Original Article

Prevalence and Impact of Mental and Physical Comorbidity in the Adult Singapore Population

Siow Ann Chong,[1] *MMed (Psychiatry), MD, FAMS*, Edimansyah Abdin,[1] *PhD*, Luo Nan,[2] *PhD*, Janhavi A Vaingankar,[1] *MSc*, Mythily Subramaniam,[1] *MBBS, MHSM*

Abstract

Introduction: This study aims to assess the prevalence rates of mental disorders and chronic medical conditions in the Singapore resident population, and examine their association and respective impact on the quality of life. Materials and Methods: A household survey was carried out on a nationally representative sample of the adult (18 years and above) resident population. The main instrument used to establish the diagnosis of mental disorders is the World Mental Health Composite International Diagnostic Interview (WMH-CIDI). The mental disorders included in study were major depressive disorder, bipolar disorder, generalised anxiety disorder, obsessive compulsive disorder, alcohol abuse and alcohol dependence. Respondents were asked if they had any of the chronic medical conditions from a list of 15 conditions. Health-related quality of life was assessed with the EQ-5D. Results: Of the 6616 respondents, the lifetime prevalence of mental disorders was 12.0%, and that of chronic medical disorders were 42.6% and those with comorbid mental and medical disorders was 6.1%. The prevalence of any physical disorder in this population was high (42.6%). Among those with chronic physical disorders, 14.3% also had a mental disorder, and among those with mental disorders, more than half (50.6%) had a medical disorder. Most of the mental disorders were not treated. Males, Indians, older people, and those who were separated or divorced were more likely to have comorbidity. The health-related quality of life was significant worse in those with both mental and medical disorders compared to those with either mental or medical disorder. Conclusion: Our study re-emphasised the common occurrence of mental and medical disorders and the importance for an integrated care system with the capability to screen and treat both types of disorders. It also identified certain subpopulations which are more likely to have comorbidity for which a more targeted intervention could be planned.

Ann Acad Med Singapore 2012;41:105-14

Key words: Chronic conditions, Ethnicity, Health-related quality of life, Marital status

Introduction

The co-occurrence of mental and medical disorders in the same person, regardless of the chronological order in which they occurred or their causal relationship—commonly referred to as comorbidity[1-3]—is not uncommon. The National Comorbidity Survey Replication (NCS-R), which was a nationally representative epidemiological survey in the US, found that at least 68% of adults with a mental disorder had at least one general medical disorder, while 29% of those with a medical disorder had a comorbid mental health disorder.[4,5] Research across a swathe of countries has consistently shown that people with mental illnesses have high rates of physical illnesses that were largely not diagnosed.[6,7]

People with serious mental illnesses have 2 to 3 times higher rates of cardiovascular diseases (CVD) as compared to the general population;[8] diabetes occurs in approximately 15% of people with schizophrenia compared with 5% in the general population;[9] findings of community-based population studies demonstrate that anxiety symptoms and anxiety disorders are associated with increased risk for incident CVD, such as myocardial infarction, sudden cardiac death, angina pectoris, and hypertension.[10,11] Similarly, people with chronic medical disorders have been shown to have an association with mental illnesses. A study by

[1]Research Division, Institute of Mental Health
[2]Department of Epidemiology and Public Health and Centre for Health Services Research, Yong Loo Lin School of Medicine, National University of Singapore
Address for Correspondence: A/Prof Chong Siow Ann, Research Division, Institute of Mental Health, Buangkok Green Medical Park, 10 Buangkok View, Singapore 539747.
Email: siow_ann_Chong@imh.com.sg

Goodwin et al[12] showed significant associations between asthma and a range of mental illnesses; rates of depression and depressive symptoms are higher among persons with diabetes compared with the general population.[13,14] Longitudinal studies have demonstrated that this relationship between mental and physical illnesses is bidirectional.[15,16]

Such comorbidity has a number of consequences including increased symptom burden, functional impairment, decreased quality of life,[17-20] loss of economic productivity from absenteeism and presenteeism,[21,22] high individual and societal financial costs,[23,24] and elevated risk of premature mortality—where most were not from suicides and accidents but rather from "natural" causes such as cardiovascular disease.[25,26]

The aims of this study were to establish the prevalence rates of comorbidity of medical and mental disorders, and their associated factors and health outcomes in the Singapore adult resident population.

Materials and Methods

The Singapore Mental Health Study was a national household survey involving non-institutionalised Singapore citizens and permanent residents aged 18 years and older. Face-to-face interviews were conducted from December 2009 to December 2010. A detailed description of the survey design is provided elsewhere.[27] The study was approved by the Ethics Committee (National Healthcare Group, Domain Specific Review Board) and all participants and parents / guardians gave written informed consent (for those respondents who were less than 21 years of age) for participating in the study. All respondents were given a resource brochure that provided them with contact details of the relevant counselling and psychiatric services in Singapore and were advised to contact any of them should they want to seek help.

The main instrument used in the survey is the World Mental Health Composite International Diagnostic Interview (WMH-CIDI)[28] which ascertains both 10th Edition of the International Classification of Diseases (ICD-10) and the Diagnostic and Statistical Manual, Fourth Edition, of the American Psychiatric Association (1994) (DSM-IV) lifetime and 12-month diagnoses using hierarchy rules for diagnoses. The mental disorders included in our survey were major depressive disorder (MDD), bipolar disorder, generalised anxiety disorder (GAD), obsessive compulsive disorder (OCD), alcohol abuse and alcohol dependence. We did not include schizophrenia and other non-affective psychoses, as they are not part of the core WMH assessment. Previous validation studies have shown psychotic disorders are overestimated in lay-administered interviews like the CIDI.[29]

The computerised i.e. the Computer Assisted Personal Interviewing (CAPI) version of the instrument was used for English and Chinese language interviews. The Chinese language CIDI was developed by the WMH-CIDI group in China and was adapted for use in our survey. All the modules used in SMHS were translated into Bahasa Melayu (the official written language of the Malays). DSM-IV diagnoses were generated by running algorithms provided by the WMH-CIDI consortium on the de-identified data by trained researchers.

