

Prevalence of Depression among Older Adults—Results from the Well-being of the Singapore Elderly Study

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Abstract

Introduction: Depression is a significant public health issue across all sociodemographic groups and is identified as a common and serious mental health problem particularly among the older adult population. The aims of the current study were to determine the prevalence of depression and subsyndromal depression among older adults in Singapore. **Materials and Methods:** The Well-being of the Singapore Elderly (WiSE) study was a comprehensive single phase, cross-sectional survey. Stage I Geriatric Mental State-Automated Geriatric Examination for Computer Assisted Taxonomy (GMS-AGECAT) depression syndrome was used for this analysis. Association of depression and subsyndromal depression with sociodemographic characteristics, social support as well as comorbidity with chronic physical illnesses and quality of life was assessed. **Results:** The prevalence of GMS-AGECAT depression and subsyndromal depression was 3.7% and 13.4%, respectively. The odds of depression were significantly higher among those aged 75 to 84 (2.1) as compared to those aged 60 to 74 years and in those who had a history of depression diagnosis by a doctor (4.1). The odds of depression were higher among those of Indian and Malay ethnicities (5.2 and 3.2 times, respectively) as compared to those of Chinese ethnicity. Those with depression and subsyndromal depression were associated with more disability, poorer life satisfaction, and medical comorbidities. **Conclusion:** Our study suggests that the prevalence of depression seems to have decreased as compared to a decade ago wherein the prevalence of depression was estimated to be 5.5%. This positive trend can be ascribed to concerted efforts across various disciplines and sectors, which need to be continually strengthened, monitored and evaluated.

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Introduction

Depression is a significant public health issue across all sociodemographic groups and is identified as a common and serious mental health problem particularly among the older adult population.^{1,2} The World Health Organization (WHO) estimated that the overall prevalence rate of depressive disorders among the elderly in the community ranges from 8% to 20%.³ Clinically significant depressive symptoms among older adults lead to a number of negative consequences including functional decline, disability, decreased quality of life, comorbid medical conditions⁴⁻⁶ and an increase in healthcare utilisation associated with increased healthcare costs.⁷ In addition, depression is significantly related to a higher suicide rate and higher mortality.^{8,9}

Singapore is a multi-ethnic country in Southeast Asia, with a resident population of 3.9 million¹⁰ of which 74.2% are Chinese, 13.3% are Malays, 9.1% are Indians and 3.3% belong to Other ethnic groups. The population of older adults (defined as persons aged 65 years and older) in Singapore has grown significantly over the past few decades. In a study done about 10 years ago, the prevalence rate for syndromal and subsyndromal depression was reported to be 5.5% and 9.6%, respectively among older adults (those aged 60 years and above) in Singapore,¹¹ while a more recent study reported the estimated prevalence of depressive symptoms among the community-dwelling elderly in Singapore to be 11.4%.¹²

The Well-being of the Singapore Elderly (WiSE) study was initiated in 2011 to provide an updated mental health

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profile of the Singapore elderly, and to inform mental health policy. The aims of the current article were to determine the prevalence of depression and subsyndromal depression among older adults in Singapore according to the Geriatric Mental State-Automated Geriatric Examination for Computer Assisted Taxonomy (GMS-AGECAT) diagnosis.¹³ The article also examines the association of sociodemographic characteristics and social support with depression. The extent of disability, comorbidity with chronic physical illnesses and quality of life associated with depression was also assessed.

Materials and Methods

The WiSE study was a single phase, cross-sectional survey conducted to determine the prevalence of dementia and depression in the Singapore population. A probability sample was randomly selected using a disproportionate stratified sampling design. In order to make inferences of prevalence rates of mental disorders to the entire population of Singapore residents, the survey data were weighted to the 2011 resident population. The study population comprised Singapore residents (including Singapore citizens and permanent residents) aged 60 years and above who were living in Singapore at the time of the survey. Statistical power calculations for binary proportions after adjusting for design effect were estimated to determine the sample sizes for the overall prevalence estimate of dementia, as well as for subgroups by age and ethnicity, with precision of 5%.¹⁴ A target sample size of 2500 was estimated to be adequate to provide sufficient precision to measure the prevalence of dementia.

