

From Department of Learning, Informatics, Management and Ethics (LIME)
Medical Management Centre (MMC)
Karolinska Institutet, Stockholm, Sweden

**SOCIAL AND REGIONAL
DIFFERENTIALS IN
POPULATION HEALTH STATUS,
VALUES FOR HEALTH, AND
SUBJECTIVE WELL-BEING IN CHINA**

Sun Sun 孙 荪



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On the cover¹: a picture of a bat can be a visual pun for happiness, because both characters are pronounced as ‘fu’. A charm displayed with five bats stands for the ‘Five Blessings’, namely ‘longevity, wealth, health, virtue, and the desire to die a natural death in old age’. These are the key elements for happiness in traditional Chinese culture (五福：寿、富、康宁、攸好德、考终命).

¹ Created by an anonymous author, using traditional Chinese handcraft–paper cutting. Picture source: <http://www.nipic.com/show/2/25/6352882k5b0b5e68.html>

ABSTRACT

The overarching aim of this thesis is to increase knowledge on population health-related quality of life and subjective well-being, and to explore values for health states in China.

The EQ-5D instrument was included in the National Health Services Survey 2008 (n = 120,700, aged 15-103 years) to measure health-related quality of life (HRQoL) in all 31 provinces in mainland China. Respondents completed the EQ-5D questionnaire and reported their current health status on a visual analogue scale (VAS), enabling the measurement of population HRQoL and its distribution in China, and modelling the association between the experience-based VAS values and self-reported problems on EQ-5D dimensions and severity levels. The Household Health Survey 2010 (n = 8,000, aged 15–102 years) used a question on self-reported happiness adopted from the World Values Survey (WVS) to measure subjective well-being (SWB), together with the EQ-5D, the VAS, and a self-rated health question.

The EQ-5D distinguished well for the known groups: there was a positive association between socio-economic status (educational level, income, and occupational status) and health status, and the a priori expected differences in health status between regions were observed among the Chinese population. VAS values were generally negatively associated with problems reported on the EQ-5D dimensions, and the anxiety/depression dimension had the greatest impact on VAS values. The feasibility of deriving an experience-based VAS value set for EQ-5D health states was supported. SWB varied with socio-economic characteristics in the expected way, and SWB varied strongly with subjective health status. Of the different dimensions of health, the anxiety/depression dimension was the most important for SWB. Reported SWB was also higher in rural counties than in urban counties in the same area, after controlling for socio-economic characteristics and subjective health status.

Norms for Chinese population EQ-5D health status were established, based on a national representative sample. The results showed that there were substantial differences in HRQoL and SWB across different socio-economic groups and regions, and that regional differentials were partly due to social differentials between regions. This thesis might provide important information for policies aiming at reducing inequalities in health in China. Knowledge regarding social and regional inequalities in different health dimensions in China, especially the anxiety/depression dimension, indicates the importance of mental health for individuals' HRQoL and SWB. The analysis of experience-based VAS values was significant in generating index values for EQ-5D health states but raised fundamental secondary issues concerning the universal nature of the classification system and the extent to which Chinese respondents utilise the same concepts of health as defined by the classification system.

Keywords: China; general population; health surveys; health-related quality of life; experience-based value set; subjective well-being; inequalities; socio-economic status

LIST OF PUBLICATIONS

- I Sun S, Chen J, Johannesson M, Kind P, Xu L, Zhang Y, Burström K. Population health status in China: EQ-5D results, by age, sex and socio-economic status, from the National Health Services Survey 2008. *Quality of Life Research*. 2011;20(3):309–20.
- II Sun S, Chen J, Johannesson M, Kind P, Xu L, Zhang Y, Burström K. Regional differences in health status in China: Population health-related quality of life results from the National Health Services Survey 2008. *Health & Place*. 2011;17(2):671–80.
- III Sun S, Chen J, Kind P, Xu L, Zhang Y, Burström K. Experience-based VAS values for EQ-5D-3L health states in a national general population health survey in China. (submitted)
- IV Sun S, Chen J, Johannesson M, Kind P, Burström K. Subjective well-being and its association with subjective health status, region, and socio-economic characteristics in a Chinese population study. (submitted)

In this thesis, these publications will be referred to as Studies I–IV.

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LIST OF ABBREVIATIONS

GDP	Gross Domestic Products
HHS	Household Health Survey
HRQoL	Health-Related Quality of Life
HUI	Health Utility Index
MAD	Mean Absolute Difference
MoH	Ministry of Health
NHSS	National Health Services Survey
OLS	Ordinary Least Square
QALY	Quality-Adjusted Life Year
QoL	Quality of Life
RS	Rating Scale
SCC	Spearman Rank Correlation Coefficients
SF-36	Medical Outcomes Study 36-Item Short Form
SG	Standard Gamble
SRH	Self-Rated Health
SWB	Subjective Well-Being
TTO	Time Trade-Off
VAS	Visual Analogue Scale
WVS	World Values Survey

1 INTRODUCTION

Since market-oriented reforms were launched in the 1980s, China has undergone a period of rapid economic growth, with dramatic social and political transitions [1, 2]. Great achievements have been made since then. However, because of the emphasis placed on the importance of economic development, GDP growth has been accompanied by cuts in financial support to public services such as education and health care and reductions in social welfare [1–3]. The benefits of development have not been shared equally across different population groups, and the social and regional inequalities are increasing [3–5]. Rapid development has also led to the depletion of natural and social resources, environment pollution, and deteriorating ecological systems [1].

This development has a significant negative impact on people's health and general well-being, which has prompted a reconsideration of the GDP-focused development model [1]. The Chinese government is seeking sustainable and balanced development, so people can live a happy lives within a harmonious society [6]. Both the central government and local governments are shifting their focus from GDP to people's health and well-being [6]. Therefore, it is important to measure the health and well-being of the population, including regional patterns across the country.

In China, population health studies have primarily used mortality [5, 7], life expectancy [8], and usage of health care as health indicators [7, 9]. Few studies in China have used health-related quality of life (HRQoL), especially among the general population. EQ-5D is a generic HRQoL instrument and has been used worldwide [10], as well as in China [11]. In 2008, for the first time, the EQ-5D was included in the National Health Services Survey (NHSS) (n = 120,700, aged 15–103 years) to measure population HRQoL in all 31 provinces in mainland China. The respondents completed the EQ-5D questionnaire and reported their current health status on a visual analogue scale (VAS), enabling measuring, describing and analysing social and regional differentials in population HRQoL in China, and modelling the association between the experience-based VAS values and self-reported problems on EQ-5D dimensions and severity levels.

Although there is an increasing interest in studying subjective well-being (SWB) in China [12, 13], most studies have been conducted in urban areas [14–17], with only a few available for rural areas [18–20]. The Household Health Survey (HHS) 2010 (n = 8,000, aged 15–102 years) was carried out in both urban and rural areas, and a validated Chinese version of a question on self-reported happiness, adopted from the World Values Survey, was included to measure SWB. Associations between SWB and age, sex, region, socio-economic characteristics, and subjective health status were investigated. Furthermore, by including EQ-5D in the HHS 2010, associations among

different dimensions of health and SWB were also investigated, which compensate for the dearth of research in this area.

This research falls within the framework of health economics and public health. Williams divides the scope of health economics into eight topics (Figure 1) [21], with the topic of this thesis being situated in box A (what influences health, other than health care?) and box B (what is health and what is its value?). The focus of this thesis is on population health-related quality of life, subjective well-being, social and regional inequalities, and values for health states in China.