We also used a modified version of the CIDI checklist of chronic medical disorders and the respondents were asked to report any of the disorders listed in the checklist. The question was read as, 'I'm going to read to you a list of health problems some people have. Has a doctor ever told you that you have any of the following…' This was followed by a list of 15 chronic medical disorders which were considered prevalent in Singapore's population. We then reclassified these disorders into 8 types of physical disorders: (1) respiratory disorders (asthma, chronic lung disease such as chronic bronchitis or emphysema), (2) diabetes, (3) hypertension and high blood pressure, (4) chronic pain (arthritis or rheumatism, back problems including disk or spine, migraine headaches), (5) cancer, (6) neurological disorders (epilepsy, convulsion, Parkinson's disease), (7) cardiovascular disorders (stroke or major paralysis, heart attack, coronary heart disease, angina, congestive heart failure or other heart disease), and, (8) ulcer and chronic inflamed bowel (stomach ulcer, chronic inflamed bowel, enteritis, or colitis).

We used the EQ-5D to measure the health related quality of life. EQ-5D is a standardised measure of health status developed by the EuroQol Group. It provides a simple, generic measure of health for clinical and economic appraisal.[30] It comprises a descriptive system and a visual analogue scale (VAS) .The descriptive system assesses 5 domains (i.e., mobility, self-care, usual activities, pain/ discomfort, anxiety/depression) and respondents were asked to rate their health today on a three-point scale (no problem/moderate problem/ extreme problem). The EQ VAS records the respondent's self-rated health on a vertical, visual analogue scale where the endpoints are labelled 'Best imaginable health state' (100) and 'Worst imaginable health state' (0). The EQ-5D defines a total of 243 health states. The utility of EQ-5D health states was elicited using the time trade-off method from a representative sample of the UK general population.[31] This utility-based EQ-5D index score ranges from −0.59 to 1.00, with negative values representing health states worse than being dead, 0 representing being dead, and 1.00 representing the state of full health.

Statistical Analyses

All estimates were weighted to adjust for over sampling and post-stratified for age and ethnicity distributions between the survey sample and the Singapore resident population in 2007. Mean and standard deviations were calculated for continuous variables, and frequencies and percentages for categorical variables. Analysis of variance was used to determine differences in the EQ-5D Index and VAS scores across groups. Multiple logistic regression models were used to examine the socio-demographic correlates of any mental disorder, any physical disorder and comorbid mental-physical disorder. A series of multiple logistic regression models were also used to generate odd ratios (ORs) and 95% confidence intervals to indicate association between 8 classes of physical disorders and mental disorders. Standard errors (SE) and significance tests were estimated using the Taylor series linearisation method. Multivariate significance was evaluated using Wald x^2 tests based on design corrected coefficient variance–covariance matrices. Statistical significance was evaluated at the <0.05 level using 2-sided tests. All statistical analyses were carried out using the Statistical Analysis Software (SAS) System version 9.2.

Results

In all, the total number of respondents was 6616 representing a response rate of 75.9%. The socio-demographic distribution of the entire sample is shown in Table 1.

The prevalence of any mental disorder and comorbid mental-physical disorder in this population was 12.0% and 6.1% respectively. The prevalence of any physical disorder in this population was high (42.6%). The rate of any mental illness in those with any chronic physical disorder was 14.3%. The rate of any chronic physical disorder in those with any mental illness was 50.6%. Majority (84%) of those with comorbid mental-physical disorder did not have any treatment for their mental disorders.

Multiple logistic regressions showed that being older, of Indian or Other ethnicity (as compared to Chinese), male gender, and being divorced or separated increased the odds of having comorbid mental-physical disorder (Table 2).

Those with any mental, physical or comorbid mental-physical illness had lower EQ-Index and EQ-VAS scores than those without any of these disorders. The EQ-Index and EQ-VAS scores were almost similar among those with mental and physical illnesses (0.94 vs 0.93 and 80.5 vs 81.1 respectively). However, those with comorbid illness had significantly lower EQ-Index (0.86) and EQ-VAS (74.7) scores as compared to all the other groups i.e. those with mental illness only, physical illness only and those without any of the disorders. Significantly higher proportions of those with comorbid illness endorsed moderate and severe problems in pain/discomfort and anxiety/depression domain as compared to the other groups (Table 3).

Table 4 shows the prevalence of the various physical disorders in people with mental disorders. After adjusting for age and gender in multiple logistic regression analyses, we found that those with any mental disorder have significantly

Table 1. Socio-demographic Characteristics of the Study Sample

	Unweighted		Weighted
	N	%	% (s.e)
Age			
Mean (SE), SD	42.0	14.5	43.9 (0.3)
Age group			
18-34	2293	34.7	31.7 (0.0)
35-49	2369	35.8	34.1 (0.0)
50-64	1542	23.3	23.1 (0.0)
65+	412	6.2	11.1 (0.0)
Ethnicity			
Chinese	2006	30.3	76.9 (0.0)
Malay	2373	35.9	12.3 (0.0)
Indian	1969	29.8	8.3 (0.0)
Others	268	4.1	2.4 (0.0)
Gender			
Female	3317	50.1	51.5 (0.9)
Male	3299	49.9	48.5 (0.9)
Marital status			
Never Married	1825	27.6	28.9 (0.6)
Currently Married	4290	64.9	62.4 (0.8)
Divorced/Separated	262	4.0	4.2 (0.4)
Widowed	237	3.6	4.4 (0.4)
Education			
Pre-primary	307	4.6	5.5 (0.4)
Primary	929	14.0	14.7 (0.6)
Secondary	1975	29.9	27.6 (0.8)
Pre-U/Junior College/Diploma	1342	20.3	22.4 (0.7)
Vocational	721	10.9	7.9 (0.4)
University	1342	20.3	21.9 (0.7)
Employment			
Employed	4594	71.5	71.0 (0.8)
Economically inactive*	1522	23.7	24.5 (0.7)
Unemployed	313	4.9	4.5 (0.4)
Personal income (annually)			
Below S$ 20,000	3392	54.0	51.3 (0.8)
S$20,000 – 49,999	1924	30.7	31.2 (0.8)
S$50,000 above	962	15.3	17.5 (0.7)

