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The Health Status of the Singaporean Population as Measured by a Multi-Attribute Health Status System

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ABSTRACT

Background: This paper presents an assessment of the health status of the Singaporean population by the Health Utilities Index (HUI) Mark 3 system. The HUI approach is a generic health status measure that uses a Multi-Attribute Health Status Classification (MAHSC) system. The assessment describes the health status of the population on eight aspects or dimensions of health: seeing, hearing, speaking, walking, use of hands and fingers, feelings, memory and thinking, and pain.

Discussion: Differences in health status among different socio-economic and demographic groups are discussed.

Conclusion: The results of the study may help to better understand population health and health care needs and to plan health care services.

Keywords: health status, population health, health status assessment, multi-attribute health status classification system (MAHSC), health utilities index (HUI)

INTRODUCTION

The effectiveness of a health care program or intervention is ultimately determined by its influence upon the health of its recipients. Therefore, to evaluate and compare health interventions or treatment programs, it is necessary to develop common measures of health outcomes. Traditionally, condition-specific mortality and morbidity rates have been used for these purposes. However, with the shift in emphasis from the curing of disease to minimising the impact of illness on everyday activities in recent years, the efficacy and effectiveness of health care programs or interventions can no longer be judged by morbidity or mortality rates. Measures of the actual performance of activities have to be developed to provide a relevant and sensitive indicator for evaluating population health, assessing health care needs and determining the allocation of resources[1-4].

A number of generic health status measures have been developed for such purposes in North America and Europe in the last three decades[6, 7]. However, little work in this field has been conducted in Asia. This paper reports an application of the Health Utilities Index (HUI) approach to health status measurement[5] to measure the health profile of the Singaporean population. The HUI approach is a generic health status measure that uses a multi-attribute health status classification system to evaluate the health status of a population. A nation-wide random sample was taken. Population health status and its relationship with socio-economic and demographic factors are discussed. Results from this and other similar research may be useful to better understand population health and health care needs and help the planning of health care services.

METHODS

The HUI approach consists of three components: (i) a multi-attribute health status classification (MAHSC) system; (ii) a measurement system of preferences for health states, and (iii) a combination of health status data and preference data to yield information on the desirability of health care programs or interventions. This paper reports the application of the HUI Mark 3 MAHSC system in measuring the health status of the Singaporean population. The other parts of the research will be reported separately.

Health status measurement

A MAHSC system is a method of describing the health status of an individual at a point in time[9]. It defines health in different dimensions or attributes, each with multiple levels of functioning varying from good to poor. An individual's health status is classified according to his or her functioning level on each of the attributes. Each unique combination of levels represents a person's health or a (different) health state.

The first MAHSC system was developed more than 20 years ago by Bush and colleagues in the United States[10]. Following their work, a number of other MAHSC systems have been developed in different countries. Depending on its purpose, each system has different health attributes and/or different functioning levels on each attribute. Such systems have been increasingly used in clinical research, clinical practice and policy analyses[11, 12].

A MAHSC system developed at McMaster University in Canada was used in this study. This system has evolved three generations from the original Mark I system with four attributes: physical function, role function, social-emotional function, and health problem[13] to the current Mark 3 system with eight

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attributes: seeing, hearing, speaking, walking, feelings, memory and thinking, use of hands and fingers, and pain[11]. This system was selected for this study for several reasons. First, it provides a compact but comprehensive health status measurement framework for population health assessment and program evaluation. The system is capable of describing a total of 972,000 different health states, although not all of the health states are feasible. Second, the system has been successfully applied in a number of population health surveys[11] and evaluative clinical studies[14-16]. Finally, the system has been developed to be compatible with measuring preferences of health states, which is one of the objectives for our large study. The complete MAHSC (Mark 3) system is shown in Table I.

Table I: Multi-Attribute Health Status Classification System: Mark 3

Seeing

1. Able to see well enough to read ordinary newsprint and recognise a friend on the other side of the street, without glasses or contact lenses.
2. Able to see well enough to read ordinary newsprint and recognise a friend on the other side of the street, but with glasses or contact lenses.
3. Able to read newsprint with or without glasses but unable to recognise a friend on the other side of the street even with glasses or contact lenses.
4. Able to recognise a friend on the other side of the street with or without glasses, but unable to read ordinary newsprint, even with glasses or contact lenses.
5. Unable to read newsprint and unable to recognise a friend on the other side of the street, even with glasses or contact lenses.
6. Unable to see at all.