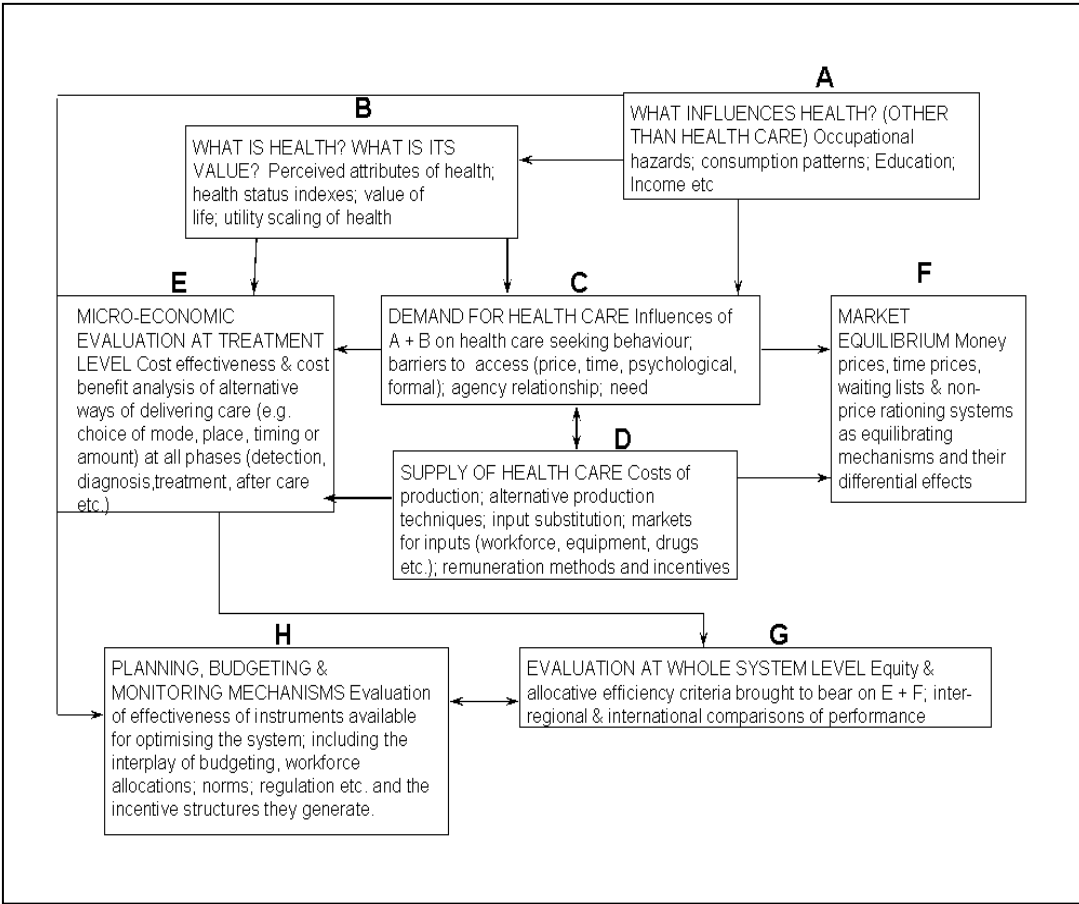


Figure 1 The scope of health economics by Williams (1987) [21]

2 BACKGROUND

2.1 CHINA'S DEMOGRAPHIC CHARACTERISTICS

China is a heterogeneous country, with 1.37 billion inhabitants distributed over 9.6 million km² of territory, making it the most populous country in the world [22]. There are three large geographic areas in China: the eastern, middle, and western areas. Each of these areas contains about 10 provinces, for a total of 31 provinces in mainland China [3]. Each province contains cities in urban areas and counties in rural areas, with an average of 70 cities/counties per province. About 51% of the Chinese population lives in rural areas [1].



Figure 2 Map of China

China's population is aging rapidly. The population 65 years and older accounted for 9% of the entire population in 2010 [22], and the number is expected to reach 23% in 2050 [1]. Population aging is shifting disease patterns towards chronic diseases and disabilities, which will generate higher health costs [23]. China is also experiencing a rapid, large-scale urbanization [1]. During the past 60 years, China's urban population has rising from 10% to 50% of the country's residents, similar to a process that took 150 years in Europe. The transition has created great opportunities but has also placed great pressure on resources, and it is challenging the existing system for health care, social welfare, education, and other public services. China's rapid urbanisation is characterised by massive internal migration. In 2011, the migrating population reached 260 million, and the number is expected to reach 310 million by 2030 [1]. The term

inner-immigrants refer to those who have family registration (Hukou) in rural areas but live in urban areas. This group is often associated with low educational levels, poor economic conditions, harsh working and living conditions, and difficulties in accessing health care and social security networks [3, 24–27].

2.2 INCREASING SOCIAL AND REGIONAL INEQUALITIES IN CHINA

During the past 30 years China's GDP has grown by an average of 9.4% per year, and the proportion of the population in absolute poverty has decreased from 31% to 3% [2, 22]. However, the benefits of development have not been shared equally across different population groups, inequalities in education and income are increasing, and unemployment has appeared following the collapse of state-owned enterprises [4, 5]. Rapid economic growth and dramatic transitions in the social and political system have assumed different magnitudes in different regions, being felt more thoroughly and deeply in the east and in urban areas [3, 4].

There is significant income inequality in China. The national Gini coefficient was 0.47 in 2012, higher than the warning level of 0.40 set by the United Nations [28]. China's income inequality is characterised by the large income gap between the urban and rural areas, e.g., the per capita income of urban residents is triple that of rural residents. At the same time, with the increasing income gap in the urban area, the urban poor, who mainly include the unemployed and inner-migrants [5], have become a new social problem that has drawn government attention. There are significant variations in GDP by province; for example, per capita GDP in Beijing in the eastern area (the highest in China) is seven times that of Guizhou in the western area (the lowest in China) [1].

Although China has made great achievements in education (e.g., its literacy rate has reached the same level as that of middle-income countries), there are still major inequalities between urban and rural areas. For example, illiteracy among people aged 15 and older is 3% in urban areas but 9% in rural areas. Such inequalities also exist across the eastern, middle, and western areas: illiteracy is less than 10% in the eastern area, but nearly 20% for provinces located in the western area [1]. Although basic education (primary and middle school) is public financed and free for local residents, inner-immigrants' children do not have equal access to the primary education because they are not registered as local residents [1].

In urban areas the registered unemployment rate is about 4%. However, the actual number might be much higher, since unemployed inner-migrants and college students are not taken into consideration. Since 1999, unemployment among college graduates has become more and more serious, with only 80% of new graduates able to secure their first job. In rural areas a large proportion of the population, especially those younger than 40, are working off the farm, usually as inner-immigrants. The agricultural labour force consists mainly of older persons [29].

2.3 SOCIAL AND REGIONAL INEQUALITIES IN HEALTH IN CHINA

The dramatic socio-economic transitions of recent decades have had major impacts on health: overall the Chinese live longer and are healthier, and average life expectancy has increased from 67.9 years in 1981 to 74.8 years in 2013 [1]. But at the same time, inequalities in health between different regions [1, 4] and between groups with different educational attainment, incomes, and occupational statuses are increasing [3–5, 9]. For example, there are large gaps in life expectancy between urban and rural areas (75.2 versus 69.6 years) and eastern and western areas (77.2 versus 69.5 years) [1].

Though the new round of national health care reforms aims at providing universal health care coverage by 2020, and major achievements have been made since 2009 (e.g., national insurance coverage increased from 23% to 90%, and about 95% of rural residents are covered by the New Rural Cooperative Insurance System [30]). However, inequalities in access to health care remain between the poorest and the better-off, among eastern, middle, and western areas, and between urban and rural areas [1, 30, 31]. Along with this, the increasing burden of medical costs and difficulties in access to medical services are increasing [32], as the existing public health system cannot provide effective primary health care services to the entire population. Although the medical insurance coverage rate is high, reimbursement is around 60–70%, and there are inequalities between different insurance schemes and between different regions. Many people still face high out-of-pocket medical costs, and low-income families still find it difficult to afford health care. Poor health continues to be a contributor to poverty [32].

2.4 HEALTH AND HEALTH MEASURES

The most widely adopted definition of health is given by the World Health Organization (WHO), which states that *health* is ‘a state of complete physical, mental and social well-being and not merely absence of disease and infirmity’ [33]. This thesis focuses on self-assessed health status as measured by a multi-dimensional instrument, the EQ-5D.

Health-related quality of life (HRQoL) is a subjective account of health assessment that reflects the multi-dimensions of health, such as physical, psychological, social, spiritual, and role function, as well as general well-being [34]. Two types of measures have been developed to measure HRQoL, *generic instruments* and *condition- or disease-specific instruments* [35, 36]. Generic instruments are intended for general use, irrespective of the patient’s illness or condition [36]. They can be used both in clinical studies and in population health surveys. Condition- or disease-specific instruments focus on symptoms and signs that reflect the status of a given disease [35]. The advantage of generic instruments is that they can be applied to a wide range of diseases, which enables comparison between different patient groups. However, they might not be sensitive to subtle changes in health [35, 36]. Several generic instruments have been

developed to measure HRQoL; widely used ones include the Medical Outcomes Study 36-Item Short Form (SF-36) [37], the Health Utility Index (HUI) [38], and the EQ-5D [39].

One fundamental characteristic of the generic instruments is that they cover different *health dimensions*, which means general concepts of HRQoL that are defined using measurable and relatively concrete constructs [35]. With such multidimensional instruments, a score can be assigned to each dimension; with a combination of the scores for all dimensions being defined as a *health profile* or *health state* [36]. An index is a single score generated by summarising scores for all the health dimensions [36]. There are different ways of generating indexes [36]: the first is *aggregating*, i.e., to simply add the scores. With this method, each health dimension is weighted equally. The other is *weighted sum-scores*, which adds the scores together but assigns different weights to different health dimensions [36, 40]. By doing so, individuals' preferences for different health states are revealed; that is to say, we know that individuals prefer one health state more than another. For each health state, a weighted score can be assigned, and *values for health states* are obtained.

