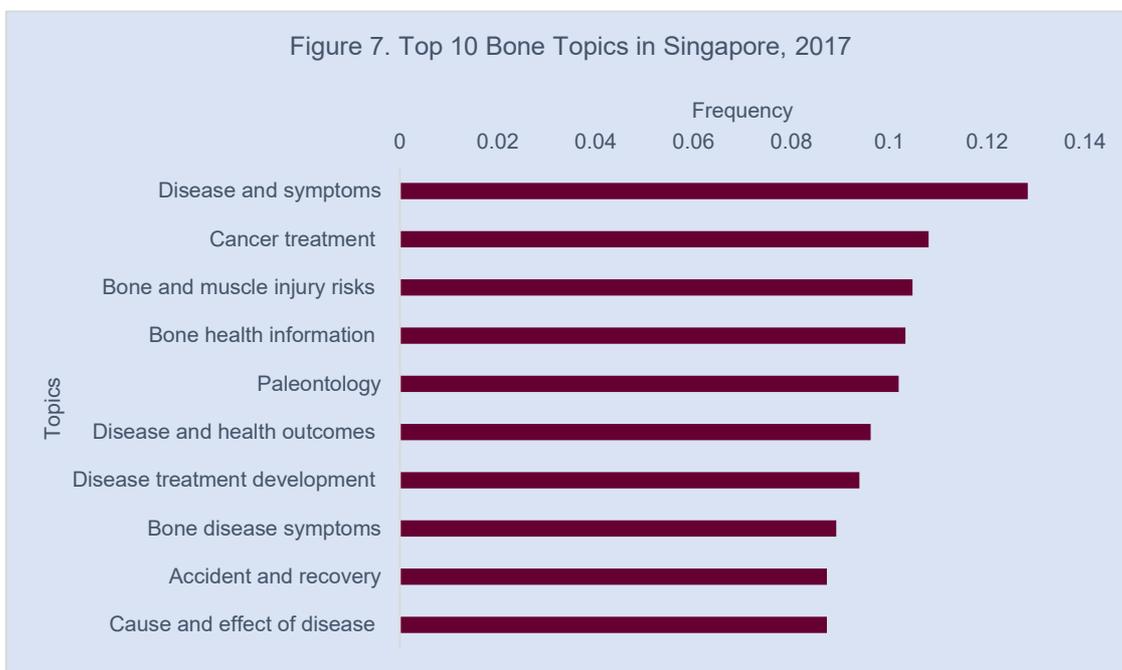
Despite the global decline of 'bone health' conversations, Singapore's media attention on the topic has increased significantly since 2010, though its prevalence rate still has the potential for further growth, as shown in Figure 6. The osteoporosis narrative, on the other hand, did not see significant change for the eight years. It is an alarming observation as Singapore is ageing rapidly, and hip fracture cases have increased 5-fold for women aged 50 and above and 1.5-fold for men of the same age group over the last 30-years.¹³

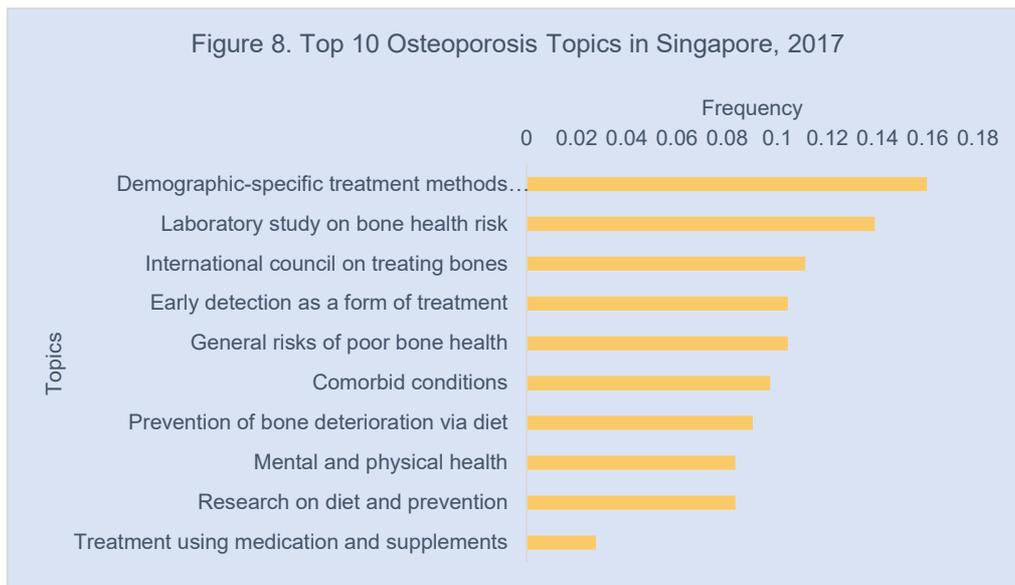
¹³ Health Promotion Board, *Osteoporosis*, 2019



Bone and Osteoporosis Narratives in Singapore – 2017 data

In 2017, bone-related narratives in Singapore shared similar themes with the Asian region. Conversations are focused on bone-related disease and treatment. Cancer treatment also appeared to be a prevalent topic in bone health. This trend is likely due to the public's fearful and worrying reaction towards cancer in general.





A systematic review found that people feared cancer more than other diseases. The general public often associates cancer with treatment, incapacitation, or even death. Therefore, it is likely media would report stories that incite a heightened reaction among the masses. On the other hand, osteoporosis is often called the 'silent disease' because bone loss is asymptomatic until the patient experience a strain, fall, and fracture.

Similar to bone health, osteoporosis narrative in Singapore also has a focus on treatment. However, osteoporosis treatment has a gender focus on women (**Figure 8.**). This is not surprising as the female gender is more susceptible to osteoporosis, especially after menopause. This gender focus on osteoporosis is a positive trend, and stakeholders should also extend the discussion to other vulnerable groups.

Results in this section showcase declining global trends around “bone health” and “osteoporosis” conversations in online media. Moreover, falls among elderly are rarely discussed despite being one of the major health concerns in among community dwelling older adults.



