UCL SCHOOL OF PHARMACY
DEPARTMENT OF PRACTICE AND POLICY

Beliefs about Medicines and Self-Reported Medication Adherence in Chinese Patients with Chronic Diseases

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Declaration

I, Bo Nie, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signature ______________________________

Date _________________

Abstract

Background

For many chronic conditions, medication adherence is considered to be a crucial behaviour to achieve optimal outcomes. This thesis investigated beliefs about medicines and their associations with medication adherence in the Chinese patients.

Methods

Mixed methods were applied: 1) a meta-analysis summarised the correlations between specific beliefs about medicines and medication adherence in Chinese population; 2) semi-structured interviews explored Chinese patients' cognitive representations about medicines (CRM) and links with medication-taking; 3) a 'think-aloud' task checked participants' comprehension of a Chinese translation of the Beliefs about Medicines Questionnaire (BMQ); 4) an online survey assessed CRMs and medication adherence among Chinese patients and investigated determinants of low adherence using the logistic regression models; 5) 'structural validity' of an expanded version of the BMQ (e-BMQ) was explored using factor analysis.

Results

The main findings of this PhD work were: 1) Necessity beliefs (r=0.21, 95%CI: 0.07, 0.34) and concerns about medicines (r=-0.40, 95%CI: -0.48, -0.32) showed significant correlations with adherence in the Chinese population. 2) Five BMQ components (Necessity, Concern, Harm, Benefit, Overuse), perceived sensitivity to medicines

(PSM), trust in medicines and beliefs about traditional Chinese medicines (TCM) were identified as themes to describe Chinese people's CRMs that influenced medication taking. 3) The adjusted odds ratios of low adherence were significantly associated with Necessity (0.60, 95%CI: 0.46, 0.79), Harm (1.36, 95%CI: 1.02, 1.81) and PSM (1.27, 95%CI: 1.03, 1.55) among 742 Chinese patients with CHD, hypertension and T2DM. 4) Two additional factors of the e-BMQ, Trust in medicines (0.65, 95%CI: 0.42, 0.99) and beliefs about TCM (2.15, 95%CI: 1.02, 4.53), showed significant correlations with low adherence in diabetic patients and TCM users, respectively.

Conclusion

The expanded BMQ appears to be a validated measurement to assess beliefs about medicines in the Chinese population that gives insight into why low adherence occurred.

Impact statement

Chronic diseases have become the leading threats to public health in China. The Chinese government and researchers have paid more attention to disease management in recent years. Medication non-adherence has been widely recognised as a factor reducing the treatment efficacy and is a key element in chronic disease management. Beliefs about medicines are one of the most widely researched determinants of adherence outside of China; however, little is known about beliefs about medicines and its impact on medication non-adherence in China. This PhD project filled this research gap.

The work presented in this thesis has the potential to be put to beneficial use both inside and outside academia. Inside academia, our findings contribute to the limited knowledge in this area. The Beliefs about Medicines Questionnaire (BMQ) was confirmed as a useful tool in the Chinese population. The PhD project also highlighted the predictive effect of beliefs about medicines in medication non-adherence in China. These results were presented in several important academic conferences, including the 34th International Conference on Pharmacoepidemiology and Therapeutic Risk Management, the 11th Asian Conference on Pharmacoepidemiology and the 5th Annual Conference of the European Association of Psychosomatic Medicine. The presentation attracted the international counterparts' attention and obtained high praise. Future studies in China could use the results of this PhD research as a base, and adapt the Chinese BMQ for other treatments, such as injected medicines, inhaler and complementary medicines.

Outside of academia, the findings of this PhD project could support disease management in clinic practice. Healthcare providers may be able to use the BMQ tool to identify patients who are at high risk of low adherence. Therefore, a patient-centred intervention can be planned and implemented to support adherence. This PhD study provided more awareness of factors leading to non-adherence, and the development of ways of supporting patients to adhere is likely to have an impact on patient health and wellbeing. Some big general hospitals have shown their interests in this PhD work and are willing to be involved in future studies. Moreover, as the first study assessed Chinese people's beliefs about medicines and adherence via an online platform, this PhD project preliminarily examined the feasibility of the online BMQ in a Chinese population. Compared with the traditional questionnaire survey, the online survey was an efficient and cost-efficient way of asking people how about their medication beliefs and use. During the data collection stage of our online survey, I had some initial contacts with two provincial centres for disease control and prevention. Future studies aiming to generalise our findings to broader sample groups are likely to get support from these departments.

Publications and presentations arising from this PhD

- **Peer-reviewed article**

Nie, B., Chapman, S. C., Chen, Z., Wang, X., & Wei, L. (2019). Utilization of the beliefs about medicine questionnaire and prediction of medication adherence in China: a systematic review and meta-analysis. Journal of psychosomatic research, 122, 54-68. https://doi.org/10.1016/j.jpsychores.2019.03.184.

- **Conferences abstracts**

Nie, B., Chapman, S., Chen, Z., Wang X., Wei, L. Utilization of the Beliefs about medicine Questionnaire and Prediction of Medication Adherence in China: A Systematic Review and Meta-Analysis. 11th Asian Conference on Pharmacoepidemiology (Xi-an, October 2018): Poster presentation, Conference scholarship recipient.

Nie, B., Wei, L., Chapman, S. Beliefs about medicines and nonadherence in patients with coronary heart disease, hypertension, type 2 diabetes mellitus: A cross-sectional online survey in China. 34th International Conference on Pharmacoepidemiology and Therapeutic Risk Management (Prague, August 2018): Spotlight session poster presentation, Conference scholarship recipient.

Nie, B., Chapman, S., Wei, L. Chinese patients' beliefs about medicines: a qualitative study in Jiangsu China. 5th Annual Conference of the European Association of Psychosomatic Medicine (Barcelona, August 2017): Oral presentation, UCL conference travelling grant recipient.

- **Manuscripts in preparation**

Nie, B., Wei, L., Wang, X., Chapman, S. Cognitive representations of medicines amongst Chinese patients with CHD, hypertension and T2DM: a qualitative study in Jiangsu China.

Nie, B., Chapman, S., Wang, X., Wei, L. Associations between Beliefs about Medicines, Perceived Sensitivity to Medicines, Illness Perceptions and Medication Adherence: A Cross-Sectional Online Survey in China.

Nie, B., Wei, L., Wang, X., Chapman, S. A factor analytic validation of an extended Chinese version of the Beliefs about Medicines Questionnaire.

- **Publications related to this PhD work**

Wei, L., Chapman, S., Li, X., Li, S., Chen, R., Nie, B., . . . Horne, R. (2017). Beliefs about medicines and non-adherence in patients with stroke, diabetes mellitus and rheumatoid arthritis: A cross-sectional study in China. BMJ Open, 7(10), e017293.

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List of abbreviations

ACEI	Angiotensin converting enzyme inhibitor
ARB	Angiotensin receptor blocker
BAASIS	Basel Assessment of Adherence with Immunosuppressive medication Scales
BG	Blood glucose
B-IPQ	Brief Illness Perception Questionnaire
BMIUE	Basic Medical Insurance for Urban Employee
BMIUR	Basic Medical Insurance for Urban Resident
BMQ	Beliefs about Medicines Questionnaire
BMQ-G	General subscale of BMQ
BMQ-S	Specific subscale of BMQ
BP	Blood pressure
CCB	Calcium-channel blockers
CFA	Confirmatory factor analysis
CHD	Coronary heart disease
CI	Confidence interval
CRM	Cognitive representations of medicines
CSM	Common-sense Model
DoB	Date of birth
e-BMQ	Expanded version of BMQ
e-BMQ-G	Expanded version of general subscale of BMQ
e-BMQ-S	Expanded version of specific subscale of BMQ
EFA	Exploratory factor analysis
GDP	Gross Domestic Product
HbA1c	Glycated haemoglobin/Glycosylated haemoglobin
HBM	Health Belief Model
ICWM	Integrated Chinese and Western medicine
IPQ	Illness Perception Questionnaire
KMO test	Kaiser-Meyer-Olkin test
MARS-5	Medication Adherence Report Scale 5-item version
MCS	Medical Compliance Scale
MI	Myocardial infarction
MMAS-4/-8	Morisky Medication Adherence Scale 4-/8-item version
MOOSE	Meta-analysis of Observational Studies in Epidemiology
NCD score	Necessity-Concerns differential score

NCF	Necessity-Concerns Framework
NHS	National Health System
NICE	National Institute for Health and Clinical Excellence
NRCMS	New Rural Cooperative Medical System
OR	Odds ratio
PaPA	Perceptions and Practicalities Approach
PCA	Principal Component Analysis
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PSM	Perceived Sensitivity to Medicines
RCT	Randomised controlled trial
RMSEA	Root mean square error of approximation
SD	Standard deviation
SRT	Self-Regulatory Theory
TA	Thematic analysis
TCM	Traditional Chinese Medicine
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
T2DM	Type 2 diabetes mellitus
WHO	World Health Organization
WM	Western Medicine
VAS	Visual Analogue Scale

Part 1: Literature reviews

This part consists of three chapters:

1: The first chapter introduces the background to this thesis and reviews literature on the Chinese healthcare system, the three chronic conditions studied in this PhD work and key concepts about medication adherence.

2: The second chapter introduces the research aims and objectives of the PhD work and provide an outline of the whole thesis.

3: The third chapter is a systematic review of all quantitative BMQ studies conducted in China which evaluates associations between BMQ components and medication adherence using meta-analysis.

Chapter 1 Introduction and literature review

Chronic non-communicable diseases, such as coronary heart disease (CHD), hypertension and type 2 diabetes mellitus (T2DM), cause 41 million deaths annually, accounting for 71% of all deaths globally (WHO, 2018b). These diseases can affect people from all age groups, but particularly affect people aged over 70 (WHO, 2015b). Data from low- and middle-income countries has shown that around 85% of premature deaths appeared to be caused by chronic diseases (WHO, 2018b).

As the largest developing country with the largest ageing population, the People's Republic of China is facing a series of threats to public health arising from chronic diseases. In 2017, approximately 8.8 million Chinese people died from chronic diseases, accounting for 89% of the total deaths that year (WHO, 2017). For CHD, hypertension and diabetes, pharmacotherapy is the most effective treatment to control these diseases (Bernardi et al., 2015; Jorgensen et al., 2014; Lindhardsen et al., 2012). Therefore, correctly taking the therapeutic regimen as instructed is essential for disease management. However, many people do not take their medicine as prescribed, often because of beliefs about medicines such as doubts about medication benefits or concerns about potential adverse effects. This PhD focused on medication-related beliefs and behaviour in Chinese patients with CHD, hypertension and T2DM.

1.1. Overview of the Chinese healthcare system

1.1.1. Healthcare facilities and services

China has a population of 1.4 billion. In 2018, there were 3,607,156 certified doctors, 4,098,630 nurses, 467,685 pharmacists and 907,098 village medical practitioners operating in mainland China (National Health and Family Planning Commission of the PRC, 2019). National healthcare services are provided by hospitals, primary healthcare institutions and specialised healthcare facilities. In 2018, there were a total of 33,009 hospitals in mainland China, including 19,693 general hospitals, 4,939 Chinese medicine hospitals, 7,900 specialist hospitals, and 477 nursing homes (National Health and Family Planning Commission of the PRC, 2019). These hospitals undertook most inpatient treatment with 6.5 million ward beds, accounting for 77.6% of total ward beds in China. Additionally, 943,639 primary healthcare institutions play an essential role in disease prevention and primary treatment in communities and rural areas (National Health and Family Planning Commission of the PRC, 2019).

Depending on the type of medical services provided, the healthcare facilities in China can be briefly classified into two types: western medicine facilities mainly provide allopathic medicine services; Chinese medicine facilities mainly provide traditional medical services. As an important component of the national healthcare system, there were 60,696 Chinese medicine facilities in mainland China in 2018, consisting of 3,977 traditional Chinese medicine (TCM) hospitals, 650 integrated Chinese and Western medicine (ICWM) hospitals, 312 minority medicine hospitals and 55,757 specialised TCM/ICWM clinics (National Health and Family Planning Commission of the PRC, 2019). These institutions treated 1.1 billion outpatient visits annually, 16.1% of these patients consumed TCM service. Additionally, 3,986 general hospitals and 17,465 primary healthcare institutions also provided TCM services. In 2018, registered TCM doctors and pharmacists accounted for 16.0% and 26.5%, respectively, of the total number of doctors and pharmacists in China (National Health and Family Planning Commission of the PRC, 2019). Systematic reviews have found that TCM has played an essential role in the treatments of chronic diseases, such as CHD, hypertension and diabetes. (Layne & Ferro, 2017; Pandey et al., 2011; Yuwen et al., 2018).

1.1.2. Health expenditure and social medical insurance

According to the source of funding, health expenditure in China is divided into three categories (social expenditure, government investment and out-of-pocket payment). In 2018, the total annual health expenditure was ¥5.9 trillion (about £0.7 trillion) (National Health and Family Planning Commission of the PRC, 2019). Since 1980, the Chinese government has made several efforts to improve healthcare services. The annual healthcare expenditure per capita grew from ¥14.5 (about £1.6) in 1980 to ¥4,237.0 (about £464.6) in 2018 without considering inflation (National Health and Family Planning Commission of the PRC, 2019). Moreover, the percentage of government health expenditure in Gross Domestic Product (GDP) increased from 1.0% in 1990 to 1.8% in 2018. By 2012, China has established a universal Basic Social

Medical Insurance System, which contains three separate schemes for urban employees, unemployed urban residents and rural residents, covering around 95% of the population (Blumenthal & Hsiao, 2015). An additional reimbursement scheme for 34 kinds of chronic diseases also came into effect after 2009 (Jiang et al., 2012). However, these schemes do not cover many healthcare expenditures, so patients still commonly pay significant proportions of their healthcare costs out-of-pocket.

1.1.3. China's healthcare challenges

While China has made impressive achievements in the public healthcare area in the past decades, the Chinese healthcare system confronts several challenges. First, although the total health expenditure has increased about 16-fold over the past 20 years, health spending per capita was still inadequate. According to the data from the World Bank (World Bank, 2018), the health spending per capita in China was $440.8 (about £355.6) in 2017, which was far lower than the average value of $1,101.4 (about £888.4) of 180 countries in that year. In 2016, China's health expenditure as a share of the GDP was about 5%-6%, which was lower than that in many Asian countries (National Health and Family Planning Commission of the PRC, 2019; WHO, 2019).

Second, individual healthcare expenditure is a major impediment for low-income and rural populations needing to access healthcare. Different from the countries employing the single-payer system (e.g. NHS in the UK), China implemented a mix of public insurance models, in which people enrolling on the Basic Social Medical Insurance schemes still need to pay part of their treatment costs by themselves, termed as out-of-pocket payment (La Forgia & Burns, 2017). The proportion of out-of-pocket payments in the total treatment costs peaked at 59% in 2000 and decreased to 28.6% in 2018 (National Health and Family Planning Commission of the PRC, 2019). This proportion needs to be further decreased if the government is committed to protecting patients from overwhelming medical costs (La Forgia & Burns, 2017; World Bank, 2011).

