Trend in health-related quality of life and health utility and their decrements due to non-communicable diseases and risk factors: analysis of four population-based surveys between 1998 and 2015

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Abstract

Purpose

To revisit the population norms of health-related quality of life (HRQoL) and health utility for Hong Kong general population, compare these scores over past health surveys, and assess the association of scores with non-communicable diseases (NCDs) and their risk factors.

Methods

HRQoL data measured by the standard Short Form 12 Health Survey-version 2 (SF-12v2) were extracted from the surveys in 1998, 2003/2004, 2008/2009 and 2014/2015. SF-12v2 data were mapped to Short-form 6-dimension (SF-6D) preference-based measure to generate the health utility scores. Population weighting based on the sex, age and type of accommodation in the second quarter of 2015 was applied when generating population normative values. Linear regression models were fitted to assess the effect of the number of NCDs and modifiable lifestyle factors on HRQoL and health utility.

Results

The general population mean scores of SF-12v2 domains and SF-6D in 2014/15 were greater compared to past surveys. Linear increases in General Health, Vitality and Mental Health domains were observed from 1998 to 2014/15. More doctor-diagnosed NCDs, insufficient physical activity and fruit/vegetable consumption, poor sleep quality and insufficient or excessive amount of sleep (<6/≥10 hours) were all associated with worse physical- and mental-related HRQoL and health utility.

Conclusion

This study compared HRQoL and health utility in the Hong Kong general population derived from multiple surveys and found an improving trend over twenty years. More NCDs were associated with worse HRQoL. It is suggested that promoting adequate physical activity, consumption of fruit/vegetable and 6-9 hours of sleep could improve public health.

Keywords: Population norm; Health-related quality of life; Health utility; Hong Kong Chinese population; Non-communicable disease

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Introduction

Health-related quality of life (HRQoL) has been defined as an individual's self-perceived assessment of their health and how it impacts their ability to live a fulfilling life [1-3]. More specifically, HRQoL is a multidimensional construct as it refers to functioning based on physical, social and emotional well-being [1]. Reference values, or population norms, for HRQoL are directly elicited using standardised instruments in population health surveys, and thus facilitate the normative score comparisons for evaluating the clinical significance of healthcare and policy interventions [4]. Normative comparisons also enable the assessment of the burden of certain health conditions, particularly non-communicable diseases (NCDs). Furthermore, such comparisons can lead to the identification of various sociodemographic and clinical subgroups that deviate considerably from normative scores [5]. Local normative data support not only within-country normative comparisons but also comparisons between countries, regions and ethnic groups. These comparisons enhance health knowledge and inform healthcare policies related to inequities at both the local population and inter-regional levels [6].

The administration of generic multi-attribute utility instruments, such as EuroQol 5-dimension and Short-form 6-dimension (SF-6D), enable the gathering of response options covering severity levels of each dimension within a health state classification system [7]. The application of country-specific scoring algorithms can estimate the health utility scores based on each response option of the multi-attribute utility instrument, which can serve as health effectiveness input to quality-adjusted life-years outcomes in health economic evaluations [7]. With the validated SF-6D scoring algorithm available in Hong Kong, data from the 36-item Short Form Health Survey (SF-36) and Short Form 12 Health Survey (SF-12) estimate SF-6D health utility scores informing health and healthcare policy [6]. The latest population norms for the SF-12v2 and SF-6D applicable to Chinese populations have been published using a telephone survey conducted in 2008/09 [8] and 1998 [9] respectively, which were between one to two decades ago. The historical normative comparisons of HRQoL and health utility data are therefore of great concern.

In sum, the analysis of population-based representative data can provide strong estimates that can be used to assess disease burden as well as inform healthcare and policy planning at the

population level. The primary aim of this study is to generate new HRQoL and health utility population norms based on an updated and representative sample obtained from the Hong Kong Population Health Survey 2014/15 (PHS 2014/15) and compared the values to previous results. Additional aims of this study include identifying the sociodemographic and modifiable lifestyle factors HRQoL and health utility scores and evaluating any decrements associated with HRQoL and health utility specifically due to the presence and number of NCDs for reference in studies of health evaluation and health economics.

Methods

Study design and sampling

2014/15 data was sourced from the PHS 2014/15. The PHS 2014/15 is a cross-sectional population-based study conducted by the Department of Health of the Government of the Hong Kong Special Administrative Region between 2014 and 2015. Systematic replicated sampling was applied to select a sample that covered all the land-based non-institutional population (aged ≥15 years) but excluded foreign domestic helpers and visitors [10]. A total of 5,435 of 7,205 households were interviewed, which gave a household response rate of 75.4%. Of the recruited households, 12,022 individuals completed a comprehensive, self-administered questionnaire that included sociodemographic information and measures of HRQoL, health status and lifestyle factors. The data in 2003/04 were collected from the Population Health Survey 2003/04 (PHS 2003/04) [11], a previous version of PHS 2014/15. A similar recruitment approach and subject inclusion criteria of PHS 2014/15 were adopted in PHS 2003/04.

The data in 1998 and 2008/09 were collected from various cross-sectional telephone surveys and details can be found in the previous publications [8,9,12]. Random digit dialing or randomly selection of household telephone number from residential telephone directories was performed to recruit one member who was Chinese and ≥18 years in each household.

Weighting conversion to general population

To estimate the HRQoL and health utility scores in general Hong Kong population in the 2014/15, weighting was applied to the PHS 2014/15 survey data. The weighting factors compiled by the Census & Statistics Department were allocated according to the age group, gender and the type of accommodation of each respondent. The distribution of age group, gender and type of accommodation of respondents after applying weighting conversion are the same as that of Hong Kong population in the second quarter of 2015. The population

distribution in the second quarter of 2015 was referred since it is the latest version available when the PHS 2014/15 was conducted in 2016 [10].

