

# **Research Brief Series : 14**

Oral Health, Vision and  
Hearing Status of Older Adults  
Participating in a Nationwide  
Community-Based Screening  
Programme in  
Singapore

Seema Aithal, Abhijit Visaria, Rahul Malhotra

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# Oral Health, Vision and Hearing Status of Older Adults Participating in a Nationwide Community-Based Screening Programme in Singapore

*Seema Aithal, Abhijit Visaria, Rahul Malhotra*

## Key Findings:

- Project Silver Screen (PSS) is a nationwide community-based programme in Singapore for screening the oral health, vision and hearing of older adults, aged 60 years and above, coupled with provision of follow-up services for those with abnormal screening results.
- This brief presents findings from PSS screenings conducted between January 2018 and July 2021, in which 76,459 unique participants (contributing to 84,601 assessments) were screened.
- Of the three domains screened, the domain with the highest proportion of an 'abnormal' result was hearing (65%), followed by vision (54%) and oral health (35%).
- The proportion with abnormal oral health increased with age, was higher among males (41%) compared to females (32%), and was the highest for Malays (44%) across the three main ethnic groups.
- Two-in-three (61%) participants used dentures (partial or full). Denture use increased with age, was higher among females (42%) compared to males (38%), and was the highest for Chinese (64%).
- The proportion with abnormal vision increased with age, was slightly higher among males (55%) compared to females (53%), and was the highest (54%) for Malays and Indians.
- Nearly half (45%) of the participants who wore spectacles during vision screening had abnormal vision. Among participants not wearing spectacles (61%) during vision screening, 59% had abnormal vision.
- The proportion of participants with abnormal hearing increased with age, was higher among males (78%) compared to females (56%), and was the highest for Chinese (65%) across ethnic groups.
- Only 3% of the participants reported using a hearing aid. Hearing aid use increased with age, was higher among males, and among Chinese.
- Among PSS participants for whom all three domains were screened, 82% had an abnormal result in one or more domains. While 46% of the participants had an abnormal result in only one domain, 31% had an abnormal result in two domains, and 6% had an abnormal result in all the three domains.
- Of the PSS participants with abnormal screening results in one or more domains who required referral (94-100%), nearly all (95-99%) were given referral for further evaluation of their condition.

# 1. INTRODUCTION

Many countries are experiencing population ageing at a rapid pace, <sup>1</sup> and Singapore is no exception to this trend. According to the United Nations (medium fertility variant estimates), the proportion of older adults, aged 60 years or older, in Singapore is expected to increase from 20.8% in 2020 to 30.2% in 2030 and 41.5% by 2050, and the proportion of those aged 80 years or older is projected to increase from 2.3% in 2020 to 4.0% by 2030 and 13.5% by 2050. <sup>2</sup>

Vision and hearing impairments are common at older ages. <sup>3</sup> The prevalence of self-reported vision impairment (i.e., self-reported poor or fair vision) and hearing impairment (i.e. self-reported poor or fair hearing) in Singapore was 30.7% and 25.6% respectively in 2016-2017 among older adults. <sup>4</sup> Studies in diverse populations suggest that sensory impairments, especially multiple impairments, are predictors of decreased survival independent of traditional mortality risk factors like diabetes and hypertension. <sup>5-7</sup> Moreover, vision and hearing impairment, especially when co-occurring, are associated with functional limitations, lower social networks, higher levels of loneliness and depressive symptoms, and poorer quality of life among older adults. <sup>8-10</sup> Similarly, poor oral health among older adults has been associated with frailty, sarcopenia, cognitive impairment, low quality of life, increased hospitalization and poor survival. <sup>11-14</sup> Screening for vision, hearing and oral health impairment, can aid in their early detection and timely management, and potentially enhance general health outcomes, psychosocial well-being and quality of life of older adults.

Project Silver Screen (PSS) is a nationwide community-based programme for screening the oral health, vision and hearing of older Singapore citizens and permanent residents, aged 60 years and above, with a view to improve their quality of life and support ageing-in-place. PSS aims to enable early detection of decline in these three domains of function, and provide timely follow-up services for those with abnormal screening results.

PSS implements a tiered approach to screening, comprising three levels. Level 1 (L1) entails oral health, vision and hearing screening by trained staff in the community. An electronic 'health screening booklet' is used to collect information on socio-demographic characteristics, administer questions, and record L1 screening results. Those with abnormal screening results are referred for follow-up to community or institution-based facilities. The Centre for Ageing Research and Education (CARE), Duke-NUS Medical School was commissioned to conduct an evaluation of PSS, using both qualitative and quantitative methods, by the Ministry of Health (MOH), Singapore in 2021. The quantitative portion of the study, whose data is presented in this brief, consisted of analysis of PSS administrative data collected during L1 screening of older adults, conducted between January 2018 and July 2021.

In this brief, we present **(1)** the oral health, vision and hearing status (including normal / abnormal screening result, and use of aids) of PSS participants, overall and by age, gender, and ethnicity, and **(2)** the prevalence of co-occurring abnormal status in oral health, vision and hearing among the participants, overall and by age, gender and ethnicity.

## 2. METHODS

### 2.1 Data

L1 data of older adults screened in PSS between January 2018 and July 2021 comprised 84,061 observations pertaining to 76,459 unique individuals. Most individuals (69,424; 90.8%) had attended only one PSS screening, i.e., they underwent screening for one or more of the three domains on the same day. The remaining individuals (7035; 9.2%) contributed multiple observations as they had attended more than one PSS screening, i.e., they underwent screening of one or more of the domains more than once. Therefore, we refer to the total number of observations in the analysis as ‘PSS participants’. (Table 1)

**Table 1: Composition of observations in the analysis sample (N=84,061)**

	Number
Observations of individuals with only one screening of one or more domains	69,424
Observations of 6496 individuals with two screenings of one or more domains	12,992
Observations of 511 individuals with three screenings of one or more domains	1,533
Observations of 28 individuals with four screenings of one or more domains	112

### 2.2 Oral health screening

Oral health was evaluated using the Oral Health Assessment Tool (OHAT).<sup>15,16</sup> The OHAT uses responses to questions on the state of lips, tongue, gums, natural teeth or dentures, dental pain and oral cleanliness to classify participants into *healthy* (no treatment required), *requires self-care* (advice on improvement of oral hygiene) and *unhealthy* (refer to dentist). Information on use of dentures and type of dentures used, if applicable, was also collected. **Abnormal oral health was defined as an OHAT result of *unhealthy*.** This was also the criteria for further referral after L1 screening.

