

Measuring Health-related Quality of Life in Singapore: Normal Values for the English and Chinese SF-36 Health Survey

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Abstract

Objective: To determine norms for assessing Health-related Quality of Life (HRQOL) in Singapore using the Short Form 36 Health Survey (SF-36). **Materials and Methods:** Mean SF-36 scores were calculated for 24 population subgroups (categorised by age, gender, ethnicity and questionnaire language) and for subjects with self-reported co-morbid conditions using data from a community-based survey in Singapore. **Results:** The English and Chinese SF-36 was completed by 4122 and 1381 subjects, respectively, 58% (n = 3188) of whom had self-reported co-morbid conditions. SF-36 scores varied in subgroups differing in age, gender and ethnicity. In general, subjects with self-reported co-morbid conditions had lower SF-36 scores than those without these conditions, the magnitude of which exceeded 20 points in several instances. A method for calculation of SF-36 scores adjusted for age, gender, ethnicity and questionnaire language is described. **Conclusion:** We present norms for English and Chinese SF-36 versions in Singapore and describe potential uses for these data in assessing HRQOL in Singapore.

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Key words: Asia, Co-morbidity, Ethnic groups, Quality of life, Reference values, Singapore

Introduction

Advances in diagnosis and therapy in the second half of the 20th century have lead to impressive improvements in survival for patients with many chronic illnesses. With improvements in survival, patients' perceptions of health are increasingly being recognised as an important outcome in clinical medicine,^{1,2} especially in illnesses where therapies, though improving survival, may be associated with significant morbidity. This emphasis on patients' perceptions of health is all the more important given that patients' functional status and perceptions of health often differ from physician assessment of patients' health status.³ For example, patients with systemic lupus erythematosus

may have quiescent disease with no organ damage, yet have disabling fatigue and poor physical and emotional functioning.⁴ This highlights the need to measure patients' perceptions of health in addition to physician assessment of patients' status.

In the last two decades, efforts to measure patients' perceptions of health have lead to the development of various health-related quality of life (HRQOL) scales, which measure various domains of perceived health, for example physical and social functioning.¹ An extensive and growing body of literature documents the reliability, validity and clinical utility of such scales and has fostered their use in clinical research, for example in showing the

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superiority of dual chamber over ventricular pacing⁵ and of paroxetine over psychotherapy in patients with depression and dysthymia.⁶

The Short Form 36 Health Survey (SF-36) is a validated,⁷⁻⁹ internationally used measure of quality of life which has been used to measure HRQOL in over 130 diseases as reported in over 1000 publications to date.¹⁰ Through the International Quality of Life Assessment (IQOLA) project,^{11,12} the SF-36 is being validated in many languages and socio-cultural contexts, including at least 9 countries in Asia.¹³ The SF-36 appears to be a suitable QOL measure for use in multi-national studies, and is fast becoming the *de facto* standard for non-disease specific HRQOL measurement. In studies of a community-based, cross-sectional sample of 5503 Chinese, Malays and Indians in Singapore¹⁴ and in Singaporeans with systemic lupus erythematosus,^{15,16} we found that English and Chinese SF-36 versions fulfilled assumptions for Likert scale scoring, internal consistency-reliability, test-retest reliability, factor structure and construct validity and displayed good subject acceptability, and therefore appeared to be valid measures of HRQOL in Singapore. To date, the SF-36 has been used to study HRQOL in Singaporeans with SLE,¹⁵⁻¹⁷ osteoarthritis,¹⁸ differentiated thyroid carcinoma¹⁹ and anxiety disorders,²⁰ as well as to assess the results of total knee arthroplasty²¹ and lumbar spinal surgery.²² These results have been particularly valuable because the use of the same scale has allowed comparison of HRQOL among various diseases in Singapore. As comparisons with expected SF-36 scores in the general population and subjects with various illnesses may also be helpful in interpreting SF-36 scores from patients, we present SF-36 scores for the Singapore population and for Singaporeans with self-reported co-morbid conditions for the English (UK) and Chinese (HK) SF-36 versions derived from this community-based survey of 5503 Chinese, Malay and Indian Singaporeans.¹⁴

Materials and Methods

Study Design and Data Collection

From April 1998 to January 1999, we performed a cross-sectional, community-based survey of a random sample of Chinese, Malay and Indian subjects resident in Toa Payoh-Bishan Group Representation Constituency, a district in Singapore with approximately 120,000 residents including both public and private housing projects. Inclusion criteria were: age between 21 to 65 on 1 January 1998; the ability to read a newspaper in English or Chinese; Chinese, Malay or Indian ethnicity; and status as free-living adults in the community. Individuals more than 65 years of age were not included because of low literacy rates in this age group.²³ Details of the sampling methodology and data collection