Study instruments

SF-12-version 2 (SF-12v2)

The Chinese (Hong Kong) standard SF-12v2 was administered to measure HRQoL. Across the four surveys, the SF-12 survey items were listed after the demographic information, followed by the self-reported NCDs. This 12-item questionnaire measures eight domains of HRQoL - physical functioning (PF), role physical (RF), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotion (RE) and mental health (MH). Each domain score ranges from 0 to 100. The eight domain scores are aggregated based on standardized weights and norm-based on the mean and standard deviation of the Hong Kong population weights to calculate two summary scores: the physical component summary (PCS) and mental component summary (MCS). A higher domain or summary score indicates better HRQoL. The standard SF-12v2 has been validated for use in the Hong Kong general population [13,14]. Population weighting was applied when generating the new normative values standardized population normative values [10].

As the PHS 2003/04 included the standard SF-12-version 1 (SF-12v1), allocations had to be performed on 7 of the 12 items (items 4, 5, 6, 7, 9, 10 and 11) due to the differences in the survey items between the two versions (SF-12v1 and SF-12v2). For items 4-7, responses of SF-12v1 were allocated to SF-12v2 by the self-reported general health status item (item 1), while random allocations were done for items 9-11. Further details of the allocation are listed in Supplementary Material 1 and assessment of reliability and consistency of the conversion method on PCS and MCS are shown in Supplementary Material 2. In brief, high reliability and consistency are observed for the conversion method from SF-12v1 to SF-12v2 on PCS and MCS.

SF-6D

The SF-6D was administered to evaluate health utility. This measure assesses six health subscales, including PF, RL, BP, VT, MH and SF. The EuroQol 5-dimension and Health Utility Index are other common instruments to evaluate health utility, yet the validated scoring method of the two instruments were not available for Hong Kong Chinese population when the data was collected [15,16]. Population norms of SF-6D scores were derived from the SF-36v1, SF-

36v2 and SF-12v2, which were administered in 1998, more than two decades ago [9]. The SF-6D has been found to be acceptable, reliable and valid when tested among the Hong Kong general population [9].

In this study, the SF-6D score was mapped from responses to the standard SF-12v2. A total of 7 out of 12 responses (items 2, 5, 6, 8, 10 11 and 12) from standard SF-12v2 were transformed to values in each SF-6D domain, based on the specific algorithm for the Hong Kong population [17,18]. The SF-6D scores were calculated by the sum of the 1 (best health state), values deducted in each domain and additional deduction if applicable. From this algorithm, the SF-6D score of each individual ranges from 0.315 (worst health state) to 1 (best health state) [17,18]. The mapping algorithm is listed in Supplementary Material 3.

NCDs and related risk factors

The doctor-diagnosed NCDs were reported by survey respondents in the PHS 2014/15. The detailed list of diseases analyzed in this study is shown in Supplementary Table 1. For the HRQoL and health utility due to co-morbidity, simple counts of NCDs were adopted as this is one of the most commonly used measures of co-morbidity in healthcare research [19]. NCD risk factors consist of lifestyles including smoking, drinking, physical activity, fruit/vegetable consumption, eating out habits, sleep quality, sleeping hours and with/without regular medical check-up. Eating out habits are considered to reflect the salt intake level and risk of developing NCDs [10]. Furthermore, eating out can also be viewed as an indicator of ability to move around as well as social cohesion level. Sociodemographic variables, including gender, age, marital status, highest educational level attained, employment status, living quarter type and monthly household income, were considered as confounding factors which affected the HRQoL and health utility.

Statistical analysis

Descriptive statistics, i.e. mean and standard deviation (SD) for continuous factors and proportion (%) for categorical factors, were used to describe the sociodemographic characteristics of the samples as well as PCS, MCS of SF-12v2 and SF-6D scores.

To estimate the new population norms of SF-12v2 and SF-6D scores, population weighting was applied to the sample scores in order to estimate the results with respect to 2014/15 Hong Kong population. After applying the population weighting, the population norms of SF-12v2

and SF-6D should reflect the HRQoL and health utility of Hong Kong citizens aged 15 or above (n = 6,080,200) in the second quarter of 2015 [10]. Comparisons of sample domain scores of SF-12v2 and SF-6D across different years were assessed by independent t-tests and the magnitude in change were checked by effect size [20]. The effect sizes were categorized as small (magnitude≥0.2), medium (magnitude≥0.5) and large (magnitude≥0.8) by Cohen [21].

Subgroup analyses of impact of number of NCDs diagnosed on the HRQoL and health utility scores were performed. One-way analysis of variance test was applied to compare the mean scores within years. The effect of the number of NCDs and related risk factors on PCS, MCS and SF-6D health utility scores were explored by multivariable linear regressions with forced entry method, adjusted for socio-economic status. 39 respondents were excluded from the regression analyses due to the incomplete data on household income or frequency of fruit and vegetable consumption. Multicollinearity between independent variables was checked by the variation inflation factors. Since all the variation inflation factors were < 10, there does not appear to be a multicollinearity problem in this study. The goodness-of-fit of the regression models were measured by root mean square error (RMSE) and coefficient of determination (R^2).

No strategies and imputations on missing data were applied in light of full data completion of socio-demographic information, HRQoL and health utility scores. All analyses were performed using Stata Version 13.0 (StataCorp LP. College Station, Texas, US). P-value < 0.05 were considered as statistically significant in this study.

Results

Table 1 presents the participant characteristics in both sample level and estimated 2014/15 population in PHS 2014/15. Of the 12,022 respondents, 47.1% (n=5,665) were men and 52.9% (n=6,357) were women. The mean (SD) age of the sample was 47.2 (18.5) years. Due to the small effect sizes compared to the Hong Kong general population, the sample data is estimated to be representative after applied the population weighting. After adopting the population weighting, the sample represents 6,080,200 Hong Kong citizens, of which 47.6% were female with a mean (SD) age of 46.7 (18.2) years. Supplementary Table 2 displays the sex-age distribution of survey respondents in 1998, 2003/04, 2008/09 and 2014/15. The majority of the effect sizes compared to the PHS 2014/15 are <0.2, indicating that the difference of sex-age distribution between the surveys and 2014/15 are very small. However, the effect size on age

between 2003/04 and 2014/15 is 0.23, which means that there is a minor difference on the age distribution between two surveys.