### 2.3 Vision screening

Vision screening began by noting whether the participant was wearing spectacles at the time. If so, subsequent tests were conducted while the participant wore his/her spectacles. Visual acuity was first tested using the Snellen eye chart,<sup>17</sup> in both eyes, followed by the pinhole test.<sup>18</sup> Those with an abnormal Snellen chart test result (i.e., 6/18 or worse) in an eye were subsequently administered the pinhole test in that eye. **Abnormal vision was defined as ‘visual acuity of 6/18 or worse in either eye by the Snellen eye chart test’.** This was also the criteria used for further referral after L1 screening, with the type of referral (to an eye specialist or an optometrist) contingent on the results of the pinhole test.

## 2.4 Hearing screening

The questions or tests used for hearing screening in PSS varied over time. They comprised combinations of the Hearing Handicap Inventory for Elderly (HHIE), questions assessing presence and extent of tinnitus, and conduct of examinations/tests like otoscopy, practice-tone audiometry (60dB) and puretone audiometry (25dB and 40dB). Data on use of hearing aids was also collected.

HHIE is a 10-item questionnaire assessing self-perceived handicap of hearing impairment.<sup>19,20</sup> It comprises 10 questions each with three response options: “yes” (scored as 4 points), “sometimes” (2 points), and “no” (0 points), with the total score calculated as the sum of all responses. A score of >8 indicates hearing handicap, according to the American Speech-Language-Hearing association (ASHA) draft guidelines.<sup>21</sup> In PSS, participants were classified based on their HHIE scores into 3 categories – no handicap (0-8), mild-moderate handicap (10-24) and severe handicap (26-40).<sup>22</sup> Those with mild-moderate handicap (10-24) or severe handicap (26-40) required referral. Participants who had tinnitus (asked in terms of whether they had “continuous ringing, hissing, or other sounds in their ears or head”) were asked how much of a problem this sound was for them. Those who reported it as a “very big problem” also required referral. Participants with no tinnitus or who had tinnitus but did not report it as a very big problem, or for whom tinnitus was not assessed, underwent otoscopy. Those who failed the otoscopy required referral. Participants who passed otoscopy underwent the practice-tone audiometry test at 60dB. Those who failed the practice-tone audiometry test required referral, while those who passed it subsequently underwent puretone audiometry at 25dB. A ‘fail’ result in any puretone audiometry test with 25dB at increasing frequencies (500Hz, 1000Hz, 2000Hz, 4000Hz) necessitated further audiometry testing at 40dB in that specific ear. Puretone audiometry was carried out at 40dB intensity to check for the quietest sound that could be heard at different frequencies (500Hz, 1000Hz, 2000Hz, 4000Hz) giving a ‘pass’ or ‘fail’ result.<sup>22-24</sup> Participants who failed in any of the puretone audiometry tests conducted with 40dB at increasing frequencies (500Hz, 1000Hz, 2000Hz, 4000Hz) required referral.

Following the differences in the criteria used for further referral, **abnormal hearing was defined as either HHIE score of >8 or tinnitus being a ‘very big problem’ or otoscopy in either ear having a fail result or practice-tone test having a fail result or any of the audiometry tests carried out with 40dB intensity at increasing frequencies (500Hz, 1000Hz, 2000Hz, 4000Hz) having a fail result in either ear.**

## 2.5 Analysis

We used descriptive statistics to assess the distribution of variables, overall and if applicable, by age group (60-69, 70-79, 80-89, 90 and above), gender (male and female) and ethnicity (Chinese, Malay, Indian, Others). We compared the distribution of participants with abnormal oral health, vision or hearing across age groups using the Cuzick test, which checks if the trend across groups is statistically significant, and across

gender and ethnicity using the Chi square test. A p-value <0.05 indicated statistical significance. All analyses were performed using Stata v14.2. <sup>25</sup>

### 3. Results

**Table 2: Demographic characteristics of PSS participants (N=84,061)**

Characteristics	Categories	Number (%)
<b>Age group, in years</b>	60 – 69	39,846 (47.4%)
	70 – 79	32,560 (38.7%)
	80 – 89	10,499 (12.5%)
	90 & above	1,156 (1.4%)
<b>Gender</b>	Male	33,117 (39.4%)
	Female	50,944 (60.6%)
<b>Ethnicity</b>	Chinese	72,984 (86.8%)
	Malay	5,580 (6.6%)
	Indian	3,780 (4.5%)
	Others	1,717 (2.0%)

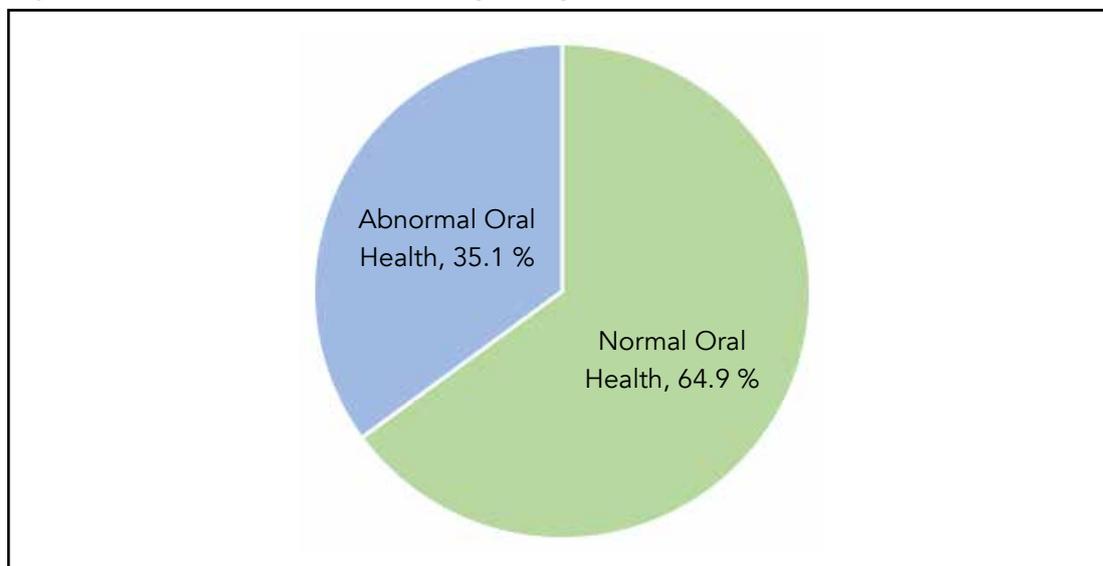
#### 3.1 Demographic characteristics

The average age of PSS participants was 71.1 (standard deviation: 7.2) years. The highest proportion of the participants were aged 60-69 years (47.4%), female (60.6%) and of Chinese ethnicity (86.8%). **(Table 2)**

Next, we present the detailed results for each of the three domains – oral health, vision and hearing – among PSS participants.

### 3.2 Oral Health

**Figure 1: Oral health status of PSS participants (N=80,516)**



Note: Abnormal indicates that the Oral Health Assessment Test (OHAT) result was classified as unhealthy.