Hearing

1. Able to hear what is said in a group conversation with at least 3 people without a hearing aid.
2. Able to hear a conversation with 1 other person in a quiet room without a hearing aid, but requires a hearing aid to hear what is said in a group conversation with at least 3 other people.
3. Able to hear a conversation with 1 other person in a quiet room with a hearing aid and able to hear what is said in a group conversation with at least 3 other people with a hearing aid.
4. Able to hear a conversation with 1 other person in a quiet room without a hearing aid, but unable to hear what is said in a group conversation with at least 3 other people even with a hearing aid.
5. Able to hear a conversation with 1 other person in a quiet room with a hearing aid, but unable to hear what is said in a group conversation with at least 3 other people, even with a hearing aid.
6. Unable to hear at all.

Speaking

1. Able to be understood completely when speaking with strangers or people who know me well.
2. Able to be understood partially when speaking with strangers but able to be understood completely when speaking with people who know me well.
3. Able to be understood partially when speaking with strangers or people who know me well.
4. Unable to be understood when speaking with strangers but able to be understood partially when speaking with people who know me well.
5. Unable to be understood when speaking with other people (or unable to speak at all).

Walking

1. Able to walk around the neighbourhood without difficulty and without walking equipment.
2. Able to walk around the neighbourhood with difficulty, but does not require walking equipment or the help of another person.
3. Able to walk around the neighbourhood with walking equipment, but without the help of another person.
4. Able to walk only short distances with walking equipment, and requires a wheelchair to get around the neighbourhood.
5. Unable to walk alone even with walking equipment. Able to walk short distances with the help of another person, and requires a wheelchair to get around the neighbourhood.
6. Cannot walk at all.

Feelings (Emotion)

1. Happy and interested in life.
2. Somewhat happy.
3. Somewhat unhappy.
4. Very unhappy.
5. So unhappy that life is not worth living for.

Use of Hands and Fingers (Dexterity)

1. Full use of two hands and ten fingers.
2. Limitations in the use of hands or fingers, but does not require special tools or the help of another person.
3. Limitations in the use of hands or fingers, is independent with the use of special tools and does not require the help of another person.
4. Limitations in the use of hands or fingers, requires the help of another person for some tasks (not independent even with use of special tools).
5. Limitations in the use of hands or fingers, requires the help of another person for most tasks (not independent even with the use of special tools).
6. Limitations in the use of hands or fingers, requires the help of another person for all tasks (not independent even with the use of special tools).

Memory and Thinking (Cognition)

1. Able to remember most things, think clearly and solve day to day problems.
2. Able to remember most things, but has a little difficulty when trying to think and solve day to day problems.
3. Somewhat forgetful, but able to think clearly and solve day to day problems.
4. Somewhat forgetful and have a little difficulty when trying to think and solve day to day problems.
5. Very forgetful and have great difficulty when trying to think and solve day to day problems.
6. Unable to remember anything at all, and unable to think and solve day to day problems.

Pain

1. Free of pain and discomfort.
2. Mild to moderate pain that prevents no activities.
3. Moderate pain that prevents some activities.
4. Moderate to severe pain that prevents some activities.
5. Severe pain that prevents most activities.

To describe a person's health is to select the most appropriate level for the person on each attribute. In this way, an individual's health or a health state is described by an eight element vector (x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8), where x_i is the level on attribute i (i = 1, ..., 8). The measurement system is developed independently of factors such as age and gender, but it is used in the circumstances normal for the subject. For example, cognition levels for children should be assessed according to children's normal standards of memory and thinking capacities. For the speaking and hearing attributes, it is assumed that a common language or dialect spoken by both the speaker(s) and the listener(s) is used for the assessment.

Field work

The target population of the study was the general residential population of Singaporean citizens. A random sample of individuals, one from each household, was taken from the 1992 Register of Electoral Voters. The sample was designed to select 1,000 individuals or households for the survey, comprising 45% Chinese, 35% Malays and 25% Indians. The stipulated proportions were used to partially reflect the actual population proportions of the three major racial groups, although an equal number of responses in each group is desirable to yield maximum statistical power in comparison. The sampling was carried out by a combination of random sampling and quota sampling. Individuals or households were randomly taken from the register in each constituency until the quota for each racial group was met.