Several important methodological considerations must be taken into account in order to derive the weighted scores, in particular, which valuation method should be used and which values should be applied. Many methods have been developed to obtain health state values, including *standard gamble (SG)*, *time trade-off (TTO)* and *rating scale (RS)* [40]. However, none of these methods is recognised as the standard measure for evaluating health in economic evaluations [40–42]. Similarly, there are differences of opinion as to which values to use in health state evaluation. *Experience-based values* are based on assessments made by individuals who are actually in the health state, while *hypothetical values* are based on an assessment of health state descriptions [41–45]. The use of hypothetical values is supported by the argument that, as taxpayers and potential patients, everyone is affected by health policies and interventions [46], and adaptation should not be reflected in valuations [42]. In contrast, those who support the use of experience-based values argue that preferences are from the best informed, and adaptations are reflected in the valuation process [41, 45, 47–49]. Different valuation methods and perspective will lead to different values for health states.

2.5 EQ-5D INSTRUMENT

EQ-5D is a widely used generic HRQoL instrument [39] with applications in clinical studies, economic evaluation of health care [40], and population health surveys [10]. EuroQoL Group is the official scientific body of the EQ-5D instrument. The EQ-5D classifies respondents' present-day health status in five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression). The instrument was originally designed with three severity levels (no problems/some or moderate problems/severe problems), which is referred as EQ-5D-3L. Recently, a five-level description system has been developed (EQ-5D-5L) [50]. The EQ-5D-3L is available in

160 language versions, including four Chinese versions (mainland China, Hong Kong, Taiwan, and Singapore). This thesis uses the EQ-5D-3L; therefore EQ-5D here refers to the EQ-5D-3L.

EQ-5D population health studies

The EQ-5D instrument has been used to measure population health status in many countries in Europe, as well as in the United States, Canada, and Zimbabwe. Population norms are population-based reference values from the general population as a whole or for various subgroups [36]. Population norms data can be used as reference values to be compared with the health status of a specific group of interest. EQ-5D population norms have been established by age, sex, and socio-economic status [10, 51–55]. There is an increasing interest in applying the EQ-5D instrument in Asia. However, most studies are performed among patients, e.g., in Bangladesh [56], Singapore [57], Japan [58], Malaysia [59], South Korea [60], mainland China [61], and Thailand [62]. Studies have been performed among the general population in China [11], Japan [63], Malaysia [55], and Singapore [54].

EQ-5D value sets

The first EQ-5D value set was developed in the United Kingdom in 1997 [64], based on hypothetical values; the method was referred to as the UK MVH protocol. The UK MVH study is based on TTO values, but it integrates VAS as part of the valuation exercises [64, 65]. This method was widely used in many EQ-5D value set studies [66, 67]. EQ-5D value sets have been established in many countries [66, 67], but not in China. Both TTO and RS (visual analogue scale [VAS]) have been used to obtain EQ-5D value sets [66, 67], and recently the discrete choice method was tested [68]. Early in the development of the EQ-5D, the EuroQoL group adopted VAS as its standard valuation method [69], the main reason for this was that it can be used in self-completion questionnaires. However, later on TTO becomes a more favoured choice, as it is considered a choice-based method. Among the existing value sets, using hypothetical values has been a common choice [66, 67]. However, which values should be used is debatable; recently several studies have advocated using experience-based values [41, 44, 48, 70–73], since adaptation is reflected in the valuation task [41, 70] and respondents are not focused as much on the transitory change from one health state to another as they usually do in a hypothetical valuation task [48]. Such value sets have been investigated both for TTO [44, 49, 70] and VAS [44, 71, 72]. Previous studies have shown that experience-based values tend to be higher than hypothetical values [43, 44, 47, 48, 73–77], and the mood dimension seems to be more important when values are experience-based [44, 47, 48, 73, 74]. For EQ-5D valuation studies based on hypothetical values, in general, VAS values are higher than those using TTO [66, 78]. For studies based on experience-based values, so far there has been only one study performed using both TTO and VAS valuation tasks [44]; in it, the TTO values were higher than the VAS values. Further studies are needed to see if this conclusion can be

generalised. Cross-country value set comparison studies [79–82] suggest that there might be substantial differences in values across countries.

2.6 POPULATION HEALTH STUDIES IN CHINA

Population health studies in China have mostly used mortality [5, 7], life expectancy [8], and usage of health care as health indicators [7, 9]. Mortality and life expectancy may not adequately reflect health and its development over time, because disease patterns have changed from a prevalence of acute infectious diseases toward a predominance of chronic non-communicable diseases [22], and the proportion of persons living in a poor state of health has increased. Mortality measures do not take health status into consideration: while mortality decreases, the fraction of people living with poor health might simultaneously increase. Usage of health care does not necessarily reflect health status. Individuals with poor health tend to consume more health care, but on the other hand those with poor health may not be able to afford health care, especially in a country like China where health care is provided largely based on out-of-pocket payments. The global self-rated health question (‘How is your health today?’ for which the five response options are: very good, good, fair, bad, or very bad) is commonly used to obtain health status, including in China [83]. However, this measure does not distinguish between different dimensions of health. In China, some studies have also been based on HRQoL data, but were conducted among patients [84–86]. The EQ-5D has been applied to measure HRQoL in some studies in China as well, but most studies have been among patients [61], and very few have studied the general population. One EQ-5D study was performed among a general population sample of 2,994 individuals drawn from one urban district in Beijing [11].

In 2008, the EQ-5D was included in the National Health Services Survey (NHSS) for the first time to measure population HRQoL in all 31 provinces in mainland China. The respondents completed the EQ-5D questionnaire and reported their current health status on a visual analogue scale (VAS), which allowed social and regional differences in population HRQoL to be measured, described, and analysed. The associations between the experience-based VAS values and self-reported problems on EQ-5D dimensions and severity levels were modelled.

2.7 SUBJECTIVE WELL-BEING

Subjective well-being (SWB) refers to people’s self-reported or experienced well-being [87, 88]. Diener’s widely adopted definition of SWB characterises it as ‘people’s evaluations of their life as a whole or of its various domains, e.g., health, work, family, income’ or ‘people’s actual feelings, both positive feelings such as happiness, pleasure or negative feelings such as pain, worry and anger’ [89, 90].

SWB can be measured either by single-item instruments or multi-component instruments. The latter are still under development, and there is no common agreement

regarding which components should be taken into consideration [88, 91–93]. Primarily three types of single-item instruments have been used to investigate SWB [87, 94, 95]: a *general life-satisfaction item*, e.g., ‘All things considered, how satisfied are you with our life as a whole these days?’ [96]; *Cantril’s Ladder item*, ‘Where on the ladder would you say you personally stand at the present time?’ [97]; and a *happiness item*, e.g., ‘Taking all things together, would you say you are very happy, quite happy, not very happy, or not at all happy?’ [98].

However, the terms *SWB*, life satisfaction, and happiness are often used interchangeably [99, 100]. The Household Health Survey (HHS) 2010 (n = 8,000, aged 15–102 years) used a question on self-reported happiness adopted from the World Values Survey (WVS) [98] to measure SWB. The WVS is a worldwide investigation of sociocultural and political change that uses a national representative sample of 1,000 individuals aged 18 years and older in each country [98]. In China, WVS studies have been conducted in five waves since 1990.

Most studies on SWB have been performed in Western countries [89, 94, 99–101]; however, there is increasing interest in studying SWB in China as well [12, 13]. In China, most studies have been conducted in urban areas [14–17], with only a few available for rural areas [18–20]. Findings from studies of SWB in China [13–19] are similar to findings from Western countries [89, 90, 94, 100]. There is typically a U-shaped relationship between age and SWB, indicating the lowest SWB among the middle-aged group. Women tend to have better SWB than men. Education and health status are positively associated with SWB, but being divorced or unemployed are negatively associated with SWB.

Studies in Western countries have found that the relationship between income and SWB is complex. In cross-sectional data there is typically a positive association between income and SWB [99, 102, 103]. However, although income has increased over time, SWB has typically not increased over time [104–107]. These findings have been confirmed in China as well: a positive association between income and SWB has been found for individuals in both urban and rural areas [19, 20], but SWB has not increased over time even though income has increased over the past 30 years [108]. A proposed explanation is that relative income might play a more important role for SWB than absolute income [107, 109, 110]. This may also possibly explain why little difference in SWB was found between urban and rural areas in China, since rural residents might compare their income to others in the local community even though there is a large income gap between urban and rural areas [19].