Just over one-third (35.1%) of the 80,516 PSS participants whose oral health was screened had abnormal oral health.

**Table 3: Oral health status of PSS participants by age, gender and ethnicity**

	Age Group (years)				Gender		Ethnicity			
	60 - 69	70 - 79	80 - 89	90 & above	Male	Female	Chinese	Malay	Indian	Others
Oral health, %										
Normal	65.6	64.6	63.6	61.2	59.4	68.5	66.1	56.5	57.7	56.1
Abnormal <sup>a</sup>	34.4	35.4	36.4	38.8	40.6	31.6	33.9	43.5	42.3	43.9
p-value <sup>^</sup>	<0.001				<0.001		<0.001			

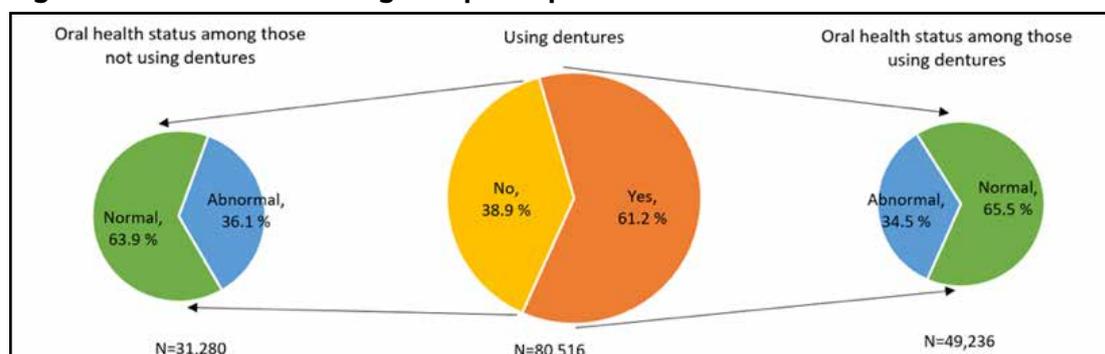
Note: All percentages are column percentages.

<sup>a</sup> Abnormal indicates that the Oral Health Assessment Test (OHAT) result was classified as unhealthy.

<sup>^</sup> p-value for trend across age groups based on Cuzick's test, and p-values for gender and ethnicity based on Chi square test.

The proportion of participants with abnormal oral health increased with age, was higher among males compared to females (40.6% vs 31.6%), and was the highest for Malays (43.5%) across the three major ethnic groups. **(Table 3)**

**Figure 2: Denture use among PSS participants**



Note: Abnormal indicates that the Oral Health Assessment Test (OHAT) result was classified as unhealthy.

Nearly two-thirds (61.2%) of the participants used dentures. Among those using dentures, nearly a third (34.5%) had abnormal oral health. Among participants not using dentures, about 36% had abnormal oral health. (Figure 2)

**Table 4: Denture use among PSS participants by age, gender and ethnicity**

	Age Group (years)				Gender		Ethnicity			
	60 - 69	70 - 79	80 - 89	90 & above	Male	Female	Chinese	Malay	Indian	Others
Denture use, %	49.6	70.9	73.7	70.4	57.2	63.8	64.0	45.2	37.7	42.6
Oral health of those <i>using dentures</i> , %										
Normal	64.7	65.9	66.7	66.1	61.2	68.1	66.0	62.7	58.4	58.0
Abnormal <sup>a</sup>	35.4	34.2	33.3	33.9	38.8	32.0	34.0	37.3	41.6	42.0
Oral health of those <i>not using dentures</i> , %										
Normal	66.5	61.6	54.8	49.4	57.0	69.2	66.3	51.3	57.3	54.7
Abnormal <sup>a</sup>	33.5	38.4	45.2	50.6	43.0	30.8	33.7	48.7	42.7	45.3

Note: All percentages are column percentages

<sup>a</sup> Abnormal indicates that the Oral Health Assessment Test (OHAT) result was classified as unhealthy.

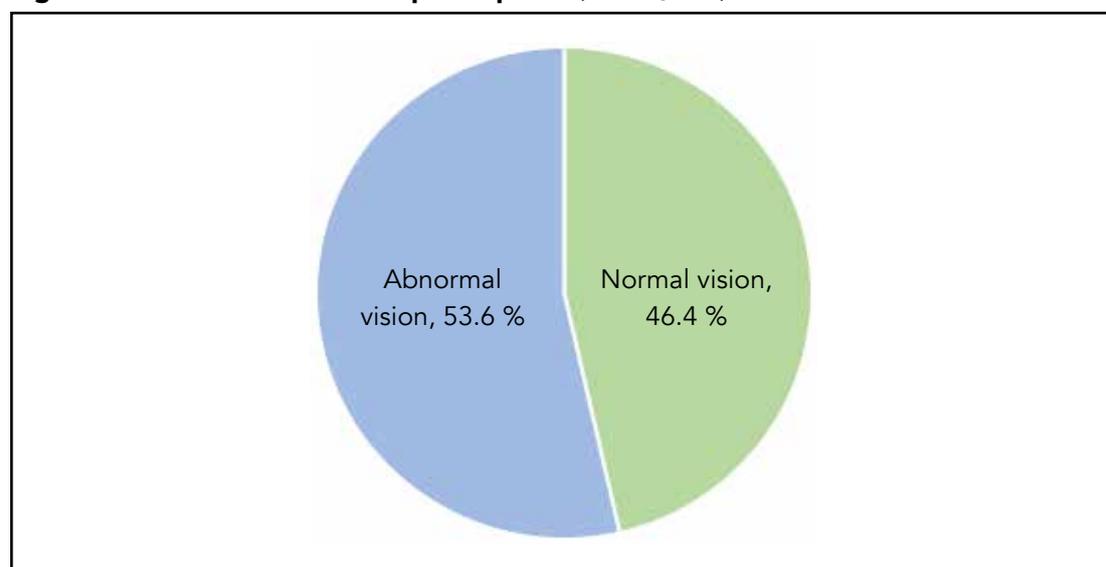
The proportion of participants who used dentures increased with age, was higher among females (63.8%) compared to males (57.2%) and was the highest among Chinese (64%). Among participants *using dentures*, the proportion with abnormal oral health was relatively similar across age groups (34-35%), was higher in males (38.8%) versus females (32.0%) and was the highest among Indians (41.6%) and Malays (37.3%). Likewise, among participants *not using dentures*, the proportion with abnormal oral health increased with age, was higher in males (43.0%) versus females (30.8%) and was highest for Malays (48.7%) and Indians (42.7%). Comparing those using and not using dentures, the proportion of participants with abnormal oral health was higher among those not using dentures at ages 70-79, 80-89 and 90 years and above, among males, and among Malays, Indian, and Others. **(Table 4)**

### Referral

All participants who had abnormal oral health required referral. Among those who required referral, nearly all (99-100%) were given referral for further evaluation of their oral health.