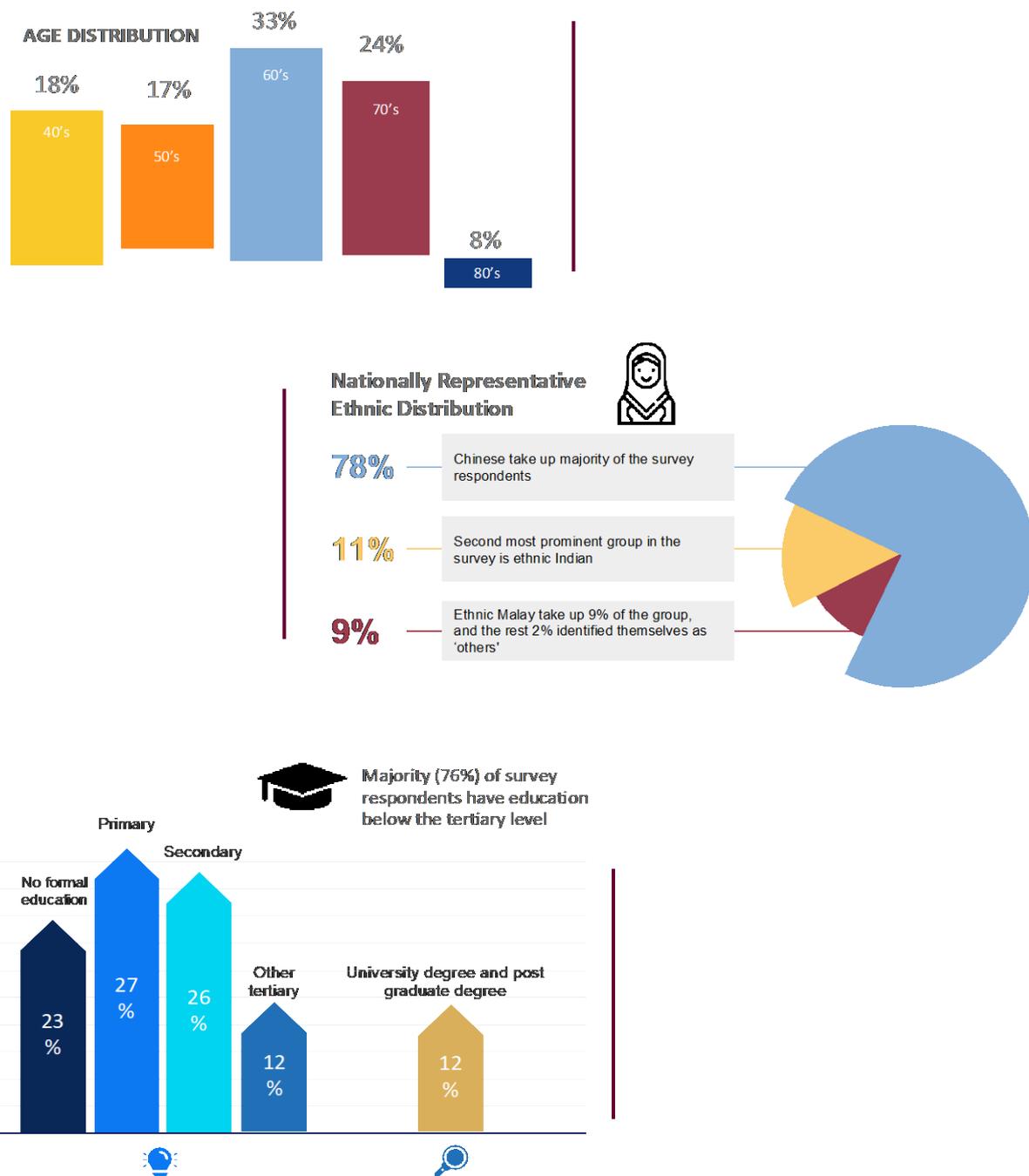
Chapter 3

National Representative Survey Results in Singapore

Survey data description

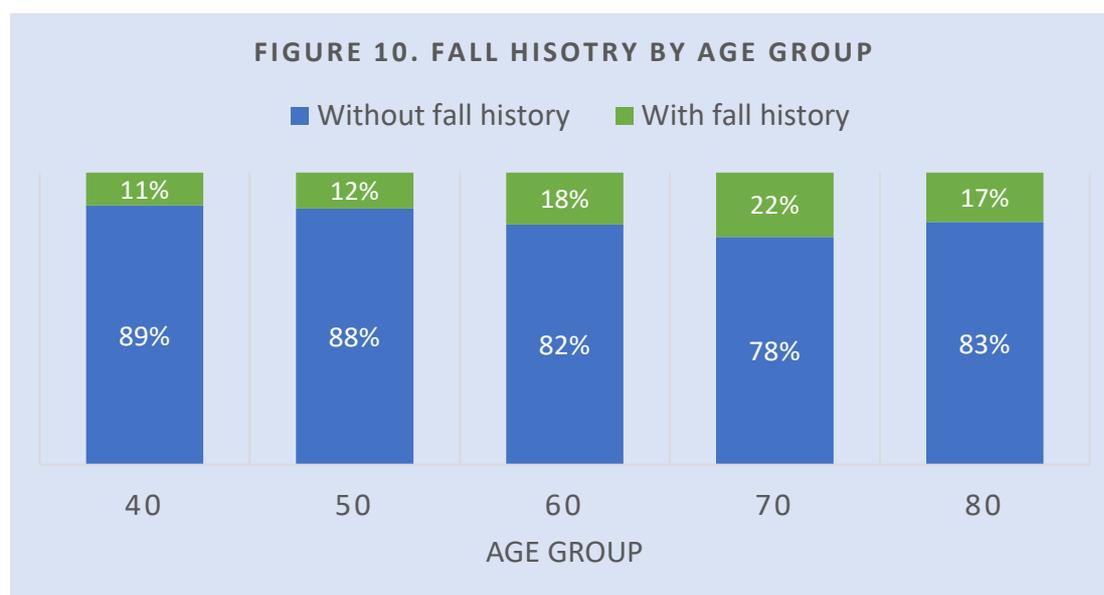
This section presents nationally representative data obtained from the Department of Statistics of Singapore. A total number of 1800 of people were reached, and 858 completed the survey. Annex A presents detailed descriptions of the survey sampling process and survey section breakdowns and sample questions. The following infographics show descriptive statistics of the survey respondents.

Figure 9. Descriptive Statistics of Survey Respondents



Falls History

Figure 10 below presents the percentage of survey respondents who reported whether they have fallen in the past 12 months, categorized by age group. The proportion of respondents with falls history in the past 12 months increased with age until the 80-year old group. This finding aligns with literature that age is one of the main risk factors of falls.¹⁴ Moreover, each age group includes a considerable number of people with fall history; therefore, falls education and prevention programs should consider expanding their target audience to cover a broader range of age groups.



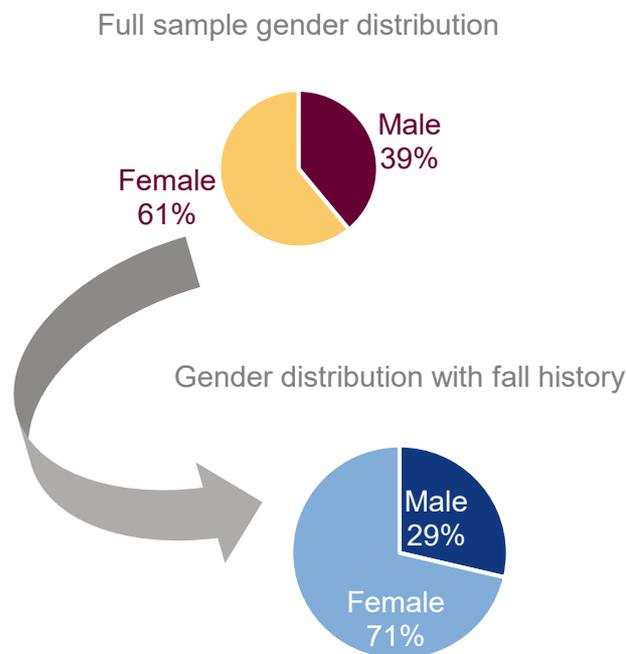
Gender and Fall History

The survey result shows 71% of all respondents who have fall history in the past 12-month are females compared to 29% males. Compared with the whole sample gender distribution, females are disproportionately represented in terms of falls history. This finding aligns with the falls and bone health literature that the female gender significantly increases the risk for falls (Dai et al., 2018) as they are more susceptible