Although studies have investigated the association between health and SWB [94, 100, 111, 112], relatively little is known about the association between different dimensions of health and SWB. Existing studies suggest that the mental health dimension is more strongly associated with SWB than the physical health dimension [97, 113, 114]. In

China, a positive association between health and SWB has been found as well [14, 17, 20]. However, to the best of our knowledge no study has investigated the relationship between different dimensions of health and SWB.

2.8 TERMS USED IN THE THESIS

Health is an important component of well-being [88, 89, 91], but sometimes well-being is seen as a component of health [33, 35]. In this thesis, the first approach is adopted: that is to say, well-being is used as an umbrella term that describes the overall concept, and health is a component of well-being. Similarly, *quality of life (QoL)* and HRQoL are often used interchangeably [36]. In this thesis, QoL is considered a broader concept than HRQoL. QoL refers to ‘those aspects of life that shape human wellbeing beyond the command of economic resources’ [88]. Meanwhile, HRQoL refers to ‘health related aspects of quality of life’, which is a sub-concept under QoL. Sometimes QoL is also used interchangeably with the concepts of well-being [13, 88], health [99], or SWB [99]. In this thesis, the term QoL is avoided, the term SWB is used for subjectively perceived well-being (self-reported happiness), and the term HRQoL is used for subjectively perceived health status measured by a multidimensional instrument (EQ-5D).

In health valuation studies, the phrase *values from the general public* is often used as synonymous with *hypothetical values* and *patient values* is often used as synonymous with *experience-based values* [66]. However, since both hypothetical values and experience-based values can be elicited either from the general public or from patient groups, in this thesis only the terms *hypothetical values* and *experience-based values* are used [44].

3 AIM

3.1 OVERARCHING AIM

The overarching aim of this thesis is to increase knowledge on population health-related quality of life and subjective well-being, and to explore values for health states in China.

3.2 RESEARCH QUESTIONS

- How is population health-related quality of life distributed by age, sex, region, and socio-economic status in China? (Study I and II)
- What is the feasibility of estimating values for EQ-5D health states based on experience-based VAS values using general population health survey data? (Study III)
- How is subjective well-being associated with subjective health status, age, sex, region, and socio-economic characteristics in a Chinese general population sample? (Study IV)

4 MATERIALS AND METHODS

4.1 STUDY SAMPLE AND DESIGN

National Health Services Survey 2008 (Study I, II and III)

The National Health Services Survey (NHSS) has been organised by the Chinese Ministry of Health (MoH) every five years since 1993. The 2008 surveys were carried out from mid-June through mid-July, and face-to-face interviews were conducted by trained local interviewers. The NHSS 2008 questionnaire included more than 200 questions on acute diseases and injuries, chronic and other diseases, hospitalisation, health-related behaviour, educational level, family income and employment status, social relations, safety and security, medical costs, accessibility (distance and time), and satisfaction with health services, insurance coverage, vaccination and disease control, and women's and paediatric health services. In 2008 the EQ-5D was included for the first time.

The NHSS 2008 sampled 56,400 households using a multi-stage stratified cluster random sampling [115]. In the first sample stage, 2,400 counties were stratified based on socio-economic, health care, and population structure, arriving at a sample of 94 counties. In the second stage, 2,350 streets (urban areas) and townships (rural areas) in the 94 counties were stratified based on population size and per capita income, arriving at a sample of 470 streets and townships. In the third stage, 940 residential committees (urban areas) and villages (rural areas) were sampled using the same criteria as in the second stage. In each residential committee or village 60 households were randomly selected; all family members in a sampled household were interviewed individually. The EQ-5D was administered to persons aged 15 years and over, with no upper age limit applied. Hence, the study did not include persons under the age of 15.

In total, the NHSS 2008 included 177,501 respondents. Of these, about 18% below the age of 15 were excluded, since EQ-5D questions should only be administered to respondents 15 years and older. Respondents who did not answer the questions by themselves were excluded (13%). In total, less than 2% of respondents had missing answers on age or sex, or at least one of the EQ-5D dimensions, or on VAS, or reported a VAS higher than 100. After applying the previous exclusion criteria, Studies I and II used a total of 120,703 respondents. Study III imputed VAS values of 100 for the six respondents with a profile at 11111 and a VAS higher than 100; therefore 120,709 respondents were included in this study.

Data were entered at the provincial level; two persons independently entered the same data using software provided by the MoH, and disagreements were checked and corrected. Each province reported the data to the MoH, where data were cleaned up and a national data set created.

Household Health Survey 2010 (Study III and IV)

The Household Health Survey 2010 (HHS 2010) used the same protocol as the NHSS 2008, and the HHS 2010 questionnaire was based on a subset of questions from the NHSS 2008, plus an additional question on happiness.

The HHS 2010 selected two urban counties and three rural counties from the counties sampled in the NHSS 2008. In each county, 600 households were randomly selected, and all family members in a sampled household were interviewed individually. Three provinces were selected, from the eastern, middle, and western areas, respectively: Jiangsu Province in the eastern area, Henan Province in the middle area, and Gansu Province in the western area. The selected provinces represent the middle economic development level in each area, respectively. One urban county and one rural county were selected from Jiangsu Province and Henan Province, respectively, while one rural county was selected from Gansu Province. The selected counties represent the middle economic development level in each province for urban and rural areas, respectively.

In total, 9,677 respondents were included in the HHS 2010. Of these, those below the age of 15 were excluded (about 14% of respondents), since EQ-5D questions should only be administered to respondents 15 years and older. Respondents who did not answer the questions by themselves were excluded (3%). Respondents who did not answer the happiness question ($n = 4$), who had missing answers on at least one of the EQ-5D dimensions ($n = 7$), who had missing data on SRH ($n = 5$), marital status ($n = 14$), occupational status ($n = 2$), or income ($n = 7$) were also excluded. After applying these exclusion criteria, 8,000 respondents were used in Study IV. In Study III, 8,031 respondents were used for calculation values for dead, as respondents who had missing on happiness, SRH, marital status, occupational status or income were included.

Ethical considerations

The project itself involves ethical aspects such as who should assign a value to a health state. All data have been collected through face-to-face interviews with informed consent. Some respondents might have found some of the questions sensitive to answer. In March 2008, the MoH notified the local health authorities that the NHSS would be carried out in June 2008 and asked them to notify local residents. The local health authorities announced the information via radio, local newspaper, poster advertisements, and meetings. Local residents were informed that the survey was organised by the MoH and that the purpose was to collect information regarding their health in order to provide information to policymakers. They were also informed that their data would be well protected and that individuals could not be traced. The above information was repeated verbally at the beginning of each interview, and respondents could choose whether they wanted to participate in the survey. Respondents could also choose to quit in the middle of an interview. Usually two interviewers (one woman and one man) worked as a group to perform the interviews in one household; respondents could choose to answer to either one or to both interviewers. The respondent could also

choose whether other family members could be present during the interview, since in China, older respondents in particular might feel more comfortable with the presence of other family members. The HHS 2010 used an interview protocol similar to that of the NHSS; residents were informed regarding the survey by locally organised meetings. All results are presented on group level, and therefore individuals cannot be traced. Ethical permissions were granted by the Regional Ethics Committee, Stockholm, Sweden, for the analyses of the studies (Dnr: 2009/1892-31/5 for NHSS 2008; Dnr: 2011/581-31/5 for HHS 2010).

4.2 FACE-TO-FACE INTERVIEWS

Interview procedure

The NHSS has been performed in four waves since 1993; all waves applied face-to-face interviews, because response rate to postal surveys is usually low in China and face-to-face interviews allow researchers to collect information from those who have difficulty reading the questionnaire by themselves.

Interviewers for the NHSS 2008 were recruited from among local health workers. Interviewer supervisors were trained at the national level (4 supervisors per county, recruited from local health authority staff and county interviewers). The supervisors then trained the interviewers in each county (30 interviewers per county). The MoH provided instructions for performing face-to-face interviews on NHSS questions. Supervisors checked the completeness of the questionnaire at the end of each day as a form of quality control. If information was missing, the interviewer went back the same day or next day to ask the missing questions again. The instructions for the EQ-5D was translated by the research team, authorised by the EuroQoL Group and harmonised to the NHSS interview instructions. The research team has also carried out interviewer training work in nine counties in Jiangsu Province and participated in the MoH Quality Control Group to supervise the fieldwork. During the fieldwork the research team carried out interviews among the interviewers, and their first-hand experiences were well documented in written documents, photographs, and videos.

The HHS 2010 used many of the same interviewers as the NHSS 2008. The supervisors (three supervisors per county, two of whom were recruited from among teachers and masters students at Nanjing Medical University with experience in health survey and fieldwork, and one of whom was from a local health authority) and interviewers (25 interviewers and supervisors per city/district or county) were all trained by the research team.