Third, the investment and distribution of healthcare resources are inequitable across geographic regions. In 2016, the health spending per urban resident was ¥4,471.5 (about £509.7), compared with only ¥1,846.1 (about £210.4) per rural resident. In 2018, there were 8.7 ward beds per 1,000 people in urban health institutions, which is 1.9 times as much as the figure in rural health institutions. Likewise, the ratio of healthcare professionals (registered doctor and nurse) per 1,000 people in urban areas was more than twice that it in rural areas (10.9 per 1,000 people versus 4.6 per 1,000 people) (National Health and Family Planning Commission of the PRC, 2019). In addition to this urban-rural gap, interprovincial disparities are also stark. High-quality medical resources are concentrated in economically developed areas, such as coastal provinces in eastern China (J. Jin et al., 2015; National Health and Family Planning Commission of the PRC, 2019; Sun & Luo, 2017).

Fourth, a rapidly ageing population and increasing epidemics of non-communicable diseases have raised the demand for healthcare. The elderly population (aged 60 or over) is forecast to increase from 209 million in 2015 to over 358 million in 2030, accounting for 21.8% and 14.8% of the total population in rural and urban areas, respectively (United Nations, 2015; WHO, 2015b). In 2013, more than 100 million older Chinese people had at least one non-communicable diseases (Wang & Chen, 2014). If the epidemic of non-communicable diseases, such as CHD, hypertension and diabetes, cannot be controlled, the healthcare burden from these diseases is expected to increase by about 40%-50% by 2030 (World Bank, 2011).

1.1.4. Health China 2030 Plan and strategies to address healthcare challenges

To respond to these healthcare challenges, the Chinese government initiated healthcare reforms in 2009 and launched an ambitious Health China 2030 Plan in 2016 (Central Committee of the CPC & State Council of the PRC, 2016). The core health targets set by the guidelines for 2030 include 1) the average life expectancy will increase to 79 years old; 2) the percentage of the personal out-of-pocket payment in medical expenditure will drop down to less than 25%; 3) premature mortality caused by chronic non-communicable diseases will reduce by 30% relative to 2015 levels. Moreover, a series of goals specific to the prevention and treatment of non-communicable diseases were set in China's National Medium- and Long-Term Plan (State Council of the PRC, 2017). The goals set for delivery by 2025 include: 1) mortality from cardiovascular disease will decrease by 15% from 2017 levels (241.3 per 100,000 people); 2) the number of hypertensive patients receiving effective treatment will increase from 88 million to 110 million; 3) the number of diabetic patients receiving effective treatment will increase from 26 million to 40 million; 4) the proportion of patients with hypertension and diabetes who are effectively self-managing their condition will increase from 50% to 70%; 5) The uptake of TCM as part of their healthcare among patients aged 65 or over will increase from 45% to 80%.

To achieve the above goals, the government set up some specific strategies to intervene in health-influencing factors, protect health across the lifespan, and prevent and control major diseases. Non-communicable diseases, such as cardiovascular disease, diabetes, cancer, chronic respiratory disease, and diabetes, are central to these strategies for disease prevention and treatment. Some new initiatives related to this PhD work included: 1) promoting the development of new techniques in the healthcare industry - especially the use of mobile internet technology for tele-medical services, big-data research and patient monitoring; 2) establishing a national-level healthcare information platform, enabling to share the relevant resources and data between public health policymakers, clinical practitioners, medical researchers and medication suppliers; 3) conducting the health education to guide patients effectively managing their chronic conditions through healthy lifestyle and correct use of medication; 4) emphasising the role of primary healthcare institutions in pre-diagnosis, risk assessment, following-up and disease management of the non-communicable disease; 5) promoting the modernisation of TCM and reinforcing TCM’s leading role in prevention, supporting role in major disease treatment and central role in recovery (Central Committee of the CPC & State Council of the PRC, 2016; State Council of the PRC, 2017).

This PhD work fitted well with the above national health strategies. First, the government encourages the application of internet and big-data research in the healthcare area fitting with this PhD in which I developed an online survey. This simple and efficient data collection method may be able to help clinicians, especially those in the primary healthcare, understand patients' situations and optimise the drug delivery. The government also emphasised the importance of self-management in healthcare and disease treatment. Cognitions related to treatment (the focus of this PhD work) have been shown to be important in other populations for successfully engaging with treatment and also have been found to be modifiable by interventions to promote self-management. Finally, I considered how these cognitions were affected by combining the use of TCM and western medicines (WM). This reflects how patients often use medication in China and relevant to the goal of promoting the utilisation of TCM.

1.2. CHD, hypertension and T2DM in China

1.2.1. Coronary heart disease

Coronary heart disease, also referred to as 'coronary artery disease' or 'ischaemic heart disease', is caused by the narrowing or blockage of the coronary arteries by a gradual build-up of fatty material (atheroma) (British Heart Foundation, 2015). If there is a sufficient extent of coronary artery blockage, it can lead to impaired supply of oxygen-containing blood to the myocardium causing angina and myocardial infarction (MI). Angina, which manifests as chest pain, is the early warning sign of CHD. Pain typically occurs when coronary arteries are partially blocked and may spread to the arm, neck, jaw, face, back or stomach (Townsend et al., 2012). If the arteries are completely blocked, the myocardium tissue becomes permanently damaged, causing MI, or heart attack in lay terms. The symptoms of MI may resemble those of angina, but usually are more severe. Patients may also experience dizziness, faintness, nausea, pain in other parts of the body and shortness of breath (Falk, 2007; NHS, 2017). However, some silent MIs occur very quickly and without any symptoms and so are very dangerous (Dörr, 2010).

The sixth national population census showed that China has approximately 11.4 million patients (aged 15 or over) with CHD. According to the data from the 5th National Family Health Survey, the overall prevalence of CHD among people (aged 15 or over) was 1.2% in urban areas and 0.8% in rural areas (National Center for Cardiovascular Disease, 2017). Moreover, CHD is the second leading cause of death in China and accounted for 19.1% of total deaths in 2018 (National Health and Family Planning Commission of the PRC, 2019). ***Table 1-1*** shows that mortality in males was higher than females in both urban and rural areas (National Health and Family Planning Commission of the PRC, 2019).

Table 1-1 CHD mortality in urban and rural areas by gender (per 100,000 people) in 2018 (National Health and Family Planning Commission of the PRC, 2019)

	Urban			Rural		
	Total	Men	Women	Total	Men	Women
Overall CHD	120.2	123.9	116.4	128.2	132.6	123.7
Acute myocardial infarction	62.3	67.8	56.7	78.5	84.2	72.5

Reducing blood pressure (BP) and widening arteries are the two primary targets of pharmacological treatment for CHD. The most common medicines for CHD are classified into several categories based on their mechanisms (Falk, 2007; Fihn et al., 2012):

- **Angiotensin-converting enzyme inhibitor (ACEI) and angiotensin receptor blocker (ARB):** The angiotensin-converting enzyme can reduce the production of angiotensin II, increase the activity of bradykinin (a peptide that dilates blood vessels and causes the contraction of smooth muscles), and consequently increase BP. ACEI and ARB can eliminate this effect and make the blood vessels relax and widen.
- **Anti-platelet medicines** (e.g. aspirin) **and anticoagulant medicines:** These medicines can help prevent harmful blood clots from forming.
- **Beta-blockers:** This medicine acts by slowing the heart rate, lowering BP and reducing the workload of the heart. It is very effective in preventing episodes of angina but works very slowly.
- **Calcium-channel blockers (CCB):** These medicines can relax and widen the coronary arteries by reducing the amount of calcium entering the heart muscle cells, hence providing better blood supply to the heart.
- **Cholesterol-lowering medicines:** These are used to lower the total amount of cholesterol in the blood, particularly low-density lipoprotein, which is a ‘bad’ type of cholesterol and can increase the risk of arteriosclerosis, stroke and myocardial

infarction.

- **Nitrates or vasodilators:** These can improve oxygen supply to the heart by relaxing the muscles in the walls of blood vessels.

1.2.2. Hypertension

Hypertension, or high blood pressure, develops when the walls of the larger arteries lose their natural elasticity and become rigid, and the smaller blood vessels become narrower (NICE, 2011; Thompson, 2015). Hypertension can be categorised into primary hypertension and secondary hypertension. Primary hypertension, also known as essential hypertension, is not caused by a comorbid medical condition but may be due to some risk factors as family history or lifestyle. Secondary hypertension results from use of certain medicines or comorbid disease and is commonly seen in kidney disease, endocrine disorder and diabetes (NICE, 2011; Thompson, 2015). The American College of Cardiology and the American Heart Association lowered the diagnostic criteria in 2017 (Whelton et al., 2018), most other countries, including the UK and China, still use the old cut-off points for defining when blood pressure is sufficiently high for a diagnosis of hypertension and subsequent treatment. In the latest version of *Guideline for Prevention and Control of Hypertension* (Chinese Society of Cardiology of Chinese Medical Association, 2018), people whose systolic BP is equal to or over 140 mm Hg and/or whose diastolic BP is equal to or over 90 mm Hg can be considered to have hypertension.

One recent national hypertension survey indicated that the prevalence of hypertension among Chinese adults was between 23.2% and 27.9% (Revision Committee of Chinese guidelines for hypertension prevention and treatment, 2018; Wang et al., 2018). The results of the China Health and Nutrition Survey (Zhang et al., 2014) showed that the prevalence of hypertension was 10.0% for 18-44 years old, 34.7% for 45-59 years old and 57.0% for 60 years old and over. Moreover, the prevalence in urban areas was slightly higher than that in rural areas (26.8% vs 23.5%, respectively). In 2016, hypertension was estimated to cause about 2 million premature deaths annually and to be responsible for at least 50% of deaths from MI and 70% of deaths from stroke (National Center for Cardiovascular Disease, 2017). The overall mortalities of all hypertension-related diseases were 69.7 per 100,000 people in urban areas and 97.3 per 100,000 people in rural areas. Men had higher mortalities than women from most hypertension-related conditions (National Health and Family Planning Commission of the PRC, 2019).

Although hypertension has become a severe health threat to many Chinese people, the awareness, treatment and control rates among hypertensive patients were 19.8%, 83.6% and 45.0%, respectively (Chen & Yuan, 2018), indicating disease management is far from optimal. As controlling BP is one of the treatments for CHD, the therapeutic regimens of hypertension and CHD are relatively similar (Thompson, 2015; Whelton et al., 2018). More details of ACEI, ARB and CCB can be found in the CHD section.

- **ACEI** includes Enalapril, Lisinopril, Perindopril, and Ramipril.

- **ARB** includes Candesartan, Irbesartan, Losartan, and Valsartan.
- **Beta-blockers** are considered to be less effective than others used to treat high BP. Carvedilol, Metoprolol, Sotalol and propranolol are the most commonly used beta-blockers (G. W. Wong et al., 2015).
- **CCB** includes Amlodipine, Nifedipine, and Lacidipine.
- **Diuretics** are also called ‘water tablets’ because they remove excess water from the body. Diuretics act on the kidneys to increase the output of water and salt in the urine, which helps to relax the blood vessel walls. Certain diuretics given at a lower dose can help to lower BP. The four common types are thiazide diuretics, loop diuretics, potassium-sparing diuretics, and quinazoline diuretics (Blowey, 2016).

1.2.3. Diabetes mellitus

Diabetes mellitus is a chronic, progressive metabolic disorder which occurs when the pancreas cannot produce enough insulin to function properly, or when the body’s cells do not react to insulin (WHO, 2006, 2016). The major characteristics of diabetes mellitus include raised blood glucose (BG), thirst, frequent hunger, excessive urination, weight loss and blurred vision. Moreover, untreated diabetes can lead to kidney disease, retinopathy, amputation, and fatal diabetic ketoacidosis. According to the latest diagnosis criteria from the American Diabetes Association (2018), if a person has a fasting plasma glucose higher than 6.9 mmol/L (125 mg/dL) or 2-hour plasma glucose higher than 11.1 mmol/L (200 mg/dL), they can be diagnosed as having hyperglycaemia, and they may have diabetes. Moreover, the WHO (2011) and the International Expert Committee (Nathan, 2009) also suggested using glycated haemoglobin (HbA1c) with a cut-off level of 6.5% as a criterion. It reflects the average BG levels for the previous two to three months and is considered to be reliable evidence of diabetes.

In 2013, a national diabetes survey with a sample of 170,287 participants found that the overall estimated prevalence of diabetes in the Chinese adult population was 10.9% (95% CI: 10.4%, 11.5%) (Wang et al., 2017). ***Table 1-2*** shows that the prevalence of diabetes in three age groups were 5.9% (under-40s), 12.9% (40-59 years old) and 20.2% (over-60s), respectively. Men had a higher prevalence in prediabetes and undiagnosed groups. People living in urban areas showed a higher prevalence in diabetes groups and a lower prevalence in the prediabetes group than those in rural areas (see ***Table 1-2***). In 2016, mortalities from diabetes amounted to 18.4 per 100,000 people in urban areas, and 14.6 per 100,000 people in rural areas (National Health and Family Planning Commission of the PRC, 2019). According to the most recent statistics (Chinese Diabetes Society, 2018; Hu & Jia, 2018; Weng et al., 2018), T2DM, formerly called non-insulin-dependent diabetes, is estimated to account for the vast majority, 90%-95%, of all diabetes cases in China. Therefore, diabetic patients in the present study were specific to the patients with T2DM.

Table 1-2 Prevalence rate of diabetes and prediabetes among Chinese adults in 2013 (Wang et al., 2017)

	Total diabetes	Diagnosed diabetes	Undiagnosed diabetes	Prediabetes
Age (years)				
<40	5.9 (5.1, 6.6)	1.3 (1.0, 1.7)	4.5 (4.1, 4.9)	28.8 (26.8, 30.9)
40-59	12.9 (12.3, 13.5)	5.0 (4.7, 5.4)	7.8 (7.5, 8.1)	39.5 (37.8, 41.2)
≥60	20.2 (19.1, 21.2)	8.8 (8.0, 9.5)	11.4 (10.8, 12.0)	45.8 (44.3, 47.2)
Sex				
Men	11.7 (10.9, 12.4)	3.9 (3.5, 4.3)	7.7 (7.4, 8.1)	36.4 (34.6, 38.2)
Women	10.2 (9.7, 10.7)	4.1 (3.7, 4.4)	6.1 (5.9, 6.4)	35.0 (33.4, 36.7)
Location				
Urban	12.6 (11.7, 13.6)	5.4 (4.8, 6.1)	7.1 (6.8, 7.5)	34.3 (32.3, 36.3)
Rural	9.5 (9.0, 10.1)	2.8 (2.5, 3.0)	6.8 (6.4, 7.1)	37.0 (35.0, 38.9)

Prevalence rate was presented as percentage (95% CI).

The early detection of diabetes can decrease the possibility of further complications. However, many diabetes patients are asymptomatic that results in underestimating the severity of their disease. In 2013, the awareness, treatment and BG controlled rates among people with diabetes were only 36.5% (95% CI: 34.3%, 38.6%), 32.2% (95% CI: 30.1%, 34.2%) and 49.2% (95% CI: 46.9%, 51.5%), respectively (Wang et al., 2017). Diabetes is therefore often poorly managed and has been estimated to cost \$9.1 billion (about £7.1 billion) for disease treatment and prevention in China (Hu et al., 2015).