A contact letter from the project investigators and a supporting letter from the Dean of Nanyang Business School, Nanyang Technological University (NTU), were sent to each individual or household, requesting participation in the study. This was followed by telephone calls if a telephone number for the selected respondent could be found in the telephone directory. Otherwise, site visits were made to elicit consent. If a subject agreed to participate, arrangements were made for a face-to-face interview. A subject was given up if contact could not be established after at least five telephone calls or two site visits spanning a period of three weeks.

Interview instruments developed at McMaster University in Canada were adapted for this study. These instruments have been successfully used in a number of similar studies[5, 11, 12]. Their use allows a comparison of functional status and health state preferences among different populations. The instruments included written interview manuals and props to help respondents describe their own health status and compare different health states. The interview manuals contained detailed explanations and instructions for each step of the interview and emphasised the importance of phrasing each question consistently to ensure consistency of data. The adaptation of the instruments included modifications of questions to account for cultural and language differences. The adapted instruments were translated to Chinese and Malay. The translations were tested extensively for their accuracy.

Interviews were conducted by 30 final-year students at Nanyang Business School between July and November 1996. The interviewers were recruited and trained by the project investigators over a period of three months. The training included discussions of study and interview procedures, followed by trial interviews with peer interviewers and NTU lecturers. A pilot study was conducted at the final stage of the training period. Feedback from the trial interviews and the pilot study was used to assess the progress of training as well as to improve the interview instruments. The data from the pilot study were not included in the results reported in this paper. The interviewers were organised in ten groups of three and households were randomly assigned to each group.

For the health status measurement task, the interviewer first explained the MAHSC system and its use to describe a person's health to the respondent. The respondent was then presented with a card with the detailed descriptions of the attribute levels as shown in Table I, for each of the eight single attributes. The respondent was asked to read the descriptions of the functional levels and select the one that most appropriately described his/her ability on that attribute. After describing his/her own health on all the eight attributes, the respondent was asked to describe the health status of each family member in the same way. Respondents were allowed to discuss his/her assessment with family members. If necessary, the questionnaire could be returned by mail at a later date in a self-addressed envelope provided by the interviewer.

RESULTS

Contact letters were sent to a total of 829 households out of 1,000 households due to time constraint. Among them, 326 were not contactable within a three-week consecutive period, 50 were considered to be ineligible due to language and other barriers and 210 refused to be interviewed. A total of 243 households were interviewed. This represents a response rate of 53.6% of the contacted and eligible households.

Health status measurements were obtained for a total of 981 individuals. This group of individuals closely represented the target population. The respondents consisted of 432 (44.13%) Chinese, 297 (30.34%) Malays, 242 (24.72%) Indians and 8 (0.82%) Others. The proportions for the three major ethnic groups are very close to the designed proportions. The sample also closely resembled the actual Singaporean population in other demographic aspects such as gender, age, marriage status, etc. For example, the sample contained 495 (50.5%) males and 486 (49.5%) females; 291 (30.2%) who were 20 years old or younger, 504 (50.2%) between the ages of 20 and 50, and 170 (17.6%) above 50; 508 (51.8%) were married, 462 (47.1%) were single, and 11 widowed or divorced (1.1%). These proportions are very close to the proportions of the actual population[17]. It is noted that 2 respondents did not report their race and 16 respondents refused to

disclose their age. These respondents were excluded from the respective calculation above.

General functional status of the population

A total of 179 different health states were reported by 981 respondents in the survey. Table II lists the top 11 health states that were reported by at least ten respondents. Because the sample does not have the same ethnic composition as the actual Singaporean population, the frequencies (%) reported by the sample were then adjusted by the actual ethnic composition reported from the last Singapore census of population[17] to estimate the proportion of the Singaporean population in each health state. The frequencies (%) reported by the sample and the adjusted frequencies (%) for the population are provided in the last two columns of Table II.

According to the survey, about 70% of the Singaporean population is in the top eleven health states. In particular, about 28.58% of Singaporeans are in perfect health and 17.97% of Singaporeans have level 2 of vision (wearing glasses or contact lens) and normal functioning on every other attribute. The commonly reported deficiencies are level 2 of vision, level 2 of emotion, level 2 and level 3 of cognition, and level 2 of pain.