Supplementary Table 3 illustrates the new population norm updated as 2014/15 and mean scores of SF-12v2 domain and summary scales and SF-6D utility across different years. Figure 1 provides a pictorial display of the sampled SF-12v2 domain scores and SF-6D health utility scores at different time points. A linear increasing trend was observed especially in VT, GH and MH domains when time pasts, while V-shape was observed in other domains and health utility. PCS scores were similar across different years (all effect sizes<0.2), but MCS score was the highest in 2014/15. Besides, it was also observed that health utility and most of the domain scores (all effect sizes<0.2 except PF, BP and SF) were the highest in 2014/15, indicating that the Hong Kong population was healthiest compared to other time points. Table 2 displays the sex-age specific HRQoL and health utility scores in 2014/15. All the SF-12v2 domain, summary and SF-6D scores were higher for male and young respondents in both the sample level and estimated 2014/15 population, meaning that male and respondents with smaller ages had a better quality of life and utility in 2014/15.

The HRQoL and SF-6D scores classified by the number of NCD are shown in Supplementary Table 4. When compared with the eight domains in SF-12v2, PCS and MCS, mean scores of all domains were the highest for individuals without any NCDs and decreased significantly as the number of NCDs increased ($p<0.001$) in both 1998 and 2014/15. The mean health utility score greatly increased with respect to the decreasing number of NCDs (Mean±SD: 0.84±0.11, 0.80±0.13, 0.77±0.14 and 0.69±0.16 in 1998; 0.90±0.11, 0.86±0.13, 0.84±0.15 and 0.76±0.18 in 2014/15 for 0, 1, 2, 3 or more NCDs respectively).

Figure 2 depicts the forest plot of scores of PCS, MCS and SF-6D by type of NCD with population weighting. As shown, the scores of SF-6D, PCS and MCS were substantially lower for individuals who suffered from neurological disease (SF-6D=0.68), stroke (PCS=34.8) and any mental illness (MCS=39.5) respectively. The detailed results are displayed in Supplementary Table 5.

Table 3 presents the relationship between socio-economic status and lifestyles with HRQoL. It was observed that the PCS (β=0.50, p=0.001) and SF-6D scores (β=0.006, p=0.017) in men were significantly higher than women. The PCS (β=-0.13, $p<0.001$) and SF-6D scores (β=-

0.001, p<0.001) of respondents declined with increasing age, while score of MCS (β=0.02, p<0.001) rose as age increased. In terms of marital status, individuals who had never married or who were widowed, had lower PCS (β=-0.70, p<0.001; β=-1.66, p<0.001) and SF-6D scores (β=-0.008, p=0.016; β=-0.017, p=0.001) than those who were married. Individuals who were divorced or separated also had lower MCS than those who were married (β=-0.89, p=0.009). The PCS (β=0.55, p=0.004), MCS (β=0.49, p=0.017) and SF-6D scores (β=0.010, p=0.003) of respondents with household income greater than the Hong Kong median were significantly higher than those with a household income of less than 50% of the Hong Kong median. In addition, respondents classified as active employees had higher scores in PCS (β=0.48, p=0.002) and SF-6D (β=0.008, p=0.004) than people who were not currently employed. The PCS, MCS and SF-6D scores of individuals with secondary education or above were higher than respondents with primary educational level or below. Moreover, for lifestyle risk factors, scores of MCS (β=-0.85, p<0.001) and SF-6D (β=-0.007, p=0.038) for current smokers were significantly lower than non-smokers. The scores of PCS and SF-6D of current drinkers and ex-drinkers were lower than non-drinkers. It was shown that insufficient physical activity and fruit/vegetable consumption significantly lowered the MCS (β=-0.64, p<0.001; β=-1.35, p<0.001) and SF-6D scores (β=-0.006, p=0.014; β=-0.022, p<0.001). It was also found that individuals had lower scores in all PCS, MCS and SF-6D in following scenarios: eating out less than 10 times per week, poor sleep quality, less than 6 hours or more than 9 hours sleep each day, and one or more NCDs. The RMSE of the models assessing PCS, MCS and SF-6D are 6.87, 7.35 and 0.12 respectively. The R^2 of the models on PCS, MCS and SF-6D are 0.332, 0.045 and 0.163 respectively.

Discussion

This study revisited the population norm of HRQoL and health utility in the Hong Kong general population using a large representative sample and compared the results to previous findings. We also examined the impacts of the presence of NCDs and lifestyle risk factors on HRQoL and health utility.

Our principal findings were an improvement in the HRQoL from the previous surveys to the current PHS 2014/15 survey. This improvement included most of the domains of the SF-12v2, and the health utility, indicating that the population health had generally improved over the past decades. A linear increase was observed in the GH, VT and MH while V-shape were observed in the other domains and health utility. A potential explanation for better scores in

GH and VT may be the promotion of physical activity, which was initiated in the 2000s [22] and 2009 [23] by the Hong Kong government. MH domain and MCS score were highest and increased in a large magnitude in 2014/15 compared to other years (effect sizes: 0.65-1.19). The possible reason might be the promotion of mental support across years in the community [24]. However, to our knowledge, there is no publication discussing the change in scores of SF-12v2 domains and health utility in a general population.

Compared to the previous population norm in 2008/09, similar results were found for age, sex, educational level and NCD status. As age increased, there were statistically significant decreases in PCS scores but increase MCS scores. Female respondents had lower PCS scores than males. There were no significant differences between genders for MCS. Lower educational level and self-reported NCDs were associated with lower PCS and MCS scores. However, respondents had similar PCS scores in 2008/09 regardless their marital status, but significantly higher PCS scores for married, divorced/separated and lower for widowed compared to single respondents in 2014/15. Married respondents were also found to have significantly higher MCS in 2008/09, but only divorced/separated respondents had lower MCS score in 2014/15 when compared with respondents who had never married. The possible reasons for this could be due to the difficulty of owning a property for couples [25,26], therefore the stress is much higher as a decrease in MCS score was found for married respondents [25,26]. Also, since the age at first marriage is increasing [27], the chance of remarriage might be less possible once divorced, which could result in a decrease in MCS scores when compared to previous results.