Treatment of diabetes most commonly involves oral hypoglycaemic drugs and injected insulin although other treatments such as bariatric surgery are available. A literature review (Tran et al., 2015) and recent guidelines (NHS, 2014; WHO, 2018a) list seven distinct categories of pharmacologic medications which are available. Metformin, sulphonylureas, acarbose and injectable insulin are the first-line treatment in China (Parkin, 2015):

- **Metformin** is usually the first to treat T2DM. It can improve the sensitivity of the body's cells to insulin and reduce the amount of glucose released by the liver.
- **Sulphonylureas** work by increasing the amount of insulin produced by the pancreas. Common sulphonylureas include glibenclamide, gliclazide, glimepiride, glipizide, and gliquidone.
- **Acarbose** works by slowing down the rate at which the digestive system breaks carbohydrates down into glucose. It can prevent the BG level from increasing too much after eating.
- **Thiazolidinediones** also improve the body's sensitivity to insulin and are usually used as a combination with metformin and/or sulphonylureas.
- **Gliptins** work by increasing the levels of GLP-1 hormones, which help the body produce more insulin in response to high BG levels.
- **SGLT2 inhibitors,** such as canagliflozin, dapagliflozin and empagliflozin, can reduce the amount of glucose absorbed in the kidneys and pass the excess glucose out via urine.
- **Nateglinide and repaglinide** can stimulate the release of insulin by the pancreas. However, they are not commonly used due to a short efficacy duration.
- **Insulin** is a hormone which helps the body use glucose for energy. There are several categories of insulin, including rapid-acting analogues (to be taken before eating), long-acting analogues (normally to be injected once or twice a day), and mixed insulin (a combination of medium- and short-acting insulin).

1.2.4. Rationales of focusing on patients with CHD, hypertension and T2DM

This PhD work focused on patients with CHD, hypertension and T2DM for three reasons.

Firstly, these three conditions are the leading non-communicable disease to the Chinese population. Both hypertension and diabetes have a high prevalence in China. According to previous studies, the average standardised prevalence of hypertension between 2012 and 2015 was 23.2% (Revision Committee of Chinese guidelines for hypertension prevention and treatment, 2018; Wang et al., 2017), and the estimated prevalence of diabetes and prediabetes were 10.9% and 35.7%, respectively (Chinese Diabetes Society, 2018). The prevalence of CHD is not as high as that of hypertension and T2DM; however, it is the second biggest killer in China, slightly after cancer and malignant tumours, and threatens 11.4 million patients' lives (National Center for Cardiovascular Disease, 2017).

Secondly, these three conditions cause huge economic losses to healthcare systems and patients. In 2013, the medical costs for hypertension alone totalled approximately ¥210 billion (about £24 billion), accounting for 6.6% of the total health expenditure in that year (National Center for Cardiovascular Disease, 2017). Beyond this, the indirect loss of income due to these conditions reached $550 billion (around £432.2 billion) in China between 2000 and 2010 (Bloom, 2011; WHO, 2005). The WHO estimated that about 80% of cardiovascular disease and T2DM are preventable if their risk factors can be reduced (WHO, 2013a). The World Bank has announced that if China can reduce the mortality from cardiovascular disease by 1% per year from 2010 to 2040, the generated economic value would be equivalent to $10.7 trillion (about £8.4 trillion) (World Bank, 2011).

Thirdly, these three conditions have strong associations with each other. Hypertension and diabetes are the main risk factors for CHD. For example, raised BP can increase the risk of CHD three to fourfold, and overall cardiovascular risk two to threefold (Escobar, 2002; WHO, 2003). In China, about 50% of myocardial infarctions were attributable to hypertension, and approximately 87% of cardiovascular disease patients had hypertensive BP (National Center for Cardiovascular Disease, 2017). Hypertension is also a common complication of diabetes, affecting about 20% to 60% of afflicted patients. In one epidemiology study, each 10-mmHg decrease in mean systolic BP could reduce 12% of risks for any complication and 15% of risks for deaths related to diabetes (American Diabetes Association, 2003).

1.3. Medication adherence

1.3.1. Compliance, concordance and adherence

Historically, several terms have been used to describe the behaviour of taking medication as prescribed. Three most commonly used terms are compliance, concordance and adherence.

- **Compliance** is defined as ‘the extent to which the patient’s behaviour matches the prescriber’s recommendations’ (Haynes, 1979). It was commonly used in the medical and pharmaceutical literature. However, the term ‘compliance’ cannot express the patients play the principal part in medication-taking and implies that patients should passively accept doctors' advice (Bosworth et al., 2006).

- **Concordance** is a more recent concept, which is defined as 'an agreement reached after negotiation between a patient and healthcare professional that respects the beliefs and wishes of the patient in determining whether, when and how medicines are taken' (Marinker, 1997). It avoids the negative connotation of patients passively accepting doctors' advice and interprets behaviour more neutrally. However, if patients come to an agreement with their doctors but do not do as promised, we can say they are concordant, but they do not follow prescriptions. Therefore, concordance cannot accurately express actual behaviour (Lehane & McCarthy, 2009).
- **Adherence** is used to indicate that patients do not just passively accept prescriptions, and they have the right to decide whether to follow the doctor's advice. In a WHO report (WHO, 2003), researchers merged the definitions of Haynes (1979) and Rand (1993) as 'the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a healthcare provider'. In this PhD work, I solely focused on medication-taking behaviour. At the 13th European Society for Patient Adherence, Compliance and Persistence meeting in September 2009, 60% of the 80 attendees voted 'medication adherence' as the most appropriate term to describe medication-taking behaviour. In this conference,

researchers established the uniformed definition of ‘adherence to medications’ as “the process by which patients take their medications as prescribed, composed of initiation, implementation and discontinuation” (Vrijens et al., 2012). Therefore, medication adherence was used throughout this PhD work.

1.3.2. Taxonomies of non-adherence

Contrary to adherence, patients who do not follow the prescription or advice are described as ‘non-adherence’. There are several taxonomies categorising medication non-adherence into different types.

1.3.2.1. Primary and secondary non-adherence

Primary non-adherence refers to a patient’s failure to take an initial prescription from a pharmacy in the first place (Raebel et al., 2013). It can be caused by many reasons, such as an unaffordable expense, an unsatisfactory treatment regime or an inaccessible pharmacy. Secondary non-adherence occurs when a patient obtains the first fill of medication but does not refill the subsequent prescriptions or takes the medication improperly (Adams & Stolpe, 2016). More specifically, secondary non-adherence can be further classified into five subtypes (Jin et al., 2008), including changing the medication dosage, changing the frequency, taking medication at the wrong time, stopping the treatment too early, and delaying a subsequent prescription.

1.3.2.2. Full and partial non-adherence

According to the extent of coincidence between medication-taking behaviour and given prescription, non-adherence was also described as full non-adherence or partial non-adherence in some studies (Masand et al., 2009; Olivares, Alptekin, et al., 2013; Olivares, Thirunavukarasu, et al., 2013; Pappa & Mason, 2020). The full non-adherence refers to not taking any prescribed doses. Likewise, full adherence refers to taking all doses as prescribed. The partial adherence refers to all other patterns (Masand et al., 2009). However, since full adherence is rare and only applies to a limited proportion of patients, partial non-adherence was regarded as acceptable in some studies (Masand et al., 2009; Susic et al., 2008). According to Haynes's empirical definition (Haynes et al., 1980), correctly taking ≥80% of medication was regarded as sufficient adherence, while 70% and 90% were also selected as thresholds sometimes (Llorca, 2008; Olivares, Alptekin, et al., 2013; Olivares, Thirunavukarasu, et al., 2013). Therefore, simply dichotomising as full or partial non-adherence is less help to describe whether patients meet therapeutic goals. Moreover, the disparity of cut-offs led to the difficulty of comparisons of non-adherence across conditions and treatments (Lam & Fresco, 2015).

1.3.2.3. Vrijens's taxonomy of non-adherence

Vrijens (2012) and colleagues conducted a consensus panel to address variation in the terminology used to describe adherence. They divided adherence to medications into three phases: 'Initiation', 'Implementation' and 'discontinuation'. 'Initiation' of treatment occurs when starting to take the first dose of prescribed medication. 'Discontinuation' refers to patients taking the last dose, and no more dose will be taken after that. The extent that the patient's actual dosing regimen corresponds to the prescribed dosing regimen between 'Initiation' and 'discontinuation' is termed 'implementation' (Vrijens et al., 2012). Consequently, non-adherence can be described as late or non-initiation of the treatment, inappropriate implementation of the dosing regimen, or early discontinuation of the treatment. This taxonomy describes and conceptualises the non-adherence based on the timeline of medication-taking behaviour. In this PhD work, I did not seek to understand how adherence varied over time, just why non-adherence occurs. Therefore, I focused on the 'implementation' aspect instead of investigating all aspects of non-adherence. All patients involved in my study were current medication users and were prescribed long-term medication, non-initiation and discontinuation of the treatment were not significant issues for the present study. Moreover, compared with non-initiation and discontinuation, suboptimal implementation of the prescribed regimen is the most common form of non-adherence in patients with chronic disease (Vrijens et al., 2017). In a cohort of 16,907 participants derived from 95 clinical studies, only 4% of patients never initiated treatment (Blaschke et al., 2012). In another retrospective cohort study involving 21,326 hypertension patients, between 54% and 75% of patients initiated a second course of treatment after initial discontinuation within a year (Bourgault et al., 2005). Additionally, the implementation issues could be assessed using the validated Medication Adherence Report Scale (MARS) (Horne & Weinman, 1999), while there is no self-reported measure of non-adherence assessing all aspects of adherence within Vrijens' taxonomy.

1.3.2.4. Intentional and unintentional non-adherence

According to the degree of volition, non-adherence can be thought of as intentional or unintentional (Wroe, 2002). Intentional non-adherence arises when patients decide not to take the prescribed medication for a deliberate purpose. Whereas, unintentional non-adherence occurs when the patient wants to follow the agreed treatment but is prevented by some barriers beyond their control (Nunes, 2009). Therefore, these two types of non-adherence can be simply summarised as 'don't want to adhere' (intentional) and 'not able to adhere' (unintentional).

Horne analysed the causes of intentional/unintentional non-adherence using a Perceptions and Practicalities Approach (PaPA), in which the perceptual barriers (e.g. beliefs, knowledge, experience and preference) impact individuals' motivation, and practical barriers (e.g. carelessness, difficulties in understanding the instructions and resource limitations) impact individuals' ability (Horne et al., 2019; Horne et al., 2005) (see **Figure *1-1***). The PaPA suggests that low motivation is the primary cause of the intentional non-adherence, and unintentional non-adherence is mainly caused by lacking ability to engage the treatment.

There were several rationales for choosing this model to describe non-adherence within the current PhD. Firstly, compared with other taxonomies introduced before, the intentional/unintentional taxonomy focuses on the reason for rather than the extent and the occurrence timeline of non-adherence. Perceptual barriers and causes of intentional non-adherence were the focus of this PhD study. Secondly, the PaPA provides insight into patients' active role in medication-taking behaviour, indicating that patients do not always passively implement the doctor's regimen. Thirdly, the PaPA is a simple framework which is easy for clinicians to understand and apply, and was recommended by the NICE guideline for intervention development and appraisal (Nunes, 2009).

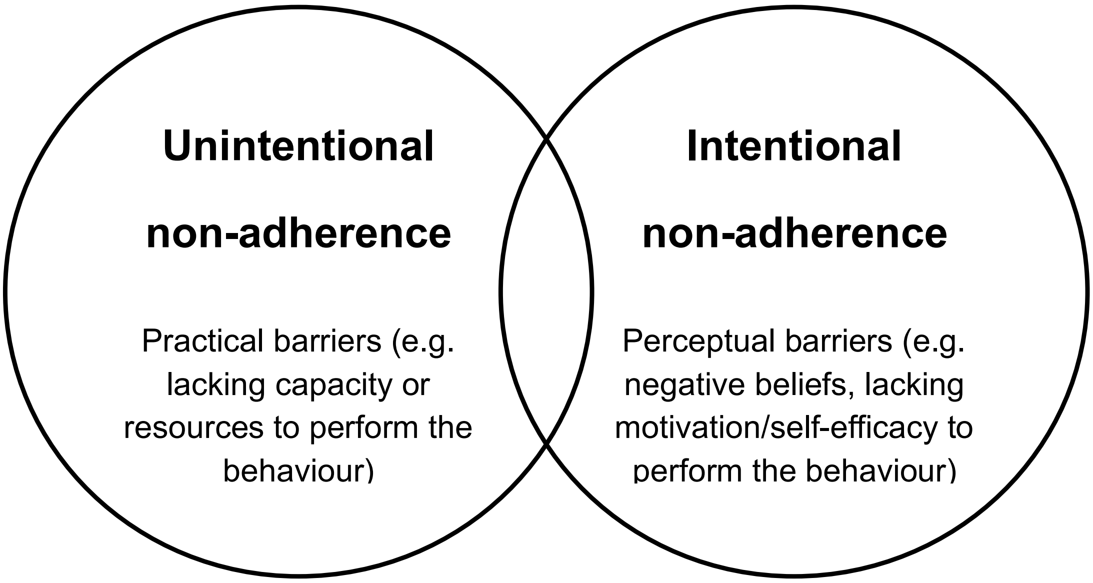


Figure 1-1 Perceptions and Practicalities Approach (PaPA) adapted from *Horne et al. (2005)*

1.3.3. Variation in measures used to assess non-adherence

An accurate assessment is essential to understand the magnitude of medication non-adherence. It enables researchers to describe the relations between determinants and adherence and evaluate the effects of an intervention on improving adherence. A variety of measurements, such as self-reporting, clinician assessments, pill counting, electronic monitoring and pharmacy refill, have been reported in previous studies

(Lam & Fresco, 2015). These measurements were categorised as subjective or objective according to their operational definitions (WHO, 2003).

1.3.3.1. Subjective measures

Subjective measurements require judgements of adherence from patients or healthcare professionals (Velligan et al., 2007). Self-report and clinician assessment are the two most common subjective measures. Self-report measures can be conducted via written questionnaires, online survey or interviews, therefore, can be flexible and easy to use (Nguyen et al., 2014). In the past decades, numerous self-reported adherence scales were developed, such as Morisky Medication Adherence Rating Scale (MMAS) (Morisky et al., 1986), Medication Adherence Report Scale (MARS) (Horne & Weinman, 1999) and Visual Analogue Scale (VAS) (Kalichman et al., 2009). These are widely used in adherence studies (Garfield et al., 2011). However, self-reported adherence relies on the patient's memory; thus, the accuracy of results may be affected by recall bias (Sayner et al., 2015; Stirratt et al., 2015). Moreover, patients may provide an overestimate of their adherence due to embarrassment about the non-adherent behaviour (Daniels et al., 2011; Velligan et al., 2007). Clinician assessment is another common subjective measure which can be independently used or combined with self-report scales. However, previous studies found that the clinician assessment may also overestimate patients' adherence (Ciechanowski et al., 2000; Daniels et al., 2011).

1.3.3.2. Objective measures

Compared with subjective measures relying on recall and personal estimation, objective measures obtain information by calculating adherence through observed data, such as pill counts, electronic monitoring and medical records.

Counting the remaining doses of medication in the container is a common method known as ‘pill count’ (Glynn & Fahey, 2015). Through comparing the expected doses left and the actual remaining doses, researchers can calculate the volume of medication consumption. However, through this method, researchers may overestimate adherence result because it is unknown whether medication removed from the container has been taken appropriately (Whalen & Kripalani, 2009).

