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Cohort Profile: Panel on Health and Ageing of Singaporean Elderly (PHASE)

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Why was the cohort set up?

Singapore is one of the world's most rapidly ageing countries.[1] The proportion of the population aged ≥60 years (hereafter, elderly), 19.7% in the year 2017,[2] is expected to reach 40% by 2050.[3,4] This increase is primarily driven by declining fertility rates and increasing life expectancy.[5] In addition, the number of elderly Singaporeans living alone or only with an unrelated elderly person has been increasing in recent years, in turn raising concerns regarding their social isolation and associated health risks.[6] Given the emphasis on filial piety and the elderly's reliance on intergenerational transfers in Asian societies,[7] understanding the profile of familial support and living arrangements of the elderly within the Singapore context has wide-ranging implications for health and social policy. Wave 1 of this prospective observational study was therefore initiated and funded by the Ministry of Social and Family Development, Singapore (formerly, Ministry of Community Development, Youth and Sports, Singapore) in order (i) to understand the interactions among physical health status, social engagement, socioeconomic status, social network support and loneliness; (ii) to understand the constraints on and channels for social participation; and (iii) to identify preferences for preventing and responding to isolation among elderly Singaporeans.

Who is in the cohort?

The Panel on Health and Ageing of Singaporean Elderly (PHASE) Wave 1, also known as the 'Social Isolation, Health and Lifestyles Survey (SIHLS)', conducted in 2009, was a nationally representative survey of community-dwelling elderly Singapore citizens and permanent residents; it included those who lived in public or private housing and excluded those who were institutionalized. Anticipating a 60% response rate and a target sample size of 5000, a random sample of 8400 elderly Singaporeans stratified by gender, ethnicity and age (by 5-year age

bands) was drawn from the national database of dwellings. Those aged ≥75 years as well as minority ethnicities (Malays and Indians) were oversampled by a factor of two to ensure sufficient numbers in these subgroups for analysis. A total of 1195 (14.2%) addresses in the sample were found to be invalid. Of the rest, a total of 4990 elderly Singaporeans [or their proxy, for the elderly unable to respond due to health reasons ($n = 458$, 9.2%])] were interviewed face-to-face at their residence with a structured questionnaire after written informed consent, for a response rate of 69.3%. The 2115 non-respondents included those who refused to participate (59.1%) and those who could not be contacted even after a minimum of three household visits (40.9%); they were more likely to be aged ≥70 years and more likely to represent the 'Others' ethnicity (Singapore officially considers four ethnicities: Chinese/Malay/Indian/Others)[8] relative to the respondents.

Table 1 details the socio-demographic characteristics of the cohort participants at Wave 1 or baseline. A majority had no formal education, lived in 4–5-room Housing and Development Board (HDB) flats, and were living with both their spouse and at least one child.

Table 1. Socio-demographic characteristics of study participants in the Panel on Health and Ageing of Singaporean Elderly (PHASE) at Wave 1 or baseline ($n = 4990$)

Characteristics	*n*	Weighted %[a]
Age (years)		
60–64	971	32.7
65–69	1073	24.6
70–74	855	17.4
75–79	1007	12.5
80–84	652	7.2
85+	432	5.6
Sex		
Men	2253	45.8
Women	2737	54.2
Ethnicity		
Chinese	3572	83.0
Malay	851	9.5
Indian	508	6.2
Others	59	1.4
Highest education level completed [b]		
No formal education	1832	30.8
Primary school	1791	36.4
Secondary school	998	23.6
Above secondary school	353	8.8
Housing		
1 or 2 room Housing Development Board flat	411	7.0
3 room Housing Development Board flat	1342	26.6
4 or 5 room Housing Development Board flat	2603	53.6
Private housing	608	12.4
Others	26	0.5
Living arrangements		
Living alone	292	5.2
Living with spouse only	882	18.7
Living with at least one child only	1639	26.3
Living with spouse and at least one child	1911	43.3
Living with others only	266	5.6

[a]Weighted using sampling weights for Wave 1.
[b]Sixteen observations were missing for this variable, thus the percentages do not add to 100%.

How often have they been followed up?