The results from our survey are compared similarly with results from some large national health surveys. Table III lists the five most common health states and their frequencies reported in the 1991 Canadian General Social Survey[18]. The Canadian national health survey reported 29.72% of Canadians being in perfect health, which is slightly higher than the proportion of Singaporeans being in perfect health obtained in our survey. The second most common health state in both surveys has level 2 of vision (wearing glasses or contact lens) and normal functioning on every other attribute. The reported frequency of this health state for the Canadian population was 22.05%, while the estimated frequency of this health state for the Singapore population is 17.97%. The major difference observed by comparing the results from the two surveys is that a higher proportion of the Singaporean population reported to be in a health state with pain than the Canadian population. Results similar to the Canadian national health survey have been reported in other health surveys[20].

For individual attributes, we divided the eight attributes into two groups: (i) five attributes of seeing, hearing, speaking, walking, and dexterity; and (ii) three attributes of feelings, cognition, and pain. Group one represents a person's capacities in using the eyes, ears, mouth, legs and feet, and hands and fingers, respectively. They are the "hard" dimensions of health of which the performance level can be measured objectively. Group two represents a person's "soft" dimensions of health of which the performance level can only be measured subjectively. The "soft" attributes are used to assess a person's emotional, cognitive and morbidity aspects of life. Table IV displays the reported frequencies on levels of each attribute from the sample. Note that the total number of respondents for some attributes is smaller than 981 because of missing data or undefined cases. (For example, a respondent completely lost one eye (ear) but had normal vision (hearing) from the other.) Similar to Table II, the reported frequencies by the sample have been adjusted by the actual ethnic composition to obtain the frequencies for the population.

The Singaporean population has near perfect functional status on the "hard" attributes except for the attribute of seeing. It is estimated that only 4.83%, 8.67%, 3.80% and 2.36% of the population has a deficiency (a level higher than level 1) on the attributes of hearing, speaking, walking and dexterity, respectively. However, high deficiency rate was reported on the attribute of seeing. It is estimated that 49.41% of the population have perfect vision, 46.98% of the population have vision deficiency correctable with glasses or contact lens, and 3.62% of the population has either long-sighted or short-sighted vision problems that are not correctable with glasses or contact lens. No blindness was reported in the survey.

A relatively high percentage of deficiency was reported on all the three "soft" attributes. For the feelings attribute, 73.01% of the Singaporean population was estimated to be happy and interested in life, 23.41% only somewhat happy, 3.27% somewhat unhappy, 0.31% very unhappy and 0.18% so unhappy that life was not worth living for. For the cognition attribute, 72.98% of the population was estimated to be able to perform normally, 13.55%

Table II – Population health status by health state

No.	Health state (V, H, S, W, D, E, C, P)	Frequency	Percentage (sample)	Percentage (population)
1	(1, 1, 1, 1, 1, 1, 1, 1)	323	32.93	28.58
2	(2, 1, 1, 1, 1, 1, 1, 1)	158	16.11	17.97
3	(2, 1, 1, 1, 1, 1, 1, 2)	43	4.38	4.87
4	(2, 1, 1, 1, 1, 2, 1, 1)	33	3.36	3.94
5	(1, 1, 1, 1, 1, 2, 1, 1)	32	3.26	3.74
6	(1, 1, 1, 1, 1, 1, 1, 2)	27	2.75	3.13
7	(1, 1, 1, 1, 1, 1, 2, 1)	20	2.04	1.64
8	(2, 1, 1, 1, 1, 1, 3, 1)	16	1.63	2.31
9	(2, 1, 1, 1, 1, 2, 1, 2)	14	1.43	1.48
10	(2, 1, 1, 1, 1, 1, 2, 2)	11	1.12	1.28
11	(1, 1, 1, 1, 1, 2, 1, 2)	11	1.12	0.98
Total		687	70.17	69.94

Table III – The five most common health states reported in the 1991 Canadian General Social Survey