¹⁴ Robbins AS et al. Predictors of falls among elderly people. Results of two population-based studies. Archives of internal medicine, 1989, 149:1628-1633.

to osteoporosis.¹⁵ Among community-dwelling individuals aged 50 and above, the osteoporosis prevalence rate is 49% for women compared to 9% overall.¹⁶

Figure 11. Gender Distribution, Caregiver and Full Sample Comparison



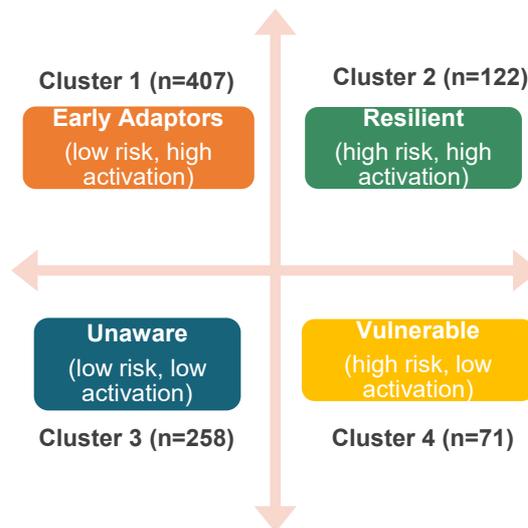
Sample Personas and Intervention Strategies

Effective policies and public education campaigns will require relevant stakeholders to understand individual differences and circumstances. Having a better understanding of community-dwelling older adults' different characteristics provides policymakers, healthcare providers, and industry insights to design targeted interventions. Segmentation of the community population can help identify groups within the country or community. For this report, we employed statistical K-means testing and identified four clusters. The four groups are placed on a 2x2 Matrix based on their health risk level (x-axis) and awareness and participation level of fall-preventing activities (y-axis). Analytical results also demonstrate unique demographic characteristics, falls knowledge and prevention activities participation level. We also suggested intervention strategies based on the findings.

¹⁵ Zhou et al, "Investigation and analysis of osteoporosis, falls, and fragility fractures in elderly people in the Beijing area: a study on the bone health status of elderly people ≥ 80 years old with life self-care". Archives of osteoporosis, 2017

¹⁶ Resnick et al, "The impact of osteoporosis, falls, fear of falling, and efficacy expectations on exercise among community-dwelling older adults", Orthopedic nursing, 2014

Figure 12. Segmentation of Community-dwelling Elders in Singapore



Cluster 1 – Early Adopters

Respondents in this group are younger with a better health outcome. Specifically, 98% did not report having fallen in the past 12 months. Among all the respondents hold education degree or above, 45% are from cluster 1.

Based on the characteristics above, fall prevention programs or educational campaign should aim to equip and assist the Early Adopters. As they have better health outcome and a higher rate of degree holders, they will be able to seek for resources if needed.

Cluster 2 – Resilient

Close to 30% respondents in of Cluster 2 have four or more diseases; which is the highest percentage among the 4 clusters. Moreover, 84% of this cluster also reported having fallen in the last 12 months. Meanwhile, the participation rate of fall-preventing activities is relatively higher in Cluster 2 across all 5 of the activities.

Although significant number survey respondents in Cluster 2 are disease-ridden and a majority of the group have fallen, they are fortunately still active and informed. Therefore, it is crucial to help them maintain this momentum so that they wouldn't become disengaged for physical or financial reasons.

Cluster 3 – Unaware

93% of Cluster 3 are older adults aged 60 and above – making it the most senior group. Yet, only 6% of them reported having fallen in the past 12 months. With only 5% having a college degree or above, it is not surprising that the group also reported being the least aware of fall preventing activities. This group likely fell through the cracks of bone health engagement or campaign programs. The good news is that they are still relatively healthy. But age and limited education, and low awareness level still make

them a vulnerable group. Hence, community program managers should look for alternative ways to identify and reach out to this group.

Cluster 4 – Vulnerable

Cluster 4 is the second worst in terms of health status, with 77% having one disease or more. Moreover, 1 in 4 reported having fallen in the past 12 months, and 94% of the group are either single, widowed or divorced. To make the matter worse, all respondents in this group live alone. Without a close and reliant social network, cluster 4 lacks the necessary support when needed. In terms of participating in fall-preventing activities, this cluster performs poorly for adopting the assistive device (13%) and falls education (9%).

Given their fall history, health status and living condition, health care and social workers should give them immediate attention and intervention.

Summary of Intervention Strategies

- **Cluster 1** (early adopters): **Equip and assist**
- **Cluster 2** (resilient): **Maintain and encourage**
- **Cluster 3** (unaware): **Monitor and prevent**
- **Cluster 4** (vulnerable) : **Intervene**

Address the Awareness and Participation Gap

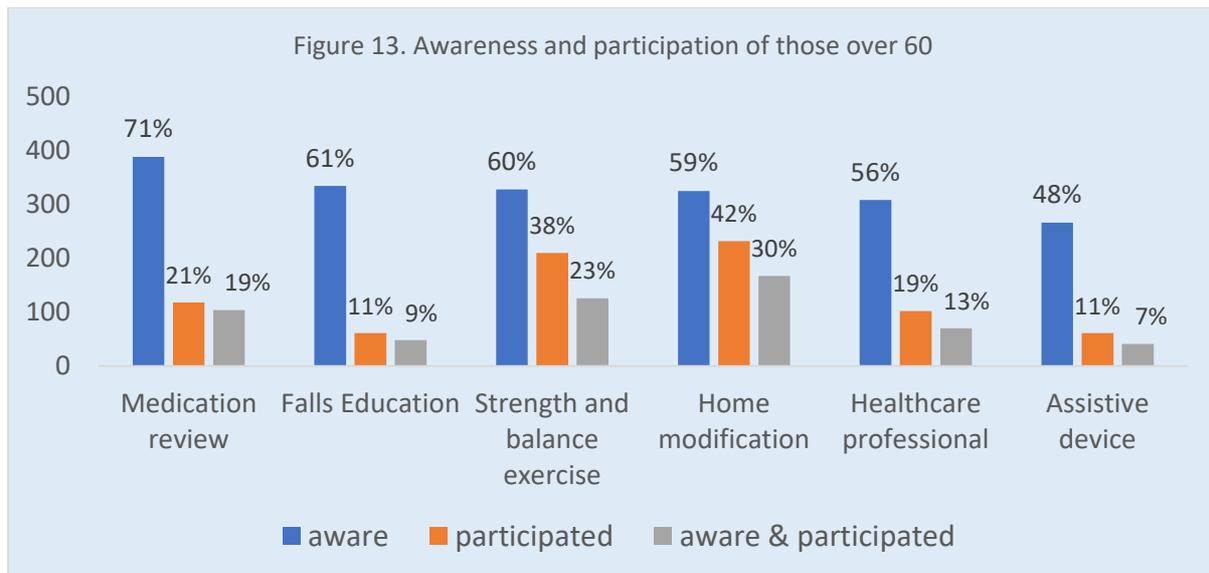


Figure 13. shows that for respondents aged 60 and above, awareness of bone health and fall-prevention does not necessarily lead to action or participation. In reality, there exists a wide gap between awareness and participation across all knowledge domains. It is crucial to understand the factors that lead to differences in participation before designing health interventions. This study tested a broad range of demographic and risk factors including, age, gender, living arrangements, health status and more, aiming to explain the differences in the awareness and participation gap.