## 3.3 Vision

**Figure 3: Vision status of PSS participants (N=79,520)**



Note: Normal indicates visual acuity of 6/6 or 6/9 or 6/12 on Snellen eye chart. Abnormal indicates visual acuity of 6/18 or worse on Snellen eye chart. Those with an abnormal result were referred for pinhole test.

Among the 79,520 PSS participants whose vision was screened, just over half (53.6%) had abnormal vision. **(Figure 3)**

**Table 5: Vision status of PSS participants by age, gender and ethnicity**

	Age Group (years)				Gender		Ethnicity			
	60 - 69	70 - 79	80 - 89	90 & above	Male	Female	Chinese	Malay	Indian	Others
Vision <sup>a</sup> , %										
Normal	56.8	41.0	26.6	11.4	45.4	47.1	46.3	46.4	48.5	48.3
Abnormal	43.2	59.0	73.4	88.6	54.6	53.0	53.7	53.6	51.5	51.7
p-value <sup>^</sup>	<0.001				<0.001		0.03			

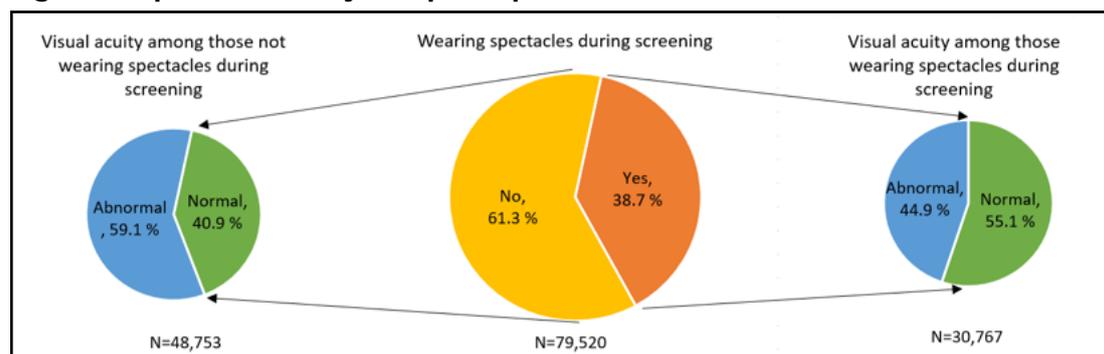
Note: All percentages are column percentages.

<sup>a</sup> Normal: visual acuity of 6/6 or 6/9 or 6/12 on Snellen eye chart. Abnormal: visual acuity of 6/18 or worse on Snellen eye chart.

<sup>^</sup> p-value for trend across age groups based on Cuzick's test and p-values based on Chi square test for gender and ethnicity

The proportion of PSS participants with abnormal vision increased with age, was slightly higher in males (54.6%) compared to females (53.0%), and varied by ethnicity, being the highest among Chinese (53.7%) and Malays (53.6%). **(Table 5)**

**Figure 4: Spectacle use by PSS participants**



Note: Normal indicates visual acuity of 6/6 or 6/9 or 6/12 on Snellen eye chart. Abnormal indicates visual acuity of 6/18 or worse on Snellen eye chart.

About 2 in 5 (38.7%) participants whose vision was screened wore spectacles during screening. Among those *wearing* spectacles during vision screening, nearly half (44.9%) had abnormal vision. The proportion of those with abnormal vision was higher (59.1%) among those *not wearing* spectacles during screening. **(Figure 4)**

**Table 6: Spectacle use by PSS participants by age, gender and ethnicity**

	Age Group (years)				Gender		Ethnicity			
	60 - 69	70 - 79	80 - 89	90 & above	Male	Female	Chinese	Malay	Indian	Others
Wore spectacles in vision screening, %	42.1	37.0	31.9	29.5	37.6	39.4	38.8	37.8	36.8	39.4
Visual acuity of those <i>wearing spectacles</i> during vision screening, %										
Normal <sup>b</sup>	65.9	47.4	31.9	15.0	54.8	55.3	55.0	53.6	59.0	57.2
Abnormal <sup>b</sup>	34.1	52.7	68.1	85.0	45.2	44.7	45.0	46.4	41.0	42.8
Visual acuity of those <i>not wearing spectacles</i> during vision screening, %										
Normal <sup>b</sup>	50.3	37.2	24.2	10.0	39.8	41.7	40.7	42.0	42.3	42.5
Abnormal <sup>b</sup>	49.8	62.8	75.9	90.0	60.2	58.3	59.3	58.0	57.7	57.5

Note: All percentages are column percentages

<sup>a</sup> Visual acuity on Snellen's eye chart.

<sup>b</sup> Normal: Visual acuity of 6/6 or 6/9 or 6/12 on Snellen eye chart; Abnormal: Visual acuity of 6/18 or worse on Snellen eye chart.

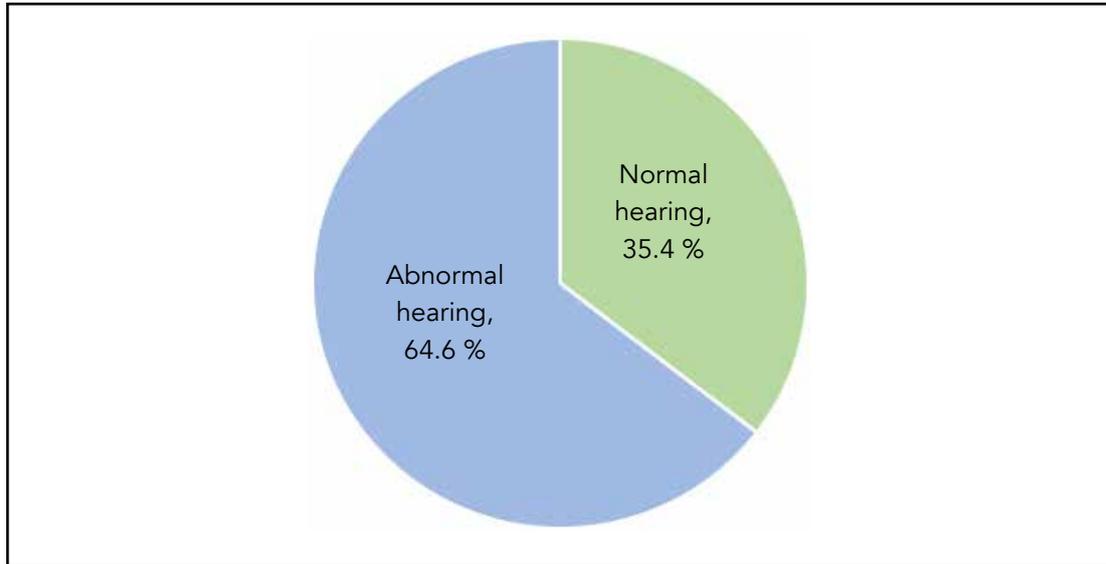
The proportion of participants wearing spectacles during vision screening decreased with age, was slightly higher among females versus males, and was the highest for Chinese. Among participants wearing spectacles, the proportion of those with abnormal vision increased with age, was similar for males and females (45.2% vs 44.7%) and was the highest among Malays (46.4%) and Chinese (45.0%). Among participants not wearing spectacles, the proportion with abnormal vision increased with age, was slightly higher in males (60.2%) versus females (58.3%) and was highest for Chinese (59.3%). Comparing those wearing and not wearing spectacles, the proportion of participants with abnormal vision was higher among those not wearing spectacles for all age groups, genders and ethnic groups. **(Table 6)**

### Referral

Of the participants with abnormal vision, the majority (94.0%) required referral as they did not have an upcoming eye-related appointment or follow-up with an eye specialist. Among those who required referral, 95.0% were given referral for further evaluation of their vision.