No.	Health state (V, H, S, W, D, E, C, P)	Frequency (000's)	Percentage
1	(1, 1, 1, 1, 1, 1, 1, 1)	6079.8	29.72
2	(2, 1, 1, 1, 1, 1, 1, 1)	4510.9	22.05
3	(2, 1, 1, 1, 1, 1, 3, 1)	829.7	4.06
4	(1, 1, 1, 1, 1, 2, 3, 1)	808.3	3.95
5	(1, 1, 1, 1, 1, 2, 1, 1)	787.4	3.85

Table IV – Population functional status by individual attribute

Level	1	2	3	4	5	6	Total
Seeing							
Frequency	535	404	25	9	5	0	978
%	49.41	46.98	2.70	0.73	0.18	0.00	100.00
Hearing							
Frequency	937	29	4	5	1	1	977
%	95.17	3.71	0.57	0.47	0.05	0.03	100.00
Speaking							
Frequency	901	60	16	1	1	N/A	979
%	91.33	6.87	1.44	0.18	0.18		100.00
Walking							
Frequency	945	25	6	3	0	0	979
%	96.20	2.75	0.65	0.41	0.00	0.00	100.00
Dexterity							
Frequency	949	25	2	2	1	0	979
%	97.64	2.03	0.06	0.10	0.18	0.00	100.00
Feelings							
Frequency	729	213	32	3	1	N/A	978
%	73.01	23.41	3.27	0.12	0.18		100.00
Cognition							
Frequency	738	127	91	19	3	0	978
%	72.98	13.55	10.99	2.08	0.41	0.00	100.00
Pain							
Frequency	695	216	57	7	3	N/A	978
%	70.88	23.37	5.10	0.56	0.09		100.00

have a little difficulty in coping with everyday problems, 10.99% somewhat forgetful, 2.08% somewhat forgetful and have a little difficulty in coping with everyday problems, and 0.41 % very forgetful and have a little difficulty in both thinking and memory. For the pain attribute, 70.88% of the population was estimated to have no pain or discomfort, 23.37% have mild to moderate pain that prevents activities, 5.10% have moderate pain that prevents some activities, 0.71% have moderate to severe pain that prevents some activities, and 0.64% have moderate to severe pain that prevents most activities.

Demographic factors and health status

Information was collected on the following demographic and socio-economic factors: age, race, education, occupation, gender, marital status, and household income. Because the health status measurements are categorical, the association of these factors with a person's health status is difficult to analyse. Some preliminary results by using analyses of variance (ANOVA) on the number of deficiencies and tests of homogeneity on the proportions of respondents on the levels of each attribute among different demographic groups[21] are reported in this paper. Only the three major ethnic groups were used in statistical analyses with the racial factor because there were only 8 respondents of other races.

An ANOVA was first conducted on the number of deficiencies. The number of deficiencies is defined as the number of attributes on which a respondent reported a functional level less than normal or higher than level 1. Table V displays the results of the analysis. A significant effect on the number of deficiencies, at the significance level of 1%, was detected for age, household income, and race.

A significant ageing effect is expected because of the human ageing process. Table VI shows the percentage of respondents who reported perfect functioning (level 1) on each attribute in different age groups. It can be observed that the percentage of respondents with perfect functioning on each attribute decreases as age increases.

Some details of the results appear to be worthy of emphasis. The percentage of perfect functioning decreased at different rates and in different patterns for different attributes. This implies that the human ageing process acts differently on different attributes. This information is very important for the understanding of the health care needs of a population and the planning of health care services. In general, it seems that the health status on the "soft" attributes deteriorates faster than the health status on the "hard" attributes except vision. For the vision attribute, the percentage of perfect eye sight had two dramatic decreases: one at the schooling stage (8 to 24 years) and one at the late middle-age stage to early elderly stage (45 to 64 years). The functional deterioration on the other four "hard" attributes occurred mostly at the elderly stage (> 64 years).

For the three major ethnic groups, Malay respondents reported a significantly lower average number of deficiencies (0.97) than the Chinese respondents (1.63) and the Indian respondents (1.65). It is noted that this evidence may not necessarily imply that one racial group is healthier than another because the number of deficiency is not an established overall measurement of health status. With the current state of knowledge, no globally accepted single index has been established for health status measurement. To examine the racial differences in health status, it is worthwhile to examine the functional status on each attribute for the three ethnic groups. Table VII shows the reported frequencies on the levels of each attribute by the three major ethnic groups.