The interviews were conducted by trained lay interviewers at the residence of the older adult. Respondents who were in day care centres, nursing homes and institutions were included while residents who were living outside the country and not contactable due to incomplete or incorrect addresses were excluded from the study. The 10/66 protocol¹⁵ was adopted for this study. All respondents in the study received the full assessment, lasting approximately 2 to 3 hours. For each selected individual, an informant was chosen and both were administered the culturally adapted version of the 10/66 questionnaires. The study was approved by the institutional ethics review boards of participating institutions (National Healthcare Group Domain Specific Review Board [DSRB] and the SingHealth Centralised Institutional Review Board [CIRB]). All respondents provided written informed consent and for respondents who were unable to provide informed consent, written informed consent was taken from their legally acceptable representative/next of kin. The study has been described in greater detail in an earlier article.¹⁶

Assessment of Depression

The Geriatric Mental State (GMS) is one of the most frequently used diagnostic instruments for the elderly. The instrument comprises a semi-structured interview and a rating section, covering psychopathology, sensory functions and frailty. Diagnoses are obtained using the Automated Geriatric Examination for Computer Assisted Taxonomy (AGECAT).¹³ The GMS-AGECAT, generates 4 syndrome clusters: organicity (dementia); schizophrenia and related paranoia; depression; and anxiety neurosis. A severity level is provided for each syndrome, ranging from 0 (no symptoms) to 5 (very severely affected). Level 3 and greater constitutes a 'case' while levels 1 and 2 represent 'subcases'. These 'stage 1' diagnoses are then organised into a single 'stage 2' diagnosis on the basis of precedence determined by a hierarchically structured algorithm. A previous study by Kua¹⁷ in Singapore reported that the concordance between AGECAT and the psychiatrist's diagnoses for depression achieved kappa values of 0.88.

Similar to the earlier study by Guerra et al¹⁸ we used the stage 1 GMS-AGECAT depression syndrome for this analysis—this is subsequently referred to as 'GMS-AGECAT depression'. The decision was based on the finding that the sensitivity was consistently higher for the stage 1 than for the stage 2 depression diagnosis, against the Montgomery-Åsberg Depression Rating Scale in the pilot studies.¹⁹ This is explained by the tendency of the AGECAT hierarchical system to accord dementia diagnosis precedence over depression in the hierarchical determination; in other words, stage 2 diagnosis uses dementia as an exclusion criteria for selection into the depression group. All 'cases' were classified as depression while 'subcases' were classified as subsyndromal depression.

Other Assessments

Overall Health Status, Physical Activity and Quality of Life

Overall health status was measured by asking the respondents, "How would you rate your overall health in the past 30 days?" using a 5-point scale (4 = very bad, 3 = bad, 2 = moderate, 1 = good, 0 = very good).

Physical activity was assessed by asking respondents, "Taking into account both work and leisure, would you say that you are very physically active (1), fairly physically active (2), not very physically active (3) or not at all physically active (4)?" Satisfaction with life in general was assessed by asking, "How would you describe your satisfaction with life in general at the present time: good, fair or poor?"

Other Health Conditions

The presence or absence of health conditions was determined by asking respondents whether a doctor had ever told them that they had any of the following: depression, hypertension, heart trouble (myocardial infarction, cardiac failure and valvular heart disease), stroke, diabetes and transient ischaemic attacks (TIAs); and self-reports of physical impairments (arthritis or rheumatism; eyesight problems; hearing difficulty or deafness; persistent cough; breathlessness, difficulty breathing or asthma; stomach or intestine problems; faints or blackouts; paralysis, weakness or loss of 1 leg or arm; skin disorders such as pressure sores, leg ulcers or severe burns and cancer) were obtained from the respondents.

Disability

The World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0)²⁰ was used to measure limitation and participation restriction. The instrument was developed for use in cross-cultural comparative epidemiological and health services research. The WHODAS 2.0 measures functioning across 6 domains—cognition, mobility, self-care, getting along, life activities and participation in community activities, over the past 30 days. It uses a 5-point scale that ranges from none (0 – no difficulty) to extreme or cannot do (4 – extreme difficulty).

Sociodemographic Status

Participants' ages were established from participant and informant reports and official identification documents. Information was also collected on gender, ethnicity, marital status, education and employment.

Social Support and Loneliness

A series of questions related to contact with family members, friends and neighbours were used to assess social support. 'Never', 'less than monthly' and 'monthly' contacts with family, friends and neighbours was used as a proxy measure of lack of social support. While those who reported 'daily', '2 to 3 times a week' and 'at least weekly' were assessed as having social support.