### 3.4 Hearing

**Figure 5: Hearing status of PSS participants (N=82,561)**



Note: Abnormal indicates that either the Hearing Handicap Inventory for Elderly (HHIE) score was >8, or tinnitus was a very big problem, or otoscopy in either ear had a 'fail' result, or practice-tone test had a 'fail' result, or any of the audiometry tests carried out with 40dB intensity at increasing frequencies (500Hz, 1000Hz, 2000Hz, 4000Hz) had a 'fail' result in either ear.

Of the 82,561 participants whose hearing was screened, nearly 2 in 3 (64.6%) had abnormal hearing. **(Figure 5)**

**Table 7: Hearing status of PSS participants by age, gender and ethnicity**

	Age Group (years)				Gender		Ethnicity			
	60 - 69	70 - 79	80 - 89	90 & above	Male	Female	Chinese	Malay	Indian	Others
Hearing <sup>a</sup> , %										
Normal	46.3	29.5	14.5	10.6	21.9	44.2	35.2	36.6	38.7	35.0
Abnormal	53.7	70.5	85.5	89.4	78.1	55.8	64.8	63.4	61.4	65.0
p-value <sup>^</sup>	<0.001				<0.001		<0.001			

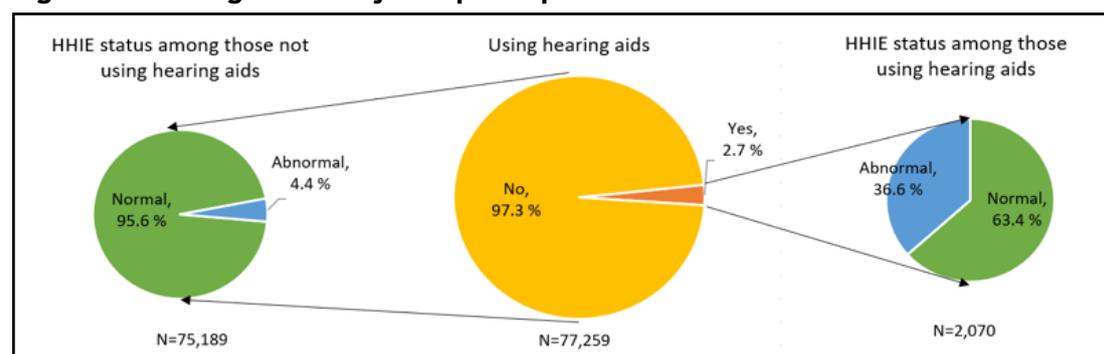
Note: All percentages are column percentages.

<sup>a</sup> Hearing: Abnormal indicates that either the Hearing Handicap Inventory for Elderly (HHIE) score was >8, or tinnitus was a very big problem, or otoscopy in either ear had a 'fail' result, or practice-tone test had a 'fail' result, or any of the audiometry tests carried out with 40dB intensity at increasing frequencies (500Hz, 1000Hz, 2000Hz, 4000Hz) had a 'fail' result in either ear.

<sup>^</sup> p-value for trend across age groups based on Cuzick's test and p-values based on Chi square test for gender and ethnicity.

The proportion of participants with abnormal hearing increased with age, was higher among males compared to females (78.1% vs 55.8%), and varied by ethnicity, being the highest for Chinese (64.8%). (Table 7)

**Figure 6: Hearing aid use by PSS participants**



Note: HHIE- Hearing Handicap Inventory for Elderly. Data pertaining to PSS screenings between January 2018 and January 2020.

Normal: No hearing handicap (HHIE score ≤8). Abnormal: Mild-moderate or severe hearing handicap (HHIE score ≥10).

Among participants whose hearing was screened, only 2.7% reported using a hearing aid in either or both ears. Of those using a hearing aid, a third (36.6%) had an abnormal HHIE result. Of those not using a hearing aid, only 1 in 20 (4.4%) had an abnormal HHIE result. **(Figure 6)**

**Table 8: Hearing aid use by PSS participants by age, gender and ethnicity**

	Age Group (years)				Gender		Ethnicity			
	60 - 69	70 - 79	80 - 89	90 & above	Male	Female	Chinese	Malay	Indian	Others
Hearing aid used, %	1.5	2.8	6.1	8.1	3.4	2.2	2.7	2.1	3.0	1.8
HHIE status among those who reported <i>using</i> a hearing aid, %										
Normal <sup>b</sup>	68.7	66.4	56.6	40.0	58.5	68.2	63.3	67.5	61.0	61.9
Abnormal <sup>b</sup>	31.3	33.6	43.4	60.0	41.5	31.8	36.7	32.5	39.0	38.1
HHIE status among those who reported <i>not using</i> a hearing aid, %										
Normal <sup>b</sup>	97.1	95.8	90.3	76.9	94.4	96.3	95.5	96.3	95.0	95.7
Abnormal <sup>b</sup>	2.9	4.2	9.7	23.1	5.6	3.7	4.5	3.7	5.0	4.3

Note: HHIE- Hearing Handicap Inventory for Elderly. All percentages are column percentages.  
<sup>a</sup> Individuals who attended PSS screenings for hearing between January 2018 and January 2020.  
<sup>b</sup> Normal indicates no hearing handicap (HHIE score  $\leq 8$ ); Abnormal indicates mild-moderate or severe hearing handicap (HHIE score  $\geq 10$ )

Among participants whose hearing was screened, the proportion using a hearing aid increased with age, was slightly higher among males versus females, and was highest for Indians. Among those *using a hearing aid*, the proportion with an abnormal HHIE result increased with age, was higher in males (41.5%) compared to females (31.8%) and was highest among Indians (39%) across ethnic groups. Likewise, among those *not using a hearing aid*, the proportion with an abnormal HHIE result also increased with age, was higher in males (5.6%) compared to females (3.7%), and was highest for Indians (5%). Comparing those using and not using a hearing aid, the proportion with abnormal hearing was significantly higher among those using a hearing aid for all age groups, genders and ethnic groups. **(Table 8)**