Results show that marital status, housing type, health status, falls efficacy and fear of falling are factors hindering the adoption of assistive devices, despite being aware of the benefits. Home modification, living arrangement, falls efficacy and knowledge of fall-preventing activities are significant factors affecting active adoption¹⁷ of home modification. Detailed information on the regression results are presented in Annex B.

Evidence-based health interventions should be designed based on the risk profiles of individuals/communities. Marital status, housing type, health status, falls efficacy, fear of falling, should be assessed when designing behavior nudges to promote the adoption of assistive devices.

¹⁷ meaning the participant used the home modification knowing the benefits.

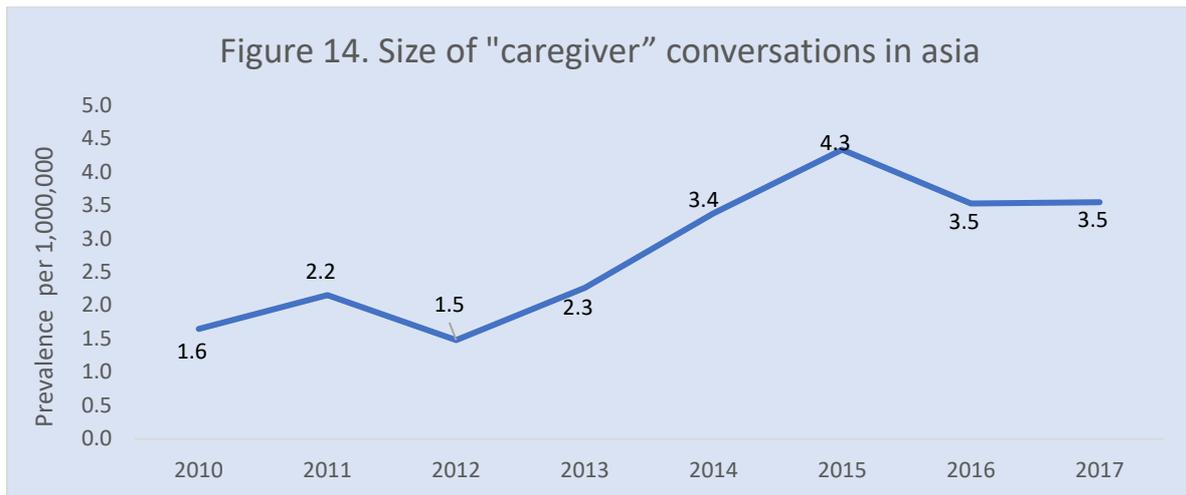


Chapter 4

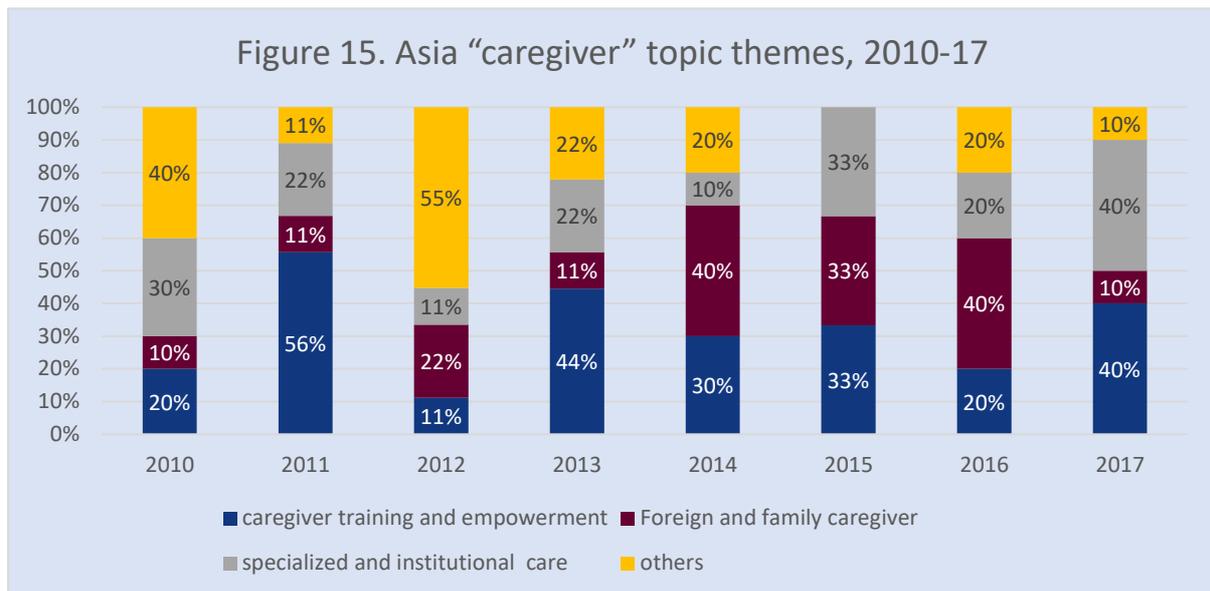
Caregiver Narratives in Asia

Big Data Analytics and Caregiver Narratives around the World

Global prevalence of caregiver conversations has grown over eight years. From 2010 to 2017, the number of times ‘caregiver’ appeared per million words have increased from 1.6 to 3.5. However, as shown in the figure below prevalence of conversations did not grow significantly in the last two years – offering a need to generate continuous growth of caregiver conversations as ageing countries are facing various challenges in the caregiver or nursing industry.



In terms of the conversation themes, analytical results show a great diversity from year to year. Three main topics appeared across the years, namely: caregiver training and resources, family vs foreign caregivers, specialized and institutional care. Moreover, a unique topic¹⁸ also appeared in each year, showing the variety of concerns around the caregivers. Yearly study on the subject is necessary to monitor themes of caregiver topics.