After the completion of PHASE Wave 1, the research team at Duke-NUS Medical School, Singapore aimed to follow this nationally representative sample over time to develop a longitudinal database on the physical, social and mental health profile of elderly Singaporeans, in order to assess changes over time. Thus, two subsequent waves of data collection, following up the individuals interviewed in Wave 1, have been conducted, in 2011-12 (Wave 2; 3103 respondents) and in 2015 (Wave 3, also known as the 'Singapore Assessment for Frailty in Elderly – Building upon the Panel on Health and Ageing of Singaporean Elderly (SAFE-PHASE), 2015'; 1575 respondents). The data collection approach for Waves 2 and 3 was similar to Wave 1, i.e. participants were interviewed face-to-face at their residence with a structured questionnaire after written informed consent. For those who had passed away since the previous wave, a decedent questionnaire was administered to their willing next-of-kin, on circumstances surrounding the elderly participant's death. This was further supplemented with data on date of death obtained from the Singapore Registry of Births and Deaths databases (hereafter, mortality databases), enabling mortality matching for the cohort participants. A total of 1094 participants passed away in the 6-year period between Wave 1 and Wave 3, and among these, 336 decedent interviews were conducted with their next-of-kin. Figure 1 summarizes the flow of the PHASE participants across the three waves of data collection. PHASE Waves 2 and 3, analysis of de-identified data from PHASE Wave 1, and linkage with the mortality databases have been approved by the Institutional Review Board at the National University of Singapore.

At Waves 2 and 3, a proportion of the previous wave's participants was not interviewed because they (i) had died by the time they were contacted for the interview or (ii) were alive but refused participation at contact/were uncontactable or (iii) for Wave 3, did not provide consent to be contacted for it during their Wave 2 interview. The distribution of participant status at a subsequent wave, i.e.

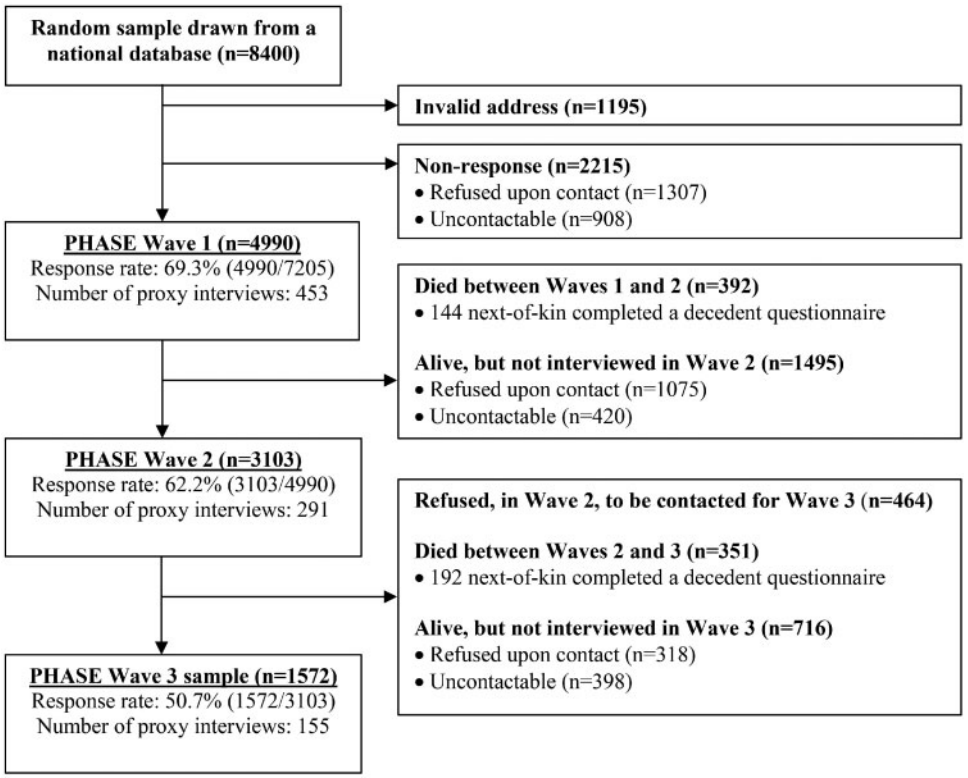

Figure 1. Flowchart of PHASE: Waves 1, 2 and 3.