*Includes homemakers, students and retirees/pensioners

Table 2. Factors Associated with: (a) any Mental Disorder only, (b) any Physical Disorder only, and (c) Comorbid Mental-physical Disorder

		Any mental disorder only		Any physical disorder only		Comorbid mental-physical disorder	
		OR	95% CI	OR	95% CI	OR	95% CI
Age group	18-34	1.0		1.0		1.0	
	35-49	0.6	(0.4, 0.9)*	1.2	(0.9,1.6)	0.8	(0.5,1.3)
	50-64	0.4	(0.2,0.8)†	2.5	(1.9,3.3)†	0.8	(0.4,1.4)
	65+	0.1	(0.01,0.5)†	6.8	(4.1,11.4)†	3.4	(1.3,8.5)†
Ethnicity	Chinese	1.0		1.0		1.0	
	Malay	0.9	(0.7,1.3)	1.0	(0.9,1.2)	0.9	(0.6,1.2)
	Indian	1.4	(1.05,1.8)*	1.2	(1.05,1.4)*	1.5	(1.1,2.0)†
	Others	3.3	(1.9,5.6)†	1.3	(0.9,1.9)	3.3	(1.9,5.6)†
Gender	Male	1.0		1.0		1.0	
	Female	1.1	(0.8,1.5)	0.8	(0.7,1.0)*	0.7	(0.5,0.9)*
Marital status	Single	1.0		1.0		1.0	
	Married	1.3	(0.9,1.9)	1.3	(1.03,1.7)*	1.0	(0.7,1.6)
	Divorced/Separated	5.0	(2.7,9.4)*	1.4	(0.9,2.2)	5.2	(2.8,9.8)†
	Widowed	0.3	(0.1,1.7)	2.2	(1.2,4.1)*	2.4	(0.8,7.5)
Education	Pre Primary	-	-	1.0	(0.6,1.6)	0.6	(0.2,2.1)
	Primary	0.8	(0.4,1.6)	1.2	(0.8,1.7)	0.8	(0.3,1.8)
	Secondary	1.1	(0.6,1.8)	1.4	(1.1,1.9)*	2.1	(1.2,3.8)†
	Pre-U/Junior-College/ Diploma	0.8	(0.5,1.3)	1.1	(0.8,1.5)	1.4	(0.8,2.2)
	Vocational	0.9	(0.5,1.6)	1.2	(0.8,1.7)	1.4	(0.7,2.8)
	University	1.0		1.0		1.0	
Employment	Employed	1.0		1.0		1.0	
	Economically Inactive	0.5	(0.3,0.8)*	1.3	(1.05,1.7)*	0.9	(0.6,1.6)
	Unemployed	2.3	(1.3,4.5)†	1.3	(0.8,2.0)	1.7	(0.9,3.2)
Income	Below $SD 20,000	1.0		1.0		1.0	
	$SD 20,000-49,000	1.0	(0.7,1.5)	0.9	(0.7,1.2)	0.9	(0.6,1.4)
	Above $SD 50,000	0.7	(0.4,1.3)	1.1	(0.8,1.5)	1.1	(0.6,2.1)

*$P \leq 0.05$, †$P \leq 0.01$

Table 3. Comparison of EQ-5D* Health Problems and Index Scores Among Those with Mental illness, Physical illness, Comorbid Mental-physical Illnesses and Controls

EQ5D domains	**Mental illness only (n = 346)**		**Physical illness only (n = 2014)**		**Comorbid mental-physical illness (n = 362)**		**Controls (n = 2872)**		**Statistical significance**	
	% indicating a problem (moderate or extreme)									
	%	**SE**	**%**	**SE**	**%**	**SE**	**%**	**SE**	***X²***	***P* value**
Mobility	0.8	0.3	7.5	0.9	5.8	1.9	0.8	0.2	101.9	<0.0001
Self care	0.3	0.17	1.1	0.4	0.5	0.3	0.1	0.07	26.6	<0.0001
Usual activities	1.1	0.4	4.5	0.7	3.6	1.3	0.5	0.2	74.4	<0.0001
Pain/discomfort	11.6	2.3	22.9	1.4	37.5	3.7	7.6	0.7	178.7	<0.0001
Anxiety/depression	17.1	2.7	9.5	0.9	30.5	3.6	3.6	0.5	177.6	<0.0001
	Mean	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**F**	
EQ-5D UK index	0.94	0.01	0.93	0.001	0.86	0.01	0.98	0.001	64.8	<0.0001
EQ-5D VAS	80.5	1.0	81.1	0.5	74.7	1.2	86.0	0.3	49.6	<0.0001

*The EQ5D was administered only among 5594 respondents.

Table 4. Prevalence of Physical Disorders Among People With and Without Mental Disorder