Loneliness has often been measured by a single item in various studies. The questions asked include, "Do you feel lonely?"²¹ and "Do you suffer from loneliness?"²² In the current study, loneliness was measured by a single item, "Do you ever feel lonely?" with 3 response alternatives: "Yes, often", "Yes, sometimes", and "No, never". Participants were also asked specifically if they were bothered or depressed by current loneliness.

Statistical Analysis

Statistical analyses were carried out using the SAS System version 9.3. All data analyses were performed using weighted data. A series of multivariate regression models were used to examine sociodemographic correlates of depression, associations between depression and other health outcomes with adjustment for sociodemographic variables such as age, gender, ethnicity, marital status, education and employment status. To account for the effects of complex sample design due to stratification and weighting, standard errors and significance tests were estimated using the Taylor series linearisation method. Multivariate significance was evaluated using the Wald test based on design-corrected coefficient variance-covariance matrices. Statistical significance was set at the conventional level of $P < 0.05$, using two-sided tests.

Results

The sociodemographic characteristics of the respondents are shown in Table 1. A total of 2565 respondents were included in the present study. The sample comprised 55.9% female and 44.1% male respondents. Majority of the sample was aged between 60 to 74 years (75%), of Chinese ethnicity (83.3%), and currently married (64%). The prevalence of GMS-AGECAT depression and subsyndromal depression was 3.7% and 13.4%, respectively. Table 1 also shows the prevalence of depression by sociodemographic characteristics of the sample. The odds of GMS-AGECAT depression were significantly higher among those aged 75 to 84 years and those who had a history of depression diagnosis by a doctor, while the odds of both depression and subsyndromal depression were higher among those of Indian and Malay ethnicity. Having no formal education and being divorced/separated was also significantly associated with higher odds of having subsyndromal depression (Table 2).

Table 3 shows the prevalence and odds ratio of other health conditions with depression. After adjusting for covariates in multiple logistic regression analyses, we found GMS-AGECAT depression was significantly associated with heart problem, diabetes, TIA, arthritis or rheumatism, persistent cough, asthma, stomach or intestine problems and paralysis. Subsyndromal depression was associated with stroke, diabetes, TIA, arthritis or rheumatism, eye problems, persistent cough, asthma, stomach or intestine problems, faints or blackouts, paralysis, and skin disorders.

The relationship between depression and disability, quality of life as well as social support is shown in Table 4. The mean disability status (as measured by WHODAS 2.0) was significantly higher among those with depression and subsyndromal depression. Those with depression and

Table 1. Sociodemographic Characteristics of the Sample and Prevalence of Depression