Interview quality

The research team participated in fieldwork for both the NHSS 2008 and the HHS 2010, including interviewer training, interviewing, and quality control. During the fieldwork, interviews among the interviewers were also carried out, asking their reflections about the interview situation. Fieldwork diaries were written in each county.

One of the main focuses is whether or not the high ceiling effect in China (the majority of respondents report no problems on the EQ-5D dimension) is due to interviewer bias.

Possible situations that might generate interview-related ceiling effects were identified. For example, some interviewers filled in the EQ-5D for the 'mobility' item by themselves because the respondent did not seem to have problems. However, this type of mistake was reduced through interviewer training that emphasised the importance of allowing respondents to answer the questions by themselves and reading out all three options for the EQ-5D question. This was especially important for the HHS 2010, since because all the interviewers were trained by the research team interviewers in all the regions provided consistent information. However, in practice, respondents might already answer 'no problem' even before the interviewer read out all the options, since they may have discovered the pattern of the EQ-5D question. In such circumstances, interviewers were suggested to ask: 'so do you say you do not have any problems in ..., or do you have any problems?' The respondents often commented that the question is too 'wordy' and 'repetitive'. This problem might suggest the existing face-to-face interview protocol provided by the EuroQoL group needed to be improved. Respondents seemed to easily understand the question on VAS, and in most cases (even the elderly) could answer the question without difficulties. The question regarding the value for dead was not as sensitive as interviewers and the research team had expected. The impression was that if the explanation was given clearly and correctly, most people (even the elderly) could answer the question.

Data analysis for checking interviewer bias

The NHSS 2008 is a comprehensive study which involved nearly 2,000 interviewers located in different areas. Interviewer bias refers to opinions or prejudices on the part of an interviewer that are on display during the interview process and thus affect the outcome the interview. In order to reduce interview bias, the MoH provided an interview protocol and training for all the questions in NHSS [115], where the importance of avoiding interference between family members was emphasised. However, in reality such interference could not be avoided in all situations, e.g., a family might have only one room, or an elderly person might need assistance from other family members during the interview. In a large country such as China, where dialects, customs, and living circumstances vary considerably from region to region, the ways in which this might affect interviews requires further investigation.

There are no variables for each interviewer in the dataset; however, the village code can be used as a proxy variable for interviewer group, since usually two interviewers (one male and one female) worked as a team to perform the interviews in all the households in one village. There are a few exceptions, however; for example, cases where two interviewer teams interviewed one village or one team interviewed more than one village.

Health status varies between villages even within the same county, which may reflect one of two things: actual differences in health status or interviewer bias. One way to check is to see whether different health variables (EQ-5D, VAS, percentage of respondents with clinical characteristics [discomfort within last 14 days, diagnosed chronic disease, hospitalised within the last year], self-rated health) in each village follow the same pattern. This can be found in most villages with a few exceptions. Therefore, we can conclude that a few interviewers in the NHSS 2008 and the HHS 2010 were linked with bias patterns, and these interviewers were randomly distributed. Therefore, interviewer bias can be considered noise in the data. The high ceiling effect in China is not mainly due to interviewer bias.

4.3 MEASURES OF SOCIO-ECONOMIC CHARACTERISTICS

Marital status was classified into single, married, divorced, or widowed. The highest attained educational level was classified into below primary school, primary school, junior middle school, senior middle school, college and above. Individuals' annual income was assessed by dividing household annual income by the numbers of persons living in the household within the last half-year, regardless of age and employment status. Respondents were then ranked from lowest to highest by annual income and divided into five groups of equal size: for NHSS 2008 the income groups are: below 2,500 RMB; 2,500–3,999 RMB; 4,000–5,999 RMB; 6,000 –9,999 RMB; 10,000 RMB and above. For HHS 2010 the income groups are: below 2,334 RMB; 2,334–4,166 RMB; 4,167–7,999 RMB; 8,000–11,999 RMB; 2,000 RMB and above. Employment status was categorised into employed, unemployed, student, or retired.

4.4 MEASURES OF REGION

Urban and rural areas

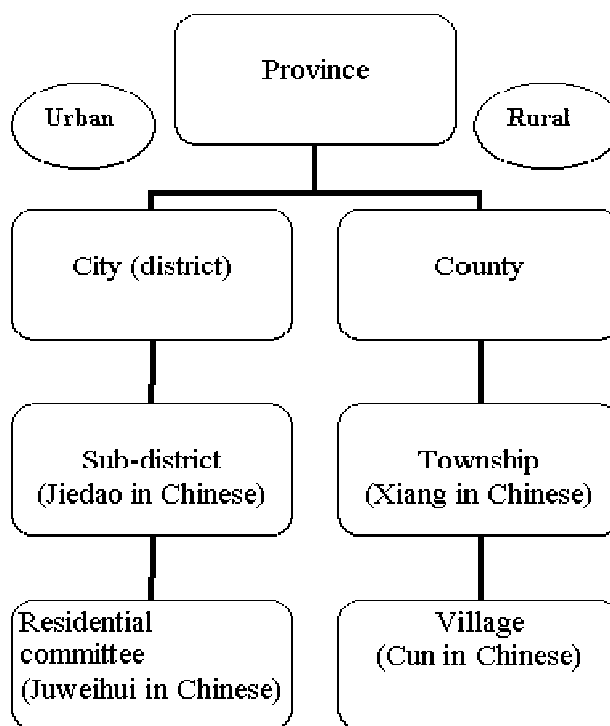


Figure 3 Under-provincial administrative tiers in China

Each province contains both urban and rural areas, averaging 70 urban cities and rural counties (including county-level cities) per province. The under-provincial administrative tiers are presented in Figure 3. Below city (district) level in urban areas the administrative tiers (from high to low) are sub-districts (*jiedao*) and residential committees (*juweihui*), while below county level in rural areas the administrative tiers are townships (*xiang*) and villages (*cun*).

Eastern, middle, and western areas

The eastern area is alongside the seacoast and is the most developed area, including 11 provinces. Further inland is the middle area, including 9 provinces. The western area is the least developed area, including 11 provinces.

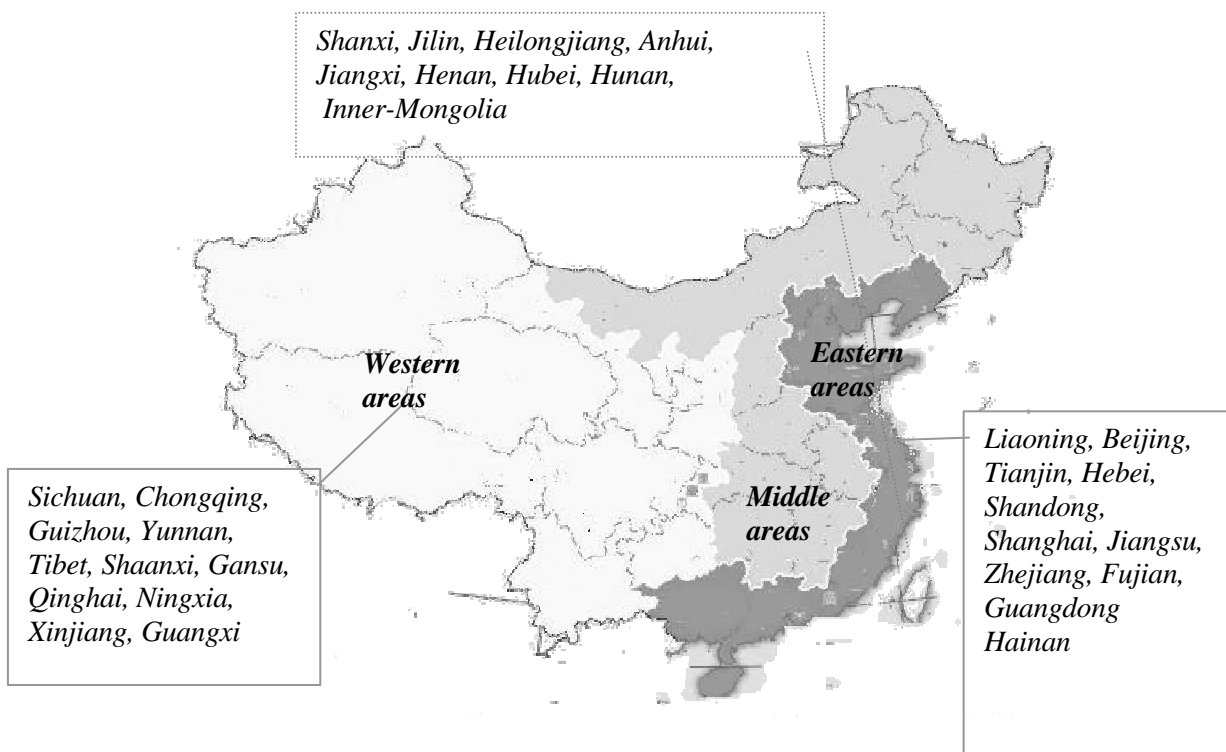


Figure 4 Eastern, middle, and western areas

4.5 MEASURE OF SUBJECTIVE HEALTH STATUS

The EQ-5D instrument (Study I-IV)

The EQ-5D instrument is a generic HRQoL outcome measure [39] that classifies respondents' present-day health status along five dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression); each dimension is represented by one question with three severity levels (no problems, some problems, and severe problems). The EQ-5D instrument defines 243 health states in total.