A test of homogeneity was performed for each attribute, in which a level was combined to the next (higher) level if the expected frequency was less than 5. The reported proportions are significantly different, at the significance level of 1%, for the attributes of vision ($p < 0.0001$), feelings ($p < 0.0001$), cognition ($p = 0.0003$), and pain ($p < 0.0001$). For the vision attribute, the difference was due to the number of people wearing glasses or contact lens. The Chinese group had the highest proportion of respondents wearing glasses or contact lens, followed by the Indians and then the Malays. For the three "soft" attributes, Malay respondents reported consistently the highest percentage on level 1 functioning among the three groups. Because the assessments on the three "soft" attributes were subjective, the detected differences might imply some difference in the perception of health among the three groups. Further research is needed to investigate this issue.

For the household income factor, Table VIII displays the reported percentage of perfect functioning on each attribute for different

Table V – ANOVA for the number of deficiencies

Source of variation	SS	DF	MS	F	p-value
Covariates	174.494	1	174.494	119.943	0.000
Age	174.494	1	174.494	119.943	0.000
Main effects	123.823	23	5.384	3.701	0.000
Education	5.978	7	0.854	0.587	0.767
Gender	1.260	1	1.260	0.866	0.352
Income	29.097	6	4.849	3.333	0.003
Marriage	2.630	1	2.630	1.808	0.179
Occupation	10.478	6	1.746	1.200	0.304
Race	52.361	2	26.180	17.996	0.000
Explained	565.155	24	23.548	16.186	0.000
Residual	1251.132	860	1.455		
Total	1816.287	884	2.055		

Table VI – Percentage of perfect functioning for various age groups

Age	Vision	Pain	Emo.	Cog.	Speak	Hear	Walk	Dext.
0 – 7	99.0	90.0	95.0	94.0	91.0	100.0	99.0	99.0
8 – 17	67.8	90.4	89.0	84.9	92.5	99.3	99.3	99.3
18 – 24	48.9	80.0	73.3	78.9	97.8	98.9	98.9	100.0
25 – 34	58.9	79.2	75.9	78.7	94.3	97.4	99.0	96.9
35 – 44	61.6	67.8	70.0	72.3	91.5	94.9	98.9	96.6
45 – 54	31.3	51.9	64.9	67.2	93.9	94.7	97.0	93.9
55 – 64	23.4	48.7	63.6	59.7	90.9	96.1	87.0	93.5
> 64	20.4	25.9	51.9	49.1	77.8	73.6	75.9	94.4

household income groups. A test of homogeneity was also performed on the proportions reported on the levels of each attribute. Significant differences, at the significance level of 1%, were detected for the attributes of vision ($p = 0.0001$), speaking ($p = 0.0004$), feelings ($p = 0.001$), cognition ($p = 0.008$), and pain ($p = 0.003$). In general, higher household income groups reported higher rates of vision deficiency. The reason for this phenomenon is not clear. It is felt that income and vision might be confounded with other factors such as education. For the other attributes, the lowest household income group (< $30,000) reported the highest rate of deficiencies in speaking, cognition, and pain. The causal relationship between physical health and income is difficult to assess. In other words, it is not clear whether income improves a person's physical health or poor physical health is a barrier to high income. Nevertheless, a person's mental health does not show the same pattern. For the feelings attribute, no pattern of association was observed between income and happiness level. Rich people were not necessarily happier or less happy than others.

For the other demographic factors, tests of homogeneity detected no significant gender effect for any of the eight attributes. The marriage factor is confounded with the age factor because unmarried people were younger. Occupation had a significant effect only on vision ($p = 0.0011$), for which professionals reported a higher percentage of vision deficiency (wearing glasses or contact lens) than others. For the education factor, tests of homogeneity excluding pre-school children detected a significant effect on vision ($p < 0.0001$), speaking ($p = 0.004$), cognition ($p < 0.006$) and pain ($p = 0.01$). Table IX displays the reported percentage of perfect functioning for different educational groups. In general, respondents with a university education reported higher percentage of wearing glasses or contact lens. However, respondents with low education reported more serious vision problems that were not correctable with glasses or contact lens. Respondents with little or no formal schooling also reported higher deficiency rate in speaking and cognition and higher level of pain.