Demographic Characteristic	Category	n	Unweighted %	Weighted %	SE	GMS-AGECAT Depression								
						Cases			Subcases			Non-Cases		
						n	%	SE	n	%	SE	n	%	SE
Age group (years)	60 – 74	1494	58.2	75.0	0	96	59.8	5.7	226	72.5	2.7	1172	76.1	0.5
	75 – 84	669	26.1	19.5	0	52	32.0	5.5	122	21.1	2.5	495	18.6	0.5
	85+	402	15.7	5.5	0	29	8.2	2.2	77	6.5	1	296	5.3	0.2
Gender	Men	1117	43.5	44.1	1.4	52	32.8	5.9	149	36.7	3.6	916	45.8	1.6
	Women	1448	56.5	55.9	1.4	125	67.2	5.9	276	63.3	3.6	1047	54.2	1.6
Ethnicity	Chinese	1012	39.5	83.3	0	34	62.0	4.9	129	78.2	1.8	849	85.1	0.3
	Malay	745	29.0	9.3	0	58	19.0	3.1	137	11.6	1.2	550	8.5	0.2
	Indian	772	30.1	6.0	0	83	16.8	2.5	152	8.5	0.8	537	5.1	0.1
	Others	36	1.4	1.4	0	2	2.2	1.5	7	1.8	0.6	27	1.4	0.1
Marital status	Never married	136	5.3	8.0	0.8	7	4.2	2.8	25	8.6	2.3	104	8.0	0.9
	Married/cohabiting	1484	57.9	64.0	1.3	84	63.4	5.6	209	53.1	3.7	1191	65.8	1.5
	Widowed	836	32.6	22.5	1	72	25.7	4.7	172	29	3.1	592	21.3	1.2
	Divorced/separated	107	4.2	5.5	0.7	14	6.7	2.9	19	9.2	2.4	74	4.9	0.7
Education	None	511	20.0	16.5	1	54	28.6	5.2	110	24.3	3.1	347	14.6	1
	Some, but did not complete primary	620	24.3	23.9	1.2	37	19.9	4.8	122	26.5	3.3	461	23.7	1.3
	Completed primary	640	25.1	24.8	1.2	41	24.8	5.5	94	21.7	3.1	505	25.3	1.4
	Completed secondary	517	20.3	22.4	1.2	28	14.1	4	73	19.9	3.1	416	23.1	1.3
Employment	Completed tertiary	262	10.3	12.4	1	16	12.6	4.7	24	7.6	2.1	222	13.2	1.1
	Paid work (part time and full time)	688	27.2	33.9	1.3	27	21.0	5.4	94	30.2	3.6	567	35.0	1.5
	Unemployed (looking for work)	32	1.3	1.5	0.4	4	1.3	0.7	5	1.8	1.1	23	1.5	0.4
Doctor-diagnosed depression	Homemaker	808	31.9	26.3	1.2	70	36.4	5.9	166	31.4	3.4	572	25.0	1.3
	Retired	1006	39.7	38.3	1.3	73	41.3	6.1	156	36.5	3.6	777	38.5	1.5
GMS-AGECAT: Geriatric Mental State-Automated Geriatric Examination for Computer Assisted Taxonomy	No	167	94.4	2.9	417	98.5	0.8	1931	98.3	0.4				
	Yes	10	5.6	2.9	8	1.5	0.8	32	1.7	0.4				

Table 2. Sociodemographic Correlates of Depression and Subsyndromal Depression

Demographic Characteristic	Category	Depression				Subsyndromal Depression			
		OR*	95% CI		P Value	OR*	95% CI		P Value
Age group (years)	60 – 74	Ref.							
	75 – 84	2.1	1.1	3.9	0.018	1.0	0.7	1.5	0.942
	85+	1.7	0.7	3.8	0.208	1.0	0.6	1.7	0.978
Gender	Men	Ref.				Ref.			
	Women	1.7	0.8	3.7	0.190	1.2	0.8	2.0	0.378
Ethnicity	Chinese	Ref.				Ref.			
	Indian	5.2	3.1	8.7	<.0001	2.1	1.6	2.8	<.0001
	Malay	3.2	1.9	5.4	<.0001	1.4	1.1	2.0	0.020
	Others	2.4	0.5	12.7	0.301	1.8	0.7	4.5	0.227
Marital status	Married	Ref.				Ref.			
	Divorced/separated	1.8	0.6	5.2	0.309	2.1	1.0	4.3	0.044
	Never married	0.6	0.1	3.0	0.577	1.3	0.6	2.6	0.489
	Widowed	0.6	0.3	1.2	0.121	1.2	0.8	1.9	0.318
Education	Completed tertiary	Ref.				Ref.			
	None	1.6	0.5	4.7	0.403	2.5	1.2	5.4	0.018
	Some, but did not complete primary	0.8	0.3	2.3	0.711	1.8	0.9	3.7	0.096
	Completed primary	1.0	0.3	2.7	0.954	1.4	0.7	2.9	0.348
	Completed secondary	0.6	0.2	1.7	0.321	1.3	0.6	2.7	0.477
Employment	Paid work (part time and full time)	Ref.				Ref.			
	Homemaker	1.3	0.5	3.4	0.532	1.1	0.6	1.8	0.823
	Retired	1.5	0.7	3.0	0.309	1.0	0.7	1.6	0.862
	Unemployed (looking for work)	1.4	0.4	5.3	0.607	1.3	0.3	6.0	0.731
Doctor-diagnosed depression	No	Ref.				Ref.			
	Yes	4.1	1.1	14.9	0.030	1.2	0.3	4.2	0.826

CI: Confidence interval; OR: Odds ratio

*Odds ratio was derived from multinomial logistic regression analysis.

subsyndromal depression were less likely to endorse that their satisfaction with life was ‘fair or good’.