The PCS, MCS and health utility scores were studied by partitioning groups with different socioeconomic status and lifestyle factors. It was a common observation that men tended to rate their health and quality of life higher than women [8,12,28,29]. An increase in age was found to be associated with poorer physical and general HRQoL, however, it is important to note that emotional HRQoL improved as age increased, which is a positive finding and consistent with studies conducted in the United States and Spain [30,31]. A potential explanation for this finding was introduced in a previous study, which that found that emotional experience improved with aging [32]. The authors of this study suggested that, in line with socioemotional selectivity theory, older adults become more motivated to invest in emotionally meaningful goals and activities, maximize their psychological needs and become less reactive to daily events when compared with younger people [32]. A further finding from our study is

that participants with higher educational attainment reported better HRQoL, which was slightly different to that of our previous findings in 2008/09 as we found that the educational level only affected PCS but not MCS [8]. Similarly, in 2014/15, differences in marital status were also observed in that married participants would have better PCS, but not MCS, when compared with subjects who were never married, but a reverse result was obtained in 2008/09 [8]. A better HRQoL was observed with respondents with higher household income, which is consistent with findings from studies conducted in northeast China [33] and Singapore [34], but only for men in the United Kingdom [35] and Japan [36].

For the modifiable factors, current smokers were found to regard themselves as having poorer mental HRQoL, while current drinkers reported worse physical HRQoL. Furthermore, a significant drop of quality of mental and general health was observed for individuals with inadequate physical activities and fruit/vegetable consumption. Though a decrease in physical HRQoL was associated with insufficient physical activities and fruit/vegetable consumption, the effect was found to be insignificant in PCS score. These results are slightly different from other studies, where it was found that better HRQoL was significantly associated with more, and higher intensity of physical activity performed in France [37], Netherlands [38] and Norway [39], and sufficient fruit/vegetable consumption in the United Kingdom [40] respectively. This may be explained by cultural and environmental differences. As Hong Kong is a small and densely populated city, the majority of Hong Kong citizens rely on public transport, hence consistently walking could support their physical health [41]. In European countries, driving is more common compared to Hong Kong [42] and therefore more and higher physical activity level performed could be sensitive to the physical health status. The high walking level of Hong Kong citizens might also lead to a less protective effect of sufficient vegetable and fruit consumption on physical health compared to Europeans. In addition, poor quality and inadequate or excessive amounts of sleep (<6 or ≥ 10 hours) were associated with worse HRQoL, which is consistent with findings from France [43] and Australia [44]. It is crucial to tackle those modifiable factors (e.g. through health promotion campaigns) in order to improve population health.

A further important finding was that scores of PCS, MCS and health utility scores were associated with the number and type of NCDs. The results showed that individuals suffering from neurological diseases and stroke had relatively poor HRQoL and health status when compared with other NCDs. Meanwhile, people with liver disease and congenital blood

diseases (e.g. thalassemia, hemophilia) tended to report higher scores in PCS, MCS and SF-6D. It was observed that respondents with self-reported mental illness had impaired MCS scores but imposed modest effect on PCS. There are implications that our data could provide a benchmark to the HRQoL and health utility of different types of diseases, particularly rare diseases, such as cancer and neurological disease.

Strengths and limitations

In terms of strengths, this study provides updated HRQoL and health utility scores for the Hong Kong general population. This update will provide more accurate data for use in health evaluation and health economics research. In addition, HRQoL scores and health utility scores for certain diseases, such as cancer, were previously unknown but can now be referred to in future studies. Our study also had a high response rate of 75.4%. Household questionnaire survey fieldwork was performed by deploying systematic replicated sampling followed by adjustment on differential response, which makes the sample estimates representative of the population during the survey period by comparing the interpretability and consistency with the results conducted before. In addition, a high data completion was also achieved in the PHS with the respondents answering nearly all of the survey questions, including HRQoL and subject's covariates. Only 39 respondents (0.3%) refused to disclose their monthly household income, or did not know their consumption of fruit and vegetables, which was excluded in the analysis of the effect of socio-economics status and lifestyle factors on HRQoL. Nevertheless, 100% data completion on HRQoL was retained and therefore the population norm can be considered to be representative of the Hong Kong general population.

The findings of this study are subject to a number of limitations. First, data was self-reported, so it may be subject to bias as well as inaccuracies. Also, most respondents had obtained secondary education or above, which might affect the results by increasing the HRQoL scores. The results of SF-12v2 and SF-6D scores collected from questionnaires might vary as respondents could have various understandings and interpretations of questions that refer to feelings or ratings, and hence may bias the results. The results may also be affected by recall and non-response bias of NCD conditions collected from questionnaires due to the administration burden introduced by the length of questionnaire. Besides, surveys in 1998 and 2008/09 were conducted through telephone while PHS 2003/04 and 2014/15 were conducted through self-administered questionnaire, response bias may exist due to the different perception of the questions [45]. In addition, impact of acute health conditions on HRQoL and health

utility were not accessed in this study, which will be required for further studies. Last but not least, for the comparison of SF-12 scores across different years, it has to be noted that the survey in 2003/04 adopted SF-12v1 while other surveys adopted SF-12v2, a discrepancy of PCS and MCS in 2003/04 may exist after performed the mapping of SF-12v1 to SF-12v2. The conversion method from SF-12v1 to SF-12v2 is based on statistical allocations as there is no existing standard approach. Although high consistency and reliability were shown for the conversion method on PCS and MCS in this study (Supplementary Material 2), a standard approach for the conversion is needed and the reliability and validity in domain scores are questionable since SF-12v1 does not interpret the domain scores.

Conclusions

The present study makes a noteworthy contribution by updating the Hong Kong population norm for HRQoL and health utility scores. Population health status has improved as domain scores of the SF-12v2 and health utility had increased in 2014/15 when compared with data previously collected in 1998, 2003/04 and 2008/09. Moreover, a higher number of NCDs, current smoking, current drinking, insufficient consumption of fruit/vegetable, poor sleep quality and abnormal sleep hours were associated with poorer health. Provision of the trends of the HRQoL and health utility allows policy-makers and clinicians to review the effectiveness of the healthcare services and interventions offered to the public, which is essential for maintaining the health status of the whole population.

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Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by EHMT, CKHW, LEB, EYTY, ETYT, WD, BMYC and CLKL. The first draft of the manuscript was written by EHMT, CKHW and LEB. All authors read and approved the final manuscript.

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Compliance with ethical standards

Conflict of interest

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Ethics approval

Ethics approval was not required from the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West due to the secondary analysis of open source de-identified government data.