have been published¹⁴ and are summarised here. To ensure adequate representation of the 3 major ethnic groups in Singapore, we obtained a disproportionate stratified random sample stratified using ethnicity, gender, age and language, yielding a total of 24 subgroups (Tables I and II). We aimed to recruit 150 subjects in each subgroup for a total sample size of 3600, based on an estimate that 141 subjects would be needed to detect a 10-point difference in SF-36 scores between groups, assuming two-sided significance of 5%, 80% power and a mean SF-36 score standard deviation of 30 points.¹⁴ Fieldworkers identified eligible subjects, invited them to self-administer an identical English or Chinese questionnaire containing the English (UK) or Chinese (HK) SF-36, respectively, and checked returned questionnaires for completeness. After eligible subjects had self-administered the SF-36, fieldworkers conducted a standardised, structured interview to collect information on demographics, socio-economic status, sick days, exercise and co-morbidities. Several months after the end of the survey, we surveyed a randomly-selected sample of non-respondents to determine their demographic characteristics and SF-36 scores: first, fieldworkers revisited a sample of uncontacted subjects; second, a postal survey of 400 contacted subjects who declined participation was conducted.

Short Form 36 Health Survey (SF-36)

The SF-36 is a validated⁷⁻⁹ 36-item questionnaire measuring quality of life in eight areas of perceived health using a single multi-item scale. SF-36 scales measure perceived health in the areas of physical functioning (PF), role-physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE), and mental health (MH), with higher scores (range 0 to 100) reflecting better perceived health. As Anglicised English and metric units of measurement are generally used in Singapore, the UK English standard version²⁴ and Chinese (Hong Kong) standard version 1.0²⁵ of the SF-36 with 4-week recall and metric units of measurement²⁶ were used.

Definitions

Ethnicity was as stated in a subject's national registration identification card, which reflects paternal ethnicity. Self-reported co-morbid conditions included diabetes mellitus, high blood pressure, asthma, heart disease, stroke, cancer, rheumatological conditions and mental illnesses.

Statistical Analyses

Data were entered into an Excel spreadsheet (Microsoft Corporation). Individual SF-36 items were recoded, summed and transformed, with missing values imputed as recommended.²⁴ Subjects with missing scale scores were