Electronic monitoring is another objective measurement. Daniels (2011) used an electronic monitoring device (usually a bottle cap) to record the frequency and date of opening the container. Some devices have alert features to remind patients to take medication on time, hence increasing adherence (Checchi et al., 2014). However, due to its expensive nature, it is not possible to use electronic monitoring at a population level. Moreover, patients who use electronic monitoring may be more aware that their adherence is being monitored due to the change in packaging, and so may temporarily increase adherence to meet the researcher’s expectation.

Furthermore, for chronic patients, reviewing their medical and pharmacy refill records can also be used to evaluate adherence (Krousel-Wood et al., 2009). Medical records provide details of medication prescription refill. However, the records only reflect whether medication is collected rather than the actual ingested dose.

Additionally, recent evidence showed that the concentrations of medicines and the presence of biomarkers in body fluids or hair samples are used as indirect measurements of adherence, which measure a consequence of medication-taking (Eidlitz-Markus et al., 2003; Lam & Fresco, 2015; Osterberg & Blaschke, 2005; Vitolins et al., 2018; Vrijens et al., 2017). These approaches are termed as 'invasive methods' (Tomaszewski et al., 2014; Vrijens et al., 2017). However, not all medications currently have accurate biomarkers. Also, the concentration of medication can be affected by many factors, such as diet, drug absorption, metabolism, and drug-to-drug interactions (Fialko et al., 2008).

In general, objective measures are considered to be more accurate than subjective measures. However, there is currently no 'gold standard' measure that suits all situations. All adherence measures have advantages and disadvantages. According to a consideration of cost and feasibility, I used self-reported questionnaires to assess participants' medication adherence in my cross-sectional study.

1.3.4. Prevalence of medication non-adherence in CHD, hypertension and T2DM

For most chronic diseases, pharmacotherapy is the most effective approach to reduce the impact of the disease. However, the effectiveness depends on the actual utilisation of medicines. Reviews found that about half to two-thirds chronic patients adhere to long-term therapy (Cramer, 2004; Dulmen et al., 2007). Due to differences in disease nature, therapeutic regimen, and assessment, non-adherence rates vary widely (WHO, 2003). A systematic review involving 52,008 Chinese CHD patients reported that non-adherence rates varied between 22% and 48.9% (Ni et al., 2019). In a cohort study of 203,259 Chinese hypertensive patients, the overall rate of optimal adherence was only 32.4% (M. C. Wong, W. W. Tam, et al., 2015). In some rural areas of Northern China, a non-adherence rate to hypertension medication of up to 78.7% has been reported (Ma, 2016). For diabetes mellitus, about 32.2% to 49.3% of patients did not take the medication as instructed (M. C. Wong, C. H. Wu, et al., 2015; Xin et al., 2015).

1.3.5. Consequences of non-adherence

Medication non-adherence may have a series of adverse consequences. This section gives examples of these consequences from both patient and healthcare provider's perspective.

From the patient individual's perspective, the least severe consequence is economic losses caused by drug waste. Although the relevant studies in China are limited, the annual economic loss caused by medication waste has been estimated to be more than ¥10 billion (about £1.1 billion) (People's Daily online, 2013). Moreover, poor adherence can undermine the effectiveness of the treatments and may consequently cause symptom relapse (Bosworth et al., 2006; Thompson et al., 2000; Vermeire et al., 2001). Patients who do not control their condition may have a higher risk of complications. For instance, the risk of heart attacks in patients with uncontrolled BP is 2.3 times greater than other people (Escobar, 2002). Uncontrolled BP also increases the risk of stroke and kidney failure (WHO, 2013b). For diabetes patients, high BG increases the risk of cardiovascular diseases, ocular problems and nerve damage (American Diabetes Association, 2017c; Juutilainen et al., 2005; Kassaian et al., 2012; NICE, 2015). About 15% to 25% of diabetes patients had a foot ulcer, suggesting that non-adherence may cause the fluctuation of BG and may further lead to amputation (Cook & Simonson, 2012). In addition to causing disability, CHD, hypertension and diabetes mellitus contribute to approximately 8 million deaths annually in China (Ministry of Health et al., 2012). It has been estimated that, through appropriate disease management, about one million of these premature deaths caused by chronic diseases could be avoided (Li et al., 2017).

From the healthcare provider's perspective, patients' self-management is may be an opportunity to save public healthcare resources. In China, about 40% of outpatient visits are returning patients (Chinese Medical Doctor Association, 2015). Proper disease management by medications may reduce healthcare providers' workload, decrease the risk of rehospitalisation and save limited medical sources for other patients (Ho et al., 2006; Polonsky & Henry, 2016). Moreover, non-adherence may cause a lousy prognosis and increases treatment expenditure. In China, diabetes is estimated to cost more than £13.4 billion annually, which accounted for 5% of the total health expenditure that year (Chinese Center for Disease Control and Prevention, 2008).

However, therapeutic goals do not reply on only taking appropriate medicines as prescribed. Some alternative/non-pharmaceutical treatments are also helpful. For example, physical activity, diet control, tobacco/alcohol cessation and bariatric surgery are all beneficial for diabetic patients to control BG (American Diabetes Association, 2017b; Nery et al., 2017; Pivovarov et al., 2015; Schauer et al., 2017). Moreover, inappropriate implementation of treatment regimen, such as under-/overprescription and incorrect medication, may also cause the failure of achieving the therapeutic goals. Previous studies (Lipska et al., 2015; Wong, 2015) found that a substantial proportion of diabetic patients were overtreated, especially elderly patients. Therefore, flexible adjustment of the prescriptions can be rational and necessary for patients under some circumstances (American Diabetes Association, 2017c; Bell et al., 2016). However, current best practice guidelines highlight that regular prescribed medication is still the most appropriate treatment for the majority of patients with CHD, hypertension and diabetes (American Diabetes Association, 2017c; NICE, 2011; Revision Committee of Chinese guidelines for hypertension prevention and treatment, 2018; WHO, 2015a).

1.3.6. Factors related to non-adherence

Medication adherence can be influenced by multiple factors which have been proposed in previous studies (Midence, 1998; Osterberg & Blaschke, 2005). The WHO (2003) categorised these factors as five types: social and economic factors, health system and healthcare team-related factors, therapy-related factors, condition-related factors and patient-related factors.

1.3.6.1. Social-demographic and economic factors

The impacts of demographic and socioeconomic status on medication-taking behaviour were inconsistent in previous studies, thus are not considered to be independent predictors of adherence (WHO, 2003).

- **Age**: Increasing age is reported to be correlated with degeneration of cognitive functions and poor memory, placing individuals in a high-risk of unintentional non-adherence (Hope et al., 2004; Li et al., 2012; Li, 2015; Okuyan et al., 2013). However, some other studies also reported the controversial results, where older people demonstrated better performance than the young population (Barclay et al., 2007; Park et al., 1999).
- **Ethnicity:** Ethnicity and race were reported as a common predictor of medication adherence (Lee & Salloum, 2015; WHO, 2003). However, as China has 92 per cent Han ethnic group, the influence of ethnicity on medication adherence ought to be negligible in this PhD study.
- **Marital status:** Although marital status was not recognised as a predictor to medication adherence by WHO (2003), many studies specific to CHD, hypertension and diabetes have found that patients who were married or living with families had better adherence performance than those who were single or lived alone (Gu et al., 2017; Kardas et al., 2013; Kulkarni et al., 2006; Trivedi et al., 2008). This trend is more significant in older people (Uchmanowicz et al.,

2018), reflecting elderly patients are more likely to need assistance and support to maintain the treatment than younger patients.

Additionally, some other socioeconomic factors, such as education level, income and employment status, have also been highlighted as potential predictors of medication adherence (Aflakseir, 2012; Jiang et al., 2015; Loke et al., 2012; WHO, 2003).

1.3.6.2. Healthcare team and health system related factors

Good doctor-patient relationships and satisfaction with healthcare services are two important factors correlated with high medication adherence (WHO, 2003). Previous studies have found that that inadequate insurance reimbursement, unequal medical resource distribution, poorly trained practitioners, inadequate communication as possible factors that mays harm the treatment satisfaction and relationship between patients and healthcare providers, and consequently negatively affect engagement with treatment (Garg et al., 2016; Hefner et al., 2018; Ledford et al., 2010; Zolnierek & Dimatteo, 2009).

However, in China, the patient-doctor relationship has become strained. The incidence of violence against health providers increased by 11% annually. In 2012 alone, seven doctors and nurses were killed by patients (Yao et al., 2014). Several possible reasons may cause a tense relationship. One of the major causes is that doctors are too busy to communicate with their patients adequately (Li & Xie, 2013). Many Chinese doctors face a heavy workload. It was reported that about 32.7% of the doctors worked more than 60 hours per week and treated around 100 patients per day (Chinese Medical Doctor Association, 2015).

1.3.6.3. Therapy-related factors

Therapy-related factors can be classified as five main categories: the complexity of the treatment regimen, the duration of treatment, potential risks, the immediacy of treatment effect, and the availability of support to deal with barriers (Gellad et al., 2011; WHO, 2003). Moreover, mono-therapy regimens show higher acceptability to patients than combination therapies (Cramer, 2004). These factors are correlated with the healthcare team and health system-related factors. For example, high financial and time costs of treatment can decrease patient satisfaction of healthcare services. Patient satisfaction may also decrease if doctors lack time to explain complicated therapeutic regimens to the patients clearly (Gellad et al., 2011).

1.3.6.4. Condition-related factors

Condition-related factors which have been associated with non-adherence include the severity of conditions, visibility of symptoms and perceived prognosis (WHO, 2003). The influence of the severity of conditions on medication adherence is complicated. In general, patients with severe conditions are more likely to be adherent (Kardas et al., 2013). However, if patients perceive their conditions are too severe to be cured, they may lose confidence and give up treatment (DiMatteo et al., 2007). The absence of symptoms has also been reported to be associated with non-adherence (Kardas et al., 2013), which partly explains why the patients in the early stage or with asymptomatic conditions often feel it is unnecessary to take the medications (Jin et al., 2008). The self-regulatory model (Leventhal & Cameron, 1987) clearly explains how these factors affect medication adherence (see section ***1.3.7.3***).

1.3.6.5. Patient-related factors

A large number of patient-related factors have been liked to non-adherence including psychosocial factors such as the patient's medical knowledge, illness perceptions, beliefs about medicines, motivation and self-efficacy, which all have been found to cause intentional non-adherence, (WHO, 2003). Moreover, forgetfulness, negative emotional representations (e.g. feeling stigmatised, fears and anxiety) also have shown negative impacts on medication-taking behaviour in previous studies (Jin et al., 2008; Kardas et al., 2013).

- **Patient's medical knowledge** can refer to a 'patient's awareness of the drug name, purpose, administering schedule, adverse effects, or special administering instructions' (Ascione et al., 1986). Many previous studies report that patients who had adequate knowledge of their condition and medicines are more likely to be adherent (Al-Qazaz et al., 2011; Hope et al., 2004; Okuyan et al., 2013). However, in some cases, patients with high knowledge may choose to adjust the dosing regimen without doctors' guidance (Vermeire et al., 2001). In Schoenthaler's study (2012), low diabetes-related knowledge was reported to be associated with good adherence to antidiabetics.

- **Illness perception** Leventhal and Leventhal's (1987) Common-Sense Model (CSM) of self-regulation (see section ***1.3.7.3***) suggested that people formulate perceptions about illness by answering five implicit questions: 'What is the illness?' (illness identity); 'What causes the illness?' (cause); 'How long will illness last?' (timeline); 'Will the illness cure or be controlled?' (control); and 'How will illness affect me?' (consequences). Chen's (2009) found these illness perceptions to be significantly correlated with adherence to therapeutic regimens for patients with hypertension.
- **Beliefs about medicines** is one of the main patient-related factors. It comprises two subcomponents: general beliefs about all medicine use and specific beliefs about particular medicine (Horne et al., 1999). This factor is described in detail in section ***1.3.7.4.***
- **Expectations of the result of treatment** contain two aspects: the perceived effectiveness of treatment and the consequences of no treatment. People who perceive treatment to be effective will be more likely to take the treatment (Hudson et al., 2012). Likewise, people who believe the consequences will become severe without medication will be more likely to take the medication as prescribed (WHO, 2003).
- **Self-efficacy** has its origins in Bandura's social cognitive theory and refers to people's confidence of ability to carry out a specific task (Bandura, 1977). It has been proposed as a powerful predictor of health behaviour (Wallston, 1992). In

previous studies, patients with high self-efficacy expectancy are more likely to engage a given health behaviour, such as taking medication as instructions (Fernandez et al., 2008; McCulley et al., 2018; Nakahara et al., 2006).

1.3.7. Social cognition models to medication-taking behaviour

Social cognition models are cognitive frameworks for explaining and understanding people's behaviour basing on social cognition theories (Glanz, 2001). In the past decades, various theories and models have been developed and applied in the behaviour change area. The most famous models/theories include the Health Belief Model (HBM) (Rosenstock, 1974), Theory of Reasoned Action (TRA) (Fishbein, 1975) and its extension — the Theory of Planned Behaviour (TPB) (Ajzen, 1991), Self-regulatory theory (SRT) (Leventhal & Cameron, 1987; Leventhal, 1984), and beliefs about medicine models (Horne & Weinman, 1999). These models/theories all assumed that people's behaviour is determined by cognitive factors, such as perceptions, beliefs and attitudes. This section gives a brief introduction of the above models/theories and a rationale for selecting the beliefs about medicine models to inform this PhD work.

1.3.7.1. Health Belief Model

The HBM was initially formulated to explain why people fail to use preventive health services (e.g. health screen test) (Rosenstock, 1966; Rosenstock, 1974) and further developed to apply to compliance with medical regimens (Becker, 1974). There are four original components in the initial model and two additional constructs added in the later versions (see **Figure *1-2***).

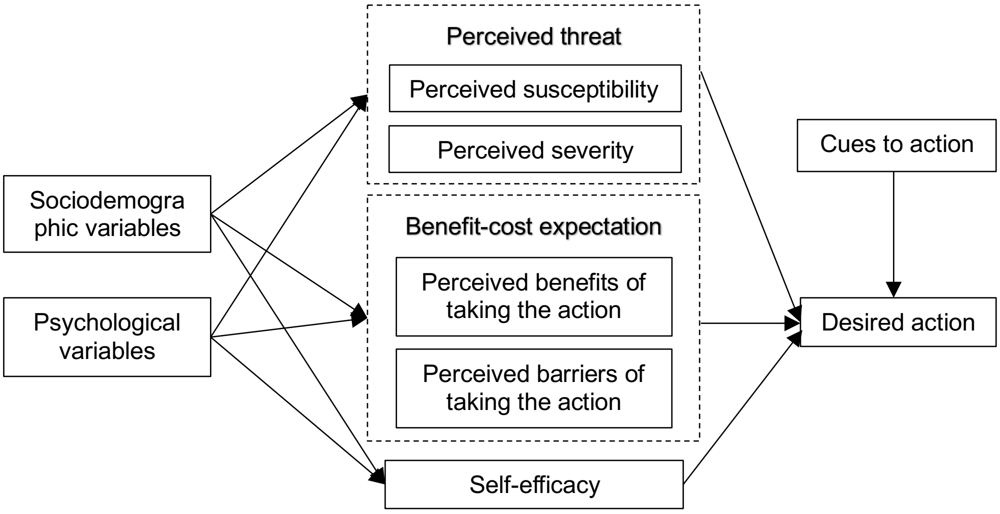


Figure 1-2 Health Belief Model adapted from *Rosenstock et al. (1994)*

- **Perceived susceptibility** refers to an individual's subjective perception of how easily a person to be involved by a disease or a health threat.
- **Perceived severity** refers to an individual's subjective evaluation of how severe disease or a health threat is.
- **Perceived benefits** refer to an individual's expectation that taking action (e.g. taking medication) can bring benefit or offset a health threat.
- **Perceived barriers** refer to the potential barriers hindering the implementation of the action, such as the high cost, time-consuming, inconvenience and unpleasant of side-effects.
- **Cues to action** is an additional component added in 1974 (Rosenstock, 1974), which refers to a trigger promoting individual's consideration of vulnerability benefit of action and potential risk. The cues can be internal (e.g. symptoms

caused by disease) or external (e.g. communication with healthcare professional or family members).