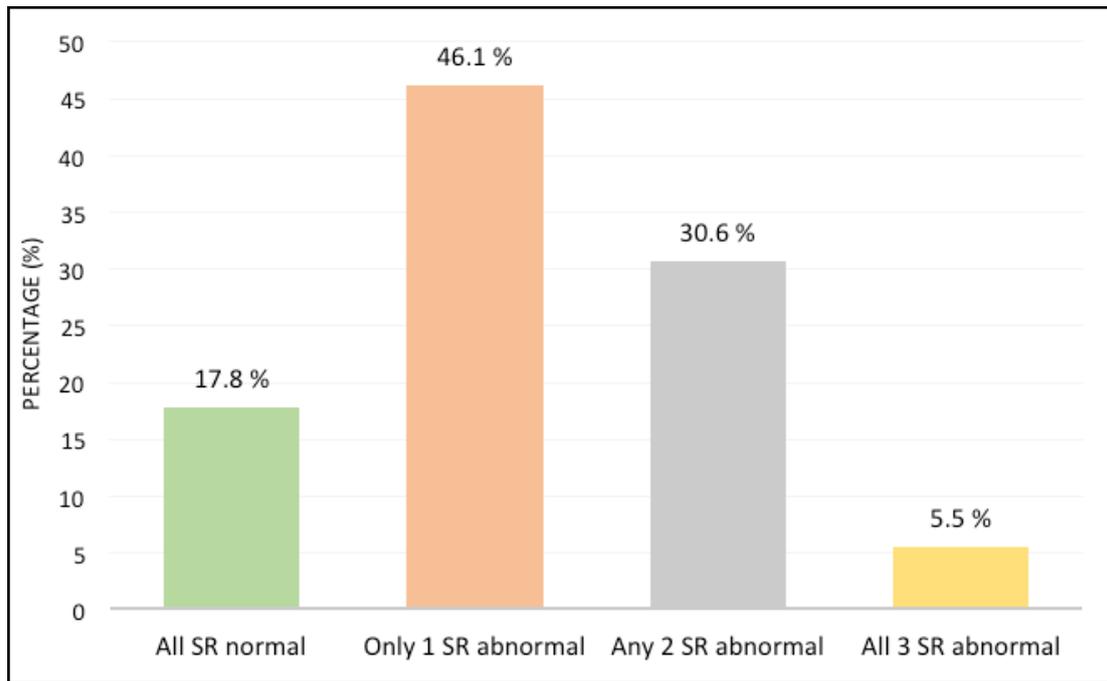
### Referral

Nearly all participants (99.1%) who had abnormal hearing required referral for further evaluation of their hearing as they did not have an upcoming Ear, Nose, Throat (ENT) medical appointment or were not on follow-up with an ENT specialist. Among those who required referral, almost all (99.4%) were given a hearing referral.

### 3.5 Combinations of screening results in the three domains

Next, we detail various combinations of oral health, vision and hearing screening results for participants who underwent screening in all three domains.

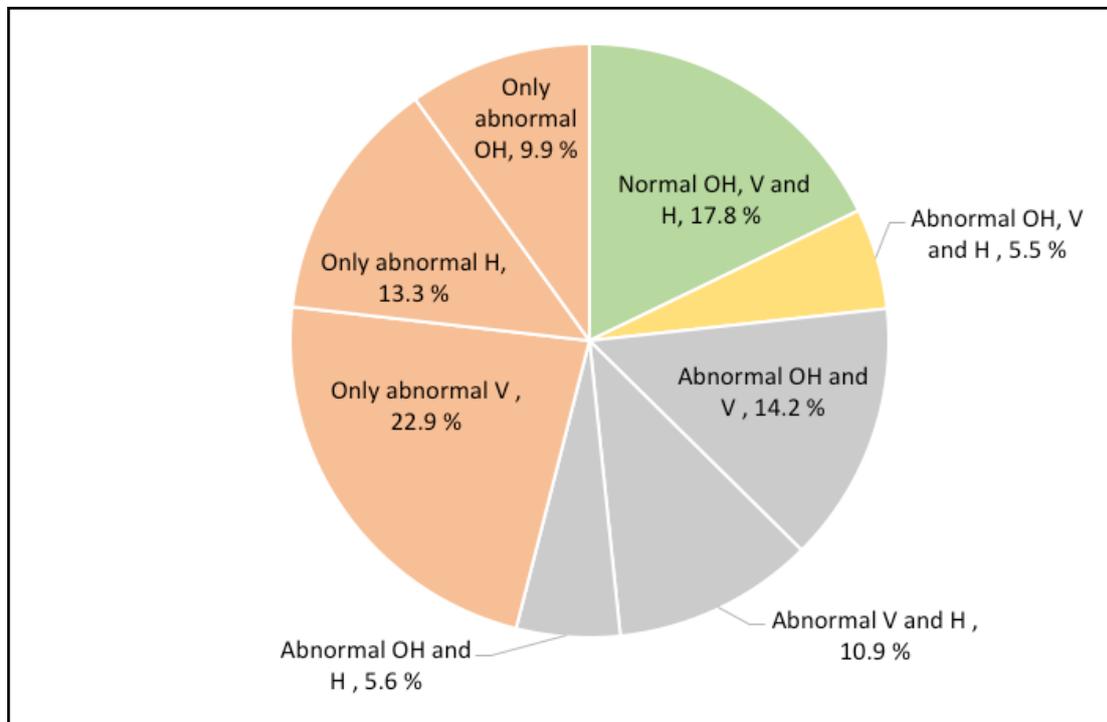
**Figure 7: Combinations of screening results for participants who underwent screening in all three domains (N=75,985)**



Note: SR – Screening Result

Of the 84,061 PSS participants, 75,985 (90.4%) underwent screening in all three domains. Among them, over 4 in 5 (82.2%) had an abnormal result in one or more domains. While nearly half (46.1%) had an abnormal result in only one domain, 1 in 3 (30.6%) had an abnormal result in any two of the three domains, and 1 in 20 participants (5.5%) had an abnormal result in all three domains. **(Figure 7)**

**Figure 8: Combinations of screening results for participants who underwent screening in all the three domains (N=75,985)**



Note: H – Hearing. OH – Oral health. V- Vision.