TABLE I: MEAN ENGLISH (UK) SF-36 SCORES BY AGE, GENDER AND ETHNIC GROUP

		Male					Female				
All		21-30 y	31-40 y	41-50 y	≥51 y	All	21-30 y	31-40 y	41-50 y	≥51 y	All
Chinese (n)	1314	228	191	154	132	705	194	202	118	95	609
SF-36 scale [Mean (SD)]											
PF	83.3 (22.1)	83.22 (23.16)	83.63 (22.03)	85.19 (21.36)	80.09 (21.60)	83.20 (22.17)	84.33 (22.88)	84.69 (20.62)	83.92 (31.95)	78.99 (22.38)	83.56 (21.92)
RP	86.7 (27.4)	85.96 (29.50)	85.73 (28.03)	87.66 (25.92)	83.65 (29.68)	85.88 (28.33)	90.72 (22.57)	87.42 (27.03)	85.59 (28.19)	85.00 (28.81)	87.76 (26.24)
BP	82.3 (19.6)	81.68 (20.22)	81.73 (20.75)	83.59 (19.94)	81.68 (17.37)	82.11 (19.77)	84.79 (18.19)	82.75 (18.97)	81.81 (21.18)	78.91 (20.48)	82.57 (19.49)
GH	69.3 (17.4)	67.71 (18.66)	69.90 (18.54)	68.18 (18.26)	69.72 (17.13)	68.81 (18.23)	71.59 (15.96)	68.99 (16.16)	68.57 (18.22)	69.81 (14.73)	69.89 (16.31)
VT	63.8 (16.4)	62.81 (16.71)	61.85 (16.87)	65.19 (15.59)	63.76 (17.53)	63.76 (17.53)	64.15 (15.28)	63.89 (15.03)	63.97 (18.17)	65.89 (16.28)	64.36 (15.98)
SF	83.9 (18.6)	82.79 (19.73)	81.87 (20.14)	85.88 (16.71)	82.74 (18.07)	83.74 (18.07)	84.21 (17.94)	84.22 (18.22)	84.22 (18.57)	84.87 (18.85)	84.34 (18.26)
RE	84.2 (30.5)	87.43 (26.88)	80.63 (33.02)	86.40 (28.80)	81.95 (30.84)	81.95 (30.84)	86.25 (29.49)	85.07 (38.45)	81.64 (34.48)	80.35 (35.23)	84.07 (31.12)
MH	72.9 (16.0)	71.80 (16.68)	71.38 (16.73)	74.53 (14.78)	73.29 (18.48)	73.29 (18.48)	72.42 (15.61)	72.51 (14.20)	75.17 (15.08)	74.35 (16.61)	73.33 (15.25)
Malay (n)	1233	141	168	159	183	651	141	196	146	99	582
SF-36 scale [Mean (SD)]											
PF	76.6 (25.2)	80.16 (23.48)	77.23 (25.93)	76.64 (35.57)	75.76 (27.70)	77.31 (25.84)	76.81 (25.88)	75.74 (24.09)	75.35 (24.70)	74.77 (23.54)	75.78 (24.54)
RP	76.1 (36.2)	76.00 (34.97)	77.64 (33.73)	76.00 (37.14)	79.60 (35.83)	77.44 (35.40)	77.07 (35.93)	76.62 (35.28)	68.20 (41.02)	77.61 (35.51)	74.81 (37.09)
BP	78.2 (20.9)	80.01 (20.13)	79.80 (20.11)	87.78 (20.61)	76.78 (21.29)	79.48 (20.61)	81.13 (19.99)	75.86 (31.38)	75.80 (21.63)	75.13 (21.12)	76.95 (21.16)
GH	68.6 (16.0)	71.76 (16.02)	68.12 (15.58)	69.30 (14.78)	66.53 (17.35)	68.75 (16.08)	71.09 (15.29)	67.83 (16.04)	68.83 (15.39)	66.02 (16.83)	68.53 (15.89)
VT	66.3 (16.5)	67.16 (16.15)	65.01 (16.32)	69.10 (16.66)	69.38 (17.46)	67.70 (16.75)	65.27 (16.48)	63.23 (15.56)	64.89 (16.03)	66.78 (16.00)	64.72 (15.99)
SF	78.7 (20.5)	81.03 (19.85)	77.22 (20.79)	78.62 (20.35)	80.23 (20.05)	79.23 (20.28)	77.66 (20.96)	77.17 (20.80)	77.89 (31.51)	80.81 (18.84)	78.04 (20.70)
RE	78.0 (36.2)	78.13 (35.02)	79.07 (34.80)	75.32 (38.95)	78.32 (37.11)	77.74 (36.49)	79.38 (36.43)	79.15 (33.99)	73.45 (39.11)	84.49 (34.12)	78.21 (36.10)
MH	75.0 (16.7)	75.86 (16.11)	72.53 (18.10)	78.11 (17.27)	77.43 (16.33)	75.99 (17.09)	73.51 (15.70)	71.68 (16.16)	74.86 (15.90)	76.91 (16.76)	73.77 (16.16)
Indian (n)	1529	137	256	196	157	746	169	312	209	93	783
SF-36 scale [Mean (SD)]											
PF	73.9 (25.8)	72.31 (26.97)	76.14 (36.70)	74.47 (24.23)	75.68 (25.70)	74.90 (25.90)	74.97 (25.58)	71.19 (25.75)	75.21 (25.25)	70.94 (26.13)	73.05 (25.65)
RP	73.9 (37.1)	75.18 (35.55)	72.56 (39.25)	73.60 (36.57)	75.80 (36.63)	73.99 (37.29)	74.59 (37.80)	71.39 (37.84)	77.55 (34.65)	72.58 (36.69)	73.95 (36.89)
BP	72.5 (23.6)	70.42 (36.27)	72.91 (23.97)	71.90 (23.56)	73.45 (22.65)	72.30 (24.01)	73.79 (23.06)	70.20 (23.69)	75.44 (23.47)	72.59 (20.99)	72.66 (23.25)
GH	70.1 (17.9)	69.76 (19.20)	70.45 (18.59)	70.13 (17.93)	70.07 (16.32)	70.16 (18.04)	70.95 (17.22)	68.87 (17.10)	71.82 (18.36)	68.02 (19.10)	70.01 (17.74)
VT	64.2 (17.6)	63.05 (18.40)	64.17 (16.96)	65.75 (17.20)	65.44 (16.28)	64.64 (17.15)	65.33 (18.20)	62.60 (17.44)	64.48 (18.93)	63.85 (16.35)	63.84 (17.89)
SF	76.1 (22.2)	71.99 (83.94)	75.49 (20.68)	75.70 (22.79)	78.11 (21.26)	75.45 (22.03)	76.63 (22.64)	75.28 (21.63)	80.26 (21.49)	73.79 (24.94)	76.72 (22.30)
RE	75.2 (37.5)	74.94 (36.33)	75.88 (38.44)	74.66 (37.87)	77.49 (35.85)	75.73 (37.31)	74.80 (38.00)	71.70 (39.07)	80.22 (34.47)	71.68 (38.37)	74.65 (37.67)
MH	71.5 (17.8)	70.20 (17.62)	70.65 (17.05)	72.35 (16.49)	74.24 (15.93)	71.77 (16.81)	72.25 (19.50)	70.03 (18.00)	72.70 (18.87)	69.34 (18.17)	71.14 (18.60)
PF: physical functioning; RP: role physical; BP: bodily pain; GH: general health; VT: vitality; SF: social functioning; RE: role emotional; MH: mental health											