CONCLUSION AND DISCUSSION

In summary, an ordinary Singaporean has a 28.58% chance of being in perfect health, a 17.97% chance of being in perfect health except for a need to wear glasses or contact lens, and a 53.45% chance of having some other deficiency on one or more attributes. These percentages are similar to results obtained from national health surveys in Canada and the United States. The respondents in our sample reported deficiencies on the eight attributes in the order of vision (50.59%), pain (29.12%), cognition (27.02%), feelings (26.99%), speaking (8.67%), hearing (4.83%), walking (3.80%) and dexterity (2.36%).

Statistical analyses were used to assess the relationship of socio-economic and demographic factors and a person's health status. Age was found to be the most important factor that affected an individual's health status. The ageing process acted in different capacity on each attribute of health. Patterns in which age affected a person's health status on each attribute were obtained from the survey. For the other socio-economic and demographic factors, serious problems on the attributes of vision, hearing, speaking, walking and cognition were reported being associated with low household income and education level. Respondents with low household income and/or education level also reported more problems in memory and thinking, and pain.

Measures of health status are often used for one of three main purposes: discrimination, evaluation or prediction[11, 21-22]. Discriminative measures are used to distinguish differences in health status within and between populations. Evaluative measures are used to assess changes in health status over time. Predictive measures are used for prognostic purposes. The HUI approach is most appropriate for the discriminative and evaluative purposes. The information obtained from this and other similar studies could be used to distinguish different health-care needs among different demographic and cultural groups. For example, the current study revealed that people with low household income and education level have greater need than other

Table VII – Attribute functional status for the three ethnic groups

Level	1	2	3	4	5	6	Total
Seeing							
Chinese	197(45.6)	221(51.2)	12(2.8)	2(.4)	0(.0)	0(.0)	432
Malay	198(66.9)	84(28.4)	9(3.0)	3(1.0)	2(.7)	0(.0)	296
Indian	136(56.2)	96(39.7)	4(1.7)	3(1.2)	3(1.2)	0(.0)	242
Hearing							
Chinese	408(94.7)	18(4.2)	3(.7)	2(.4)	0(.0)	0(.0)	431
Malay	286(96.6)	8(2.7)	0(.0)	1(.3)	1(.3)	0(.0)	296
Indian	235(97.1)	3(1.2)	1(.4)	2(.8)	0(.0)	1(.4)	242
Speaking							
Chinese	392(90.7)	32(7.4)	6(1.4)	1(.2)	1(.2)	N/A	432
Malay	277(93.3)	16(5.4)	4(1.4)	0(.0)	0(.0)		297
Indian	224(92.6)	12(5.0)	6(2.5)	0(.0)	0(.0)		242
Walking							
Chinese	414(95.8)	13(3.0)	3(.7)	2(.5)	0(.0)	0(.0)	432
Malay	292(98.3)	3(1.1)	1(.3)	1(.3)	0(.0)	0(.0)	297
Indian	231(95.5)	9(3.7)	2(.8)	0(.0)	0(.0)	0(.0)	242
Dexterity							
Chinese	423(97.9)	8(1.9)	0(.0)	0(.0)	1(.2)	0(.0)	432
Malay	290(97.6)	5(1.7)	0(.0)	2(.7)	0(.0)	0(.0)	297
Indian	228(94.2)	12(5.0)	2(.8)	0(.0)	0(.0)	0(.0)	242
Feelings							
Chinese	306(70.8)	110(25.5)	15(3.5)	0(.0)	1(.2)	N/A	432
Malay	258(86.9)	33(11.1)	4(1.3)	2(.7)	0(.0)		297
Indian	157(65.2)	70(29.1)	13(5.4)	1(.4)	0(.0)		241
Cognition							
Chinese	305(70.6)	62(14.4)	53(12.3)	10(2.3)	2(.4)	0(.0)	432
Malay	250(84.2)	27(9.1)	19(6.4)	1(.3)	0(.0)	0(.0)	297
Indian	175(72.6)	37(15.8)	19(7.9)	8(3.3)	1(.4)	0(.0)	241
Pain							
Chinese	304(70.4)	104(24.1)	22(5.1)	2(.4)	0(.0)	N/A	432
Malay	236(79.5)	52(17.5)	6(2.0)	3(1.0)	0(.0)		297
Indian	151(62.7)	56(23.2)	29(12.0)	2(.8)	3(1.2)		241

Table VIII – Percentage of perfect functioning for various household income groups