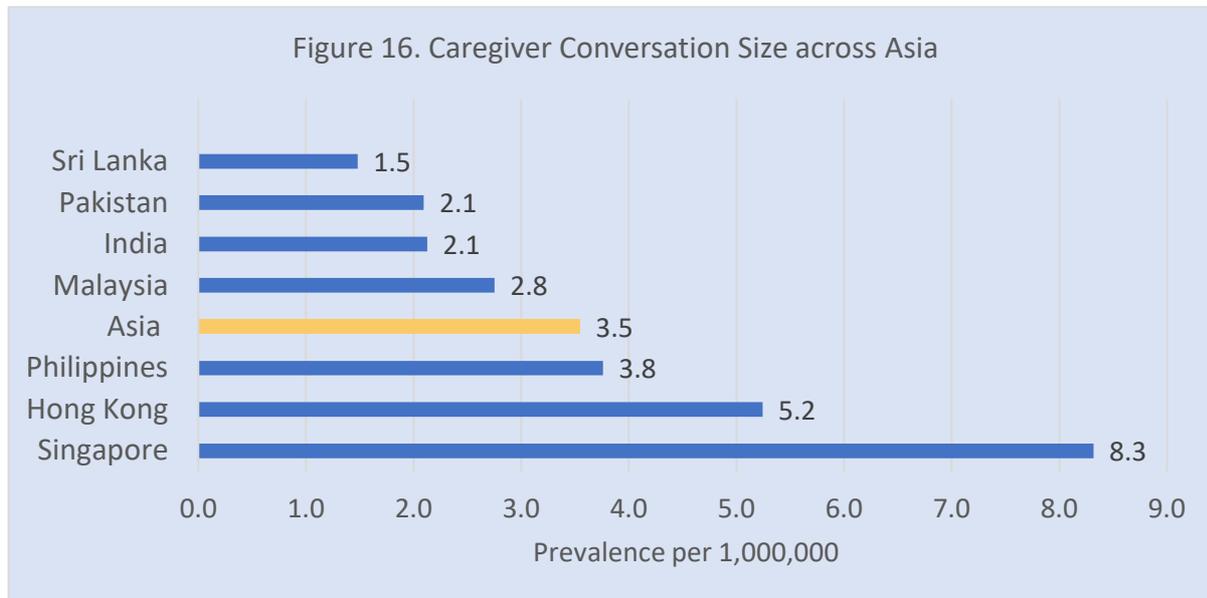


¹⁸ Topics include: physical and mental challenges (2010), elder abuse (2011), mental diseases (2012), mental stress of caregiver (2013), childcare challenges (2014), cost of caregiver (2016), mental health (2017)

Singapore and the World

This section compares Singapore's caregiver societal narrative with the rest of the region. Countries/ city include Singapore, Hong Kong, Malaysia, India, Philippines and Sri Lanka.

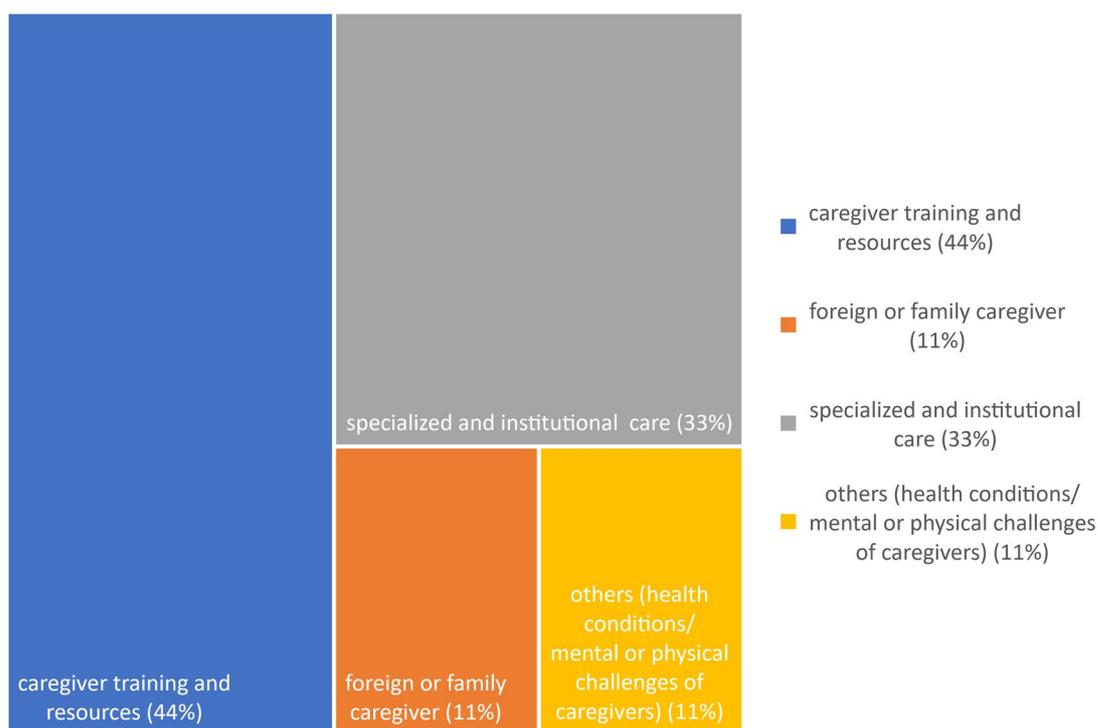
In term of size of conversation, Singapore was the top among the countries studied.



Its conversation size was more than double of Asia's average size (3.5 per million). Hong Kong and the Philippines took the second and third place – both above the Asian average. Meanwhile, Malaysia, India, Pakistan and Sri Lanka demonstrate the underwhelming prevalence of caregiver topics.

Overall, in Singapore, there are around nine times more media conversations about “hard topics” (caregiver training, specialized and institutional care, family or foreign caregiver) compared to “soft topics” such as caregiver's mental wellbeing and health conditions. Figure 17. shows the prevalence of each caregiver topics in Singapore.

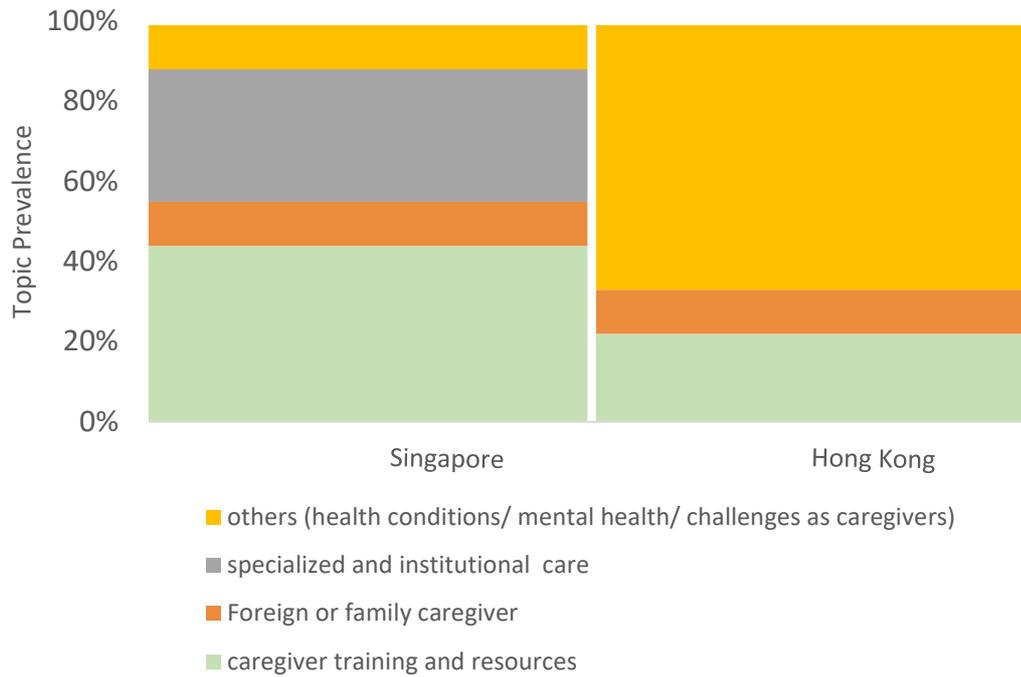
Figure 17. Singapore Caregiver Topic Prevalence (2017)