- **Self-efficacy** refers to people's confidence of ability to carry out the health preventive behaviour (e.g. follow doctor's instruction) and has been incorporated into the HBM since the late 1980s (Rosenstock et al., 1988).

Besides the above components, the likelihood of health behaviour implementation is also indirectly influenced by some demographic variables (e.g. age, gender) and psychological characteristics (e.g. personality, peer pressure) (Abraham & Sheeran, 2007). In some previous literature (Becker, 1974; Conner & Norman, 1998), a component of health motivation, which refers 'readiness to be concerned about health matters', was also suggested to be combined in the model.

The HBM posits that individuals are more likely to take preventive behaviour (e.g. taking medication) to ward off a health threat (e.g. illness) when regarding themselves at high risk of being involved by the disease (perceived susceptibility) or worry the condition will cause severe consequences (perceived severity). At the meantime, a benefit-cost expectation also acts on the decision-making process. Patients may be more likely to engage in the treatment if the perceived benefit outweighs the perceived barriers to take the treatment. Therefore, interventions often promote health behaviour through enhancing perceived benefit (e.g. health education programme), eliminating perceived barriers (e.g. sending reminding message) or both (Jones et al., 2014). Likewise, people lacking self-efficacy may also fail to take the desired action

(Huang et al., 2014; Yue et al., 2015).

As one of the most widely used cognitive models, HBM provides a straightforward model to understand how people look at health threats and cope with them. However, it is criticised for several limitations. First, the HBM does not consider the impacts of emotional factors, such as fear of taking some particular treatments, which has been identified as one of the key factors in health behaviour prediction (Nakar et al., 2007; Russell-Jones et al., 2018). Second, the HBM does not take into account that people may fail to engage in the recommended behaviour due to some non-health related reasons, such as environmental factors and cultural taboos. In China, many people avoid taking medication and surgery during the lunar New Year due to believing these behaviours will cause bad luck for the coming year (Chiu et al., 2018). Third, the cues to action were difficult to assess due to its ambiguous definition and fleeting nature (Champion & Skinner, 2008). The individual discrepancy in understanding and awareness of such cues may also cause the difficulty of the assessment. Fourth, the HBM is not well specified in terms of the relations between included constructs. It does not consider that the impact of one construct on desired behaviour may depend on the interaction of another construct (Von Ah et al., 2005). For example, the predictive power of the benefit-cost expectation in predicting the behaviour would be not salient if the perceived threat were low (Von Ah et al., 2005).

1.3.7.2. Theory of Reasoned Action and Theory of Planned Behaviour

The TRA (Fishbein, 1975) and its extension - the TPB (Ajzen, 1985, 1991) are not specific to health behaviour but have been widely applied in the health area. As the name implies, the TRA posits that people's behaviour is normally in a sensible manner and can be determined by the intention, an antecedent of executing the behaviour (Fishbein, 1975). The intention (e.g. willing to follow doctor's instruction) may arise if the attitude towards the behaviour is positive (e.g. Taking medication as instructed benefits to my condition) or the behaviour comforts to the social norm (e.g. My doctor tells me persistence of treatment is the key of disease management) (Ajzen, 1985; Fishbein, 1975). However, people are not always rational and under volitional control, which means the potential constraints and support perceived by the actor need to be taken into consideration. Therefore, Ajzen added one component into the TRA model to present the perceived ease or difficulty to carry out the behaviour and termed it as perceived behaviour control (Ajzen, 1985, 1991) (see **Figure *1-3***). The perceived behaviour control is considered to influence both intention and behaviour itself. It can be divided into internal and external parts, which conceptually overlap with the self-efficacy and the controllability, respectively (Ajzen, 1991).

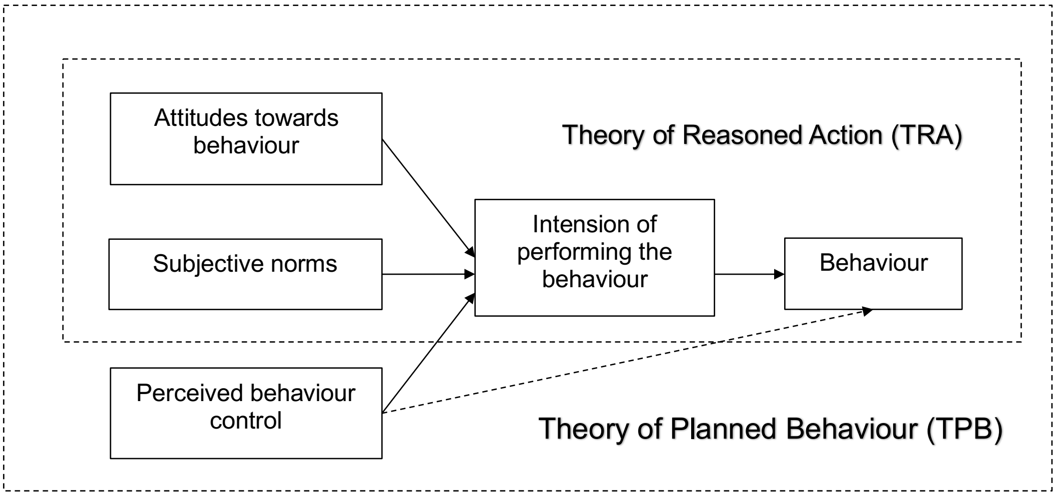


Figure 1-3 Basic models of Theory of Reasoned Action (Fishbein, 1975) and Theory of Planned Behaviour (Ajzen, 1985)

The TRA and TBP have been widely applied to predict diverse adherence behaviours, including physical activity, diet, condom use and medication adherence (Albarracín et al., 2001; Armitage & Conner, 2001; Hagger et al., 2002; McEachan et al., 2011). In a recent meta-analysis of the adherence behaviour in chronic patients (Rich et al., 2015), attitudes towards the behaviour ($\beta=0.20$, $p<.001$), subjective norm ($\beta=0.16$, $p<.001$) and perceived behavioural control ($\beta=0.39$, $p<.001$) were statistically significant predictors of intention, and the intention significantly predicted the adherence behaviour ($\beta=0.21$, $p<.001$). The total effect of perceived behavioural control, resulted from direct and mediated effects, on adherence behaviour was also statistically significant ($\beta=0.21$, $p<.001$).

Compared with HBM, TRA and TPB have some advantages. First, the concepts in the TRA/TPB model are explicitly defined and statistically testable (Taylor et al., 2006). Second, the TRA/TPB considers the influence of social factors onto the decision-making process, while the HBM does not. Third, the TRA/TPB emphasises the role of intention in predicting behaviour, which is one of the main characteristics of TRA and TPB and is not taken into account by the HBM (Ajzen, 1991).

However, TRA and TPB have been criticised for a range of reasons (Sniehotta et al., 2014). First, the TRA cannot properly explain why some people with strong intention still fail to perform the behaviour (Sniehotta et al., 2005). The TPB attempts to deal with this ‘intention-behaviour gap’ by adding a construct of perceived behavioural control but is still challenging to explain habitual behaviour and daily routine (Glanz, 2001). Second, neither TRA nor TPB reflects the influence of time on the intention-behaviour relationship, even though the developer had noted that with the follow-up period increasing, the strength of the intention-behaviour relationship would reduce (Ajzen, 1985). This issue may be amplified in our study as taking medication is a long-term behaviour for chronic patients (Rich et al., 2015). According to Rich’s meta-analysis specific to chronic patients, the TPB appears more appropriate to predict intention rather than behaviour as it explained 33% of the variance in intention while only explained 9% of the variance in adherence behaviour (Rich et al., 2015). Third, like the HBM, the TRA and TPB do not take into account for emotional factors, which has been recognised as one of the crucial predictors of health behaviours (De Ridder & De Wit, 2008).

1.3.7.3. Self-Regulation Theory and the extended Common-Sense Model

The SRT, also called 'Common-sense Model (CSM)', were developed by Leventhal and colleagues (1987; 1984) based on initial work investigating how fear-arousing communications impact health-promoting actions, such as vaccine uptake (Leventhal et al., 1966). The theory proposed that individuals actively solve health treats following three steps (see **Figure *1-4***).

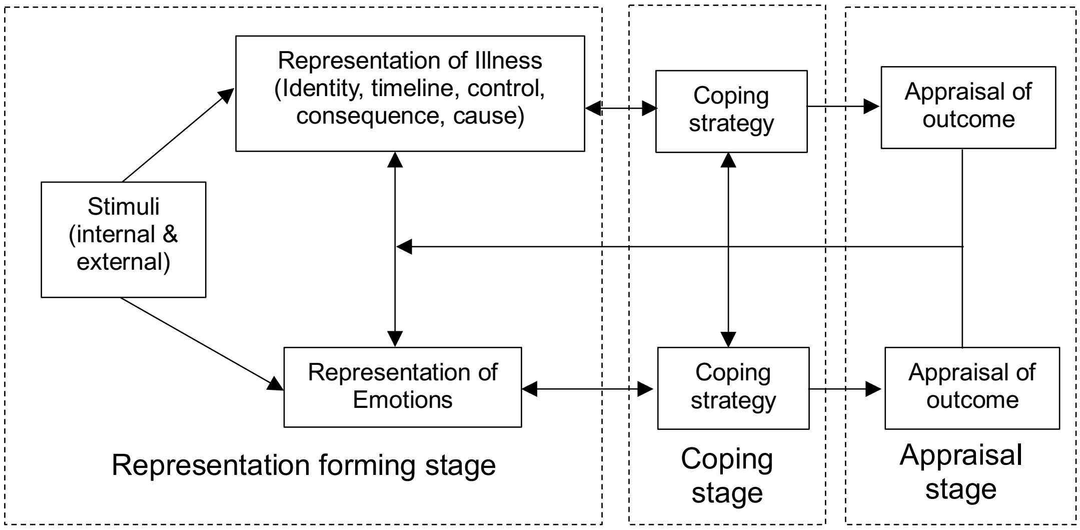


Figure 1-4 Parallel Process of early CSM adapted from *Leventhal (1984)*

In the first stage, individuals become aware of health threat (e.g. illness) according to internal and/or external stimuli. Internal stimuli can be symptom experience or personal knowledge, and external stimuli typically comprise information from other people, such as the professional diagnosis and experience from peers (Ogden, 2007). Subsequently, individuals formulate initial cognitive representations of emotion and health threat. The representation of emotion reflects individuals' feeling towards the health threat, such as fear, anxiety and depression. For patients, the representation of health threat refers to illness perception, which describes how individuals think about their illness. In CSM, the illness perception comprises five distinct components:

- **Identity** includes abstract concepts and concrete signs of illness;
- **Timeline** refers to the course and time progresses of illness;
- **Cause** refers to the causal attribution of the illness but may not be biomedically accurate;
- **Consequence** refers to perceived outcomes caused by illness, including physical, psychological and social terms;
- **Control** refers to people's confidence of disease cure (disease control) and perceived effectiveness of treatment (treatment control).

In the second stage, individuals select either an approaching coping or an avoidant coping to deal with the health threats depending on whether the representation is positive or negative (Roth & Cohen, 1986). Approaching coping includes taking treatments, consulting with doctors, and other preventive health behaviours. On the contrary, avoidant copings include denial, delay or terminate treatment (non-adherence).

In the third stage, individuals appraise the results of coping via parallel processes. The processes comprise two pathways: One appraises the coping strategy dealing with the threat and feeds back into the representation of threat (e.g. a satisfactory effect of treatment may shorten the perceived timeline of the disease). Another one appraises the coping strategy dealing with the emotional response to the threat and feeds back into the representation of emotion (e.g. a satisfactory effect of treatment may relieve patient's anxiety caused by the disease). The two pathways interact with one another and result in the adjustments in expectations of the effectiveness of coping. Patients will decide whether to continue with the previous coping strategy or switch to an alternative one (Ogden, 2007). The process repeats until the problem is solved (see **Figure *1-4***). One example following the whole process could be an asymptomatic diabetic did not take any medication (avoidance coping) due to a perception that he is healthy (symptom identity). Several months later, his condition became worse (health threat) and worried him (emotional response to illness). The patient regretted not following the doctor’s suggestions (appraising the previous coping) and decided to take treatment (changing approach coping).

Compared with HBM and TRA/TPB, the CSM comprises the constructs of emotional representation and reflects how it affects the decision-making process, which is one of the major advantages of the CSM. Moreover, the appraisal processes help researchers to explain the difference between initiation and maintenance of the behaviour that is not considered by the TRA/TPB (Bennett & Bozionelos, 2000). Although Ajzen (2015) asserted that there are also feedback loops between behaviour and cognition in the TPB, this process is at least not explicit in the original model. In a systematic review of empirical researches predicting adult’s medication adherence between 1990 and 2010, the CSM was recognised as one of the most commonly used theoretical framework (Holmes et al., 2014). The CSM showed significant association with adherence behaviour in several condition groups, including CHD (Byrne et al., 2005), hypertension (Chen et al., 2009; Hekler et al., 2008; Ross et al., 2004), hypercholesterolaemia (Brewer et al., 2002) and asthma (Horne & Weinman, 2002).

However, the CSM constructs appear to be weak predictors of some health behaviours. In a study investigating the relationships between patients' beliefs and secondary preventive behaviours, the CSM constructs only explained about 1% to 3% of the variance in smoking, exercise, alcohol use, diet and medication adherence (Byrne et al., 2005). The researcher reported a paradox that patients who held negative and pessimistic representations of illness and emotion reported a better behaviour performance instead (Byrne et al., 2005). This result suggested that whether individuals accept a recommended health behaviour is not solely determined by the cognitions about the threat. For patients with a diagnosed condition, the adherence to treatments is associated with the patient's understanding of treatment and expectation of effectiveness (Horne & Weinman, 2002; Leventhal et al., 2010). Moreover, the CSM mainly focuses on the perceptual factors, while it does not take practical barriers and ques into account. In a qualitative study of patients with congestive heart failure, an interviewee who did not attribute the symptoms (e.g. swollen leg and breathlessness) to the heart disease at all showed an excellent medication adherence due to family members' reminding (Horowitz et al., 2004). Also, the impacts of self-efficacy and personality on health behaviour are not reflected in the initial CSM, either. To address above issues, Leventhal (Leventhal et al., 2003) and collaborating researchers (Brownlee et al., 2000; Horne, 1997; Moss-Morris et al., 2002) further developed the CSM by extending with some additional components, such as the cognitive representations and emotional responses towards treatment (see **Figure *1-5***).