Mental disorder		Respiratory conditions				Diabetes				Hypertension and high BP				Chronic pain			
		%	SE	OR‡	95% CI	%	SE	OR‡	95% CI	%	SE	OR‡	95% CI	%	SE	OR‡	95% CI
Any mental disorder	No	8.3	0.5	1.0		9.3	0.6	1.0		20.2	0.7	1.0		14	0.7	1.0	
	Yes	17.0	1.8	2.0	(1.5,2.7)†	6.5	1.3	1.2	(0.7,1.8)	15.8	2.0	1.3	(0.9,1.8)	24.9	2.1	2.5	(1.9,3.2)†
MDD	No	9.1	0.5	1.0		9.1	0.5	1.0		19.8	0.7	1.0		14.4	0.7	1.0	
	Yes	13.6	2.3	1.4	(0.9,2.2)	7.0	1.9	1.2	(0.6,2.3)	17.7	3.0	1.5	(0.9,2.4)	30.2	3.2	2.7	(2.0,3.9)†
Bipolar disorder	No	9.3	0.5	1.0		9.0	0.5	1.0		19.8	0.7	1.0		15.1	0.7	1.0	
	Yes	17.1	5.5	1.7	(0.8,3.5)	3.5	3.0	1.0	(0.2,5.2)	13.2	5.4	1.4	(0.9,2.2)	30.4	6.9	3.0	(1.6,5.9)†
GAD	No	9.4	0.5	1.0		9.0	0.5	1.0		19.7	0.7	1.0		15.2	0.7	1.0	
	Yes	10.4	4.3	0.9	(0.4,2.5)	1.1	0.8	0.2	(0.04,0.8)*	13.9	6.0	1.3	(0.4,4.0)	25.9	7.1	2.1	(1.02,4.4)*
OCD	No	9.1	0.5	1.0		9.1	0.5	1.0		20.0	0.7	1.0		15.1	0.7	1.0	
	Yes	17.4	3.4	1.9	(1.2,3.0)†	4.1	1.7	0.8	(0.3,2.1)	10.8	3.0	0.9	(0.5,1.8)	21.8	3.8	1.8	(1.2,2.9)†
Alcohol abuse	No	9.0	0.5	1.0		9.0	0.5	1.0		19.8	0.7	1.0		15.0	0.7	1.0	
	Yes	22.1	4.1	2.4	(1.4,4.1)†	8.4	3.1	1.1	(0.5,2.6)	17.4	4.1	1.03	(0.6,1.8)	23.3	4.1	2.2	(1.4,3.5)†
Alcohol dependence	No	9.3	0.5	1.0		9.0	0.5			19.7	0.7	1.0		15.3	0.7	1.0	
	Yes	24.9	9.8	2.3	(0.8,6.5)					17.9	7.9	3.3	(0.9,11.5)	25.4	9.5	2.9	(1.03,9.0)*

*$P \leq 0.05$, †$P \leq 0.01$

‡Multiple logistic regression adjusted by age and gender

Table 4. (con't) Prevalence of Physical Disorders Among People With and Without Mental Disorder

Mental disorder		Cancer				Neurological disorders				Cardiovascular disorders				Ulcer and chronic inflamed bowel			
		%	SE	OR‡	95% CI	%	SE	OR‡	95% CI	%	SE	OR‡	95% CI	%	SE	OR‡	95% CI
Any mental disorder	No	0.8	0.2	1.0		3.9	0.4	1.0		3.7	0.4	1.0		1.8	0.3	1.0	
	Yes	0.3	0.1	0.5	(0.2,1.5)	3.8	1.1	1.3	(0.7,2.5)	3.4	1.0	1.8	(0.9,3.6)	4.3	1	2.8	(1.6,5)†
MDD	No	0.7	0.2	1.0		3.9	0.4	1.0		3.6	0.4	1.0		2.1	0.3	1.0	
	Yes	0.4	0.2	0.7	(0.3,2.1)	4.8	1.9	1.5	(0.6,3.5)	4.6	1.8	2.3	(0.9,5.7)	2.3	1.0	1.4	(0.6,3.4)
Bipolar disorder	No	0.7	0.2			3.9	0.4	1.0		3.6	0.4	1.0		2	0.3	1.0	
	Yes	.	.			6.3	4.1	2.6	(0.6,10.6)	5.8	4	6.4	(1.6,26.2) †	4.7	3.2	3	(0.7,12.4)
GAD	No	0.7	0.2			3.9	0.4	1.0		3.7	0.4	1.0		2	0.3	1.0	
	Yes	.	.			0.6	0.6	0.2	(0.02,1.4)	0.4	0.4	0.2	(0.03,1.5)	7.3	4.5	5.0	(1.3,19.5)*
OCD	No	0.7	0.2			3.8	0.4	1.0		3.7	0.4	1.0		2	0.3	1.0	
	Yes	0.2	0.2	0.3	(0.04,2.5)	6	2.4	2.3	(1,5.2)	1.3	1.1	0.8	(0.1,4.8)	4.8	2.2	3.0	(1.1,7.9)†
Alcohol abuse	No	0.7	0.2			4	0.4	1.0		3.7	0.4	1.0		1.9	0.3	1.0	
	Yes	.	.			1.2	1.1	0.4	(0.1,2.5)	2.4	1.2	0.7	(0.3,2.2)	6.4	2.4	3.2	(1.4,7.6)†
Alcohol dependence	No	0.7	0.2	1.0		3.9	0.4	1.0		3.6	0.4	1.0		2	0.3	1.0	
	Yes	2.4	2.4	8.6	(1.1,71.2)*	2.1	1.5	1.1	(0.2,4.7)	0.9	0.9	0.7	(0.1,6.9)	11.9	7.3	7.6	(1.9,30.3)†

*$P \leq 0.05$, †$P \leq 0.01$

‡Multiple logistic regression adjusted by age and gender

higher rate of respiratory disorders (17.0% vs 8.3%, *P* <0.01), chronic pain (24.9% vs 14.0%, *P* <0.01), ulcer and chronic inflamed bowel (4.3% vs 1.8%, *P* <0.01) than those without any mental disorder.

Similarly adjusting for age and gender in the multiple logistic regression for those with any chronic physical disorder, respiratory disorders have significantly higher rate of any mental disorder (21.8% vs 11.0%, *P* <0.01); while people with chronic pain have consistently and significantly higher rates of prevalence of mental disorders (Table 5).