The following sections compare Singapore’s caregiver societal narrative with countries or city in the region. Insights derived from the comparisons will help identify trends in caregiver conversations and gaps in caregiver narratives. Understanding the gaps will arguably inform public communication expert

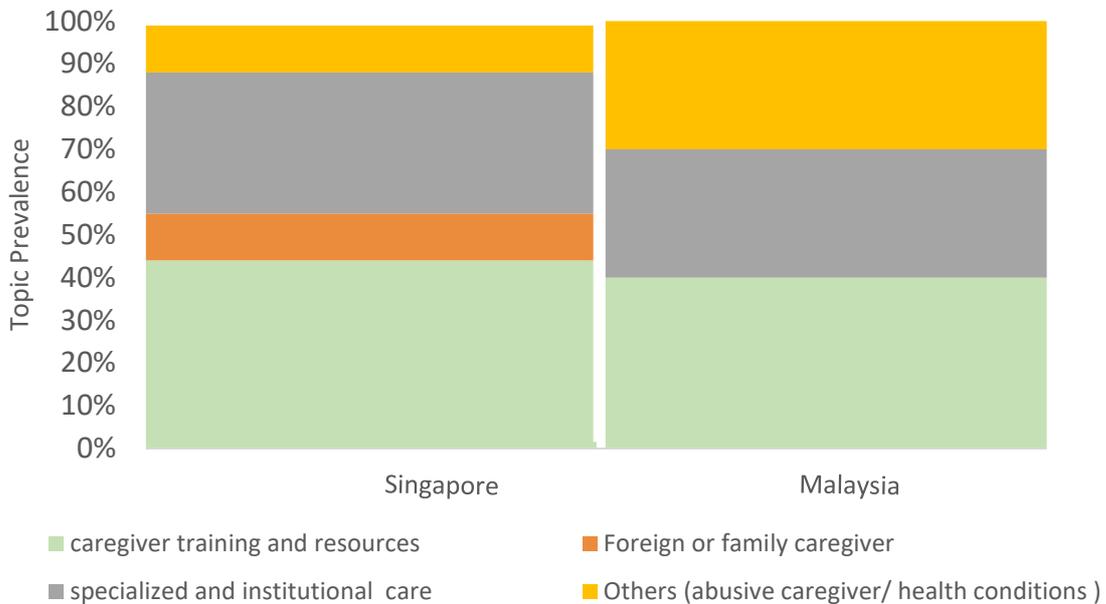
Compared to Hong Kong, Singapore’s media has much lower coverage on topics about mental and physical challenges of the caregiver, and high prevalence on caregiver training and resources (Fig. 18). Hong Kong’s media has no coverage about institutional care which reflects the family-based caregiving culture in the region.

Figure 18. TOPIC PREVALENCE SINGAPORE VS HONG KONG



Singapore and Malaysia share similar societal narratives about caregivers. However, societal narratives in Malaysia are more problem-focused judging from its higher prevalence (30%) of topics related to abusive caregiver and health concerns.

Figure 19. TOPIC PREVALENCE SINGAPORE VS MALAYSIA



10% India’s societal narrative is about specialized and institutional care compared to 33% in Singapore (Fig. 20), which reflects the different forms of care in each society. Moreover, this lack of professional nursing care narrative in India is arguably due to the lack of training and education resources in senior care.

Figure 20. TOPIC PREVALENCE SINGAPORE VS INDIA

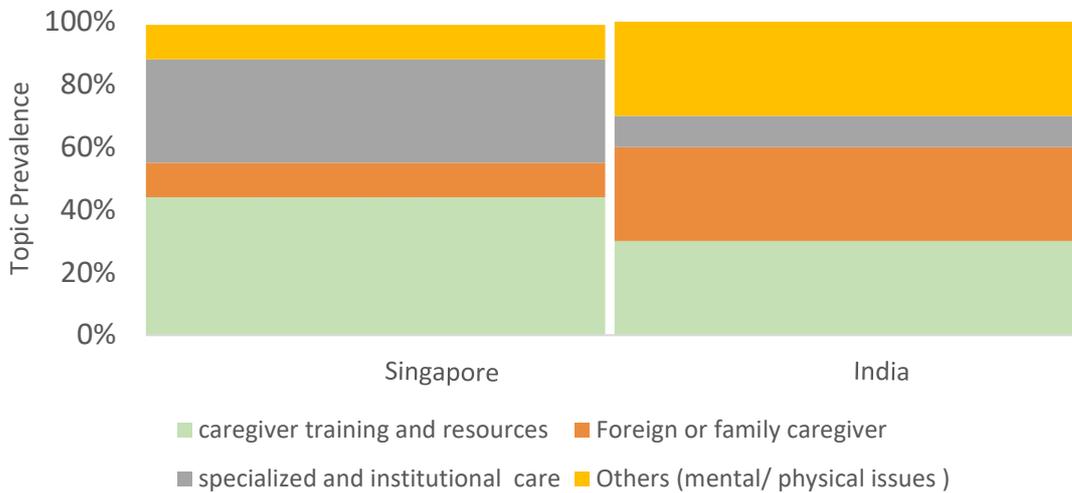


Figure 21. TOPIC PREVALENCE SINGAPORE VS PHILIPPINES

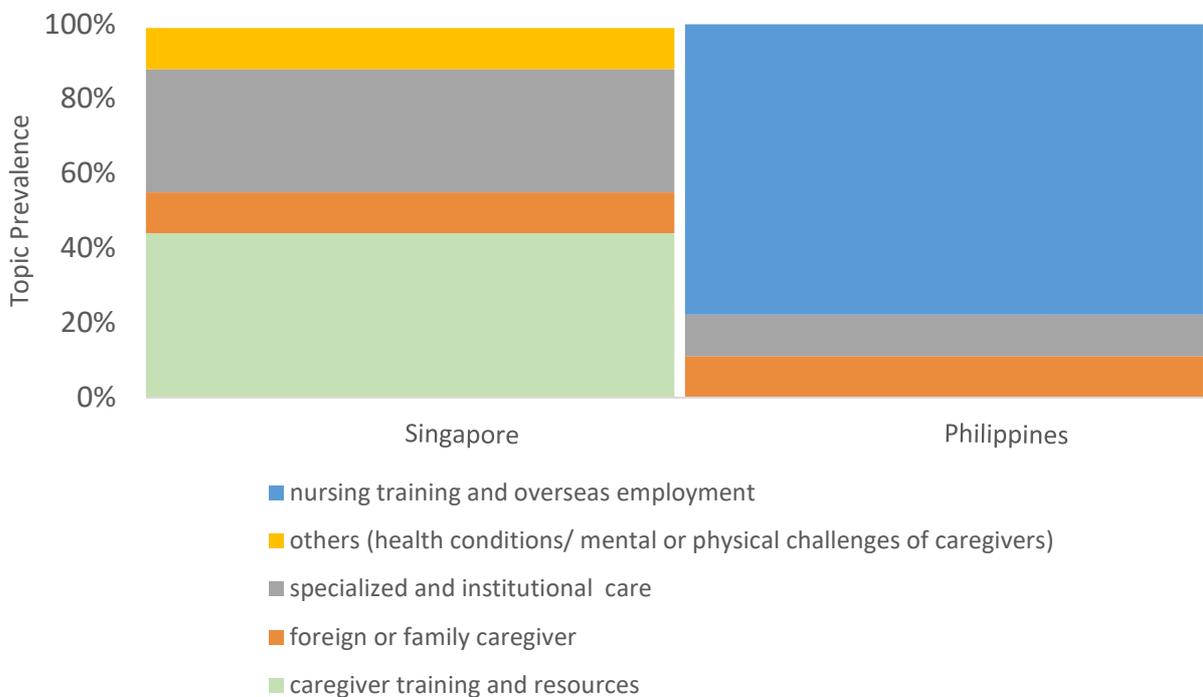


Figure 21. shows Singapore and Philippines having distinctive societal narrative around caregivers. Close to 78% of the caregiver narratives in 2017 in the Philippines is about nursing training and overseas employment. It is not surprising that the Philippines is one of the largest human resource exporters for nursing care. Recent numbers show that 18,500 Filipinos are working for the U.K. National Health Service; around 30,000 working in the United Arab Emirates and 150,000 in the United States.