Discussion

The study found that the prevalence of GMS-AGECAT depression and subsyndromal depression were 3.7% and 13.4%, respectively in the multi-ethnic, older adult population of Singapore. Guerra et al¹⁸ reported GMS-AGECAT depression between 30% and 35.9%, across 3 countries in Latin America among those aged 65 years and above. Prevalence of depression as reported by Medical Research Council Cognitive Function and Ageing Study (MRC CFAS) (United Kingdom [UK]) among those aged 65 years and above using GMS-AGECAT was 8.7% (95% CI, 7.3 to 10.2) (age and sex standardised).²³ Prevalence rates reported in studies vary considerably, partly depending on assessment scales and criteria, with symptom scales finding

higher rates, than studies based on diagnostic criteria such as the Diagnostic and Statistical Manual of Mental Disorders (DSM) or GMS-AGECAT criteria.²⁴

The prevalence of depression among older adults in Singapore seems to be lower than that reported by studies using similar methodology from Latin America and the UK. The low prevalence rate in the current study could be due to cultural differences. Past studies have shown that culture influences the experience and expression of distress symptoms.²⁵ Liao et al²⁶ who similarly observed a low prevalence of major depressive disorder (MDD) among the Taiwanese adult population attributed this tendency for under reporting symptoms to ‘cultural stoicism’.²⁷ The concept of ‘cultural stoicism’ hypothesises that a culturally determined ‘response bias’ may lead to a lower estimate of the prevalence of emotional problems. However, given the high concordance rate reported by Kua,¹⁷ this explanation

Table 3. Prevalence and Odds Ratio of Other Health Conditions in Depression

Health Conditions	Non-Cases		Subcases						Cases					
	n	%	n	%	OR*	Lower	Upper	P Value	n	%	OR*	Lower	Upper	P Value
High blood pressure	1156	58.6	281	66.1	1.4	0.9	1.9	0.095	114	53.8	0.7	0.4	1.2	0.194
Heart trouble	275	11.3	93	14.3	1.3	0.8	2.1	0.218	54	25.0	2.4	1.2	4.5	0.009
Stroke	127	6.4	52	13.4	2.2	1.2	3.7	0.006	20	13.3	2.2	0.9	5.1	0.071
Diabetes	571	23.5	155	33.5	1.6	1.1	2.2	0.016	72	40.5	1.9	1.1	3.4	0.019
TIA's	35	1.3	23	3.7	3.1	1.3	7.3	0.012	13	9.1	8.5	2.6	28.2	<0.001
Arthritis or rheumatism	507	29.9	175	42.7	1.7	1.2	2.4	0.002	86	48.0	2.2	1.3	3.7	0.003
Eyesight problems	813	45.4	209	60.1	1.9	1.4	2.7	<0.001	92	54.0	1.6	1.0	2.7	0.077
Hearing difficulty	398	18.3	100	19.8	1.1	0.7	1.7	0.56	43	23.3	1.2	0.6	2.5	0.553
Persistent cough	74	3.2	35	8.5	2.7	1.4	5.4	0.005	17	8.2	2.6	1.0	6.6	0.043
Asthma	171	6.1	57	12.6	2.1	1.3	3.5	0.003	33	21.3	3.3	1.6	6.7	0.001
Stomach or intestine problems	166	10.3	64	18.8	2.2	1.4	3.5	0.001	28	18.3	2.2	1.0	4.6	0.045
Faints or blackouts	75	4.8	41	11.2	2.4	1.4	4.3	0.003	13	11.1	2.5	0.9	7.1	0.089
Paralysis	207	7.0	107	19.8	3.2	2.0	5	<0.001	44	19.9	2.7	1.4	5.3	0.004
Skin disorders	107	4.9	47	13.1	2.8	1.6	4.9	0.001	22	8.1	1.6	0.8	3.4	0.208
Cancer	45	2.5	11	3.3	1.5	0.6	3.9	0.41	8	7.7	2.8	0.9	9.5	0.09

GMS-AGECAT: Geriatric Mental State-Automated Geriatric Examination for Computer Assisted Taxonomy; OR: Odds ratio; TIAs: Transient ischaemic attack

*Odds ratio was derived from multiple logistic regression analyses after adjusting for age, gender, ethnicity, education, marital status and employment status.