Discussion

As with other epidemiological surveys,[32,33] we found high rates of mental disorders among those with chronic physical disorders, and an even higher rate of physical disorders among those with mental disorders. Most of these mental disorders in our population were not treated—83.7% of those with any one mental disorder assessed in our study had never 'in their life "talked to a medical doctor or other professional" about the disorder'.[34] This is consistent with the findings of other studies: for example, depression is often undetected and undiagnosed in primary care,[35-37] and as well as in specialised medical centers.[38]

The association between medical disorders and mental disorders is complex and bidirectional with some common risk factors.[19] One such mechanism may arise from chronic stress leading to the weakening of the immune system and an increase in the inflammatory response and the production of cytokines which are risk factors for both medical and mental disorders.[39-41] There are other possible reasons for the high rate of comorbid mental illnesses among those with chronic physical illness and these include the detrimental effect of the latter on the quality of life and mental well-being[42] which may lead to anxiety and depression[43] while some medications for common medical disorders may also give rise to de novo psychiatric symptoms or else exacerbate underlying psychiatric disorders.[44,45] Conversely, a myriad of factors could lead to the even higher rate of physical illnesses among the mentally ill in our population. Persons with psychiatric disorders are more likely to have sedentary lifestyles, increased rates of smoking, and poor diets (foods that are high in fat and calories) leading to high rate of obesity[46-49] Coupled with this, is the greater likelihood of mentally ill individuals (as compared to the general population) not receiving preventive public health

Table 5. Prevalence of Mental Disorder Among People With and Without Physical Disorders

Major chronic physical conditions		Any mental disorder				MDD				Bipolar disorder				GAD			
		%	SE	OR‡	95% CI	%	SE	OR‡	95% CI	%	SE	OR‡	95% CI	%	SE	OR‡	95% CI
Respiratory conditions	Yes	21.8	2.3	2.0	(1.5,2.6)†	8.4	1.5	1.5	(0.9,2.2)	2.2	0.8	1.6	(0.8,3.4)	1.0	0.4	1.04	(0.4,2.6)
	No	11	0.6	1.0		5.5	0.4	1.0		1.1	0.2	1.0		0.9	0.2	1.0	
Diabetes	Yes	8.7	1.7	1.1	(0.7,1.7)	4.5	1.3	1.2	(0.6,2.4)	0.5	0.4	0.8	(0.1,4.7)	0.1	0.1	0.3	(0.1,1.2)
	No	12.3	0.6	1.0		5.9	0.4	1.0		1.3	0.2	1.0		1.0	0.2	1.0	
Hypertension & high BP	Yes	9.6	1.3	1.2	(0.9,1.7)	5.2	1.0	1.5	(0.9,2.4)	0.8	0.4	1.4	(0.5,4.3)	0.6	0.3	1.6	(0.6,4.3)
	No	12.6	0.6	1.0		6.0	0.4	1.0		1.3	0.2	1.0		0.9	0.2	1.0	
Chronic pain	Yes	19.6	1.8	2.4	(1.9,3.1)†	11.5	1.5	2.8	(2.0,3.9)†	2.4	0.7	3.0	(1.5,5.7)†	1.5	0.4	2.1	(1.04,4.4)*
	No	10.6	0.6	1.0		4.8	0.4	1.0		1	0.2			0.8	0.2		
Cancer	Yes	4.9	2.4	0.5	(0.2,1.5)	3.3	1.6	0.7	(0.2,2.0)	-	-	-	-	-	-	-	-
	No	12.1	0.6	1.0		5.8	0.4	1.0		1.2	0.2			0.9	0.2		
Neurological conditions	Yes	11.7	3.3	1.3	(0.7,2.4)	7.1	2.8	1.5	(0.7,3.5)	2	1.3	2.7	(0.6,11.3)	0.1	0.1	0.2	(0.03,1.4)
	No	12	0.6	1.0		5.8	0.4	1.0		1.2	0.2	1.0		0.9	0.2	1.0	
Cardiovascular	Yes	11.3	3.3	1.6	(0.7,2.4)	7.3	2.9	2.4	(1.01,5.9)*	1.9	1.4	4.6	(1.0,21.9)*	0.1	0.1	0.3	(0.04,2.4)
	No	12	0.6	1.0		5.7	0.4	1.0		1.2	0.2	1.0		0.9	0.2	1.0	
Ulcer and chronic inflamed bowel	Yes	24.7	5.2	2.9	(1.6,5.1)†	6.4	2.7	1.4	(0.6,3.4)	2.7	1.9	3.2	(0.8,13.2)	3.1	1.9	5.1	(1.3,19.9)*
	No	11.7	0.6	1.0		5.8	0.4	1.0		1.2	0.2	1.0		0.8	0.2	1.0	

*P <0.05, †P <0.01

‡Multiple logistic regression adjusted by age and gender

services like immunisations, cancer screenings, and smoking cessation counselling, as well as receiving worse quality of care across a range of services.[50-52] On the other hand, doctors who are inexperienced in mental health issues may feel uncomfortable probing for mental disorders among their patients with physical disorders;[52] some mentally ill patients on the other hand, might be fearful or suspicious and therefore less willing to communicate with care providers.[53]

We did not find any association with socioeconomic factors like low income and poor educational attainment to be associated with comorbidity unlike other studies that indicate an inverse association between socioeconomic status (SES).[54-56] It has been postulated that low SES limits resources like social support which both increases stress and exposure to adverse environmental conditions[57] —leading to higher levels of depressive symptoms and various chronic diseases.[3,58] We could only speculate that, compared to these studies done elsewhere, the SES of our population and the social support of our population could have been better and that the low income group in Singapore (one of the richest countries in Asia) might still be relatively higher than the low income groups in those countries.

The strength of our study is that it is a nationally representative sample which has lesser likelihood of sampling errors like Berkson's bias compared to those studies that examined comorbidity in help-seeking clinical samples.[59] It is also one of the few studies in the extant literature that examined and compared a number of specific chronic physical disorders with the associated rate of mental disorders. We found that the most likely groups of medical disorders with comorbid mental disorders are the respiratory disorders and chronic pain. An epidemiological study done in the New Zealand population similarly found that chronic pain and respiratory disorders have the highest rate of comorbid mental disorders.[60] This could be due to the differential symptom burden among the different disorders—possibly with these two disorders having the highest burden. Alcohol abuse and dependence were the commonest associated disorder in those with chronic and inflammatory bowel disorders which is likely to be the consequence of prolonged and excessive use of alcohol.