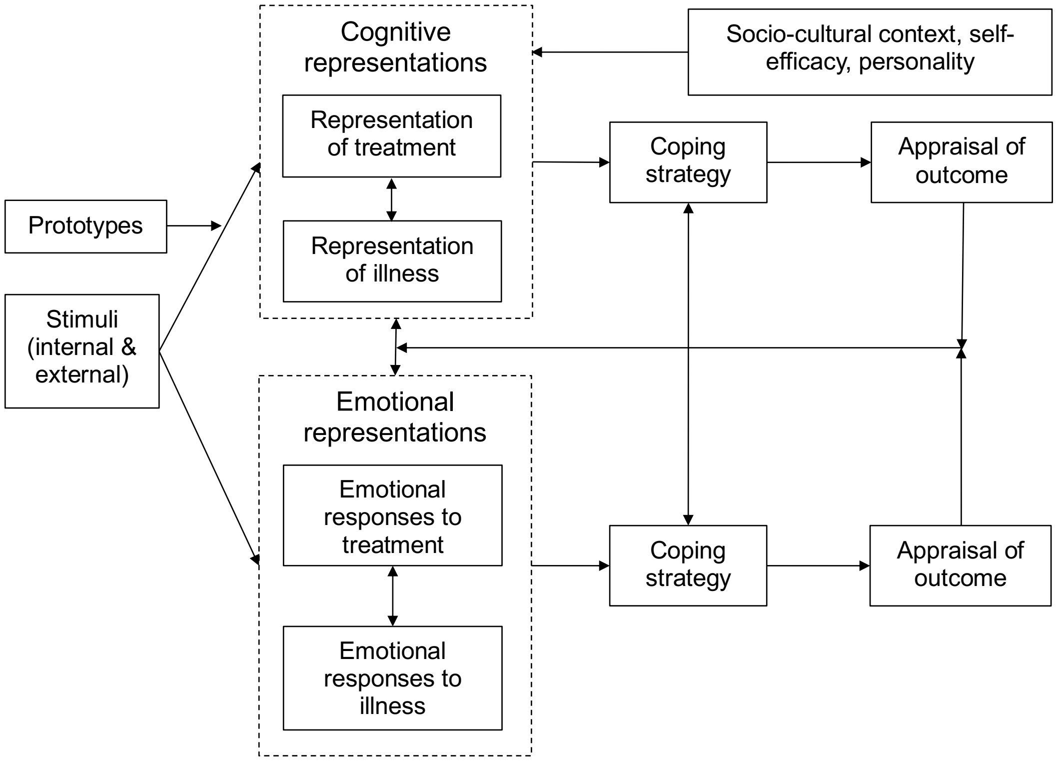


Figure 1-5 Extended CSM (e-CSM) adapted from *Leventhal et al. (2016)*

1.3.7.4. Beliefs about medicines and related models

The cognitive representation of treatment, such as medication-related beliefs, have been identified as significant predictors of adherence behaviour across multiple chronic conditions, including asthma, diabetes, psychiatric, renal and cardiovascular disease (Horne et al., 2013; Horne et al., 2004; Kumar et al., 2008). Horne further developed CSM by extending its scope to representations of prescribed treatments and treatments in general (Horne, 1997). Unlike Leventhal's interpretation (Leventhal et al., 2010), in which the treatment representation was conceptualised using the five-factor framework (identity, cause, timeline, control & consequence) similar to that for illness representation, Horne and Weinman (1999) proposed that people's beliefs about medicines are constituted by two aspects: the general attitudes to all medications, and the specific beliefs about particular medications.

The general beliefs comprise three components: believe medicines are overall beneficial for people and health (Benefit); believe that all medicines are harmful to body due to toxicity, addiction and other side-effects (Harm); believe that doctors over trust the effectiveness of medicines and overprescribe medicines to patients (Overuse) (Horne et al., 2001; Horne & Weinman, 1999).

Specific beliefs comprise two components: necessity beliefs reflect the patient's personal needs and perceived positive effect of particular medicine (Necessity); Specific concerns refers to patients' worries about possible risk and unpleasant consequences caused by taking particular medicines (Concern). Necessity beliefs motivate patients to adhere to treatment. Conversely, Concerns can lead to avoidance or termination of treatment (Horne & Weinman, 1999). According to a Necessity-Concern Framework (NCF), the attitudes towards particular medicines can be divided into four broad categories: Ambivalence (high necessity and high concern), Accepting (high necessity and low concern), Sceptical (low necessity and high concern) and Indifferent (low necessity and low concern) (Horne et al., 2009). Patients with an accepting attitude is supposed to be more likely to adhere to medical instruction.

Conversely, the strong sceptical attitude is considered to be negatively associated with good adherence performance (Kim et al., 2016; Park et al., 2018; Tibaldi et al., 2009).

As a development of the CSM, beliefs about medicines show a symbiotic relationship with illness perceptions. First, the personal need for medication is directly related to the perceived severity of illness, such as the perceived timeline and consequence of illness (Horne et al., 2000). Patients who interpret their conditions to be transitory or negligible may regard the treatment as unnecessary (Halm et al., 2006; Horne & Weinman, 2002). Second, patients may doubt the necessity of treatment if their symptoms lack improvement (Cooper et al., 2009). Therefore, the coherence between the expected outcome and actual experience is used as evidence to evaluate the effectiveness of treatment by some patients (but may be biased), which is a major origin of necessity belief (Horne et al., 2019). Third, the perception about treatment control (e.g. I believe this medication can control my condition) is conceptually overlapped with perceived effectiveness of the treatment, and the latter concept is another major origin of necessity belief. Thus, the treatment control usually shows a positive correlation with necessity belief (Horne & Weinman, 2002). Finally, illness perceptions may reinforce concerns, especially when symptoms are attributed to taking some medications (Cooper et al., 2009).

Horne developed the Beliefs about Medicine model by incorporating components of some existing social cognition models (e.g. parallel process in the CSM, intention and control constructs in the TPB) to interpret the interactions between internal/external factors of adherence and to guide the promotion intervention (Horne et al., 2019) (see **Figure *1-6***). In this model, medication adherence is impacted by both internal emotional factors (e.g. fear, anxiety and depression) and external environmental factors (e.g. social norm, health policy and cultural factors). The intention to adhere to treatment is mainly determined by the beliefs about medicines and controlled by the ability to perform adherence behaviour. Same as the process in the CSM, patients appraise the outcome of adherence and adjust representations of illness and treatment parallelly.

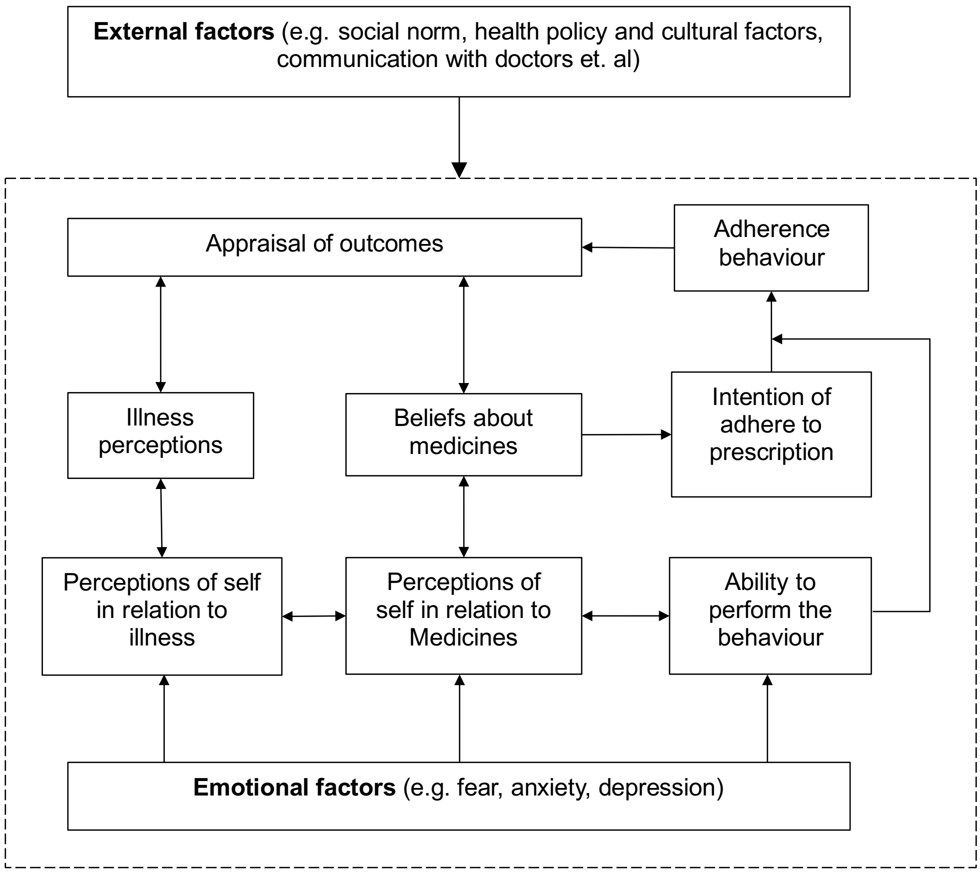


Figure 1-6 Beliefs about Medicine model adapted from *Horne et al. (2019)*

Horne's model focuses on medication-taking behaviour instead of other health behaviour (e.g. exercise, diet) and provides a validated Beliefs about Medicines Questionnaire (BMQ) to assess beliefs from both general and specific perspectives (Horne, 1997; Horne et al., 2019). The model provides a simple framework to understand how people weigh Necessity beliefs and Concerns and subsequently form beliefs specific to particular medicines. Moreover, compared with the theocratical frameworks introduced in the previous sections, Horne's model has some additional advantages to be an explanatory model for this thesis. First, as a development of the CSM, the BMQ model possesses the same advantages as the CSM (see section ***1.3.7.3***). For example, the parallel processes enable Horne's model to reflect the dynamic interplays between adherence behaviour and determinants better than static models (e.g. HBM and TRA/TPB). Second, the relationships among the constructs of the model were developed in both theoretical and evidence-based ways (Phillips et al., 2014). Third, same as the TPB, Horne considered the mediated effects of intention on adherence behaviour, while it is not reflected in the HBM and CSM (Champion & Skinner, 2008). Therefore, I have decided to use the BMQ models as the theoretical framework of this thesis.

Chapter 2 Research aims and objectives

2.1. Research aims

This PhD used a mixed methods research design aiming to:

1. investigate the validity and reliability of the BMQ when used to assess the Chinese population's beliefs about medicines and suggest improvements where necessary;
2. investigate the associations between medication-related cognitions and medication adherence in Chinese patients with CHD, hypertension and T2DM.

2.2. Objectives of the thesis

The specific objectives were set to achieve the above aims:

1. Explore and summarise the existing cognitive representations of both WM and TCM and influential factors toward these cognitions among Chinese patients with CHD, hypertension and T2DM;
2. Check the understanding of an existing Chinese translation of BMQ and make necessary modification of it;
3. Expand the existing BMQ to adapt to the Chinese population and validate the expanded version;
4. Conduct a survey to investigate associations between beliefs about medicines and medication adherence in Chinese patients with CHD, hypertension and T2DM.

2.3. Outline of the thesis

The first objective was achieved by a semi-structured interview study (***Chapter 4***), which interviewed 28 Chinese patients with CHD, hypertension and T2DM from two hospitals. A conceptual map of beliefs about medicines was formed basing on the results of the theoretical analysis.

The second objective was achieved by a 'think-aloud' task (***Chapter 5***). The participants were asked to elaborate on their thoughts when reading a Chinese translation of the BMQ. Patients' responses reflecting the difficulty of reading, understanding, interpretation or questioned items were recorded and analysed. Some translation was modified based on participants' responses (***Chapter 5***) and some other existing Chinese translations of the BMQ (***Chapter 3***) to help participants better understand the questionnaire.

The third objective was achieved by factorial analyses (***Chapter 7***). Based on the results of ***Chapter 4***, some additional beliefs about medicines specific to Chinese population were identified. These beliefs formed the candidate items for the expanded version of BMQ and validated with the items of the original BMQ together in the Chinese population (***Chapter 7***).

The fourth objective was achieved in ***Chapter 6*** (online-survey) and ***Chapter 7*** (factorial analysis). In ***Chapter 6***, I conducted an online study. The beliefs about medicines were measured using an updated version of BMQ, with some additional questions derived from ***Chapter 4*** (semi-structured interview). Medication adherence was assessed using the MARS. Some other potential determinants of medication adherence were assessed using a Perceived Sensitivity to Medicines (PSM) scale and an Illness Perception Questionnaire (IPQ). The predictive effects of determinants were analysed using logistic regression analyses.

Chapter 3 Utilisation of the BMQ and prediction of medication adherence in China: A systematic review and meta-analysis

3.1. Background

Chronic diseases, characterised by long duration and slow progression, affect around 260 million Chinese people (WHO, 2018b). Cardiovascular diseases, hypertension, diabetes and other chronic diseases contribute to approximately 8.8 million deaths annually, 89% of all deaths in China (WHO, 2017). For patients diagnosed with chronic disease, taking appropriate medications as prescribed is necessary to control symptoms and prevent complications. However, medication adherence varies widely across individuals, treatments and medical conditions (Schneider et al., 2017; Xu et al., 2017). In China, only 67.8% of diabetic patients, 65.1% of hypertension patients and 53.9% of myocardial infarction patients were estimated to adhere to prescribed treatment (Lee et al., 2013; M. C. Wong, C. H. Wu, et al., 2015; Yan et al., 2014).

Patients' beliefs about medicines have been identified as a predictor of medication adherence, commonly assessed using the BMQ (Horne, 1997; Horne et al., 2013). The BMQ contains two subscales assessing specific beliefs about particular medicines and beliefs about medicines in general (Horne, 1997; Horne et al., 1999). The specific subscale (BMQ-S) assesses beliefs about the necessity of a particular medication for a particular condition (Necessity) and concerns about the treatment's potential adverse consequences (Concerns). The general subscale (BMQ-G) assesses perceptions about whether medicines are harmful (Harm), beneficial

(Benefit) to health and overused by healthcare practitioners (Overuse).

A recent meta-analysis of ninety-four studies involving 25,072 patients indicated that patients who believe their personal needs for a specific medication and have few concerns about it are more likely to adhere to their treatment (Horne et al., 2013). Since the BMQ was published in 1997, it has been widely used across different patient groups in 18 countries. However, the previous review (Horne et al., 2013) did not search Chinese language databases and was conducted before many Chinese studies were published. The application of the BMQ in China has therefore not been systematically reviewed. Therefore, this chapter presents a systematic review and meta-analysis of beliefs about medicines using the BMQ and medication adherence in Chinese population.

3.2. Methods

This systematic review and meta-analysis were conducted in accordance with the statement of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher et al., 2009), Cochrane Handbook for Systematic Reviews (Higgins et al., 2019) and the Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines (Stroup et al., 2000).