The VAS (Study I-IV)

A visual analogue scale (VAS) was used in the survey, with anchor points 0 (worst health state) and 100 (best health state). The scale consisted of a horizontal 11 cm line where every 10th was marked and labelled 0, 10, 20..., 100. The question was framed: 'On the scale please point out which point best represents your own health state today.' The scale was harmonised to fit in the NHSS questionnaire and hence differs from the EQ VAS.

Self-rated health (Study IV)

The HHS 2010 used a global self-rated health (SRH) question—'How is your health today? Very good, good, fair, bad or very bad?'

4.6 MEASURE OF SUBJECTIVE WELL-BEING

The question on SWB was adopted from the WVS, using the validated Chinese version of the question [98]: 'Taking all things together, would you say you are...?' The four answering options were: very happy, rather happy, not very happy, or not at all happy.

4.7 VALUATION METHOD

The experience-based VAS values were obtained from the VAS question in the NHSS 2008. Details regarding the VAS question have been described above. Respondents were asked to record their value for the state 'dead' using the same VAS. The question asked was: 'This scale is the same as the one you saw before. On this scale, where would you score dead?'

4.8 STATISTICAL ANALYSES

All statistical analyses were performed using SAS version 9.2 [116], using a 5% significance level. All descriptive analyses by socio-economic characteristics and region were stratified by age and sex. The percentage of respondents reporting problems on each EQ-5D dimension, mean VAS score, and SWB were calculated. Ordinary least square (OLS) was used in all studies (Study I-IV). In Study I and II the variation in VAS scores was estimated by age, sex, region, and socio-economic status. In Study III, the variation in VAS scores was estimated together with EQ-5D dimensions, and analyses were carried out for both individual-level data and aggregated

data. Spearman rank correlation coefficients (SCC) and mean absolute difference (MAD) were used to examine the goodness-of-fit of the models. Higher SCC and lower MAD indicate a better model fit. In Study IV, variation in SWB was estimated by age, sex, region, socio-economic characteristics, and subjective health status. Multiple logistic regressions were carried out in Study II, to estimate the likelihood of having no problems in each of the EQ-5D dimensions for each region. Dummy variables were created for all the independent variables except for VAS for the purpose of OLS models and multiple logistic regressions. In Study IV, ordered logit regressions were also used to estimate how SWB varied with age, sex, region, socio-economic characteristics, and subjective health status. The results from the ordered logit models were then compared with the results from the OLS models. Due to the small number of respondents reporting being not at all happy ($n = 39$), the categories not very happy and not at all happy were merged together for ordered logit models, defined as not happy.

5 SUMMARY OF RESULTS

5.1 POPULATION HEALTH-RELATED QUALITY OF LIFE DISTRIBUTED BY AGE, SEX, REGION, AND SOCIO-ECONOMIC STATUS (STUDY I AND II)

An age gradient was noted, as moderate and severe problems reported in each EQ-5D dimension increased and mean VAS scores decreased with age. In the anxiety/depression dimension, the increase with age was less steep compared to the other dimensions. Women usually reported more problems in EQ-5D dimensions and had lower mean VAS scores than men across all age groups.

Overall, respondents with a lower educational level reported more problems on the EQ-5D dimensions and lower VAS scores than those with higher educational levels, except for women 65 years and older, while those with a middle school level of education reported the best health status. Respondents in lower income groups reported more problems on the EQ-5D dimensions and had lower VAS scores than those in the higher income groups. Unemployed persons reported more problems on all EQ-5D dimensions and had lower mean VAS scores than those who were employed. The differences in health between different socio-economic groups increased with age.

Results from the OLS analyses showed that VAS scores decreased with age and that women had significantly lower VAS scores than men. VAS scores were significantly lower for those with less education and income, and the unemployed had significantly lower VAS scores than those who were employed.

Rural respondents reported more problems on all the EQ-5D dimensions and lower VAS scores than urban respondents. The difference between rural and urban respondents in terms of problems reported on EQ-5D dimensions increased with age. Results from the regression analyses showed that without controlling for socio-economic status, urban respondents were significantly more likely to having no problems on all EQ-5D dimensions than rural respondents. When controlling for socio-economic status, these differences were reduced.

Problems reported on EQ-5D dimensions increased and VAS scores decreased from eastern to western areas for both urban and rural respondents. This gradient was steeper among rural respondents than among urbanites. Results from logistic regression analyses showed that for urban respondents, without controlling for socio-economic status, respondents in the eastern area were significantly more likely to have no problems on EQ-5D dimensions than those in the western area, with the exception of pain/discomfort. The middle and western areas exhibited a difference on the anxiety/depression dimension. When controlling for socio-economic status, the differences on the EQ-5D dimensions were reduced, and some differences became

insignificant. An eastern-middle-western gradient in health was observed for rural respondents when not controlling for socio-economic status; there were significant differences for all dimensions between all areas. When controlling for socio-economic status, differences on the EQ-5D dimensions were reduced, with the exception of the self-care, usual activities, and anxiety/depression dimensions, where the effects of regional variables increased.

5.2 FEASIBILITY OF ESTIMATING VALUES FOR EQ-5D HEALTH STATES BASED ON EXPERIENCE-BASED VAS VALUES USING GENERAL POPULATION HEALTH SURVEY DATA (STUDY III)

In total, 167 out of the 243 possible EQ-5D health states were observed, and 93 health states had more than five observations. The most frequently occurring health state was 11111 (87% of the population), followed by 11121 and 11112. The mean VAS value for 11111 was 82.6, which was 17 points below the upper boundary of the best health state. The mean VAS value for 33333 was 34, which was 34 points above the lower boundary of the worst health state.

A basic main effect model was specified using two dummy variables representing level 2 (moderate problems) or 3 (severe problems) respectively, for each of the EQ-5D dimensions. Due to the inconsistency on the self-care dimension, moderate and severe problems on this dimension were merged for the individual-level data. The intercept was 82.4, corresponded to the observed mean value for health state 11111 (82.6). For level 3, the greatest coefficient was seen for anxiety/depression, followed by pain/discomfort and usual activities. For level 2, the greatest coefficient was seen for pain/discomfort, followed by anxiety/depression and mobility. For the aggregated data, the coefficients were consistent for all dimensions, and the intercept was 74.7, which was about 9 points lower than the observed value for 11111. For level 3, the greatest coefficient was seen for anxiety/depression, followed by pain/discomfort and usual activities. For level 2, the greatest coefficient was seen for pain/discomfort, followed by mobility and anxiety/depression.

VAS values were generally negatively associated with problems reported on the EQ-5D dimensions, and the anxiety/depression dimension had the greatest impact on VAS values. The value for dead was obtained from the HHS 2010. The mean value for dead was 4.5 and the median was 0. Rescaling by the value for dead is needed when using VAS in quality-adjusted life years (QALYs) calculations.

5.3 SUBJECTIVE WELL-BEING AND ITS ASSOCIATION WITH SUBJECTIVE HEALTH STATUS, AGE, SEX, REGION, AND SOCIO-ECONOMIC CHARACTERISTICS (STUDY IV)

Without any controls for region or socio-economic characteristics, SWB decreased with age and was significantly lower for women than for men. When controlling for region and socio-economic characteristics, SWB decreased with age until the 55–64 years age group and was then constant; there was no significant difference between men and women. After controlling for EQ-5D dimensions, SWB decreased with age until the 35–44 age group and was then more or less constant with age. After controlling for SRH or VAS, SWB was relatively constant with age, with a tendency with for somewhat lower SWB in the middle-aged age groups and a U-shaped age pattern. This is the most typical result found in previous studies [14, 16, 17, 20, 89, 94, 100].

When controlling for age and sex, SWB was higher in rural counties than in urban counties within the eastern area, while within the middle area SWB was similar in rural and urban counties. When controls for socio-economic characteristics were added, SWB was significantly higher in rural counties than in urban ones in both the eastern and middle areas (but the lowest SWB was still observed in the western rural county).