Our study also showed that mental illnesses comorbid with other chronic physical illnesses produced significantly greater reductions in health than any mental or chronic

Table 5. (con't) Prevalence of Mental Disorder Among People With and Without Physical Disorders

Major chronic physical conditions		OCD				Alcohol abuse				Alcohol dependence			
		%	SE	OR‡	95% CI	%	SE	OR‡	95% CI	%	SE	OR‡	95% CI
Respiratory conditions	Yes	5.6	1.2	1.8	(1.1,2.9)*	7.4	1.5	2.5	(1.5,4.1)†	1.2	0.6	2	(0.7,6.2)
	No	2.7	0.3	1.0		2.7	0.3	1.0		0.4	0.1		
Diabetes	Yes	1.4	0.6	0.7	(0.3,1.8)	3.0	1.1	1.2	(0.5,2.8)	-	-	-	-
	No	3.2	0.3	1.0		3.2	0.3	1.0		0.5	0.1	1.0	
Hypertension & high BP	Yes	1.7	0.5	0.8	(0.4,1.7)	2.8	0.7	1.1	(0.7,1.9)	0.4	0.2	3.0	(0.8,10.9)
	No	3.3	0.3	1.0		3.2	0.3	1.0		0.5	0.1	1.0	
Chronic pain	Yes	4.3	0.8	1.8	(1.1,2.8)*	4.8	0.9	2.3	(1.4,3.7)†	0.8	0.3	2.6	(0.9,7.4)
	No	2.8	0.3	1.0		2.9	0.3			0.4	0.1	1.0	
Cancer	Yes	0.6	0.6	0.3	(0,2.3)	-	-	-	-	1.6	1.6	11.7	(1.3,102.1)*
	No	3	0.3	1.0		3.2	0.3	1.0		0.5	0.1	1.0	
Neurological conditions	Yes	4.6	1.9	2.2	(1,5.2)	1.0	0.9	0.4	(0.1,2.6)	0.2	0.2	1.1	(0.3,5.1)
	No	2.9	0.3	1.0		3.2	0.3	1.0		0.5	0.1	1.0	
Cardiovascular	Yes	1	0.9	0.6	(0.1,3.8)	2.1	1.0	0.8	(0.3,2.5)	0.1	0.1	0.8	(0.1,6.7)
	No	3.1	0.3	1.0		3.2	0.3	1.0		0.5	0.1	1.0	
Ulcer and chronic inflamed bowel	Yes	6.9	3.1	3.0	(1.1,8.0)*	9.6	3.6	3.1	(1.3,7.2)†	2.7	1.7	10.6	(2.5,45.3)†
	No	2.9	0.3	1.0		3.0	0.3	1.0		0.4	0.1	1.0	

*P <0.05 †P <0.01

‡Multiple logistic regression adjusted by age and gender

medical illness alone; thereby suggesting that comorbidity has an additive or synergistic adverse effect on health outcomes. There are few studies that have compared health outcomes among those with comorbid illness at a community level. A study by Moussavi et al[61]analysed data from the World Health Survey and reported that consistently across countries, those with comorbid depression and chronic disease had the worst health scores of all disease states.

A limitation of our study is the reliance on self-report of the physical disorders rather than by clinical assessment or verification through medical records but studies have indicated that self-report of chronic physical diseases showed moderate to strong agreement with information obtained from medical records.[62]

Our findings of the common co-occurrence of medical and mental disorders; higher impairment of health-related quality of life and high rates of untreated mental disorders in this group, re-emphasizes the call for greater awareness among health professionals of these findings and for the need of better screening and treatment. But as Harris and Barraclough had commented as far back as 1998, there had been no evidence of that happening as evidenced by the excess mortality.[63] More than a decade on, people with mental disorders not only have a 2- to 4-fold elevated risk of premature mortality[26,64] but the gap between the lifespan of the general population (which has increased) and those with mental disorders have widened[65] by as much as 25 years.[25]

In Singapore, mental disorders contribute to 11% of the disease burden of chronic illnesses.[66] The high association of mental-physical comorbidities among the local population people reported in the earlier studies[38,67] was replicated in our study. Chronic pain and respiratory disorders were the most prevalent chronic illnesses among those with any mental illness followed by hypertension. On the other hand, mental illnesses were more common in people suffering from intestinal, respiratory and chronic pain problems. Findings on the effects of different chronic disorders and their association with mental illnesses on disability would be of particular interest to policy makers and employers in Singapore for developing targeted health care interventions to decrease population and workplace disability associated with chronic disorders. Evidence on costs associated with mental- physical comorbidities could further fill the gap in knowledge and aid effective resource allocation.

What would also be needed is the training of primary care doctors in providing screening and care for common mental health disorders, and mental health doctors in screening and treatment of common medical disorders.[68] However, this would not be enough as long as there is fragmentation of the healthcare system in which the medical and mental health care providers are separated. A collaborative care model that integrates medical and mental health providers trained to deliver evidence-based services for comorbid disorders would be needed—as would be the political will to break down the silos that are still present in today's healthcare system.

Acknowledgements

This study was supported by funding from the Singapore Millennium Foundation and the Ministry of Health, Singapore.