Informed consent

Informed consent was obtained from all participants included in the study.

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Figure Legends

Figure 1. Trend in a) SF-12v2 domain, b) PCS and MCS and SF-6D health utility at 1998, 2003/04, 2008/09 and 2014/15

Figure 2. Distribution of SF-12v2 summary score and SF-6D health utility score by each non-communicable disease

Tables

Table 1. Sample characteristics from Hong Kong Population Health Survey 2014/15

	Sample level (N=12,022)	**Estimated 2014/15 population[†] (N=6,080,200)**
Socio-Demographics, %		
Gender		
Male	47.1%	47.6%
Female	52.9%	52.4%
Age (mean±SD), year	47.2±18.5	46.7±18.2
Marital Status		
Never married	29.7%	29.8%
Married	59.5%	60.0%
Divorced / Separated	4.4%	4.2%
Widowed	6.3%	6.0%
Highest educational level attained		
No Schooling/Primary	21.3%	19.8%
Secondary	52.2%	51.9%
Tertiary or above	26.5%	28.3%
Living Quarter type		
Public housing	34.2%	30.1%
Subsidized housing	18.7%	16.9%
Private housing	47.1%	53.0%
Household income		
< 50% Hong Kong median	18.8%	17.8%
≥ 50% - Hong Kong median	24.7%	24.0%
≥ Hong Kong median	56.5%	58.2%
Working Status		
Active	56.8%	58.4%
Inactive	43.2%	41.6%
Lifestyle, %		
Smoking status		
Current Smoker	14.7%	14.8%
Ex-Smoker	12.4%	12.3%
Non-Smoker	72.9%	72.9%
Drinking status		
Current Drinker	60.5%	61.4%
Ex-Drinker	17.0%	16.7%
Non-Drinker	22.5%	21.8%
Sufficient Physical exercise		
Yes	36.2%	36.1%
No	63.8%	63.9%
Eating-out habit per week		
<10 times	72.6%	71.8%
≥10 times	27.4%	28.2%
Fruit/vegetable consumption per day		
<5 serving	94.6%	94.4%
≥5 serving	5.4%	5.6%
Sleep quality		
Poor	9.7%	9.6%
Fair	33.9%	33.7%
Well	56.3%	56.7%
Sleeping hour per day		
< 6 hours	9.9%	9.7%
6 - < 10 hours	87.1%	87.4%
≥ 10 hours	3.0%	2.9%
Regular check-up status		
Yes	37.0%	37.6%
No	63.0%	62.4%

SD = Standard deviation;

Note:
† Population weighting allocated by age group, gender and type of accommodation of survey respondents was applied to sample level to estimate the results with respect to the Hong Kong general population in the second quarter of 2015.

Table 2. Sex-age distribution of health-related quality of life scores and health utility scores in 2014/15

Male/Age	Sample level								Estimated 2014/15 population†							
	15-44 (n=2,554)		45-64 (n=2,047)		≥65 (n=1,064)		All age (n=5,665)		15-44 (n=1,324,100)		45-64 (n=1,076,400)		≥65 (n=494,700)		All age (n=2,895,200)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
SF-12v2																
PF	97.5	10.8	92.0	19.5	73.7	32.1	91.1	21.4	97.5	11.0	92.2	19.2	74.8	31.5	91.6	20.6
RP	96.8	10.4	93.2	15.2	80.7	25.0	92.5	16.9	96.8	10.5	93.4	15.0	81.6	24.6	92.9	16.3
BP	93.7	13.3	88.3	17.6	78.9	23.2	89.0	18.0	93.7	13.3	88.5	17.4	79.6	22.9	89.3	17.6
GH	65.8	23.6	56.4	25.6	43.6	26.2	58.2	26.2	65.8	23.6	56.7	25.5	44.1	26.2	58.7	26.0
VT	80.9	20.1	76.9	21.1	69.9	24.8	77.4	21.8	81.0	20.0	77.0	20.9	70.2	24.6	77.7	21.5
SF	94.5	13.9	91.7	17.0	86.0	21.9	91.9	17.1	94.4	13.8	91.8	16.8	86.6	21.5	92.1	16.7
RE	95.5	11.8	94.3	13.2	89.8	17.8	94.0	13.8	95.5	11.7	94.4	13.0	90.1	17.5	94.2	13.5
MH	84.2	14.3	82.6	15.0	81.8	16.0	83.2	14.9	84.3	14.2	82.8	14.9	82.0	15.9	83.3	14.8
PCS	53.3	4.6	50.6	7.0	43.5	11.2	50.5	8.0	53.3	4.6	50.6	6.9	44.0	11.1	50.7	7.7
MCS	50.4	6.8	49.9	7.3	50.1	8.4	50.2	7.3	50.4	6.8	50.0	7.2	50.2	8.4	50.2	7.2
SF-6D‡	0.91	0.10	0.88	0.13	0.81	0.16	0.88	0.13	0.91	0.10	0.88	0.12	0.82	0.16	0.88	0.13
Female/Age	15-44 (n=2,805)		45-64 (n=2,419)		≥65 (n=1,133)		All age (n=6,357)		15-44 (n=1,460,100)		45-64 (n=1,172,100)		≥65 (n=552,800)		All age (n=3,185,000)	
SF-12v2																
PF	96.5	12.8	89.3	21.2	65.4	34.1	88.2	23.9	96.5	12.7	89.4	21.0	64.9	34.3	88.4	23.8
RP	96.3	10.9	91.5	16.2	76.3	26.9	90.9	18.2	96.2	10.9	91.7	16.1	76.0	27.0	91.0	18.1
BP	92.5	14.8	85.9	18.7	72.2	25.1	86.4	19.8	92.5	14.8	86.1	18.6	72.0	25.2	86.6	19.7
GH	62.6	24.4	51.5	26.1	39.2	25.9	54.2	26.7	62.8	24.4	51.9	26.1	39.5	25.8	54.7	26.7
VT	78.6	20.7	74.7	22.1	66.6	25.6	75.0	22.6	78.7	20.6	74.9	22.0	66.7	25.5	75.2	22.5
SF	93.7	14.2	90.7	17.3	82.3	24.0	90.6	17.9	93.7	14.2	90.9	17.1	82.0	24.2	90.6	17.9
RE	94.9	12.2	93.4	14.1	87.6	19.2	93.0	14.6	94.9	12.1	93.4	14.1	87.4	19.2	93.1	14.6
MH	83.7	14.4	81.8	15.1	78.9	17.1	82.1	15.3	83.7	14.4	82.0	15.1	79.0	17.2	82.2	15.2
PCS	52.7	5.1	49.3	7.6	40.7	11.8	49.3	8.8	52.7	5.1	49.4	7.5	40.5	11.9	49.4	8.7
MCS	50.0	7.1	49.7	7.5	49.4	9.1	49.8	7.7	50.0	7.1	49.7	7.4	49.4	9.2	49.8	7.6
SF-6D‡	0.90	0.11	0.87	0.13	0.78	0.17	0.87	0.14	0.90	0.11	0.87	0.13	0.77	0.17	0.87	0.14
All sex/Age	15-44 (n=5,359)		45-64 (n=4,466)		≥65 (n=2,197)		All age (n=12,022)		15-44 (n=2,784,200)		45-64 (n=2,248,500)		≥65 (n=1,047,500)		All age (n=6,080,200)	
SF-12v2																
PF	97.0	11.9	90.5	20.4	69.4	33.4	89.6	22.8	97.0	11.9	90.7	20.2	69.6	33.4	89.9	22.4
RP	96.5	10.7	92.3	15.8	78.4	26.1	91.7	17.6	96.5	10.7	92.5	15.6	78.6	26.0	91.9	17.3
BP	93.1	14.1	87.0	18.3	75.5	24.4	87.6	19.0	93.0	14.1	87.3	18.1	75.6	24.4	87.9	18.8
GH	64.1	24.1	53.8	26.0	41.3	26.1	56.1	26.6	64.2	24.1	54.2	25.9	41.7	26.1	56.6	26.4
VT	79.7	20.5	75.7	21.7	68.2	25.2	76.1	22.2	79.8	20.4	75.9	21.5	68.4	25.2	76.4	22.1
SF	94.1	14.1	91.2	17.2	84.1	23.1	91.2	17.5	94.0	14.0	91.3	17.0	84.2	23.1	91.3	17.4
RE	95.2	12.0	93.8	13.7	88.7	18.5	93.5	14.2	95.2	12.0	93.9	13.6	88.7	18.5	93.6	14.1
MH	83.9	14.4	82.2	15.1	80.3	16.6	82.6	15.1	84.0	14.3	82.4	15.0	80.4	16.7	82.8	15.0
PCS	53.0	4.9	49.9	7.3	42.0	11.6	49.8	8.4	53.0	4.9	50.0	7.3	42.1	11.6	50.0	8.3
MCS	50.2	7.0	49.8	7.4	49.8	8.8	50.0	7.5	50.2	7.0	49.9	7.3	49.8	8.8	50.0	7.4
SF-6D‡	0.90	0.11	0.88	0.13	0.79	0.17	0.87	0.13	0.90	0.11	0.88	0.13	0.80	0.17	0.87	0.13