TABLE II: MEAN CHINESE (HK) SF-36 SCORES BY AGE AND GENDER

		Male					Female				
All		21-30 y	31-40 y	41-50 y	≥51 y	All	21-30 y	31-40 y	41-50 y	≥51 y	All
(n = 1349)		(n = 119)	(n = 173)	(n = 178)	(n = 206)	(n = 676)	(n = 141)	(n = 175)	(n = 138)	(n = 219)	(n = 673)
SF-36 scale [Mean (SD)]											
PF	87.38 (15.52)	90.33 (13.65)	91.47 (12.02)	89.60 (13.51)	85.24 (16.89)	88.89 (14.49)	90.10 (13.03)	87.73 (13.93)	85.86 (14.91)	81.78 (19.55)	85.87 (16.30)
RP	85.21 (28.00)	86.55 (27.77)	86.43 (26.22)	88.27 (25.60)	83.98 (30.91)	86.19 (27.83)	88.93 (22.29)	86.65 (25.06)	81.96 (29.70)	81.05 (32.22)	84.29 (28.22)
BP	80.60 (20.83)	82.30 (20.60)	80.19 (20.55)	82.23 (20.21)	81.81 (20.63)	81.59 (20.46)	82.52 (19.88)	78.78 (21.04)	78.44 (22.02)	79.56 (21.45)	79.75 (21.19)
GH	66.06 (17.45)	66.76 (17.22)	65.99 (16.57)	66.57 (15.71)	65.85 (18.56)	66.24 (17.06)	68.17 (18.28)	65.44 (17.63)	66.57 (17.46)	64.57 (17.84)	65.98 (17.88)
VT	61.43 (17.26)	62.37 (17.22)	59.96 (17.21)	62.61 (17.27)	61.76 (17.74)	61.63 (17.55)	62.09 (17.78)	59.77 (16.88)	62.69 (16.85)	60.88 (16.98)	61.18 (17.09)
SF	84.47 (19.07)	84.87 (18.11)	81.79 (20.27)	83.10 (20.63)	87.02 (18.43)	84.26 (19.52)	84.31 (18.44)	85.09 (17.41)	84.38 (19.50)	84.25 (19.27)	84.50 (18.67)
RE	79.53 (34.76)	80.39 (36.93)	81.71 (32.49)	78.77 (35.10)	80.84 (33.70)	80.44 (34.30)	76.43 (37.19)	78.41 (32.29)	76.19 (36.71)	81.04 (33.52)	78.39 (35.40)
MH	70.72 (15.87)	72.24 (17.24)	69.32 (15.12)	69.65 (16.86)	72.44 (15.90)	70.87 (16.24)	70.24 (15.10)	68.86 (15.06)	71.92 (15.52)	70.99 (15.93)	70.51 (15.44)
PF: physical functioning; RP: role physical; BP: bodily pain; GH: general health; VT: vitality; SF: social functioning; RE: role emotional; MH: mental health											

excluded listwise from analysis. Mean SF-36 scores for each of 24 subgroups defined on the basis of age, gender, ethnicity and questionnaire language (Tables I & II) and for subjects with co-morbid conditions (Tables III & IV) were determined using SPSS 8.0 for Windows (SPSS Inc.).

Results

Survey Response Rates and Characteristics of the Study Population

Survey response rates were 92.8% and 85.5% for the English and Chinese versions, respectively. The English version was completed by 1332 Chinese, 1251 Malays and 1535 Indians, while the Chinese version was completed by 1381 Chinese. By design, there were equal proportions of subjects from each ethnic group and both genders, ranging from 21 to 65 years in age (Tables I & II). The proportion of missing data ranged from 0.02% to 0.50% and 0.00% to 0.34% for English items and scales and 0.00% to 0.87% and 0.00% to 0.07% for Chinese items and scales, respectively. Additional information on survey response rates and study population characteristics have been published elsewhere.¹⁴

SF-36: Norms for Singapore

Mean English SF-36 scores for each ethnic group are summarised in Table I, and mean Chinese SF-36 scores are summarised in Table II. These tables also show mean

scores for each of the 24 subgroups, and highlight differences in SF-36 scores observed in subjects differing in age, gender and ethnicity. For example, subjects aged 51 years or older generally had lower PF scores than younger subjects. Among Malays, women had lower PF scores than men (this trend not being apparent in Chinese and Indians). Ethnic differences were present in PF scores, with Chinese having the highest and Indians the lowest scores. The number of subjects per ethnic group in Tables I and II is slightly less than the total number of 4122 because some subjects had missing scale scores. Mean (SD) English SF-36 scores for all ethnic groups were as follows: PF = 77.75 (24.79), RP = 78.77 (34.42), BP = 77.40 (21.95), GH = 69.38 (17.16), VT = 64.72 (16.87), SF = 79.42 (20.79), RE = 78.94 (35.18) and MH = 73.01 (16.95).

The distribution of English SF-36 scores is illustrated in Figure 1. Distributions for Chinese SF-36 scores were similar. Substantial ceiling effects were noted for the PF, RP, BP, SF and RE scales in both versions, while minimal floor and ceiling effects were seen for the three bipolar scales (GH, VT and MH). A similar pattern has been seen in the United States²⁴ and the United Kingdom²⁷ populations.