REFERENCES

1. Feinstein A. The pre-therapeutic classification of co-morbidity in chronic disease. J Chron Dis 1970;23:455-68.
2. Valderas JM, Starfield B, Sibbald B, Salisbury C, Roland M. Defining comorbidity: Implications for understanding health and health services. Ann Fam Med 2009;7:357-63.
3. van den Akker M, Buntinx F, Metsemakers JF, Roos S, Knottnerus JA. Multimorbidity in general practice: Prevalence, incidence, and determinants of co-occurring chronic and recurrent diseases. J Clin Epidemiol 1998;51:367-75.
4. Alegria M, Jackson JS, Kessler RC, Takeuchi D. National Comorbidity Survey Replication (NCS-R), 2001–2003. Ann Arbor: Inter-university Consortium for Political and Social Research, 2003.
5. Kessler RC, Berglund P, Chiu WT, Demler O, Heeringa S, Hiripi E, et al. The US National Comorbidity Survey Replication (NCS-R): Design and field procedures. Int J Methods Psychiatr Res 2004;13:69-92.
6. Koran LM, Sox HC Jr, Marton KI, Moltzen S, Sox CH, Kraemer HC, et al. Medical evaluation of psychiatric patients. I. Results in a state mental health system. Arch Gen Psychiatry 1989;46:733-40.
7. Makikyro T, Karvonen JT, Hakko H, Nieminen P, Joukamaa M, Isohanni M, et al. Comorbidity of hospital-treated psychiatric and physical disorders with special reference to schizophrenia: a 28 year follow-up of the 1966 northern Finland general population birth cohort. Public Health 1998;112:221-8.
8. Brown S, Inskip H, Barraclough B. Causes of the excess mortality of schizophrenia. Br J Psychiatry 2000;177:212-7.
9. Bushe C, Holt R. Prevalence of diabetes and impaired glucose tolerance in patients with schizophrenia. Br J Psychiatry Suppl 2004;47:S67-71.
10. Albert CM, Chae CU, Rexrode KM, Manson JE, Kawachi I. Phobic anxiety and risk of coronary heart disease and sudden cardiac death among women. Circulation 2005;111:480-7.
11. Nicholson A, Fuhrer R, Marmot M. Psychological distress as a predictor of CHD events in men: the effect of persistence and components of risk. Psychosom Med 2005;67:522-30.
12. Goodwin RD, Jacobi F, Thefeld W. Mental disorders and asthma in the community. Arch Gen Psychiatry 2003;60:1125-30.
13. Talbot F, Nouwen A. A review of the relationship between depression and diabetes in adults: is there a link? Diabetes Care 2000;23:1556-62.
14. Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. The prevalence of comorbid depression in adults with diabetes: a meta-analysis. Diabetes Care 2001;24:1069-78.
15. Pan A, Lucas M, Sun Q, van Dam RM, Franco OH, Manson JE, et al. Bidirectional association between depression and type 2 diabetes mellitus in women. Arch Intern Med 2010;170:1884-91.
16. Golden SH, Lazo M, Carnethon M, Bertoni AG, Schreiner PJ, Diez Roux AV, et al. Examining a bidirectional association between depressive

symptoms and diabetes. JAMA 2008;299:2751-9.

17. Dickerson F, Brown CH, Fang L, Goldberg RW, Kreyenbuhl J, Wohlheiter K, et al. Quality of life in individuals with serious mental illness and Type 2 diabetes. Psychosomatics 2008; 49:1090-14.
18. Egede LE. Major depression in individuals with chronic medical disorders: Prevalence, correlates and association with health resource utilization, lost productivity and functional disability. Gen Hosp Psychiatry 2007;29:409-16.
19. Katon WJ. Clinical and Health Services Relationships between major depression, depressive symptoms, and general medical illness. Biol Psychiatry 2003;54:216-26.
20. Stein MB, Cox BJ, Afifi TO, Belik SL, Sareen J. Does co-morbid depressive illness magnify the impact of chronic physical illness? A population-based perspective. Psychol Med 2006;36:587-96.
21. Goetzel RZ, Hawkins K, Ozminkowski RJ, Wang S. The health and productivity cost burden of the 'Top 10' physical and mental health conditions affecting six large U.S. employers in 1999. J Occup Environ Med 2003;45:5-14.
22. Goetzel RZ, Long SR, Ozminkowski RJ, Hawkins K, Wang S, Lynch W. Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting U.S. employers. J Occup Environ Med 2004;46:398-412.
23. Druss BG, Marcus SC, Olfson M, Pincus HA. The most expensive medical conditions in America. Health Aff (Millwood) 2002;21:105-11.
24. Kessler RC, Heeringa S, Lakoma MD, Petukhova M, Rupp AE, Schoenbaum M, et al. Individual and societal effects of mental disorders on earnings in the United States: Results from the National Comorbidity Survey Replication. Am J Psychiatry 2008;165:703-11.
25. Colton CW, Manderscheid RW. Congruencies in increased mortality rates, years of potential life lost, and causes of death among public mental health clients in eight states. Prev Chronic Dis 2006;3:A42.
26. Eaton WW, Martins SS, Nestadt G, Bienvenu OJ, Clarke D, Alexandre P. The burden of mental disorders. Epidemiol Rev 2008;30:1-14.
27. Subramaniam M, Vaingankar J, Heng D, Kwok KW, Lim YW, Yap M, et al. The Singapore Mental Health Study: An overview of the methodology. Inter J Methods Psychiatry 2012, Feb 13. doi: 10.1002/mpr.1351. [Epub ahead of print]
28. Kessler RC, Ustun TB. The World Mental Health (WMH) Survey initiative version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). Int J Methods Psychiatr Res 2004;13:93-121.
29. Kendler KS, Gallagher TJ, Abelson JM, Kessler RC. Lifetime prevalence, demographic risk factors and diagnostic validity of nonaffective psychosis as assessed in a US community sample. The National Comorbidity Survey. Arch Gen Psychiatry 1996:53;1022-31.
30. EuroQol Group. EuroQol-a new facility for the measurement of health-related quality of life. Health Policy 1990;16:199-208.
31. Dholan P. Modelling valuations for EuroWol health states. Med Care 1997;35:1095-108.
32. Hoffman C, Rice D, Sung HY. Persons with chronic conditions. Their prevalence and costs. JAMA 1996;276:1473-9.
33. Egede LE, Zheng D, Simpson K. Comorbid depression is associated with increased health care use and expenditures in individuals with diabetes. Diabetes Care 2002;25:464-70.
34. Chong SA, Abdin E, Sherbourne C, Vaingankar J, Heng D, Yap M, et al. Treatment gap in common mental disorders: The Singapore perspective. Epidemiol Psychiatr Sci 2012;in press.
35. Coulehan JL, Schulberg HC, Block MR, Janosky JE, Arena VC. Medical comorbidity of major depressive disorder in a primary medical practice. Arch Inter Med 1990:150:2363-7.
36. Higgins ES. A review of unrecognized mental illness in primary care. Prevalence, natural history, and efforts to change the course. Arch Fam Med 1994;3:908-17.
37. Wells KB, Hays RD, Burnam MA, Rogers W, Greenfield S, Ware JE Jr. Detection of depressive disorder for patients receiving prepaid or fee-for-service care—results from the medical outcomes study. JAMA 1989;262:3298-302.
38. Chong SA, Subramaniam M, Chan YH, Chua HC, Liou PH, Pek E, et al. Depressive symptoms and diabetes mellitus in an Asian multiracial population. Asian J Psychiatr 2009;2:66-70.
39. Van Lieshout RJ, Bienenstock J, MacQueen GM. A review of candidate pathways underlying the association between asthma and major depressive disorder. Psychosom Med 2009;71:187-95.
40. Milaneschi Y, Corsi AM, Penninx BW, Bandinelli S, Guralnik JM, Ferrucci L. Interleukin-1 receptor antagonist and incident depressive symptoms over 6 years in older persons: the InCHIANTI study. Biol Psychiatry 2009;65:973-8.
41. Brown AD, Barton DA, Lambert GW. Cardiovascular abnormalities in patients with major depressive disorder: autonomic mechanisms and implications for treatment. CNS Drugs 2009;23:583-602.
42. Sprangers MAG, de Regt EB, Andries F, Van Agt HM, Bijl RV, De Boer JB, et al. Which chronic conditions are associated with better or poorer quality of life? J Clin Epidemiol 2000;53:895-907.
43. Taylor SE, Aspinwall LG. Psychosocial aspects of chronic illness. In: Costa PT, VandenBos GR, eds. Psychological aspects of serious illness: chronic conditions, fatal diseases, and clinical care. Washington, DC: American Psychological Association 1996:7-60.
44. Kotlyar M, Dysken M, Adson DE. Update on drug-induced depression in the elderly. Am J Geriatr Pharmacother 2005;3:288-300.
45. Patten SB, Barbui C. Drug-induced depression: A systematic review to inform clinical practice. Psychother Psychosom 2004;73:207-15.
46. Goodwin RD. Association between physical activity and mental disorders among adults in the United States. Prev Med 2003;36:698-703.
47. Simon GE, Von Korff M, Saunders K, Miglioretti DL, Crane PK, van Belle G, et al. Association between obesity and psychiatric disorders in the US adult population. Arch Gen Psychiatry 2006;63:824-30.
48. Compton MT, Daumit GL, Druss BG. Cigarette smoking and overweight/obesity among individuals with serious mental illnesses: A preventive perspective. Harv Rev Psychiatry 2006;14:212-22.
49. Daumit GL, Goldberg RW, Anthony C, Dickerson F, Brown CH, Kreyenbuhl J, et al. Physical activity patterns in adults with severe mental illness. J Nerv Ment Dis 2005;193:641-6.
50. Druss BG, Rosenheck RA, Desai MM, Perlin JB. Quality of preventive medical care for patients with mental disorders. Med Care 2002;40;129-36.
51. Mitchell AJ, Malone D, Doebbeling CC. Quality of medical care for people with and without comorbid mental illness and substance misuse: Systematic review of comparative studies. Br J Psychiatry 2009;194:491-9.
52. Phelan M, Stradins L, Morrison S. Physical health of people with severe mental illness. BMJ 2001;322:443-4.
53. Jeste DV, Gladsjo JA, Lindamer LA, Lacro JP. Medical comorbidity in schizophrenia. Schizophr Bull 1996;22:413-30.
54. Harper S, Lynch J. Trends in socioeconomic inequalities in adult health behaviors among U.S. States, 1990–2004. Public Health Rep 2007;122:177-89.
55. Lantz PM, House JS, Lepkowski JM, Williams DR, Mero RP, Chen JM. Socioeconomic factors, health behaviors, and mortality—results from a nationally representative prospective study of US adults. JAMA 1998;279:1703-8.
56. Lorant V, Deliege D, Eaton W, Robert A, Philippot P, Ansseau M. Socioeconomic inequalities in depression: A meta-analysis. Am J