3.2.1. Data sources and search strategy

Three commonly used databases indexing English language publications in medical and psychological areas (PubMed, EMBASE & PsycINFO), and the two largest general Chinese databases (CNKI & WANFANG DATA), were searched in October 2017 and updated in February 2019. The literature search covered publications from 1997, the year in which the BMQ was published.

The search strategy used Mesh terms (or other index terms) and keywords in full text. Phrases related to the concepts of 'beliefs about medicines' and 'questionnaire' were searched in all databases. In the non-Chinese databases, the concept of 'Chinese population' was also added to the search. Moreover, we hand-searched reference lists of all included papers to identify further studies. The full search strategy used in PubMed is presented below, and the searches and results in each database can be found in ***Appendix A.1-A.4***.

> *("China" [Mesh] OR "Taiwan" [Mesh] OR China [Text Word] OR Chinese [Text Word] OR Taiwan [Text Word] OR Taiwanese [Text Word] OR Hong Kong [Text Word] OR Macao [Text Word] OR Macau [Text Word]) AND ((("perception" [Mesh] OR belief$[Text Word] OR perception$[Text Word]) AND ("medicine" [Mesh] OR medicine$[Text Word] OR medication$[Text Word] OR drug$[Text Word])) OR "beliefs about medicine" [Text Word] OR BMQ [Text Word]) AND ("Surveys and Questionnaires" [Mesh] OR questionnaire$[Text Word] OR scale$[Text Word])*

3.2.2. Selection criteria

Studies were included if 1) participants aged 18 years old or over; 2) participants were residents of mainland China, Hong Kong, Macao or Taiwan; 3) they measured beliefs about medicine using a standard version of BMQ; 4) studies were clinical trials (randomised/nonrandomised controlled trial (RCT/non-RCT)) or observational studies (longitudinal or cross-sectional studies). Studies were excluded if 1) they did not have quantitative or mixed-methods designs; 2) the full-text could not be obtained; 3) the disease was treated by non-pharmaceutical methods.

Where data from the same study or overlapping samples were reported in multiple publications, peer-reviewed journal articles were used above other reports (e.g. degree theses) unless more data was reported in the other publication. For studies published in both English and Chinese, the English version was used unless the Chinese version provided more data.

3.2.3. Identification of studies

Titles and abstracts of publications in the first-round search were screened by two reviewers (ZC & I) independently, and the additional publications in update session were screened by reviewers XLW and me. The overall agreement between reviewers was 94%. Differences between reviewers were resolved through discussion. Where an article was deemed as potentially relevant by any reviewer, the full article was obtained. Any remaining disagreements were resolved by a fourth reviewer LW.

3.2.4. Data extraction

Data were extracted by me using a standardised form and checked by the second reviewer ZC. Where data were reported at multiple time points, the point with the fewest missing data was selected. For trial studies, if the overall baseline data across intervention groups and control groups were unavailable, only the data of the control group were extracted. The following data were extracted and coded:

- Study information: authors' names, publication year, article title, lead author's institution, study design (such as cross-sectional study or RCT), sampling strategy, and type of publication (journal article or degree thesis).
- Participant characteristics: age, gender, sample size, response rate, and diagnosis.
- Beliefs about medicines questionnaire: questionnaire type (BMQ-S and/or BMQ-G); the source of the questionnaire (existing version or self-translated); the internal consistency reliability of BMQ (Cronbach's α) specific to the participants of each study; and the mean and standard deviation (SD) of the scores of each BMQ subscale including across multiple subgroups if available. The mean and SD of the necessity-concerns differential (NCD) score, which is calculated by subtracting the Concerns score from the Necessity score, was also extracted where available.
- Medication adherence: the measurement used, adherence results (percentage of adherent participants and/or mean score), the effect size of the relationship between adherence and BMQ scores (correlation coefficient (r), regression coefficient (β) and/or odds ratio (OR)), and P-value or confidence intervals (CI). For studies using the Morisky Medication Adherence Scale, the high and middle level were defined as 'adherence', and the low level was defined as 'non-adherence' in this study. (Jiang et al., 2017; Wang, 2013; Zhao et al., 2015).

3.2.5. Quality assessment

Two reviewers (ZC & I or XLW & I) independently assessed study quality using an assessment tool (see ***Appendix B***), based on the U.S. National Institute of Health (NIH, 2002) and Hagstromer's checklists (Hagstromer et al., 2012). It assessed the quality of participant sampling, outcome measurement and statistical analyses. An additional section on medication adherence measurement was designed and applied where relevant. The quality of each study was presented using a percentage of potential quality items the study obtained scores on (see ***Appendix C***). For this total, scores of 80% and 60% were used as cut-off points to determine 'Good', 'Moderate', and 'Poor' quality. Disagreements between reviewers were resolved through discussion with the third reviewer, LW.

3.2.6. Data analysis

Effect sizes and 95% CI for associations between beliefs about medicines and medication adherence were pooled in meta-analyses using RevMan 5.3 software (2014). Both β and r were used as the effect size separately and reported in the meta-analysis in subgroups.

Heterogeneity was examined using the Chi-squared statistic (Q) and presented as the ratio of true heterogeneity to total observed variation (I^2) (Borenstein et al., 2009). An I^2 higher than 50% indicated a high heterogeneity (Higgins et al., 2019). A random-effects model was applied due to the variability between studies in terms of participant characteristics, disease categories, and study designs. Potential publication bias was detected using a funnel plot.

3.3. Results

3.3.1. Overview

Figure 3-1 shows the process and results of the systematic search. The search produced 1770 results from the non-Chinese databases and 1201 results from the Chinese databases. One additional article was identified through hand-searching. Duplicates (n=656) were removed before reviewing. After a review of titles and abstracts, 2129 records were removed due to their non-quantitative nature, adolescent participants or other exclusion criteria (see ***Figure 3-1***). One hundred eighty-seven full texts were examined, of which 58 (44 journal articles and 14 theses) met the inclusion criteria and were included in the systematic review. Forty-five of the studies had a cross-sectional design, and eleven were RCTs. There were also one longitudinal study and one study with mixed methods. All included studies were published between 2012 and 2019. Eight articles were in English and 50 were in Chinese (See ***Table 3-1*** **&** ***Table 3-2***).

3.3.2. Participants characteristics

Sample sizes ranged from 48 to 967, representing 12,595 participants in total. Nine studies did not report the mean age. The reported mean ages of participants in the remaining 49 studies ranged from 37.6 to 69.4 years old, with an overall mean age of 57.1 years old weighted by the sample size. These participants came from 28 cities of 17 provinces or regions, mainly located in developed coastal areas. The three most common conditions in the reviewed studies were cardiovascular disease (16 studies), mental health conditions (12 studies), cancer (8 studies) and kidney disease (5 studies). (See ***Table 3-1*** **&** ***Table 3-2***).

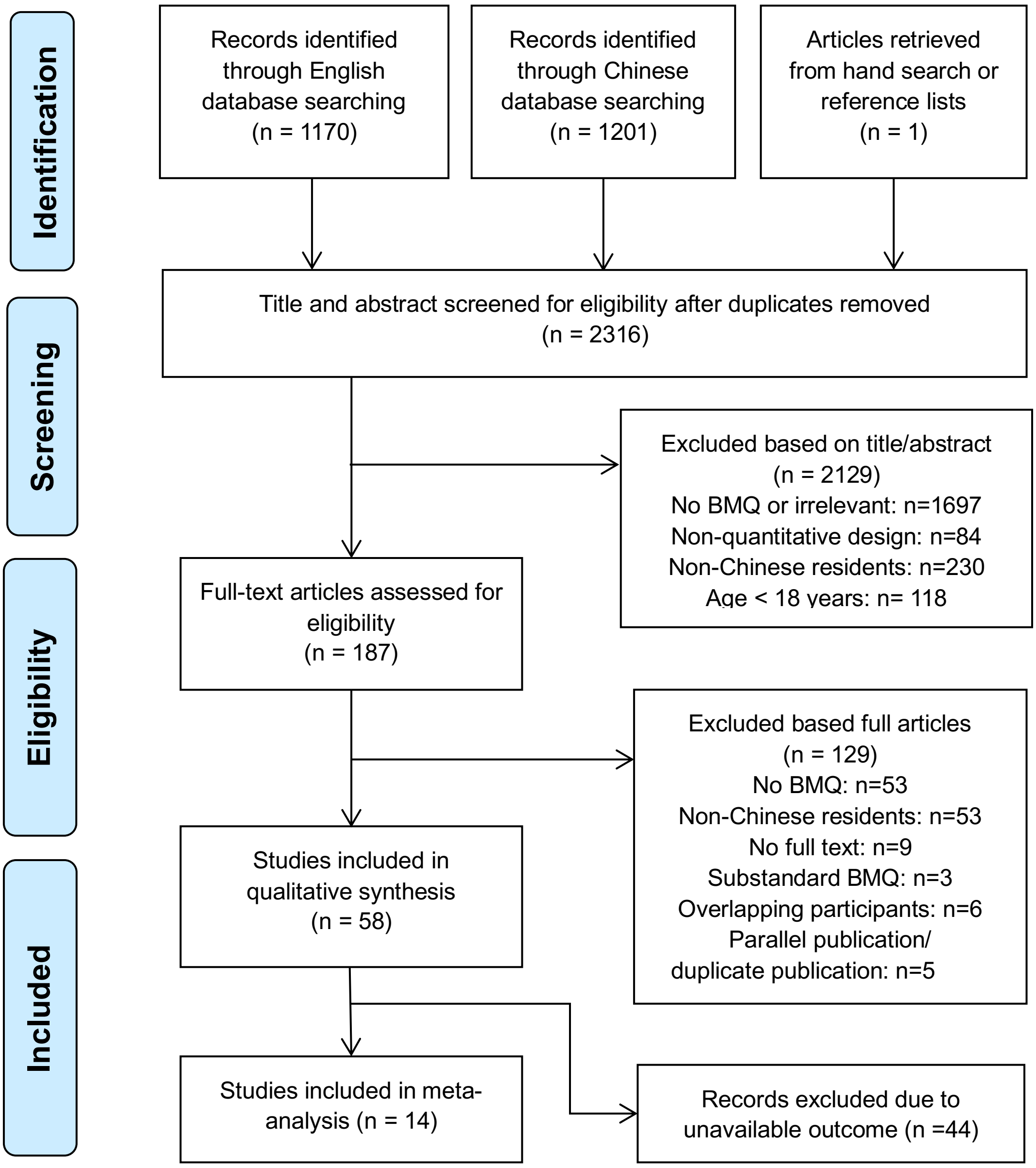


Figure 3-1 Flow chart of study selection

Table 3-1 Summary of characteristics of the included studies and participants

Characteristics	Number of studies or ranges
Article type	
Journal article	44
Thesis	14
Publication date	
2012	1
2013	4
2014	4
2015	10
2016	10
2017	12
2018	16
2019	1
Language	
English	8
Chinese	50
Research quality	
Good	12
Moderate	36
Poor	10
Study design	
Cross-sectional	45
Clinical trial (RCT/non-RCT & Open-label trail)	11
Longitudinal	1
Mixed method	1
Sample size	48-967
Response rate	77.70%-100%
Mean age	37.6-69.4
Gender	0%-82.8%
Condition	
Cardiovascular disease	16
Mental disorder	12
Cancer	8
Kidney disease	5
Other disease	17
BMQ measurement	
BMQ-S & BMQ-G	11
BMQ-S only	47
Mean sum scores of BMQ components	
Mean sum score of Necessity	10.7-22.2
Mean sum score of Concern	9.8-19.6
Mean NCD score	-5.6-11.1
Mean sum score of Harm	10.4-14.3
Mean sum score of Overuse	9.1-12.9
Mean sum score of Benefit	14.2-14.8
BMQ version	
Self-translated	11
Cited Si's version	21
Cited Lu's version	12
Cited Wu's version	3
Unknown	11
Adherence rate	33.4-100.0%
Adherence measurement	
MMAS-4/-8	34
BAASIS	3
MARS	2
MCS	1
Self-designed questionnaire	1
VAS (combined use)	1

Characteristics	Number of studies or ranges
Electronic medicine bottles (combined use)	1
Did not measure adherence	17

RCT/non-RCT: Randomised/nonrandomised controlled trial; MMAS-4/-8: Morisky Medication Adherence Scale 4-/8-item version; BAASIS: Basel Assessment of Adherence with Immunosuppressive medication Scales; MARS: Medication Adherence Report Scale; VAS: Visual Analogue Scale; MCS: Medical Compliance Scale.

Table 3-2 Detailed information of included studies in the systematic review

Author	Illness group	N	Mean Age ± SD	Gender (% male)	Response rate (%)	Study Design
BKF Wan et al. (2017)*	Chronic diseases	698	60.04±15.89	46%	Not reported	Cross-sectional
C Rui (2017)	HIV	150	45	68.7%	95%	Cross-sectional
CF Yen et al. (2014)*	Insomnia	392	48.0±13.9	38.3%	Not reported	Cross-sectional
CM Geng et al. (2018)	Kidney transplant	86	43.81±8.59	61.6%	95.56%	Cross-sectional
CY Du et al. (2017)	Liver transplant	278	53.32±10.20	75.90%	92.70%	Cross-sectional
DJ Ying & XX Zhang (2015)	Cerebral stroke	212	63.72±7.59	64.6%	96.36%	Cross-sectional
F Xu et al. (2018)	Decompensated cirrhosis	32 of 64	18-64	Not reported	Not reported	RCT
H Jiang et al. (2017)	Primary glaucoma	156	61.3±8.3	23.7%	Not reported	Cross-sectional
H Sun (2017)	Coronary artery disease	58 of 118	62.33±10.57	74.1%	96.67%	Nonrandomized clinical trial
HB Jin et al. (2015)	Cerebral Infarction	326	63.15±7.33	64.7%	93.14%	Cross-sectional
HD Tian et al. (2018)	Postpartum depression	128	Not reported	0%	100%	Cross-sectional
HF Xie et al. (2016)	Depression	48	38.67±9.91	35.42%	97.96%	Mixed method
HF Xie et al. (2018)	Depression	108	38.66±9.90	52.8%	100%	Open-label trial
HM Liu et al. (2016)	Type 2 diabetes	373	62.3±7.3	42.9%	87.15%	Cross-sectional
J Chen (2015)	Osteoporosis	365	68.35±8.21	54.2%	96.05%	Cross-sectional
J Zhang et al. (2016)	Breast cancer	192	51.34	0%	96.0%	Cross-sectional
JL Shao et al. (2015)	Acute myocardial infarction	151	62.65±11.15	82.8%	100%	Cross-sectional
JW Wu et al. (2016)	Atrial fibrillation	213	64.12±7.82	64.79%	96.80%	Cross-sectional
L Dong et al. (2017)	Ulcerative colitis	42 of 85	42.77±12.28	58.89%	93.33%	RCT
L Wang (2015)	HVR	60 of 120	52±12	54.2%	100%	RCT
L Wei et al. (2017) *	Overall Stroke Diabetes Rheumatoid arthritis	967 313, 315 339	59.08±13.5 65.8±13.7 62.5±13.9 49.7±12.8	41.5% 56.5% 55.2% 14.8%	100%	Cross-sectional
L Yuan et al. (2018)	Cerebral infarction	300	Not reported	68.3%	100%	Cross-sectional
L Zhang et al. (2018)	Depression	106	42.1±12.8	32.1%	Not reported	Cross-sectional
LQ Ning et al. (2016)	Deep venous thrombosis	101	53.33±37.84	42.6%	93.52%	Cross-sectional
M Yuan et al. (2018)	Parkinson's disease	49 of 97	66.20±8.18	59.2%	98.0%	RCT
M Yuan et al. (2018)	Parkinson's disease	155	65.68±8.54	58.1%	96.9%	Cross-sectional
MB Wu (2013)	Breast cancer	154 of 311	52.61±9.39	0%	94.8%	RCT