SF-36 Scores in Subjects with Co-morbid Conditions

SF-36 scores for subjects with self-reported co-morbid conditions are summarised in Tables III and IV. Fifty-eight per cent (3188/5503) of subjects reported a co-morbid

TABLE III: MEAN ENGLISH (UK) SF-36 SCORES IN SUBJECTS WITH CO-MORBID CONDITIONS

Co-morbid condition		Mean SF-36 scores							
		PF	RP	BP	GH	VT	SF	RE	MH
Diabetes (n = 279)	Y	73.75	73.69	74.01	67.29	64.99	78.65	76.40	73.80
	N	78.03	79.22	77.67	69.55	64.70	79.51	79.20	72.96
Hypertension (n = 423)	Y	75.93	75.26	75.71	67.90	66.27	81.18	77.22	74.02
	N	77.95	79.26	77.62	69.57	64.55	79.25	79.21	72.90
Heart disease (n = 118)	Y	73.14	71.34	73.51	66.22	63.30	80.28	73.28	73.71
	N	77.88	79.07	77.54	69.49	64.76	79.43	79.18	72.99
Stroke (n = 25)	Y	58.09	66.00	69.20	67.10	67.80	73.00	64.00	71.84
	N	77.87	78.93	77.47	69.41	64.70	79.49	79.10	73.02
Asthma or other lung disease (n = 257)	Y	77.68	82.48	76.87	69.40	63.92	79.27	80.59	71.44
	N	77.75	78.61	77.46	69.40	64.77	79.46	78.91	73.12
Cancer (n = 31)	Y	73.79	77.78	75.17	74.04	69.69	79.63	72.84	76.19
	N	77.77	78.85	77.44	69.37	64.69	79.45	79.05	72.99
Rheumatism, back pain, other bone or muscle illness (n = 1065)	Y	75.05	78.07	73.75	67.04	62.87	78.02	77.63	71.37
	N	78.68	79.12	78.69	70.21	65.36	79.95	79.48	73.59
Mental illness (e.g. depression, anxiety neurosis, schizophrenia) (n = 96)	Y	73.27	78.76	72.35	66.87	61.02	77.69	77.42	70.28
	N	77.85	78.85	77.54	69.46	64.81	79.49	79.04	73.08

PF: physical functioning; RP: role physical; BP: bodily pain; GH: general health; VT: vitality; SF: social functioning; RE: role emotional; MH: mental health

TABLE IV: MEAN CHINESE (HK) SF-36 SCORES IN SUBJECTS WITH CO-MORBID CONDITIONS

Co-morbid condition		Mean SF-36 Scores							
		PF	RP	BP	GH	VT	SF	RE	MH
Diabetes (n = 66)	Y	78.56	78.41	77.85	60.42	57.27	84.09	83.59	69.58
	N	87.83	85.60	80.70	66.38	61.65	84.46	79.34	70.78
Hypertension (n = 188)	Y	80.02	80.85	80.04	62.82	60.34	82.94	78.84	70.92
	N	88.52	85.89	80.68	66.58	61.61	84.71	79.63	70.69
Heart disease (n = 21)	Y	68.97	66.67	74.76	53.90	50.48	80.95	71.43	66.67
	N	87.67	85.52	80.68	66.26	61.60	84.51	79.67	70.80
Stroke (n = 11)	Y	74.09	61.36	78.55	47.18	51.36	80.68	81.82	64.73
	N	87.46	85.40	80.61	66.21	61.52	84.49	79.50	70.77
Asthma or other lung disease (n = 48)	Y	82.50	72.92	69.27	61.63	54.93	77.86	74.31	64.67
	N	87.53	85.67	80.98	66.21	61.69	84.71	79.76	70.97
Cancer (n = 12)	Y	82.50	75.00	74.00	67.50	57.92	80.21	88.89	66.67
	N	87.38	85.29	80.67	66.03	61.46	84.50	79.38	70.78
Rheumatism, back pain, other bone or muscle illness (n = 426)	Y	82.94	77.52	72.24	61.57	59.09	80.91	74.02	68.94
	N	89.32	88.65	84.37	68.07	62.51	86.09	81.98	71.54
Mental illness (e.g. depression, anxiety neurosis, schizophrenia) (n = 50)	Y	83.76	68.50	61.54	57.12	50.77	68.00	55.33	59.28
	N	87.53	85.82	81.31	66.41	61.85	85.11	80.42	71.17

PF: physical functioning; RP: role physical; BP: bodily pain; GH: general health; VT: vitality; SF: social functioning; RE: role emotional; MH: mental health