Wave 2 or Wave 3, by basic socio-demographic characteristics and self-rated health, at the previous wave, i.e. Wave 1 or 2, respectively, is provided in Table 2. Those older, with less education and lower self-rated health at the previous wave were less likely to be interviewed in the subsequent wave due to mortality. Moreover, in Wave 2, younger respondents and those with better self-rated health at Wave 1 were more likely to refuse participation at contact or be uncontactable. Respondents of Chinese ethnicity were more likely to refuse participation for Wave 3 in advance (i.e. when they responded to Wave 2), but overall non-response among living respondents at Wave 3 was quite similar across ethnic groups.

In 2019, PHASE participants aged ≥75 years (as of January 2019) who had agreed, during their Wave 3 interview, to participate in future research studies are being approached for participation in a new prospective observational study on family caregiving transitions, along with a family member designated as their current or future primary caregiver. The enrolled dyads, i.e. PHASE participant plus one current or future primary caregiver, will be interviewed every 6 months, for a total of four interviews. This study, titled 'Caregiving Transitions among Family Caregivers of Elderly Singaporeans (TraCE)' is funded by the National Medical Research Council, Singapore.

What has been measured?

The PHASE questionnaire included two main sections—(a) the main questionnaire and (b) anthropometric and performance measurements (conducted for those who were willing and able). In addition, in Waves 2 and 3, a decedent questionnaire was administered to the willing next-of-kin of those who had passed away since the previous wave.

Table 3 presents the domains assessed through the main questionnaire, anthropometric and performance measurements, and decedent questionnaire (Waves 2 and 3 only) in each of the three waves for the participants. Most of the physical, social and mental health domains listed in the table were measured with pre-existing scales [such as the Center for Epidemiological Studies Depression (CES-D) Scale for depressive symptoms,[9] the Short Portable Mental Status Questionnaire (SPMSQ) for cognition,[10] the three-item UCLA Loneliness Scale for perceived loneliness,[11] the modified Lubben's social network scale for social networks outside the household,[12] and the General Physical Activity Questionnaire (GPAQ) for physical activity[13]] all of which have been used in national surveys in other countries or in Singapore, for ease of comparison. For Waves 2 and 3, the SPMSQ was first administered to the elderly participant in order to determine whether the elderly respondent had the cognitive capacity to answer the main questionnaire.

Table 2. Distribution of participant status at a subsequent wave (Wave 2 or Wave 3) by basic socio-demographic characteristics and self-rated health at the previous wave (Wave 1 or 2, respectively): Panel on Health and Ageing of Singaporean Elderly (PHASE)

Characteristic, at previous wave[a,b]	Wave 2 status of 4990 Wave 1 participants						Wave 3 status of 3103 Wave 2 participants							
	Alive and interviewed ($n=3103$)		Dead ($n=392$)		Alive and not interviewed ($n=1495$)		Alive and interviewed ($n=1572$)		Dead ($n=351$)		Alive and not interviewed ($n=716$)		Refused, in Wave 2, for Wave 3[c] ($n=464$)	
	n	Row %	*n*	Row %	*n*	Row %	*n*	Row %	*n*	Row %	*n*	Row %	*n*	Row %
Age (years)														
60–69	1352	66.1	68	3.3	624	30.5	619	59.2	46	4.4	224	21.4	156	14.9
70–69	1152	61.9	140	7.5	570	30.6	628	51.8	109	9.0	295	24.3	180	14.9
80–89	538	56.8	139	14.7	270	28.5	300	39.8	160	21.3	181	24.0	112	14.9
90+	61	44.5	45	32.9	31	22.6	25	26.9	36	38.7	16	17.2	16	17.2
Sex														
Men	1412	62.7	204	9.1	637	28.3	651	46.1	163	11.5	309	21.9	289	20.5
Women	1691	61.8	188	6.9	858	31.4	921	54.5	188	11.1	407	24.1	175	10.4
Ethnicity														
Chinese	2218	62.1	259	7.3	1095	30.7	1146	51.7	236	10.6	411	18.5	425	19.2
Malay	541	63.6	92	10.8	218	25.6	268	49.5	75	13.9	176	32.5	22	4.1
Indian	312	61.4	36	7.1	160	31.5	142	45.5	35	11.2	120	38.5	15	4.8
Others	32	54.2	5	8.5	22	37.3	16	50.0	5	15.6	9	28.1	2	6.3
Highest education level completed														
No formal education	1096	59.8	189	10.3	547	29.9	548	50.0	163	14.9	251	22.9	134	12.2
Primary school	1102	61.5	149	8.3	540	30.2	563	51.1	123	11.2	259	23.5	157	14.3
Secondary school	670	67.3	37	3.7	291	29.2	350	52.2	46	6.9	149	22.2	125	18.7
Above secondary school	229	64.9	13	3.7	111	31.4	110	48.0	16	7.0	57	24.9	46	20.1
Self-rated health														
Very healthy	259	60.8	11	2.6	156	36.6	61	54.5	7	6.3	28	25.0	16	14.3
Healthier than average	910	65.0	45	3.2	446	31.8	360	63.2	38	6.7	139	24.4	33	5.8
Of average health	1481	63.1	188	8.0	679	28.9	952	50.0	181	9.5	444	23.3	327	17.2
Somewhat unhealthy	388	57.5	105	15.6	182	27.0	182	41.9	93	21.4	92	21.2	67	15.4
Very unhealthy	63	46.0	43	31.4	31	22.6	15	19.2	30	37.5	13	16.7	20	25.6