Table 4. Relationship between Depression and Functioning, Quality of Life and Social Support Factors

Variables	Non-Cases			Subcases						Cases							
	n	Mean	SE	n	Mean	SE	B*	95% CI	P Value	n	Mean	SE	B*	95% CI	P Value		
WHODAS 2.0 total scores	1962	8.7	0.4	425	18.7	1.6	8.8	5.7	11.8	<0.001	177	31.3	3.4	19.5	12.6	26.4	<0.001
Overall health status																	
	Moderate to very bad	29	1.5	0.4	21	3.8	1.4	Ref.			20	19.9	5.4	Ref.			
Satisfaction with life																	
	Good and very good	1927	98.5	0.4	404	96.2	1.4	0.4	0.2	1.1	0.065	155	80.1	5.4	0.1	0.02	0.1
Satisfaction with life																	
	Poor	588	35.3	1.6	215	59.6	3.8	Ref.			109	64.6	6.0	Ref.			
Satisfaction with life																	
	Fair & good	1804	99.4	0.2	377	95.6	1.7	0.1	0.04	0.4	<0.001	145	85.1	4.4	0.03	0.01	0.08

CI: Confidence interval; GMS-AGECAT: Geriatric Mental State-Automated Geriatric Examination for Computer Assisted Taxonomy; OR: Odds ratio

*Beta coefficient was derived from multiple linear regression analysis after adjusting for age, gender, ethnicity, education, marital status and employment status.

†Odds ratio was derived from multiple logistic regression analyses after adjusting for age, gender, ethnicity, education, marital status and employment status.

Table 4. Relationship between Depression and Functioning, Quality of Life and Social Support Factors (Cont'd)

Variables	GMS-AGECAT Depression																		
	Non-Cases				Subcases				Cases										
	n	%	SE	P Value	n	%	SE	OR [†]	95% CI	P Value	n	%	SE	OR [†]	95% CI	P Value			
Physically active	Not very physically active or not at all physically active	573	21.3	1.2		201	34.8	3.5	Ref.		97	58.4	6.0	Ref.					
	Very physically active & fairly physically active	1390	78.7	1.2	0.0004	224	65.2	3.5	0.5	0.4	0.7	0.0004	80	41.6	6.0	0.2	0.1	0.4	<0.001
Loneliness	No	1781	92.8	0.8		287	69.1	3.4	Ref.		93	48.5	6.1	Ref.					
	Yes	182	7.2	0.8	<0.001	138	30.9	3.4	5.5	3.6	8.2	<0.001	84	51.5	6.1	13.4	7.1	25.2	<0.001
Depressed by current loneliness	No	1959	99.7	0.2		392	91.0	2.2	Ref.		136	74.5	5.6	Ref.					
	Yes	4	0.3	0.2	<0.001	33	9.0	2.2	36.5	9.3	143.9	<0.001	41	25.5	5.6	161.3	35.9	724.5	<0.001
Social support factors																			
Speak to children or other relatives	Never; at least monthly or less often	311	17.7	1.2		70	22.7	3.3	Ref.		28	12.5	4.1	1.5	0.5	4.1	0.443		
	Daily; 2 to 3 times a week or at least weekly	1647	82.3	1.2	0.283	355	77.3	3.3	0.7	0.4	1.3	0.283	149	87.5	4.1	1.5	0.5	4.1	0.443
Chat or do something with one of your friends	Never; at least monthly or less often	917	44.5	1.6		239	51.1	3.8	Ref.		102	62.4	5.8	Ref.					
	Daily; 2 to 3 times a week or at least weekly	1044	55.5	1.6	0.192	186	48.9	3.8	0.8	0.6	1.1	0.192	75	37.6	5.8	0.5	0.3	0.8	0.01
Satisfied with the help and support from close friends	Dissatisfied	235	11.6	1.0		74	20.5	3.6	Ref.		36	36.3	7.4	Ref.					
	Satisfied	1178	88.4	1.0	0.013	204	79.5	3.6	0.5	0.3	0.9	0.013	82	63.7	7.4	0.2	0.1	0.5	0.001
Often see any of neighbours to have a chat or do something with	Never; at least monthly or less often	857	45.7	1.6		212	52.7	3.8	Ref.		89	59.5	5.9	Ref.					
	Daily; 2 to 3 times a week or at least weekly	1077	54.3	1.6	0.116	209	47.3	3.8	0.8	0.5	1.1	0.116	87	40.5	5.9	0.5	0.3	0.9	0.014
Has ever felt suicidal or wished to be dead	No	1814	99.3	0.3		359	87.7	2.7	Ref.		112	66.6	6.0	Ref.					
	Yes	11	0.7	0.3	<0.001	35	12.3	2.7	20.2	7.6	53.7	<0.001	57	33.4	6.0	88	31.1	249	<0.001