Epidemiol 2003;157:98-112.

57. helan JC, Link BG, Diez-Roux A, Kawachi I, Levin B. Fundamental causes of social inequalities in mortality: A test of the theory. J Health Soc Behav 2004;45:265-85.
58. Lett HS, Blumenthal JA, Babyak MA, Strauman TJ, Robins C, Sherwood A. Social support and coronary heart disease: Epidemiologic evidence and implications for treatment. Psychosom Med 2005;67:869-78.
59. Sareen J, Cox BJ, Clara I, Asmundson GJ. The relationship between anxiety disorders and physical disorders in the US National comorbidity survey. Depress Anxiety 2005;21:193-202.
60. Scott KM, Oakley BMA, McGee MA, Wells JE. Mental-physical comorbidity in Te Rau Hinengaro: The New Zealand Mental Health Survey. Aust NZ J Psychiatry 2006;40:882-8.
61. Moussavi S, Chatterji S, Verdes E, Tandon A, Patel V, Ustun B. Depression, chronic diseases, and decrements in health: results from the World Health Surveys. Lancet 2007;370:851-8.
62. Fan VS, Au D, Heagerty P, Devo RA, McDonell MB, Fihn SD. Validation of case-mix measures derived from self-reports of diagnoses and health. J Clin Epidemiol 2002;55:371-80.
63. Harris EC, Barraclough B. Excess mortality of mental disorder. Br J Psychiatry 1998;173:11-53.
64. Felker B, Yazel JJ, Short D. Mortality and medical comorbidity among psychiatric patients: A review. Psychiatr Serv 1996;47:1356-63.
65. Saha S, Chant D, McGrath J. A systematic review of mortality in schizophrenia: Is the differential mortality gap worsening over time? Arch Gen Psychiatry 2007;64:1123-31.
66. Phua HP, Chua AV, Ma S, Heng D, Chew SK. Singapore's burden of disease and injury 2004. Singapore Med J 2009;50:468-78.
67. Lim L, Ng TP, Chua HC, Chiam PC, Won V, Lee T, et al. Generalised anxiety disorder in Singapore: prevalence, co-morbidity and risk factors in a multi-ethnic population. Soc Psychiatry Psychiatr Epidemiol 2005; 40:972-9.
68. Mauer BJ, Druss BG. Mind and Body Reunited: Improving Care at the Behavioral and Primary Healthcare Interface. J Behav Health Serv Res 2010;37:529-42.