Income	Vision	Hear	Speak	Walk	Dext.	Emo.	Cog.	Pain
< 30K	61.7	95.5	87.3	96.6	96.9	73.9	68.3	64.9
30K – 60K	56.6	95.8	94.8	97.6	97.2	74.8	79.7	78.0
60K – 90K	50.3	95.3	91.9	99.3	98.0	77.2	77.2	70.5
90K – 120K	44.6	98.2	100.0	91.1	98.2	83.9	78.6	73.2
120K – 150K	43.6	97.4	100.0	100.0	100.0	71.8	87.2	87.2
150K – 180K	22.2	88.9	88.9	88.9	100.0	88.9	77.8	77.8
> 180K	29.7	100.0	91.9	83.8	89.2	37.8	75.7	54.1

Table IX – Percentage of perfect functioning for various educational groups

Education	Vision	Hear	Speak	Walk	Dext.	Emo.	Cog.	Pain
No/Lower Pri.	53.8	93.8	87.4	95.3	95.2	75.7	66.8	65.9
Primary	39.4	93.6	91.5	92.6	94.7	63.8	69.1	59.6
Lower Sec.	62.3	95.6	95.6	99.1	99.1	76.7	77.2	66.7
Secondary	49.8	94.0	89.2	94.4	96.9	69.2	71.3	70.3
Post Sec.	52.8	98.1	96.2	97.2	99.1	72.6	75.5	75.5
Diploma	46.7	100.0	98.3	98.3	93.3	76.7	78.4	75.0
Degree	31.8	97.8	96.6	100.0	97.7	69.3	85.2	73.9

groups for support to cope with serious health problems.

The HUI approach adopts a relatively narrow "within the skin" definition of health status that focuses on physical and emotional aspects of health status and excludes social interaction that is taking place "outside the skin". This focus facilitates the development of a system to measure people's preferences of different health states. At the same time, it restricts its applicability to the measurement of health-related quality of life, as opposed to more general concepts of quality of life that are implicated when social interaction and other "outside the skin" phenomena are included. Additional attributes may be added to the HUI Mark III system depending on the study objective and health status information available. Past research has identified other potential attributes for measurement of health status[26]. However, in addition to the fundamental issues involved in selecting a definition of health status, other measurement (eg., ease and mode of administration, burden to respondents, acceptability to respondents and cultural relevance of the concept of health status) and methodological (eg., reliability, validity and responsiveness) issues have to be considered when adding new attributes to the system.

The HUI approach is a generic health status measure which is broadly applicable across types and severity of disease, across different health interventions and across demographic and cultural sub-groups[27]. The measurement and methodological issues of the approach has been extensively discussed[11,32]. The approach has also been used in a number of clinical evaluative and population health survey studies[14-16, 28-31]. However, because this is probably the first attempt to apply the approach in an Asian country, two steps have been taken to investigate the reliability and validity of the scale. First, lecturers in economics, psychology, management and other disciplines were asked to be judges in a preliminary study. They were first interviewed by a student interviewer and then approached by a project investigator to discuss the methodological issues. The instruments were revised until the judges gave their consensus on the methodological issues of the instrument. Second, a follow-up study was carried out to the respondents nine months after the main study. The time horizon was chosen so that it would be long enough for the respondents to forget their previous responses and short enough so that no major changes would occur for most respondents on most attributes. The analysis revealed that there was no significant difference between responses for the attributes except vision and emotion[33]. This is considered as a further evidence for the reliability of the scale. Further study is taking place to test the validity and reliability of the preference measurement system.

There are some limitations in this study that should be noted. First, the observations reported in this paper were based on a random sample of less than 1,000 respondents. Although the sample was verified to be representative of the target population, the sample size is small particularly when the results were compared with results from other national health

surveys. Second, the statistical analyses in this study were limited to identifying differences among different demographic groups. Because each factor was considered separately, it does not provide a complete analysis of the influence of different demographic factors on a person's functional status. A complete analysis is difficult because the level on each attribute is categorical. Finally, the study does not provide an analysis on the causal relationship between the demographic factors and a person's health status. For example, respondents with no or little education and low household income reported higher deficiency in the physical aspects of health as well as cognition and pain. But it is not clear if poor health is a cause of low social-economic level or vice versa.

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