CI: Confidence interval; GMS-AGECAT: Geriatric Mental State-Automated Geriatric Examination for Computer Assisted Taxonomy; OR: Odds ratio
[†]Beta coefficient was derived from multiple linear regression analysis after adjusting for age, gender, ethnicity, education, marital status and employment status.
[‡]Odds ratio was derived from multiple logistic regression analyses after adjusting for age, gender, ethnicity, education, marital status and employment status.

may not explain our findings and it is possible that prevalence is lower in this population of older Asian adults as compared to that reported from other studies.

The prevalence also seems to have decreased as compared to results from the study conducted a decade ago in the same population that reported prevalence of depression to be 5.5%.¹¹ Using Chuan et al's prevalence estimates of depression (5.5%) and subsyndromal depression (9.6%), we found that the projected age standardised prevalence of depression and subsyndromal depression in the 2011 population was 8.3% and 14.7%, respectively. The earlier study used probability sampling from a national sampling frame of dwellings and reported a response rate of 72.4% with 1092 older adults participating in the study. The current study had a larger sample size ($n = 2565$) and investigators had translated the questionnaires into dialects to ensure further inclusivity. A person-level sampling frame was used and the response rate was 65.6%. The sample size was also determined to be adequate for estimating the lower prevalence established in the current study. Statistical power calculations for binary proportions after adjusting for design effect were re-estimated to determine the sample sizes for the overall prevalence estimates of depression, as well as for subgroups by age and ethnicity, with precision of 5%.¹⁴ The design effect after oversampling by age and ethnicity was 2.345. Using 3.7% as a prevalence estimate for depression cases in the current study, we found that the margin of error for the overall prevalence estimate was 1.1%, while the margin of error for the strata defined by age and ethnicity ranged from 1% to 3.4%. Relative standard error (RSE) was calculated and ranged from 17% to 29% and was found to be below the acceptable range of 30%.²⁸ A target sample size of 2500 was thus estimated to be adequate to provide sufficient precision for the study. Both studies used the GMS-AGECAT to generate the diagnosis of depression. Thus, while there may have been other methodological reasons which may have resulted in a lower prevalence of depression in the current study, it could also indicate an actual decrease in the prevalence. This could largely be due to the national efforts through a Ministerial Committee on Ageing in March 2007, and the Council for Third Age (C3A) in May 2007. Targeted at achieving "Successful Ageing in Singapore", various risk areas for the elderly are addressed from employment and financial security to healthcare and activities.²⁹ The initiatives include multidisciplinary teams under the Community Psychogeriatric Programme (CPGP) who provide direct care and treatment to home-bound elderly with mental health issues under the National Mental Health Blueprint, 2008. Voluntary welfare organisations such as the Singapore Action Group of the Elders and Presbyterian Community Services have stepped in to support the government initiatives in engaging the elderly and early detection of mental health issues.

The odds of GMS-AGECAT depression and subsyndromal depression were significantly higher among Indians and Malays. Several studies conducted in the Singapore population have shown a higher prevalence of depression among those of Indian ethnicity.^{30,31} A study by Soh et al³² among older adults in Singapore similarly reported that the population prevalence of clinical depression among Malays (6.5%) and Indians (6.8%) was higher than that in Chinese (2.8%). However, such ethnic differences are difficult to explain. It is possible that Indians and Malays have a greater vulnerability that might arise from some genetic and/or sociocultural factors, or that Chinese are more resilient towards developing depression. However, it is also possible that there were ethnic differences in the endorsement of symptoms leading to these differences.