With global demographic ageing and the on-going COVID-19 pandemic, it is reasonable to expect an increasing demand for nursing talents from the Philippines.

Foreign demand for Filipino nurses has drained its domestic supply of caregivers. Given the already inadequate health care infrastructure and resources, the current model of international supply and demand of Filipino nurses puts the vulnerable population at risk without proper and sufficient care. Countries and international organizations should work together to help Filipino nurses find employment at home.

Uncovering Caregiver Narratives – Survey Results

CAREGIVER

DEMOGRAPHICS

MEAN AGE:

CAREGIVER 48 y/o

NON-CAREGIVER 50 y/o



Mean age of caregiver is younger than non-caregivers



57%

female caregiver

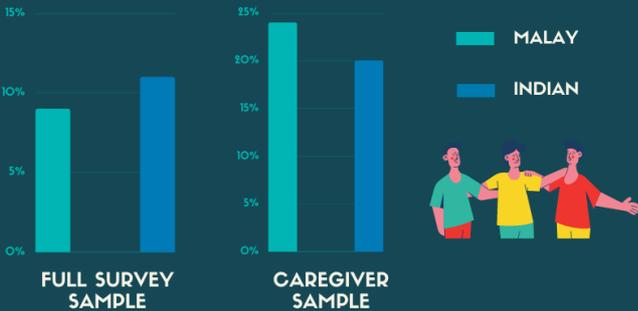


43%

male caregiver

Male representation increased in the caregiver group compared to 39% in the full sample; caregiver trainings and empowerment programs should try to include different gender perspective

GREATER ETHNIC DIVERSITY IN THE CAREGIVER GROUP



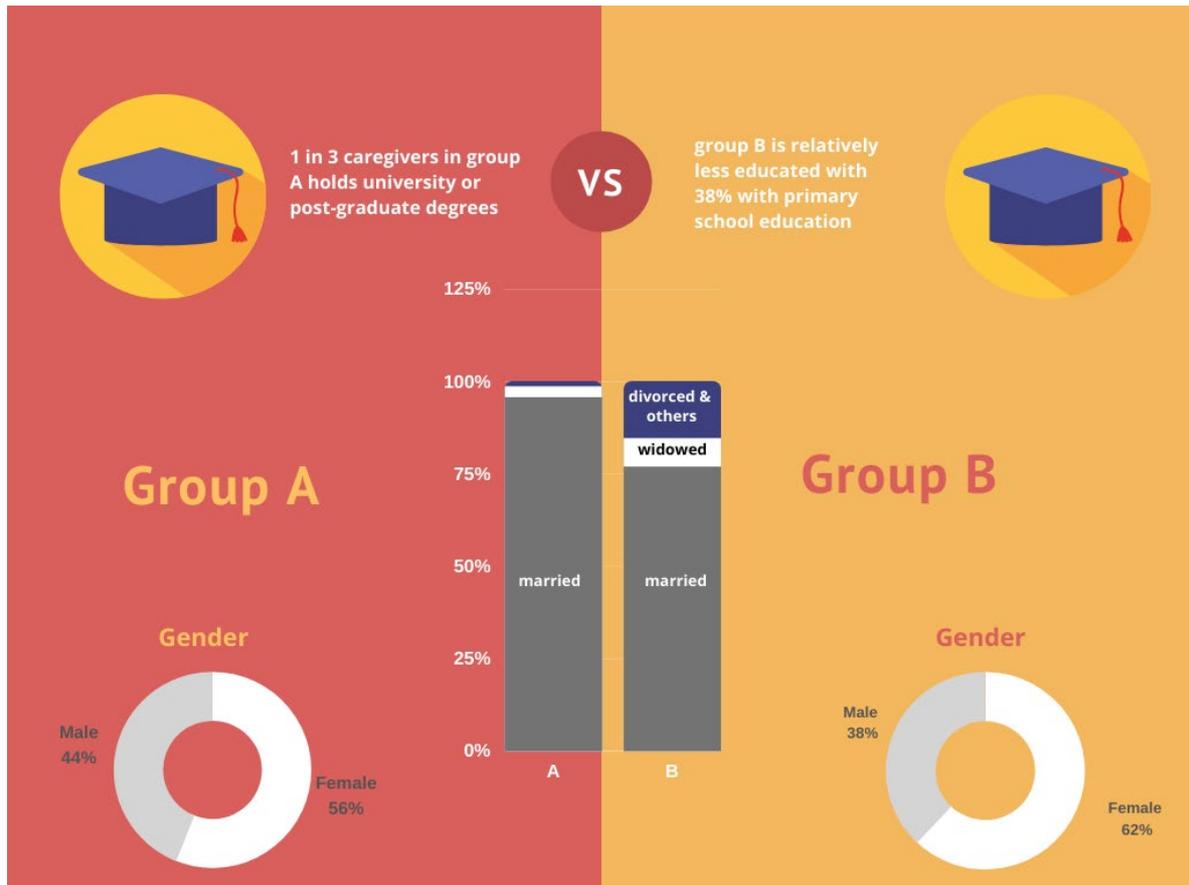
Compared with the full sample, ethnic Malay and Indian increased in the caregiver sample; communication plans should consider cultural differences

Fig. 22 presents demographics statistics of respondents who self-identified as caregivers. The study tested various demographic variables to find potential intervention levers of caregivers.

Interestingly, gender is not significantly correlated with the caregiver outcome; therefore, when designing outreach programs, it is better to use gender-neutral material and avoid gender biases. Moreover, results show that caregiver themselves are disease-ridden. Their health conditions need to be monitored and taken care of as well. Lastly, caregivers in the sample are well-aware of fall-preventing activity and would take actions to prevent falls however our knowledge on their mental/emotional well-being is lacking and merits further study.

Figure 22. Caregiver Profiles

Figure 23. Demographic Profiles of Caregiver Personas



Clustering analysis found two distinct groups of caregivers and their respective demographic characters are presented in Fig. 23.

Moreover, group A is relatively healthier than group b with majority (57%) of the group having no disease at all. Meanwhile all respondents in group B reported having at least one disease. Close to 40% of group B also reported having fallen in the past 12 months; compared to around 7% in group A.