SF-12v2 = The Short Form 12 Health Survey – Version 2; PF = Physical Functioning; RP = Role Physical; BP = Bodily Pain; GH = General Health; VT = Vitality; SF = Social Functioning; RE = Role Emotional; MH = Mental Health; PCS = Physical Component Summary; MCS = Mental Component Summary; SF-6D = Short-form 6-dimension; SD = Standard Deviation;

Notes:
† Population weighting allocated by age group, gender and type of accommodation of survey respondents was applied to sample level to estimate the results with respect to the Hong Kong general population in the second quarter of 2015.
‡ SF-6D health utility were mapped from the responses of SF-12v2 health survey.

Table 3. Adjusted effects of socio-economic status and lifestyle on health-related quality of life and health utility scores in 2014/15 (N = 11,983[†])

Covariates	PCS (R^2: 0.332)			MCS (R^2: 0.045)			SF-6D [‡] (R^2: 0.163)		
	Coefficient	95% CI	P-value	Coefficient	95% CI	P-value	Coefficient	95% CI	P-value
Socio-demographics									
Gender									
Male (vs "Female")	0.50	(0.22,0.79)	0.001*	0.21	(-0.09,0.52)	0.169	0.006	(0.001,0.011)	0.017*
Age, years	-0.13	(-0.14,-0.11)	<0.001*	0.02	(0.01,0.04)	<0.001*	-0.001	(-0.001,-0.001)	<0.001*
Marital Status (vs "Married")									
Never married	-0.70	(-1.06,-0.33)	<0.001*	0.16	(-0.23,0.55)	0.424	-0.008	(-0.015,-0.001)	0.016*
Divorced / Separated	0.28	(-0.34,0.90)	0.376	-0.89	(-1.55,-0.22)	0.009*	-0.010	(-0.021,0.001)	0.071
Widowed	-1.66	(-2.23,-1.09)	<0.001*	0.56	(-0.05,1.17)	0.070	-0.017	(-0.027,-0.007)	0.001*
Household income (vs "<50% Hong Kong median")									
≥50% Hong Kong median - Hong Kong median	0.32	(-0.08,0.72)	0.118	0.21	(-0.21,0.64)	0.326	0.005	(-0.003,0.012)	0.207
≥ Hong Kong median	0.55	(0.18,0.93)	0.004*	0.49	(0.09,0.89)	0.017*	0.010	(0.003,0.017)	0.003*
Working Status									
Active (vs "Inactive")	0.48	(0.18,0.79)	0.002*	0.12	(-0.20,0.45)	0.449	0.008	(0.003,0.013)	0.004*
Highest educational level attained (vs "Primary or below")									
Secondary	1.53	(1.16,1.91)	<0.001*	0.62	(0.22,1.02)	0.002*	0.022	(0.015,0.028)	<0.001*