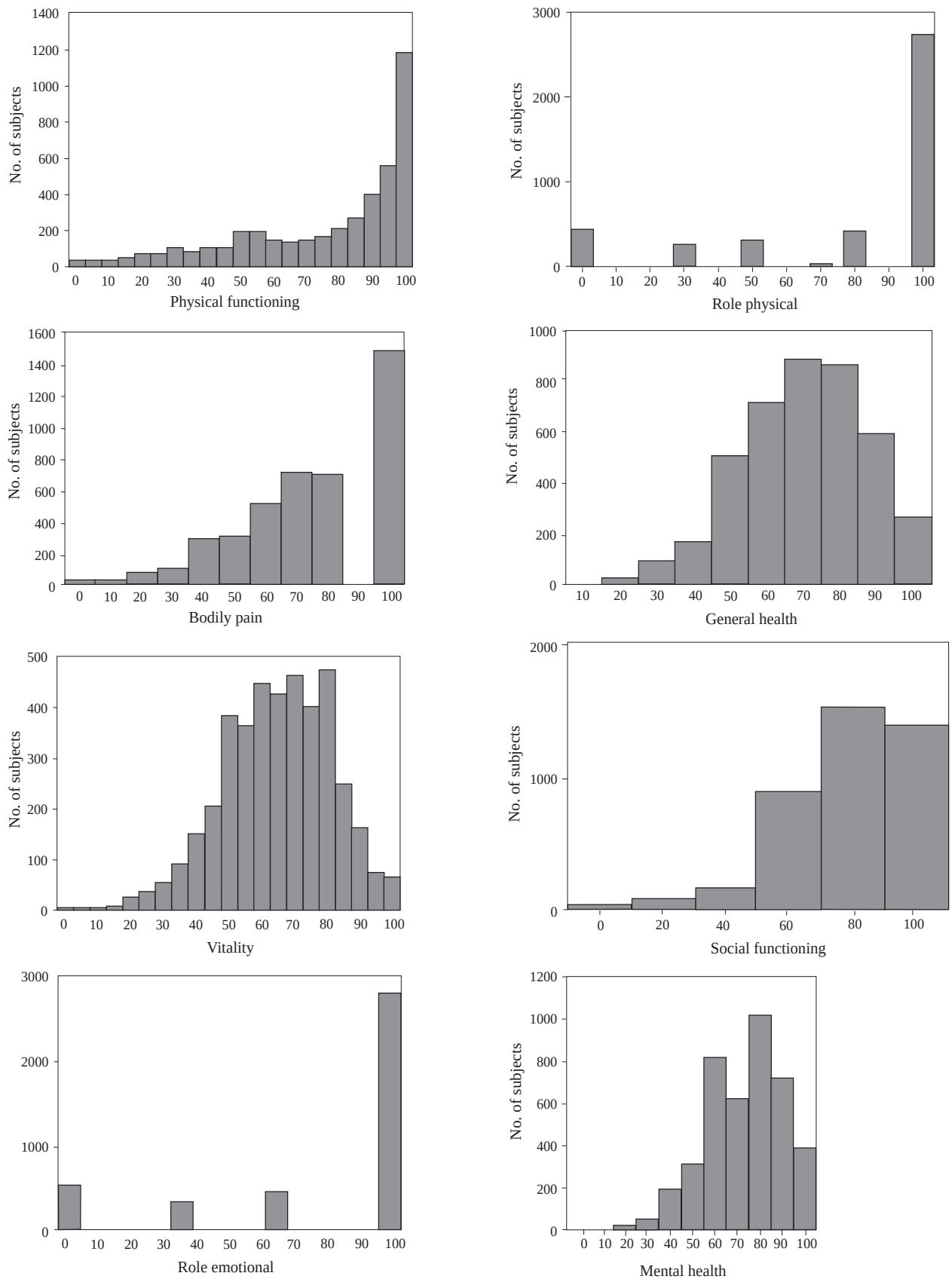
condition. The frequency of various co-morbid conditions varied widely, from 0.65% (36/5503) for strokes to 27.09% (1491/5503) for musculoskeletal problems. In general, subjects with self-reported co-morbid conditions had lower SF-36 scores than those without these conditions. The magnitude of reduction in SF-36 scores varied, and in several instances exceeded 20 points. Subjects with co-morbid conditions affecting the physical component of health had lower scores than subjects without these conditions for SF-36 scales measuring this component in Singapore¹⁴ (i.e. the PF, RP, BP, GH & RE scales). For example, patients with self-reported diabetes had lower scores for these scales, but not for the SF or MH scales (which measure the mental component of health). Of note, subjects with mental illnesses had reductions in the SF-36 scales measuring the mental component of health in Singapore (i.e. VT, SF & MH).

Use of SF-36 Normal Values

These data on SF-36 norms may be used in several ways. First, they allow comparison of HRQOL in patients with any given disease with expected HRQOL scores in Singapore adjusted for age, gender, ethnic group and questionnaire language. Second, they allow comparison of the impact of different diseases on various HRQOL domains. Third, they allow identification of specific HRQOL domains that are affected by a particular disease. These potential uses of SF-36 norms are described in detail below.