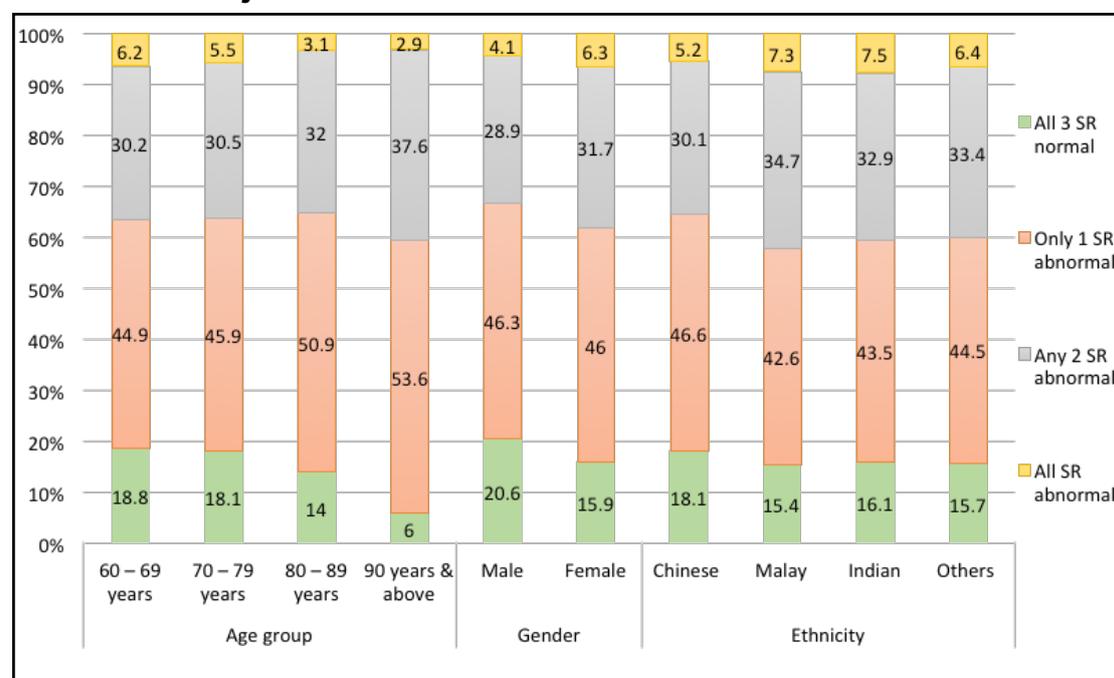
*Abnormal oral health* indicates that the Oral Health Assessment Test (OHAT) result was classified as unhealthy; *Abnormal vision* indicates that visual acuity using Snellen eye chart was as 6/18 or worse in either eye; *Abnormal hearing* indicates that either the Hearing Handicap Inventory for Elderly (HHIE) score was >8 or tinnitus was a very big problem or otoscopy in either ear had a 'fail' result or practice-tone test had a 'fail' result or any of the audiometry tests carried out at 40dB intensity and increasing frequencies (500Hz, 1000Hz, 2000Hz, 4000Hz) had a 'fail' result in either ear.

The most common result among the PSS participants who underwent screening in all three domains was only abnormal vision (22.9%). This was followed by a normal result in all three domains (17.8%) and abnormal oral health and vision (14.2%). The two least common results were abnormal oral health and hearing (5.6%) and an abnormal result in all three domains (5.5%).

Among participants who had an abnormal result in any two of the three domains, the most common combination was abnormal oral health and vision (14.2%), followed by abnormal vision and hearing (10.9%), and abnormal oral health and hearing (5.6%).

Among participants who had an abnormal result in only one domain, the most common was only abnormal vision (22.9%), followed by only abnormal hearing (13.3%) and only abnormal oral health (9.9%). **(Figure 8)**

**Figure 9: Distribution of combinations of screening results, by age, gender and ethnicity**



Note: SR – Screening Result

Co-occurrence of an abnormal result in all three domains declined with age, was slightly higher in females (versus males) and the highest among Indians and Malays (across ethnic groups). While co-occurrence of an abnormal result in any two domains increased with age, the proportion of participants with a normal result in all three domains declined with age. Among the ethnic groups, a single abnormal result was more common among Chinese, whereas Malays and Indians were relatively more likely to have an abnormal result in two or more domains. **(Figure 9)**

## 4. Discussion

This brief presents the oral health, vision and hearing status of Singapore residents aged 60 years and older who participated in Project Silver Screen (PSS) a nationwide community-based screening programme between January 2018 and July 2021. We first delineated the sociodemographic characteristics of PSS participants, and examined the prevalence of abnormal oral health, vision and hearing, overall and by age, gender, and ethnicity. We then presented the prevalence of co-occurring abnormal status in oral health, vision and hearing among the participants, overall and by age, gender and ethnicity.

The proportion of older adults with abnormal vision and abnormal hearing in PSS (53.6% and 64.6% respectively) was much higher than the prevalence of self-reported vision and hearing impairment (30.7% and 25.6% respectively) in THE SIGNS Study – I, a nationally representative survey of community-dwelling older Singaporeans aged 60 years and older, conducted in 2016-2017.<sup>26</sup> Objective measurement of vision and hearing in PSS as well as participation in PSS by older adults who may be concerned about their vision and hearing may explain the higher prevalence in PSS compared to THE SIGNS Study, where vision and hearing status was based on self-reported measures. Past studies have noted that negative age stereotypes can have constraining effects on attitudes and health behaviours, including influencing sensory perceptions of older adults who might downplay any vision or hearing issues as trivial or an inevitable part of ageing process.<sup>27, 28</sup> Thus, assessment of vision and hearing impairment based solely on self-report may underestimate the true extent of such impairments.

### 4.1 Oral health

Among PSS participants, while abnormal oral health increased with age, and was more common among males (versus females) and among Malays and Indians (versus Chinese), denture use (either full or partial) was more common among females and among Chinese. We also observed that the proportion of participants with abnormal oral health across age groups, gender and ethnicity was greater among those who were not using dentures compared to those who were using dentures. It is likely that greater contact with dental services, which would have been needed for procuring and maintaining dentures, contributed to better oral health among these older adult sub-groups.<sup>29</sup>

## 4.2 Vision

A population-based study of Singapore residents aged  $\geq 40$  years, comprising Chinese, Malays, and Indians, examined between 2004 and 2011, reported that visual impairment increased with age, and was higher among females compared to males.<sup>30</sup> Furthermore, it reported that while Malays had higher prevalence of presenting bilateral visual impairment compared to Indians and Chinese, unilateral visual impairment was predominant among Chinese. Among PSS participants, abnormal vision increased with age, was higher in males (versus females) and highest for Chinese and Malays. Thus, apart from gender, the pattern of abnormal vision by age and ethnicity was comparable between the studies. Nevertheless, these comparisons should be interpreted with caution given the differences in the study design (in sampling technique, and approach used to assess and define vision impairment), sample characteristics (in age range) and time period (which may affect the accessibility and utilization of eye care services) of the two studies.