The association of chronic physical illnesses with depression is not surprising and has been reported by numerous other studies.^{33,34} The relationship between depression and co-occurring medical illness is complex and studies suggest that depression may increase the risk of subsequent chronic illnesses.^{35,36} Simon³⁷ suggested that while chronic medical conditions are associated with an increased risk of depression, the presence of a chronic medical illness may in fact decrease the chances of recognition and therefore treatment of depression in the setting. The author suggests the use of screening tools to ensure diagnosis and early initiation of treatment. A meta-analysis of interventions in patients with diabetes and depression showed that both psychotherapies and antidepressants were efficacious in treating depression among patients with diabetes.³⁸ The meta-analysis also examined collaborative care trials and found that collaborative care was more effective in reducing depressive symptoms compared with usual primary care. Studies on patients with cardiac diseases have similarly shown that antidepressants and cognitive behavioural therapy either separately or together^{39,40} as well as collaborative care⁴¹ are efficacious in treating patients with cardiac diseases. Thus, having a high index of suspicion and use of suitable screening instruments for diagnosis of depression in a setting that manages the care of older adults with chronic physical conditions, followed by treatment using evidence-based approaches can both reduce the burden of depression and that of the comorbid medical condition in the elderly.

Depression was associated with disability as measured by the WHODAS (2.0) scale in our study. Longitudinal studies suggest that disability is much more likely to affect the increase in the trajectory of depressive symptom over time, as compared to the influence of depressive symptoms on the increase of the disability trajectory over time.⁴² Research has also pointed out that disability can be considered as a stressful condition and reactions to the disability such as feelings of worthlessness or hopelessness may contribute

to depression.⁴³ Our results confirm the widely known association between depression and decreased health-related quality of life in older adults.^{44,45} The effect of depression on quality of life can be either direct or it may be indirect through the effect of factors associated with depression that influence quality of life. In our study, the association of depression with comorbid medical conditions, loneliness and lower perceived social support may all lead to a lower quality and satisfaction with life.

Loneliness was found to be positively associated with both depression and subsyndromal depression. A 5-year longitudinal study showed that loneliness predicted changes in depressive symptoms, but not vice versa.⁴⁶ However, Luo et al⁴⁷ tested the reciprocal associations of loneliness and health, and found that loneliness both affected and was affected by depressive symptoms. In contrast, social support had a protective role with those reporting a supportive social network having lower odds of depression in this study. While our finding is consistent with that of other studies,^{48,49} this being a cross-sectional study, we are unable to speculate on the causality. While some longitudinal studies suggest that lack of social support leads to depression,⁵⁰ it is possible that depressed individuals shun contact with friends and neighbours as depressive cognition can negatively impact interpersonal functioning. Surprisingly, depression was associated with a lower perceived social support received by friends and neighbours while social support received from family was not perceived as significantly different between the 3 groups. This is in contrast to the study from Hong Kong on older adults that suggested that social support from family members is more important than support from friends.⁵⁰

While there is considerable evidence among the general population that regular participation in physical activity is associated with reduced depression symptoms,⁵¹ data examining this association among older adults is more sparse.^{52,53} Thus, the association of depression with lack of physical exercise lends well to interventions that may not be considered stigmatising and older adults may be more receptive to exercise as a treatment for depression than treatments such as medication.

The findings of the study should be interpreted in the context of certain limitations. First, our response rate was 65.6% and it is possible that those who refused to participate in our study were more physically or mentally disabled and the prevalence of depression could have been higher in this group. This being a cross-sectional study, we are unable to establish any temporal relationships between depression and the associated factors. Physical activity was not measured by capturing specific activities in terms of intensity, frequency or time and loneliness was measured by a single question and not by a validated scale. Lastly, older adults may have been reluctant to talk about mental

health problems to interviewers due to cultural barriers or the perceived stigma. The strengths of the study include its large sample size, single phase assessment, use of widely accepted assessments and questionnaires, inclusion of a representative sample of the general population that includes those who could speak only local dialects and superior quality control processes.

Our study identified risk factors of depression among older adults which are largely similar to that reported from other studies. We also corroborated the findings of other studies that subsyndromal depression was similar to depression in sharing many of the psychosocial correlates and risk factors, and associations with medical comorbidities. The impact of subsyndromal depression on disability, general health, satisfaction with quality of life and disability was significant, though the effect sizes were lower, emphasising the need to screen for and treat subsyndromal depression especially among older adults. Also a significant number of those with depression and subsyndromal depression endorse having suicidal thoughts and hence the need to stay vigilant and the role of active screening and treating those with depression cannot be over emphasised.

Most importantly, our study has shown a decrease in the prevalence of depression among older adults in Singapore over a period of 10 years. While there seems to be a positive trend brought about by a concerted effort across various disciplines and sectors, the efforts need to be further strengthened, monitored and evaluated.

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