Tertiary or above	1.20	(0.74,1.65)	<0.001*	0.68	(0.19,1.16)	0.007*	0.012	(0.004,0.020)	0.004*
Daily life habit									
Smoking Status (vs. "Non-smoker")									
Current smoker	-0.02	(-0.41,0.37)	0.936	-0.85	(-1.27,-0.43)	<0.001*	-0.007	(-0.014,0.000)	0.038*
Ex-smoker	-0.40	(-0.81,0.01)	0.057	0.08	(-0.35,0.52)	0.711	-0.001	(-0.008,0.007)	0.861
Drinking Status (vs. "Non-drinker")									
Current drinker	-0.91	(-1.24,-0.58)	<0.001*	0.22	(-0.13,0.57)	0.222	-0.008	(-0.014,-0.003)	0.005*
Ex-drinker	-1.10	(-1.45,-0.75)	<0.001*	-0.27	(-0.64,0.10)	0.154	-0.018	(-0.024,-0.012)	<0.001*
Insufficient physical activity	-0.17	(-0.43,0.09)	0.199	-0.64	(-0.92,-0.36)	<0.001*	-0.006	(-0.011,-0.001)	0.014*
Insufficient fruit/vegetable consumption	-0.33	(-0.87,0.22)	0.245	-1.35	(-1.94,-0.76)	<0.001*	-0.022	(-0.032,-0.012)	<0.001*
Eating out ≥10 times per week	0.34	(0.04,0.63)	0.028*	0.53	(0.21,0.85)	0.001*	0.008	(0.003,0.014)	0.002*
Poor/Fair Sleep quality (vs "Good")	-1.07	(-1.32,-0.81)	<0.001*	-2.35	(-2.62,-2.07)	<0.001*	-0.026	(-0.031,-0.022)	<0.001*
Sleeping hour (vs "6 - < 10 hours")									
< 6 hours	-1.40	(-1.82,-0.97)	<0.001*	-0.58	(-1.03,-0.12)	0.013*	-0.019	(-0.027,-0.011)	<0.001*
≥ 10 hours	-4.13	(-4.86,-3.40)	<0.001*	-1.18	(-1.96,-0.40)	0.003*	-0.049	(-0.062,-0.036)	<0.001*
Without regular medical check-up	-0.16	(-0.43,0.11)	0.250	-0.05	(-0.34,0.24)	0.725	-0.003	(-0.007,0.002)	0.294
Disease status									
Number of non-communicable disease (vs "0")									
1	-1.22	(-1.56,-0.88)	<0.001*	-0.82	(-1.18,-0.47)	<0.001*	-0.017	(-0.023,-0.011)	<0.001*
2	-2.63	(-3.09,-2.16)	<0.001*	-0.98	(-1.48,-0.49)	<0.001*	-0.029	(-0.037,-0.020)	<0.001*
≥3	-6.87	(-7.35,-6.38)	<0.001*	-1.65	(-2.17,-1.13)	<0.001*	-0.079	(-0.088,-0.070)	<0.001*

PCS = Physical Component Summary; MCS = Mental Component Summary; SF-6D = Short-form 6-dimension; R^2: Coefficient of Determination; CI = Confidence Interval

Notes:

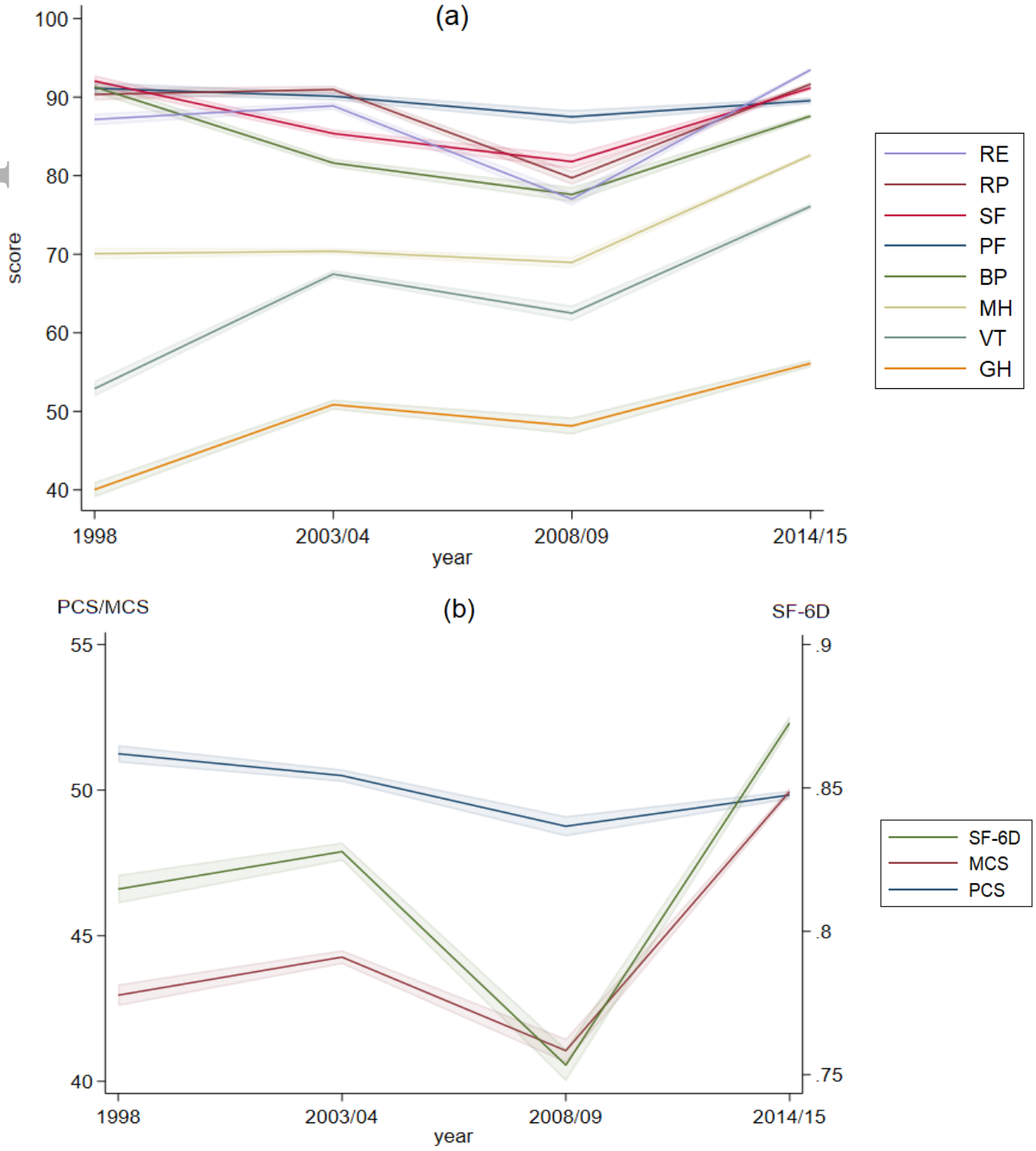
* Significant in multivariable linear regression model at 0.05 level.