[a]For sex, ethnicity and education level, the values reported at Wave 1 were used, whereas for age and self-rated health, those reported at Wave 1 or Wave 2, as applicable, were used.

[b]Percentages for some rows may not add up to 100% due to rounding.

[c]Comprise both those alive or dead by 2015, when Wave 3 was conducted.

Table 3. Measurements obtained at different waves of the Panel on Health and Ageing of Singaporean Elderly (PHASE)

PHASE Wave (year)	Measurements
Wave 1 (2009)	Main questionnaire (all self-reported)
	Basic socio-demographic characteristics; household composition and living arrangement; perceived loneliness; social networks outside the household; social participation; self-rated health, vision and hearing; chronic illnesses (ever diagnosed by a health professional); limitations in physical function, activities of daily living (ADLs) and instrumental ADLs (IADLs); pain; health behaviours, including smoking, alcohol intake, sleep duration and nap duration; dental health, including chewing ability; cognition; depressive symptoms; personal mastery; income and perceived income adequacy
	Anthropometry and performance measurements
	Blood pressure; hand-grip strength; sitting height; standing height; waist circumference; weight
Wave 2 (2011-12)	Additions to main questionnaire
	Fall history; provision and receipt of transfers from family members; healthcare insurance; healthcare use
	Additions to anthropometry and performance measurements
	Chair stand test
	Decedent questionnaire (reported by next-of-kin)
	Details about the participant's death, including place of care at the end of life and of death, and cause of death; situation at the end of life, including living arrangement, chronic illnesses, ADLs, IADLs, fall history, symptoms of memory, behaviour and mood impairment, and healthcare use
Wave 3 (2015)	Additions to main questionnaire
	Physical activity; use of medical services for each reported chronic illness; literacy; medication use and adherence; health literacy; understanding of prescription medication labels
	Additions to anthropometry and performance measurements
	Timed walk test
	Decedent questionnaire

What has it found? Key findings and publications

More than 30 papers using the data from PHASE have since been published, examining various dimensions of health.

A number of papers focus on psychological variables, such as happiness, or social connectedness variables, such as social networks outside the household and perceived loneliness, either describing their prevalence and correlates or assessing their association with health outcomes.[14–20] For example, we have shown that weak social networks outside the household are linked to more depressive symptoms[17] and to restless sleep,[20] and while older adults who perceive themselves to be more lonely have a higher risk of mortality,[18] those who perceive themselves to be more happy have a lower risk of mortality.[16] These results highlight the importance of maintaining strong social connectedness and of a positive affect for mental and/or physical health outcomes.

The prevalence and correlates or health outcomes of various physical health dimensions among older Singaporeans, such as hypertension,[21] obesity,[22,23] functional limitations,[24,25] dental health[26] and sleep[27] have been examined. Estimates of health expectancy for older Singaporeans have been calculated.[28–30] Further, aggregated data from PHASE has contributed to a global collaboration examining the epidemiology of risk factors of non-communicable diseases.[31–35] Additionally, in a comprehensive paper, we analysed 15 dimensions of health that are thought to be related to self-rated health, finding that freedom from pain had the strongest association with positive self-rated health,[36] an association seldom reported in other studies of elderly.