Comparing HRQOL for a group of patients with any given disease with expected HRQOL scores adjusted for age, gender, ethnic group and questionnaire language is illustrated using data from patients with osteoarthritis who completed the PF and BP scales for either English or Chinese SF-36 versions. Only the PF and BP scales were used to reduce respondent burden and because these domains on HRQOL are of particular relevance for such patients.²⁸ To determine the expected PF scores for a general population sample adjusted for the demographic characteristics of these patients, the number of patients in each of the 24 subgroups was determined (Table Va). The number of patients in each subgroup was multiplied by the mean SF-36 score for that subgroup (obtained from Table I or II and shown in italics in Table Vb). Values for the 24 subgroups were totalled and then divided by the number of patients (shown in bold text in Table Vb), giving the expected PF score adjusted for age, gender, ethnic group and questionnaire language. Differences in SF-36 scores between patients and the adjusted general population can also be illustrated graphically, as shown in Figure 2.

Comparing the impact of different diseases on various HRQOL domains is hindered by the fact that patients may differ in demographic characteristics, which themselves may affect HRQOL.²⁷ As illustrated in Table VI, comparing differences between actual and expected SF-36 scores (which have been adjusted for age, gender, ethnicity and questionnaire language) allows comparison of HRQOL



SF-36 Scale scores

Fig. 1. Distribution of English SF-36 scores in Singapore.

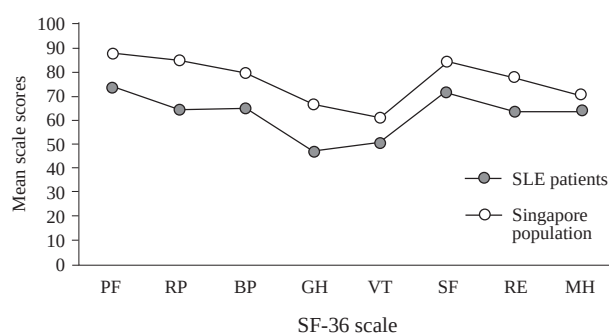
TABLE V: CALCULATION OF EXPECTED PHYSICAL FUNCTIONING SCORES IN THE SINGAPORE POPULATION ADJUSTED FOR AGE, GENDER, ETHNICITY AND QUESTIONNAIRE LANGUAGE

TABLE Va

SF-36 version	Male				Female			
	21-30 y	31-40 y	41-50 y	≥51 y	21-30 y	31-40 y	41-50 y	≥51 y
English (UK)								
Chinese	0	2	1	7	0	0	5	28
Malay	0	0	0	0	0	0	0	2
Indian	0	0	1	0	0	0	2	7
Chinese (HK)	0	0	1	10	0	0	4	52

TABLE Vb

SF-36 version		21-30 y	31-40 y	41-50 y	>51 y	Row total
English (UK)						
Chinese	Male (n)	0	2	1	7	
	Mean	83.22	83.63	85.19	80.09	813.08
	Female (n)	0	0	5	28	
	Mean	84.33	84.69	83.92	78.99	2631.32
Malay						
	Male (n)	0	0	0	0	
	Mean	80.16	77.23	76.64	75.76	0
	Female (n)	0	0	0	2	
	Mean	76.81	75.74	75.35	74.77	149.54
Indian						
	Male (n)	0	0	1	0	
	Mean	72.31	76.14	74.47	75.68	74.47
	Female (n)	0	0	2	7	
	Mean	74.97	71.19	75.21	70.94	647
Expected Mean English PF score = (813.08 + 2631.32 + 149.54 + 74.47 + 647) / 55 = 78.46						
Chinese (HK)						
	Male (n)	0	0	1	10	
	Mean	90.33	91.47	89.60	85.24	942
	Female (n)	0	0	4	52	
	Mean	90.10	87.73	85.86	81.78	4596
Expected Mean Chinese PF score = (942 + 4596) / 67 = 82.66						
English (UK) and Chinese (HK) SF-36						
Expected Mean English and Chinese PF score = (813.08 + 2631.32 + 149.54 + 74.47 + 647 + 942 + 4596) / (55 + 67) = 80.77						



PF: physical functioning; RP: role physical; BP: bodily pain; GH: general health; VT: vitality; SF: social functioning; RE: role emotional; MH: mental health

Fig. 2. HRQOL profile of Chinese speaking SLE patients versus the Singapore population (adjusted for age and gender).