† 39 respondents were excluded due to the incomplete data on household income and frequency of vegetable and fruit consumption.

‡ SF-6D health utility were mapped from the responses of SF-12v2 health survey.

Figures

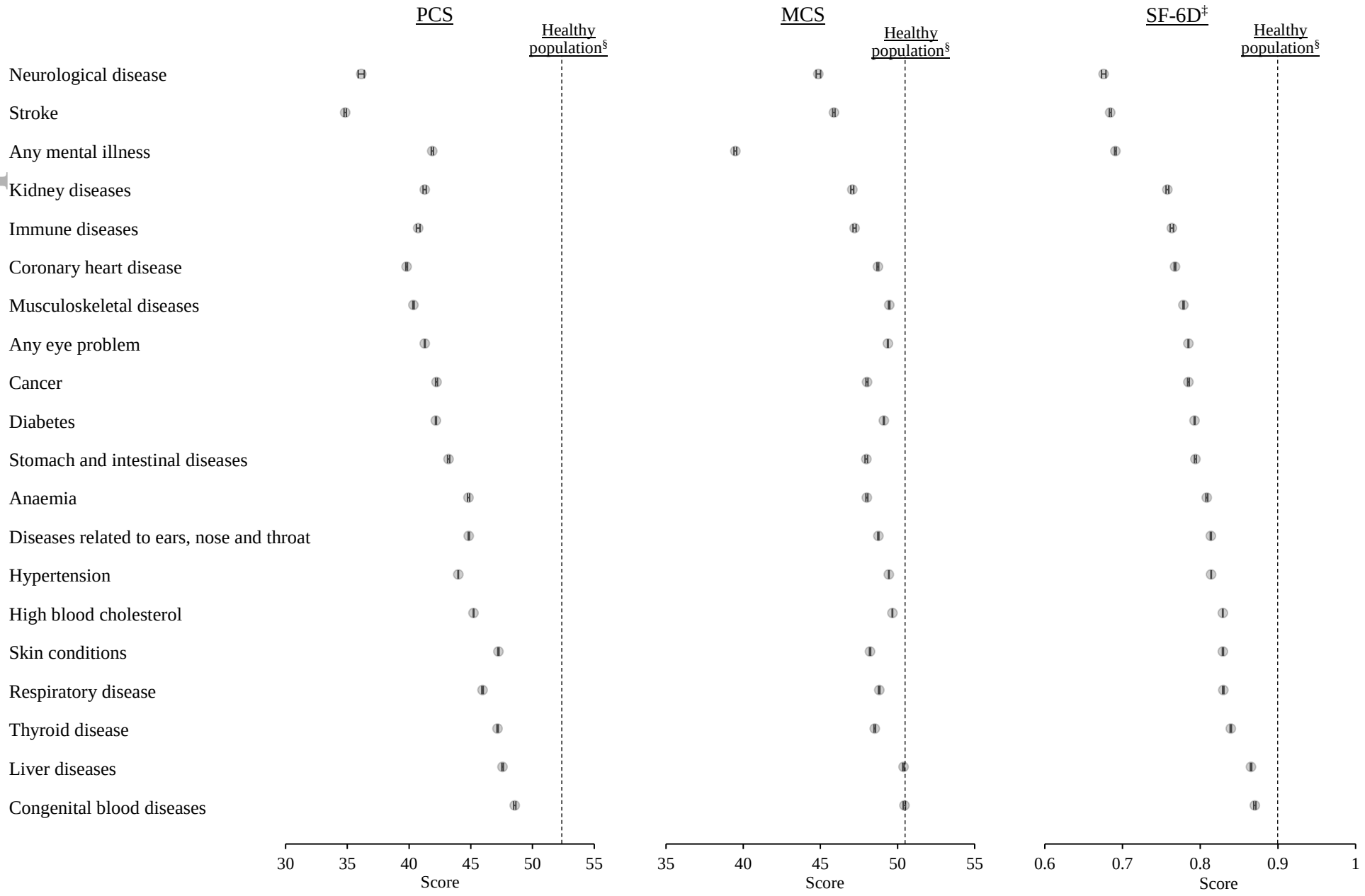
Figure 1. Trend in a) SF-12v2 domain, b) PCS and MCS and SF-6D† health utility at 1998, 2003/04, 2008/09 and 2014/15



SF-12v2 = The Short Form 12 Health Survey – Version 2; PCS = Physical Component Summary; MCS = Mental Component Summary; SF-6D = Short-form 6-dimension; RE = Role-emotional; RP = Role-physical; SF = Social Functioning; PF = Physical Functioning; BP = Bodily Pain; MH = Mental Health; VT = Vitality; GH = General Health;

Notes:
† SF-6D health utility were mapped from the responses of SF-12v2 health survey.
Shaded region represents the corresponding 95% confidence interval.
SF-12v2 results in 2003/04 was converted from SF-12 – version 1 health survey.

Figure 2. Distribution of SF-12v2 summary scores and SF-6D† health utility score by each non-communicable disease in estimated 2014/15 population†



SF-12v2 = The Short Form 12 Health Survey – Version 2; SF-6D = Short-form 6-dimension; PCS = Physical Component Summary; MCS = Mental Component Summary

Notes:

The 95% confidence interval of scores is presented in black coloured font.

† Population weighting allocated by age group, gender and type of accommodation of survey respondents was applied to sample level to estimate the results with respect to the Hong Kong general population in the second quarter of 2015.

‡ SF-6D health utility were mapped from the responses of SF-12v2 health survey.

§ Healthy population refers to respondents who did not report any non-communicable diseases.