In conjunction with data from other population surveys, the PHASE data has been used for various population-level projections for Singapore, including those for functional limitation status,[37,38] hospitalization spending,[39] and family caregiver outcomes of eldercare hours and labour market participation.[40,41] Notably, one such projection found that taking into account the changing educational composition of the elderly means that there will likely be both a greater population of the old-old and a smaller population of young-old with functional disability than previously expected.[37]

Several methodological papers examining the validity and reliability of self-reported data, the presence and extent of interviewer bias or error and the impact of varying operationalization of the same construct have also been published from the data.[29,42–44] One such paper reported the presence of interviewer error in the administration of the cognitive test[10] administered in the screener and proposed a method of correction.[42] Another used anchoring vignettes to test for and find systematic differences in the reporting of pain severity by age, gender and ethnicity.[43] The PHASE dataset has also been used to define normative values for hand-grip strength for Singaporeans aged 60–89 years[45] as well as to establish the utility of providing bilingual prescription medication labels to elderly Singaporeans to enhance their understanding of such labels.[46]

What are the main strengths and weaknesses?

There are several strengths of this prospective observational study. First, it comprises a nationally representative

sample and thus can be generalized to the elderly population of Singapore, which is particularly important for national policy in a context where there is a scarcity of health and social network data about the elderly. Second, it is the first longitudinal panel study of this nature in Singapore, following up the same elderly participants over a total of 6 years. This allows researchers to examine changes over time and to make more causal interpretations of predictors of health outcomes using temporality. Third, linkage with the mortality databases enables utilization of exhaustive data on all-cause mortality, and thus a more robust understanding of non-response and mortality risk, unlike most other studies where observations have to be censored due to uncertainty surrounding mortality. Fourth, collection of a range of anthropometric and performance measurements allows for objective assessment of the health of the study participants, complementing the rich self-reported data collected through the questionnaire. Lastly, and related to the previous point, an important strength is the use of an extensive number of self-report measures for the participants' physical, mental and social health. This allows for a wide range of analytical approaches, such as considering multiple mediating mechanisms and accounting for a large range of potential confounding variables.

One weakness of the study has to do with issues of translatability. Due to the multi-ethnic/multicultural composition of Singapore and its four official languages (English, Mandarin Chinese, Malay, Tamil), questionnaires needed to be translated into the various languages, which may have varying effects on responses depending on how accurately a question is translated and cultural perceptions of the questions themselves. This is compounded by the fact that most elderly Singaporeans in this prospective observational study did not receive much formal education. This may have resulted in more interviewer-level variation (as seen in[42]) since interviewers would be depended upon to explain and rephrase the questions. Another set of limitations concerns the linkage with the mortality databases. First, these databases cannot provide information about the mortality of the cohort participants who have died after emigrating from Singapore, unless the next-of-kin reported the death to the concerned authorities in Singapore. However, this proportion is expected to be small; Singapore does not figure in the top 20 Asian countries in terms of number of emigrants.[47] Second, the linkage was done through the national identification number, which was self-reported by the participants or their proxy in PHASE Wave 1, but was missing for 12.3% of the participants. While the linkage cannot ascertain the mortality status of participants with missing national identification numbers, their mortality status was captured during data collection at PHASE Waves 2 and 3, unless they or their next-of-kin were uncontactable.

Can I get hold of the data? Where can I find out more?

The codebooks for PHASE Waves 1 and 2 and the process for requesting access to the data are available at https://www.duke-nus.edu.sg/care/research/dataset-codebook (the codebook for PHASE Wave 3 will be made available on request). The possibility of collaboration in any potential analysis and publication is considered on an ongoing and case-by-case basis. Specific research proposals and requests can be also sent to the corresponding author Dr Rahul Malhotra (email: rahul.malhotra@duke-nus.edu.sg, copying to care-datarequest@duke-nus.edu.sg).

Profile in a nutshell

- PHASE is a prospective observational study to develop a profile of the changes in physical, social and mental health of elderly Singaporeans, aged $\geq$60 years.
- At Wave 1 (in 2009), a total of 4990 elderly Singaporeans or their proxy respondents [for 458 (9.2%) elderly unable to respond for health reasons] were interviewed face-to-face at their residences after informed consent.
- A total of 3103 participants were re-interviewed in Wave 2 (in 2011-12). Of these, 1572 participants were successfully re-interviewed for Wave 3 (in 2015).
- The dataset comprises demographic variables, information on a range of physical, mental and social health variables, anthropometric and performance measurements and mortality matching for participants with administrative mortality databases.
- The codebooks for PHASE Waves 1 and 2 and the process for requesting access to the data are available at https://www.duke-nus.edu.sg/care/research/dataset-codebook

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