With controls for age, sex, and region, for marital status, SWB was lowest for divorced individuals. For occupational status SWB was lowest for unemployed individuals and highest for students. SWB increased with both education and income. These patterns were robust when controlling for all these variables simultaneously, although the sizes of the coefficients decreased somewhat. After also controlling for subjective health status (and other socio-economic characteristics), divorced individuals still had the lowest SWB among the marital status categories. However, SWB was no longer significantly lower for unemployed individuals compared to employed individuals, with a control for SRH or VAS (with a control for EQ-5D the coefficient for unemployed was still significant). Lower subjective health status thus seems to be an important factor in the lower SWB of unemployed individuals. Students still had a higher SWB than employed individuals after controlling for subjective health status. SWB increased with both education and income even after controlling for subjective health status, although the size of the coefficients decreased.

SWB increased significantly with subjective health status (SRH, EQ-5D dimensions, and VAS). For the EQ-5D most of the coefficients for moderate and severe problems within each dimension had a negative sign, consistent with a lower SWB for individuals with moderate or severe problems compared to individuals with no problems. However, the results were only fully consistent for the mobility dimension and the anxiety/depression dimension; this implies a larger negative coefficient for severe problems than for moderate problems. The coefficients were largest for the anxiety/depression dimension.

6 DISCUSSION

6.1 MAIN FINDINGS

The following findings are similar to the EQ-5D population studies from other countries [10]: most problems were reported on the pain/discomfort dimension, followed by the anxiety/depression dimension; problems reported on the EQ-5D dimensions increase with age, and women reported more problems than men [10]. Positive association between socio-economic status and health was observed, which is similar to findings in Europe countries [10, 52, 53] and previous studies in China [5, 7, 11, 83, 84]. Population HRQoL decreased from the eastern to the western area, which is in line with previous findings [3, 31, 83]. Such differences were sharper in rural than in urban areas. HRQoL is better in urban areas than in rural areas. After controlling for socio-economic status, the differences between regions were reduced, and some differences became insignificant.

VAS values were generally negatively associated with problems reported on the EQ-5D dimensions, and the anxiety/depression dimension had the greatest impact on VAS values. The analysis of the experience-based VAS values is significant in generating index values for EQ-5D health states but raises fundamental secondary issues concerning the universal nature of the classification system and the extent to which Chinese respondents utilise the same concepts of health as defined by the classification system.

Most of our findings regarding SWB in China are consistent with previous studies in China, that SWB varies with socio-economic characteristics in the expected way [12–17, 19, 20], and that SWB varies strongly with subjective health status [14, 17, 20]. Of the health dimensions, anxiety/depression was the most important for SWB [97, 113, 114]. In each area, reported SWB was also higher in the rural county than in the urban county, after controlling for socio-economic characteristics and subjective health status.

This thesis investigates social and regional inequalities in HRQoL and SWB among the Chinese general population; the results show that there are substantial differences in HRQoL and SWB across different socio-economic groups and regions and that regional differences are partly due to social differences between regions. This thesis might provide important information for policies aiming at reducing inequalities in China. Although the Chinese government has devoted significant efforts to reducing social and regional inequalities in recent years, such as by providing free primary education, strengthening the rural pension system, providing a new Rural Cooperative Medical System, lowering taxation, and transferring national-level tax resources to the middle and western areas, inequalities in health and well-being remain between the poorest and better-off, and between different regions [7, 14–17, 20, 30, 31, 117]. Promoting equity requires action from different sectors [1], which includes further

regulating the performance and incentives of public officials, e.g., increasing financial support for public schools and hospitals, adjusting income distribution policies such as taxation policies, and increasing support for vulnerable groups such as inner-immigrants, the unemployed, and low-income families.

The EQ-5D was included in China's NHSS for the first time, and analyses for HRQoL by age, sex, region, and socio-economic status have been investigated in a nationally representative sample. Results from Study I can be used as EQ-5D norms data by age and sex, and by different socio-economic groups. Results from Study II can be used as EQ-5D norms data for different regions. These norms can be used as reference values when comparing different groups' health status with the general population in China. All analyses by region, educational level, income and employment status have been investigated in a nationally representative sample, where effects of age and sex were taken into consideration. Our study adds knowledge regarding social and regional inequalities in different health dimensions in China, apart from the knowledge of social and regional differentials in health using mortality and morbidity data. The study demonstrated the feasibility of deriving an experience-based VAS value set for EQ-5D health states. The socio-economic differences in HRQoL and SWB were found, which suggest that policies aiming to reduce socio-economic inequalities are important. Knowledge regarding the importance of the anxiety/depression dimension may suggest the importance of mental health for individual's HRQoL and SWB.

I have been involved at all stages of the project, including harmonising the EQ-5D into the NHSS 2008, translation of the instruction for the EQ-5D face-to-face interview (authorised by the EuroQoL Group) and harmonised it with the NHSS interview instruction, participation in the interviewer training and fieldwork for both the NHSS 2008 and HHS 2010, performing data clean-up and analysis at the MoH. First-hand experiences were well documented as written files, photographs, and videos, which give valuable information that can enhance our knowledge about performing such studies.

6.2 METHODOLOGICAL CONSIDERATIONS

A large proportion of the population (87%) reported themselves to be in good health (reporting no problems on any of the EQ-5D dimensions, health state 11111). This number is higher than that for the United Kingdom (36%) [72], Sweden (42%) [44], or Germany (66%) [71]. Similarly, for the self-reported happiness question, 20% of the population reported that they were very happy, and 71% reported that they were rather happy. This might be due to the fact that a majority of the population was healthy, but it may also be due to a ceiling effect, i.e., respondents tending toward the high end of distribution, which is the opposite of the floor effect [118]. The ceiling effect might be caused by the mode of administration or the design of the instrument (the ceiling effect is higher for the EQ-5D compared to SF-6D [119]), or due to cultural differences (the ceiling effect may be higher among Asian populations [67, 120, 121]).

Face-to-face interviews can impact survey results in two opposite aspects: on the one hand, face-to-face interviews might reach persons in poor health more easily than postal surveys [122]; on the other hand, in face-to-face interview situations respondents answer questions more optimistically than in a postal survey [123]. Face-to-face interviews have been used in several EQ-5D population studies [52, 124]; however, these studies did not discuss whether face-to-face interviews influenced EQ-5D self-reported health. Several studies using other instruments suggest that respondents report better health in face-to-face interviews than in postal surveys [122, 123]. There are very few studies comparing mode of administration of the EQ-5D instrument in population studies. One study showed that among AIDS patients, self-administration and interview-administration yield similar results [125], but little is known regarding the general population. Further research should compare different modes of administration for EQ-5D instrument among Chinese populations.

Measuring health and well-being from a subjective perspective provides important information, with the advantage that such measures often are standardised questions and are easy to use in practice, and reflect the individual's own perspectives. However, subjective measures are not problem-free, and they can be biased by culture differences, respondents' cognitive abilities, and expectations. Like many other HRQoL and SWB measures, both the EQ-5D and the happiness question from WVS were originally developed in English and then translated into other languages. The items are treated as if they have exactly the same meaning anywhere in the world [95, 126]. However, the equivalence of these items across different cultures is debatable [95]. Although the concept of health and well-being might be obvious to people living in most cultures, the way people think about them may vary significantly [127].

Culture can impact respondents' answers from several perspectives [95]. For example, the numbers might be used differently across different cultures: a 100 on a VAS scale might not mean the same thing across different cultures. Some items might function differently in different cultures: compared with English, Spanish, and French respondents, Chinese respondents consider the phrase 'moderate problems' to represent a more severe degree of difficulty [128]. Self-presentation will also influence respondents' answers: in the East Asia, for example, it is not desirable to say that one is 'very good' [95], and therefore respondents tend to avoid using the top end of the scale. Yet at the same time respondents can also be influenced by memory bias (a balanced amount of attention to positive events versus negative events) [95], and positivity bias (the tendency to evaluate something more positively than expected from an objective criterion) [95]. Furthermore, different cultures might use different standards and reference groups for comparison.

Although the language equivalence of the EQ-5D in English and in Singaporean Chinese was tested among rheumatism patients in Singapore [129], no test has been

performed between the English and mainland Chinese versions among a general population in China. Little is known regarding how culture differences influence respondents' answers to the EQ-5D questions in China.

The EQ-5D defines HRQoL on five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Whether or not these five dimensions are also applicable across different cultures, especially among the East Asians, merits further research. The large magnitude of the ceiling effect for the EQ-5D among the Chinese population might suggest that the model of health that provides the conceptual foundation for the EQ-5D is simply not recognised in the same way by Chinese or other East Asian respondents, as it is by respondents from Western Europe or North America [10, 11, 130–132]. While the dimensions themselves may appear to be relevant in describing health, the concept of varying degrees of problems within each dimension might not be recognised in the same way.