TABLE VI: DIFFERENCE IN SF-36 SCORES BETWEEN PATIENTS AND THE SINGAPORE POPULATION*

	SLE (n = 69)	OA (n = 126)	DTC (n = 150)
Physical functioning	-13.9	-24.6	-5.8
Role physical	-21.0	—	-12.5
Bodily pain	-14.8	-21.6	-5.7
General health	-20.0	—	2.4
Vitality	-11.0	—	-4.7
Social functioning	-12.6	—	6.0
Role emotional	-14.4	—	-11.8
Mental health	-6.3	—	-5.4

*Adjusted for age, gender, ethnicity and questionnaire language;
DTC: differentiated thyroid carcinoma; OA: osteoarthritis;
SLE: systemic lupus erythematosus

domains affected by various diseases while providing some adjustment for differences in demographic characteristics. Thus in Table VI, patients with osteoarthritis¹⁸ had poorer PF and BP scores than patients with SLE.¹⁵ Given that patients with osteoarthritis are generally older than patients with SLE, and that SLE has more of a female preponderance than osteoarthritis, scores from these two conditions cannot be directly compared, while the difference between actual and expected scores for these diseases can be directly compared because the expected scores have been adjusted for demographic characteristics.

Identification of specific HRQOL domains that are affected by a particular disease is facilitated by comparing actual with expected SF-36 scores. For example, Table VI shows that SLE patients have poorer HRQOL than expected for all SF-36 domains, while patients with differentiated thyroid carcinoma¹⁹ have scores for general health and social functioning that are comparable with those in the general population.

Although these data may be used for sample size estimation for clinical trials, it is important to note that the distribution of some SF-36 scales does not follow a Gaussian distribution. Assuming a Gaussian distribution in this situation may result in an under- or over-estimation of sample size, and the use of an alternative method for ordered categorical data has therefore been recommended.²⁹

Use of SF-36 Scores In Various Co-Morbid Conditions

Data on SF-36 scores in subjects with co-morbid conditions may be useful and in several ways analogous to the use of SF-36 norms. First, they allow comparison of the relative impact of these various conditions on HRQOL in Singapore. For example, the reduction in English PF scores in subjects with diabetes (4.3 points) is similar to the reduction seen in subjects with heart disease and cancer (4.7 and 4.0 points, respectively). Second, they allow identification of specific HRQOL domains affected by a particular disease. For example, subjects with mental illness also had reductions in scales assessing physical aspects of health (e.g. PF, BP). Third, they aid in the interpretation of observed differences in SF-36 scores by providing a clinically relevant framework for understanding the magnitude of reductions in SF-36 scores. For example, PF scores were reduced by 3.6 points in patients with musculoskeletal problems and 19.8 points in stroke patients. As physicians have an intuitive sense of the degree of impairment in physical function in such patients based on their clinical experience, these data help to make the degree of impairment associated with reductions in SF-36 scores more tangible. Fourth, these data potentially provide a baseline for comparison of SF-36 scores for subjects with a given co-morbidity seen in a hospital versus a community-based context.

Discussion

This paper presents normal values for the English and Chinese SF-36 for the Singapore population. We present these data in the hope that they shall be useful for studies of HRQOL in various diseases in Singapore, especially in comparing HRQOL in these conditions with expected scores for the general population. There are several points of note in the use of the SF-36 (and similar scales) for clinical research in Singapore. First, the SF-36, as a non-disease specific HRQOL measure, complements but does not replace disease specific HRQOL measures in assessing HRQOL. Disease specific measures may assess domains of HRQOL of particular relevance to a particular disease and are generally more sensitive to change than non-disease specific measures,¹ while non-disease specific HRQOL measures allow comparison of HRQOL among various diseases. Ideally, both types of measures should be used together. Second, SF-36 scores obtained from self-administered questionnaires are generally lower than those obtained using interviewer-administered questionnaires,³⁰ and self-administered questionnaires should ideally be used if comparisons with these normal values are planned. However, interviewer administration may be a pragmatic choice in groups of patients with low levels of literacy where a large proportion of subjects would be excluded if self-administered questionnaires were used, e.g. in Singaporeans above 50 years of age, who have literacy rates in English or Chinese of 66% and 62%, respectively.³¹ Third, there is some evidence that English and Chinese SF-36 versions are equivalent in Singapore and may be combined for cross-sectional studies,^{14,15,32} so increasing the potential sample size and representativeness of studies using this scale in Singapore. However, further studies assessing the sensitivity to change and minimum clinically significant difference for these versions are needed to determine the equivalence of these scales when used serially.

The normal values for the Singapore population presented in Tables I and II are for the general Singapore population, which included healthy subjects and those with co-morbid conditions. We chose this approach in order to reflect HRQOL in the general population rather than reflecting HRQOL only in subjects without any co-morbid conditions, who represented less than half of the general population in this and other¹ population-based surveys.

SF-36 scores for subjects with co-morbid conditions need to be interpreted in the light of the definition of co-morbid conditions used in this study and possible differences in severity of conditions seen in the community and hospital setting. The reduction in SF-36 scores in subjects with self-reported co-morbidities may be lower than that in subjects who have a physician-established diagnosis for the same condition. Scores may also differ because the severity of

co-morbid conditions in community surveys tends to be less than that seen in patients who seek medical care.

In conclusion, we have presented normative data for HRQOL in the Singapore general population using English and Chinese SF-36 versions, and have described ways in which such data may be used to assess HRQOL in Singapore.

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