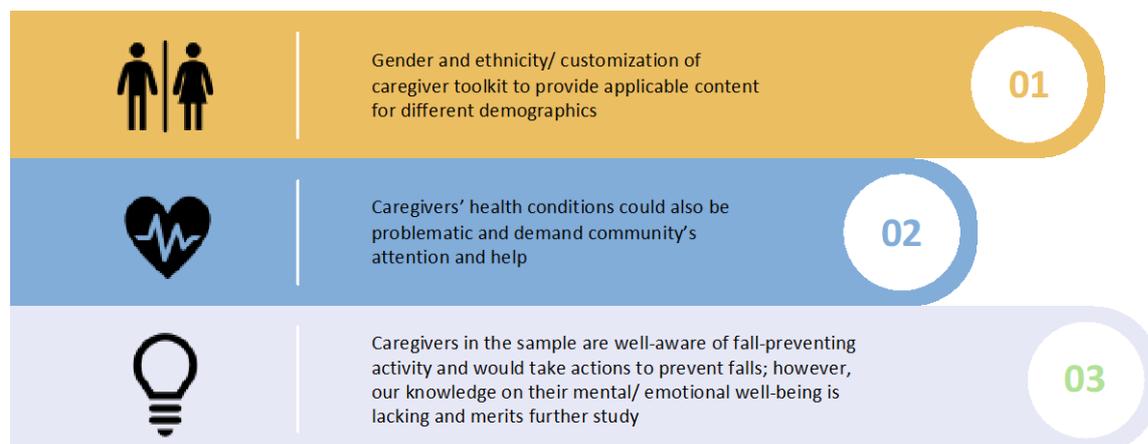
To summarize, group A is better educated, relatively healthier and has a lower percentage of caregiver fallen in the past 12 months. On the other hand, group b is more vulnerable because of their education qualification, health conditions and fall history. Such bifurcation of caregiver characteristics should suggest diversification of caregiver education content and assistance schemes.

Falls awareness and perception

Caregivers in both groups are concerned about falling despite their differences in fall experience. Although not recommended by medical professionals approximately 25% of caregivers in both groups would restrict activities to prevent falls. Research show that fear of falling and activity avoidance can cause sarcopenia and undermines social connection.¹⁹

Falls education and intervention should help caregivers correct misconception and provide alternative and sustainable strategies to avoid falls.

Insights on Caregiver



Conclusion

Given the global demographic ageing trend and ageing-related bone health issues, it is timely that the present study fills the research gap in the public's risk perception of bone health. At the same time, the present study aims to assess the public's knowledge to assist industry and policymakers with the actionable insights when engaging with the public and elderly population. This study took a two-pronged approach powered by computational linguistic analysis of 5-billion-word English corpus and the conventional wisdom of survey questionnaires.

Text analytics results show that societal bone health risk narratives are dominated by "disease and treatment". This finding indicates that in most regions bone health is a

¹⁹ Merchant, R. A., Chen, M. Z., Wong, B. L. L., Ng, S. E., Shirooka, H., Lim, J. Y., Sandrasageran, S., & Morley, J. E. (2020). Relationship Between Fear of Falling, Fear-Related Activity Restriction, Frailty, and Sarcopenia. *Journal of the American Geriatrics Society*, 68(11), 2602–2608. <https://doi.org/10.1111/jgs.16719>

medicalized issue accompanied by reactive treatment after diagnosis. But as medical literature shows preventative steps like vitamin-rich diet and weight-bearing exercise could be adopted at any age to prevent the onset of osteoporosis. Therefore, efforts are needed to de-medicalize bone health and centre the discussion around prevention. Sentiment analysis on media content also reveals that, globally, societal sentiment towards osteoporosis is overwhelmingly negative. Although people and society are unlikely to hold a favourable view towards a disease, researchers have nevertheless found optimism to be conducive for adjusting to a new lifestyle and increasing the chance of survival among chronic disease patients.

Moreover, the present study identified diverse profiles of community-dwelling older adults in Singapore. Based on the analyses, the study identified four clusters of older adults and provided customized intervention recommendations. As the world goes through the ageing demographic transition, ageing policies and health interventions will likely emerge as top priorities in government's and societies' agenda. As our findings show, even within an age cohort, older persons may have different concerns and needs. Therefore, customized interventions, instead of one size fit all solutions will likely be more effective. Moreover, in reality, governments and agencies often encounter resource constraint; therefore, recognizing pressing needs within the elderly community will also enable them to prioritize and allocate the resources efficiently.

For instance, Singapore's societal narratives on caregiver emphasize the training and resources, which only provides basic and temporary relief for caregivers and their loved ones. However, caregivers burnout, guilt and mental health conditions are often fall through the cracks. Our findings are in alignment with recent public discussion in Singapore calling for accessible and affordable caregiver services that not only alleviate their physical burden but also take care of mental health needs.²⁰ As a first step, government agencies and industry leaders and the media should collaborate on public campaign initiatives that raise public and policymakers' awareness on the issue and advocate for better policy support for caregivers in Singapore.

While this study is one of the first attempts to study the segmentation of caregivers in Singapore, it is still limited due to its sample size. However, this would be a fruitful area for future research. Recognizing the diverse characteristics among different groups of caregivers will significantly increase the chance of providing effective interventions that address their actual needs. Hence results from a future study could look into designing behavioral interventions and caregiver toolkit to help them manage mental, physical and financial stress.

²⁰ Cheryl, T., (25, October 2020), *Caregivers need more accessible support services, respite care arrangements: Experts*. Retrieved from Reuters: <https://www.straitstimes.com/singapore/caregivers-need-more-accessible-support-services-respite-care-arrangements-experts>

Project Team

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Reuben is a behavioural scientist trained at NUS, Oxford and Yale, based at the Lee Kuan Yew School of Public Policy and the Lloyd's Register Foundation Institute for the Public Understanding of Risk, NUS. He spent 16 years in government, consulting, and research. In government, he was in the Prime Minister's Office driving evidence-based policymaking through data analytics and Singapore's Smart Nation strategies. In consulting, he co-built the advanced analytics practice at a global firm, and implemented complex analytics capabilities across industries and functions. In research, he is an expert in social gerontology, ageism, the skills gap, and culture, and known for creating innovative techniques to measure societal perceptions that are applied to strategic policy communications. His work achieved international media coverage including *The Straits Times*, *Business Times*, *The Washington Post*, and *CNN*. He delivers masterclasses on Innovation that blends Data Analytics, Behavioural Insights, and Design Thinking; and serves on advisory boards within finance, education and sustainability sectors. He is the first Singaporean and Oxonian to win the International Fulbright Science and Technology Award, and recently won Singapore's most prestigious prize for early career social scientists—the Social Science Research Council's S\$1-million-dollar Fellowship.

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Yichen has a master's degree in public policy from the Lee Kuan Yew School of Public Policy (National University Singapore). Before coming to Singapore, she obtained her undergraduate degree in Political Science and Global Studies with concentrations in global political economy and East Asia at the University of Minnesota. She has extensive research experiences with local and international organisations such as the Asian Development Bank. Currently, she is doing risk analysis research to understand what people's perception and narrative around risk and how people's risk perceptions change overtime and the driving forces behind these changes. She also does big data text analysis to capture societal sentiment towards ageing, elderly and bone health.

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