This can be further observed in the truncated use of the VAS, with gaps evident at both the higher and lower ranges. Respondents who self-classify as being in the 11111 health state report a mean VAS rating that is approximately 17 points less than the defined value assigned to the best imaginable state of health. Similarly, the high value for dead creates a 34-point gap between dead and the worst imaginable state of health. This discontinuity in values might be an artefact of the valuation method itself, or a by-product of the descriptive classification. Whatever is the cause, it suggests that there are other mechanisms at work here that are still poorly understood. Taken together, these results suggest that there might be additional health elements that are not captured by the EQ-5D dimensions [72], such as energy or sleep [132]; if that is the case, respondents might not consider that 11111 is in fact the best state of health [133]. Further investigation is needed to compare the EQ-5D with other HRQoL instruments such as the HUI or SF-36, in order to explore to what extent the ceiling effect is caused by instrument design or results from other factors, such as culture differences. Additional exploration of the concept of *health* is also needed.

The definition of SWB remains complex and culture related [95, 126]. In a comparison study of perception of SWB between East Asian and Western countries, Lu & Gilmour discuss the influence of culture on SWB [134]. Generally, residents of East Asian countries tend to report better SWB than residents of Western countries with similar or higher GNPs, which might be due to culture differences. East Asian cultures possess a stronger socially orientated SWB: happiness should be based on the fulfilment of social role obligations [134]. In contrast, Western cultures possess a stronger individually orientated SWB: one should be responsible for one's own SWB and actively strive for it [13]. In China, a qualitative study by Lu also revealed that Chinese people's perception of happiness is different from that of people from Western cultures [135]. For example, Chinese culture emphasises the importance of keeping one's desires limited and being sincerely grateful for life; in it, the relationship between happiness

and unhappiness is seen as a never-ending cyclic process that enables people to easily accept their current situation.

Both life satisfaction and happiness questions can be used to measure SWB; however, they might represent different aspects of SWB. It would be interesting to investigate further the relation between these two types of questions in China. We used the happiness question from the WVS, which contains four categories. Other happiness questions use three [136] or five categories [19], or ask about duration of feeling happy [17]. Differences in the design of the SWB question might influence the results and add difficulties in comparison with other studies. Previous studies regarding SWB are mainly quantitative [94, 100]. However, qualitative studies are needed for further understanding and interpretation [137]. Furthermore, as SWB is a culturally influenced concept [95, 126], qualitative studies among different population groups would facilitate the understanding of how well existing measures truly capture the concept of well-being.

The perception of relative status, which is assessed by comparing one's current situation either across time or against other individuals in the local community, will influence respondents' subjective assessment [94, 105, 107, 138, 139]. In rural areas, due to limited information and narrow reference groups (people from the same village), residents might have lower expectations; meanwhile, their income, living conditions, and health have increased over time and they have expectations that they will continue increasing in the future as well, leading rural residents to have a positive perception of their relative status [18, 20] and to perceive their health and SWB as better than the perceptions of urban respondents. In contrast, urban residents have more information and broader reference groups (at the provincial or national level). Urbanites' higher expectations and the increasing gap in social status in urban areas gives rise to a sense of relative deprivation, which makes people feel unhappy or dissatisfied with their life or health [14, 19, 139].

VAS value sets for EQ-5D health states are available for Belgium [140], Malaysia [141], and Europe [142]. However, many health economists consider VAS to be inferior to TTO, since it is not a choice-based measure. Preference weights are widely used in generating QALYs. QALY is a summary measure of both quantity (life years) and quality (health status) of health, which can be used in economic evaluation (cost-utility analyses [42]). The purpose of performing economic evaluations is to provide information for resource allocation and decision-making. In this case, it is important that the QALY should be generated using a utility measure. However, since both TTO and VAS are decisions made under certainty, neither of them is a utility measure strictly speaking; rather, they are preference measures [40]. The difference between VAS and TTO is that TTO is a choice-based method; unlike scaling, the underlying preferences are revealed indirectly. Also, it has been developed as a more pragmatic means of eliciting health valuations that have similar empirical properties to SG [40,

42, 67]. This probably explains why TTO is preferred by many economists, although contrasting views can be seen as well [143, 144]. However, to apply QALY in economic evaluation is just one of the areas, and there are other fields, such as monitoring of health status changes in a population, either cross-sectionally or longitudinally, that do not strictly require that QALY be a utility measure [72]. Compared with the TTO method, some studies found that the VAS is easier to understand [67, 141], but it is associated with bias, e.g., end-of-scale and spacing-out bias [40]. To summarise, it is not easy to draw a conclusion on which method is superior; as the EuroQoL group states, ‘the theoretical and empirical case for favouring one method of health state valuation over another is far from clear cut. In practice, there are currently no EQ-5D value sets generated from SG methods, so for users the choice is between TTO and VAS’ [67]. The focus of the present study is to elicit a Chinese value set using the most feasible method. At the present stage using VAS is most feasible; however, in the future it will be interesting to perform valuation studies on TTO as well.

Inner-immigrants were not included in the NHSS 2008 or the HHS 2010. Both surveys’ questions applied a proxy to investigate these people’s living situation, but information on their health status and SWB is lacking. Further studies are needed among inner-immigrants. Some studies have investigated the health [24] and SWB among inner-immigrants in China [16, 25–27], finding that inner-immigrants’ health and SWB were worse than those of urban residents.

The proportion of persons with different educational level and the average household annual income are similar to data reported in official statistics [145]. However, the proportion of unemployed was higher in the NHSS than in the official statistics. This might be due to different definitions of unemployment. The NHSS is designed to reflect the socio-economic status of the Chinese population. Individual annual income was assessed based on the average income for each family member living in a household, and therefore it reflects the economic situation of the household rather than the individual. Differences by income group might therefore be underestimated. Individuals with the same income might have different employment statuses and occupations, and therefore their health insurance and social security net could be different; these factors might also influence health. Our way of converting household income into individual income was rather crude, since it did not consider economics of scale or the possibility that consumption might vary with age in the household. However, we are not aware of any equivalence scale for converting household income to individual income for China. To create a measure of absolute income, i.e. consumption possibilities, we ranked respondents from highest to lowest by their annual income and divided the population into five income groups of equal size for China as a whole. One drawback to this measure is that it does not adjust for regional differences such as the cost of living. However, adjustments of this kind are hard to make. An alternative could have been to divide the population into groups based on

localised cut-offs. However, such a measure would capture the relative rank in income in each region, rather than the absolute consumption possibilities for China as a whole. Employment status in China is not easy to pin down. Official rules regarding retirement age are only established for urban areas (men retire at 60, female non-manual workers at 55, and female manual workers at 50) [146]. Rural areas have no strict rules regarding retirement age, since the elderly do not receive government pensions. This makes it difficult to apply a universal retirement age to the entire population. For this reason, when persons over the age of 60 reported themselves to be employed or unemployed, we include them in the analyses in the manner in which they reported this.

In spite of several methodological limitations, this thesis provides empirical data on social and regional differentials in population health status, values for health, and subjective well-being in China.

7 CONCLUSION AND FUTURE STUDIES

The overarching aim of this thesis is to increase knowledge on population health-related quality of life and subjective well-being, and to explore values for health in China. This has been studied by measuring health status using the EQ-5D instrument and subjective well-being using the question on happiness, and their distribution by age, sex, region, and socio-economic status. It furthermore studied the association between subjective health status and subjective well-being. It investigated the feasibility of deriving experience-based VAS values for EQ-5D health states in a national general population health survey in China.

The EQ-5D instrument distinguished well for the known groups: there was a positive association between socio-economic status (educational level, income, and occupational status) and health status, and the a priori supposed differences in health status between regions were observed among the Chinese population. VAS values were generally negatively associated with problems reported on the EQ-5D dimensions, and the anxiety/depression dimension had the greatest impact on VAS values. The analysis of experience-based VAS values is significant in generating index values for EQ-5D health states but raises fundamental secondary issues concerning the universal nature of the classification system and the extent to which Chinese respondents utilise the same concepts of health as defined by the classification system. SWB varies with socio-economic characteristics in the expected way, and that SWB varies strongly with subjective health status. Of the dimensions of health, the anxiety/depression dimension was the most important for SWB. Reported SWB was also higher in rural areas than in urban areas in the same regions, after controlling for socio-economic characteristics and subjective health status.

Findings from this thesis suggest future studies in China: qualitative studies regarding health and SWB; tests of language equivalence for the EQ-5D between the English and mainland Chinese versions; comparison between EQ-5D and other generic HRQoL measures, different modes of administration, and different valuation methods; tests of the Chinese EQ-5D value set in different study settings, for examples, in clinical studies, economic evaluation, and population health studies; and application of multilevel analyses to NHSS data.

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