Even though the proportion of participants with abnormal vision increased with age, the use of spectacles declined with age. The increase in the prevalence of non-refractive causes of vision impairment, like age-related macular degeneration, cataract and glaucoma among older age groups, and predominance of refractive errors as a cause of low vision in younger age groups may be potential explanations.<sup>31</sup>

Nearly half (45%) of the participants for whom visual acuity was assessed while they were wearing their spectacles had abnormal vision. This could be due to either under-corrected refractive errors or non-refractive causes of impaired vision like macular disease, cataract and glaucoma which require different modes of preventative or curative intervention. Similarly, 59% of the participants for whom visual acuity was assessed while they were not wearing spectacles had abnormal vision. While some of them may have forgotten to bring their spectacles to the screening, uncorrected refractive errors or non-refractive causes of impaired vision could be other potential causes for their abnormal vision.

## 4.3 Hearing

According to the National Health Survey conducted in Singapore in 2010, the reported prevalence of at least moderate hearing loss ( $\geq 40$  dB, where at least 3 frequencies out of 4 were affected in the better ear) among residents aged 60-69 years was 9.6%.<sup>32</sup> Another prior study from Singapore found that the prevalence of disabling hearing loss ( $\geq 40$ dB) was 16% among adults aged older than 60 years.<sup>33</sup> The much higher prevalence among PSS participants, where nearly 2 in 3 (64.6%) participants had abnormal hearing, is likely due to a more comprehensive definition of abnormal hearing in PSS. Irrespective of the definition, the two studies did find the pattern of abnormal hearing to be similar by age (increasing with age) and gender (more prevalent among males versus females).

Despite the high proportion of PSS participants with abnormal hearing (64.6%), the proportion of participants using hearing aids in one or both ears was very low (2.7%). While comparable data on hearing aid use by older adults being screened in the community is lacking, studies from other countries have shown that only 15-30% of adults with mild to moderate hearing loss obtain hearing aids.<sup>34-36</sup> Likewise, according to a report from the UK, there was a general reluctance among older adults to attend screening for hearing, only 10-20% of those diagnosed with hearing impairment ever used a hearing aid, and one-third among them discontinued due to discomfort, appearance, background noise, difficulty handling etc.<sup>37</sup> Recent studies on the use of hearing aids involving older adults have noted that perceived need was the best predictor of adherence to recommendations for hearing aid acquisition.<sup>38-40</sup> While there is mixed evidence regarding the impact of hearing aids on the incidence of cognitive decline and mortality,<sup>5,41</sup> other studies have revealed a positive influence of hearing aid usage on quality of life.<sup>42</sup> Strategies like aural rehabilitation which involves services such as cognitive training and other techniques to improve communication effectiveness could help increase the uptake and compliance with the use of hearing aids.<sup>43</sup>

#### **4.4 Combinations of abnormal results in oral health, vision and hearing**

Just over 4 in 5 PSS participants (82%) had an abnormal result in one or more domains, highlighting the high burden of sensory impairment among older adults who show up for community-based screening in Singapore. Also, more than a third (36%) of the older adults had an abnormal result in two or more domains. Dual sensory impairments have been linked to increased incidence of adverse health outcomes, including higher risk of mortality.<sup>6,44</sup> Consequently, early detection and management of sensory decline among older adults is important, pointing to the value of PSS.

Our findings showed that the proportion of participants with an abnormal result in all three screenings decreased with age. However, given the cross-sectional nature of the data, this finding likely reflects differential survivorship by number of sensory impairments. It has been reported that the risk of mortality is higher for older adults with dual or multiple sensory impairments relative to those with single sensory impairment.<sup>5</sup> Consequently, we observed that the proportion of PSS participants with only one or two impairments increased with age.

## 5. Policy and Program Recommendations

### 5.1 Oral health

Studies have demonstrated an association between good oral hygiene and positive health outcomes like reduced incidence of respiratory tract infections and lower levels of cardiovascular disease.<sup>45,46</sup> Improving access to oral healthcare services for older adults can help not only reduce the burden of oral diseases among them but also address morbidity and mortality associated with other diseases or health conditions caused due to poor oral health. While the proposed analytical framework on screening for oral health among adults 18 years and older by the United States Preventative Services Taskforce (USPSTF) is still in progress, the American and Australian Dental Associations recommend regular dental visits as determined by a dentist.<sup>47</sup>

### 5.2 Vision

Since abnormal vision was detected in PSS both among those wearing spectacles during vision screening as well as those who did not, there is a need for greater awareness of the importance of regular screening for vision impairment among older adults (and their family members) in Singapore, irrespective of spectacle use. Furthermore, those already using spectacles should be mindful of potential under-correction of their vision by their spectacles or non-refractive causes of vision impairment and be encouraged to visit optometrists regularly.

Impaired vision has negative impact on vision-related functioning and quality of life.<sup>48-50</sup> Therefore, screening for impaired vision could be beneficial to older adults who do not recognise that they have a vision problem or who recognise a problem but do not seek treatment. While the USPSTF and American Academy of Family Physicians (AAFP) do not recommend screening for impaired visual acuity in asymptomatic older adults aged 65 years and older,<sup>51</sup> the American Association of Ophthalmologists (AAO) and American Optometrist Association (AOA) recommend comprehensive eye examination every 1 or 2 years in patients aged 65 years and older.<sup>52</sup> Frequency of screening for vision impairment among older adults in Singapore should be decided in consultation with experts.

### 5.3 Hearing

According to a recent review, hearing aids improve participation, overall health-related quality of life and listening ability among those with mild to moderate hearing loss by reducing psychological, social and emotional effects of hearing impairment.<sup>53</sup> In the context of screening for hearing impairment, while both the USPSTF and AAFP do not recommend screening for hearing loss in *asymptomatic* adults aged 50 years and older,<sup>54</sup> the American Speech Language Hearing Association (ASHA) recommends that adults aged 50 years or older should be screened by an audiologist every 3 years.<sup>54</sup> Frequency of screening for hearing loss among older adults in Singapore should be decided in consultation with experts.

### 5.4 Combinations of abnormal results in oral health, vision and hearing

The results presented in this brief suggest that co-occurrence of problems in vision, hearing and oral health among older adults is common. Over a third of the participants (36.2%) had two or more abnormal results, with the most common combination being abnormal oral health and vision (14.2%), followed by abnormal vision and hearing (10.9%). Co-occurrence of impairments can have serious repercussions; for instance, a population-based study from Iceland reported that older men with hearing impairment or dual sensory impairment had higher mortality from any cause and particularly cardiovascular causes within a median 5-year follow-up.<sup>5</sup> Moreover, concurrent vision and hearing impairment in older adults are associated with a range of psychosocial outcomes like increased loneliness, higher levels of depressive symptoms, lower social networks and poorer quality of life.<sup>8</sup> Thus, co-location, or location in proximity, of screening and management services for problems in vision, hearing and oral health may result in greater convenience, prompt diagnosis, and management for older adults with co-occurring impairments.

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