Author	Illness group	N	Mean Age ± SD	Gender (% male)	Response rate (%)	Study Design
MB Wu et al. (2014)	Breast cancer	204	53.74±9.72	0%	99.5%	Cross-sectional
QQ Cai et al. (2019a)*	Asthma	217	48.05±16.33	46.5%	Not reported	Cross-sectional
Q Guo et al. (2017)	Acute coronary	213	Not reported	55.9%	85.2%	Cross-sectional
QX Zhang et al. (2018)	Anxiety disorder	45 of 87	37.56±12.69	37.8%	97.8%	RCT
S Teng (2016)	Liver transplant	293	61.48±5.22	76.11%	97.67%	Cross-sectional
S Teng et al. (2015)	Renal transplant	255	47.1±12.3	59.2%	94.44%	Cross-sectional
SH Liu et al. (2018)	HVR	154	46.62±10.52	50%	Not reported	Cross-sectional
SJ Zhao et al. (2017)*	Atrial fibrillation	288	59.2±12.2	62.2%	84.71%	Cross-sectional
SL Guo (2014)*	Lung or colorectal cancer	151	63.8±11.2	51%	99.3%	Cross-sectional
SY Liu et al. (2017)	Breast cancer	237	50.77±9.742	0%	77.70%	Cross-sectional
SY Yang & ZQ Lu (2016)	Cancer	129	Not reported	53.5%	99.2%	Cross-sectional
SY Yang & ZQ Lu (2018)	Colorectal cancer	104	57.11±9.22	58.0%	87.4%	Longitudinal
TT Chen et al. (2015)*	Anxiety	148	42.2±8.8	45.90%	85.50%	Cross-sectional
W Yan et al. (2015)	Hypertension	108	60~80	43.5%	85.70%	Cross-sectional
WY Ni et al. (2018)	Breast cancer	52 of 106	Not reported	0%	96.3%	RCT
X Liu et al. (2012)	Nephritic syndrome	97	41.35±16.81	46.4%	100%	Cross-sectional
X Wang (2018)	Functional dyspepsia	269	41.34±9.57	47.2%	82.3%	Open-label trial
XX Qiao et al. (2017)	Chronic diseases	820	69.38±6.53	30.85%	97.70%	Cross-sectional
XX Zhang & DJ Ying (2016)	Chronic renal failure	217	60.12±11.98	54.8%	96.8%	Cross-sectional
XY Liu et al. (2015)	Chronic nephrosis	242	59.32±11.73	55.8%	96.8%	Cross-sectional
XY Yu & W Zeng (2016)	Permanent atrial fibrillation	92	61.28±13.08	43.5%	100%	Cross-sectional
XY Zhao (2017)	Ischemic stroke	200	64.86±10.83	61.5%	96.15%	Cross-sectional
Y Lu et al. (2014)	Depression	102	68.63±5.51	31.4%	100%	Cross-sectional
Y Lu et al. (2016)*	Depression	135	68.31±5.75	34.1%	85.4%	Cross-sectional
YF Wang (2013)	Primary glaucoma	213	60.85±9.47	29.1%	Not reported	Cross-sectional
YJ Zhu (2017)	HIV	150	44	68.7%	100%	Cross-sectional
YS Zhao (2018)	Depression	56 of 114	53.07±12.27	46.4%	93.3%	RCT
YY Dong (2018)	Allergic rhinitis	205	Not reported	62.4%	82.0%	Cross-sectional
YY Yao (2018)	Chronic diseases	399	Not reported	45.6%	95%	Cross-sectional
ZX Si (2013)	HVR	182	46.71±10.75	50%	89.22%	Cross-sectional
ZX Si et al. (2013)	HVR	164	47.02±10.52	50.6%	91.11%	Cross-sectional

* Published in English

3.3.3. Beliefs about medicines

The first Chinese BMQ study was published in 2012 (Liu & Jiang, 2012). Several Chinese versions of BMQ were identified from the included studies. The top-three commonly used versions, used in 36 of the 58 studies, were specific for patients with CHD (Si's version) (Si et al., 2013a), depression (Lu's version) (Lu et al., 2014) and breast cancer (Wu's version) (Wu et al., 2014). Most studies followed a standard scoring methodology for the BMQ, except for Wu (2014), who calculated new subscale scores based on the results of factor analysis.

All studies measured participants' specific beliefs about medicines, but seven studies did not subsequently report these results. Tian (2018) measured patients' concerns about medicines using five items, but only reported scores of two items that were marked as error data. Mean sum scores of necessity beliefs, concerns and their differential scores ranged between 10.7-22.2, 9.8-19.6, and -5.6-11.1, respectively. Eleven studies also measured participants' general beliefs about medicines. The ranges for each factor in BMQ-General subscale were 10.4-14.3 (Harm), and 9.1-12.9 (Overuse), and 14.2-14.8 (Benefit). (See ***Table 3-3***).

Seventeen studies reported the tested internal consistency (Cronbach's α) of the BMQ items. Cronbach's α for overall and each subscale were 0.67-0.94 (Overall), 0.60-0.92 (Necessity), 0.58-0.91 (Concerns), 0.55-0.73 (Harm), 0.47-0.79 (Overuse), and 0.51-0.58 (Benefit).

Table 3-3 BMQ and medication adherence results of the included studies

Author and date	BMQ subscale	Beliefs about Medicine (Mean± SD)	Adherence Measure	Adherence (%)	Effect size between BMQ and Adherence
BKF Wan et al. (Jan-2017)	BMQ-G, BMQ-S	N=16.6±3.3; C=13.5±3.1 NCD=3.1±4.2; H=11.4±2.4 O=11.9±2.2; B=14.7±1.9	MMAS-8	Not reported	Not reported
C Rui (May-2017)	BMQ-S	N_1=19.84±3.00; N_2=18.64±2.51 C_1=16.21±3.13; C_2=15.68 ±2.77 NCD1=3.63±3.88; NCD2=2.96±3.33	MMAS-4	Overall: 66.7%	β_N=0.44, SE=0.22 (P=.046); OR_N=1.56 (1.01, 2.41); β_C=-0.03, SE=0.21 (P=.87); OR_C=0.97 (0.65, 1.45)
CF Yen et al. (Dec-2014)	BMQ-S	N=10.7±3.8; C=16.3±4.4	N/A	N/A	N/A
CM Geng et al. (Jun-2018)	BMQ-G, BMQ-S	N=20.62 ±2.58; C=17.03 ±3.59 H=10.35 ±2.67; O=11.45 ±2.94	BAASIS	60.47%	Not reported
CY Du et al. (Sep-2017)	BMQ-G, BMQ-S	N=20.1±1.7; C=15.1±2.4 H=11.2±1.9; O=10.4±1.9	N/A	N/A	N/A
DJ Ying et al. (Nov-2015)	BMQ-S	N=16.2±2.1; C=10.1±1.7 NCD=6.1±1.9	N/A	N/A	N/A
F Xu et al. (Apr-2018)	BMQ-S	NCD=9.42±2.98	MMAS-8	Not reported	Not reported
H Jiang et al. (Feb-2017)	BMQ-S	Not reported	MMAS-8	53.2%	r_N=0.09 (P>.05); r_C=-0.47 (P<.01)
H Sun (Oct-2017)	BMQ-S	N=17.1 ± 2.0; C=14.5 ± 3.0	MMAS-8	55.2%	Not reported
HB Jin et al. (Aug-2015)	BMQ-S	N=16.3±1.9; C=9.8±1.7 NCD =6.4±1.8	N/A	N/A	N/A
HD Tian et al. (Nov-2018)	BMQ-S	N=17.61±0.89; C: Error data	MMAS-4	76.6%	Not reported
HF Xie et al. (Nov-2016)	BMQ-S	N=16.0±2.1; C=19.6±1.4	MMAS-4	64.6%	Not reported
HF Xie et al. (Mar-2018)	BMQ-S	(Average score) N=3.20±0.41, C=3.91±0.27	MMAS-4	75%	Not reported
HM Liu et al. (Jan-2016)	BMQ-S	N=19.3±2.4; C=13.3±3.0 NCD=6.0±4.0	MMAS-8 & ED	88.2% 64.9%	r_{NCD}=0.26 (P<.001)

Author and date	BMQ subscale	Beliefs about Medicine (Mean± SD)	Adherence Measure	Adherence (%)	Correlation between BMQ and Adherence
J Chen (Jan-2015)	BMQ-S	N=17.7±3.4; C=13.7±3.1 NCD=4.0±0.4	N/A	N/A	N/A
J Zhang et al. (Oct-2016)	BMQ-S, BMQ-G	N=13.8±2.5; C=12.2±2.3 NCD=1.6±0.4; H=11.7±1.5 O=9.1±1.3	N/A	N/A	N/A
JL Shao et al. (Oct-2015)	BMQ-S	NCD=3.9±3.6	MMAS-8	92.7%	r_N=0.17 (P=.04); r_C=-0.48 (P<.001) r_{NCD}=0.47 (P<.001) β_N=0.13 (P<.05); β_C=-0.31 (P<.001)
JW Wu et al. (Apr-2016)	BMQ-S	N=16.1±2.2; C=9.9±1.8 NCD=6.1±1.9	N/A	N/A	N/A
L Dong et al. (Apr-2016)	BMQ-S	N=18.5±1.7; C=18.6±1.5	MMAS-8	Not reported	Not reported
L Wang (Jun-2015)	BMQ-S	N=20.9±2.7; C=10.7±3.5 NCD=10.2±4.4	MMAS-8	100.0%,	Not reported
L Wei et al. (Jul-2017) Stroke group	BMQ-S, BMQ-G	(Average score) N_1=3.69 ± 0.53; C_1=3.03 ± 0.71 H_1=2.94 ± 0.78; O_1=3.22 ± 0.62 B_1= 3.70 ± 0.53	MARS	49.0%	(Non-adherence) OR_N= 0.92 (0.59,1.43); OR_C= 1.43 (1.02,2.00); OR_H= 1.30 (0.96.1.77); OR_O= 1.24 (0.85,1.82); OR_B= 0.83 (0.53,1.29)
Diabetes group		N_2=3.75 ± 0.40; C_2=3.15 ± 0.58 H_2=2.95 ± 0.50; O_2=3.12 ± 0.50 B_2=3.69 ± 0.42		73.3%	OR_N= 0.92 (0.43,1.97); OR_C= 1.15 (0.67,1.98); OR_H= 0.59 (0.32,1.11); OR_O= 1.10 (0.61,2.00); OR_B= 0.83 (0.41,1.69)
Rheumatoid arthritis group		N_3=3.66 ± 0.44; C_3=3.07 ± 0.58 H_3=2.99 ± 0.43; O_3=2.95 ± 0.51 B_3=3.55 ± 0.45		80.2%	OR_N= 1.34 (0.73,2.46); OR_C= 1.32 (0.84,2.10); OR_H= 1.27 (0.70,2.30); OR_O= 0.98 (0.60,1.60); OR_B= 0.65 (0.37,1.13)
L Yuan et al. (Jun-2018)	BMQ-S	N=16.79±1.84; C=9.69±1.53; NCD=6.47±1.52	N/A	N/A	N/A
LQ Ning et al. (Sep-2016)	BMQ-S	NCD=8.2±6.4	MMAS-8	73.3%	r_N>0 (P<.05); r_C<0 (P<.05); r_{NCD} >0 (P<.05); β_N=0.278 (P<.01)

Author and date	BMQ subscale	Beliefs about Medicine (Mean± SD)	Adherence Measure	Adherence (%)	Correlation between BMQ and Adherence
L Zhang et al. (May-2018)	BMQ-S	(Average score) NCD_{Male}=0.88±1.25; NCD_{Female}=0.81±1.34	N/A	N/A	N/A
M Yuan et al. (Feb-2018)	BMQ-S	NCD=4.69±4.11	MMAS-4	79.6%	Not reported
M Yuan et al. (Oct-2018)	BMQ-S	N=19.05±2.90; C=13.39±2.41 NCD=6.12±4.05	MMAS-4	86.45%	r_N=0.22 (P<.01); r_C=-0.23 (P<.01) r_{NCD}=0.28 (P<.01)
MB Wu (May-2013)	BMQ-S, BMQ-G	N=12.9±3.0; C=13.9±2.8	MMAS-8 & VAS	Not reported	Not reported
MB Wu et al. (Jan-2014)	BMQ-S, BMQ-G	N=12.2±3.1; C=12.2±2.4 O=9.2±1.7; Toxicity =10.7±2.3 Long-term effect=4.7±1.5	N/A	N/A	N/A
Q Cai et al. (Jan-2019)	BMQ-S	N=17.34±2.80; C=15.98±3.04	MMAS-8	50.2%	Not reported
Q Guo et al. (May-2017)	BMQ-S	N=18.42±2.72; C=13.02±3.56; NCD=5.40±1.47	N/A	N/A	N/A
QX Zhang et al (Jul-2018)	BMQ-S	(Average score) N=2.91±0.57; C=3.31±0.59	MMAS-4	84.4%	Not reported
S Teng (Jun-2016)	BMQ-S, BMQ-G	N=20.0±3.1; C=15.2±4.2 NCD=4.8± 1.1	BAASIS	43.0%	r_N=-0.28 (P<.01); r_C=0.03 (P>.05) r_{NCD}=0.18 (P<.01)
S Teng et al. (Sep-2015)	BMQ-S, BMQ-G	N=20.4±2.8; C=16.9±3.7 NCD=3.5±4.1; H=11.2±2.9; O=10.3±2.9	BAASIS	45.1%	Not reported
SH Liu et al. (Jan-2018)	BMQ-S	Not reported	MMAS-8	Not reported	r_N=0.31 (P<.01); r_C=-0.38 (P<.01) r_{NCD}=0.44 (P<.01)
SL Guo (Nov-2014)	BMQ-S, BMQ-G	N=18.9±4.5; C=16.6±5.4; NCD=2.3±7.0; H=14.3±3.8; O=12.5±2.9	MARS-5	43.4%	Not reported
SJ Zhao et al. (Feb-2017)	BMQ-S, BMQ-G	N=18.3±2.5; C=14.4±3.5; NCD=3.9±4.7; H=10.6±2.5; O=10.2±2.3	MMAS-8	67.7%	β_N=0.16 (P<.01), SE=0.05, OR=1.17 (1.06-1.29); β_C=-0.27 (P<.001), SE=0.05, OR=0.76 (0.69-0.84); β_{NCD}=0.27 (P<.001), SE=0.05, OR=1.31 (1.19-1.45); β_H=-0.20

					(P=.001), SE=0.06, OR=0.82 (0.73-0.92)
Author and date	**BMQ subscale**	**Beliefs about Medicine (Mean± SD)**	**Adherence Measure**	**Adherence (%)**	**Correlation between BMQ and Adherence**
SY Liu et al. (Aug-2017)	BMQ-S	N=15.7±3.8; C=15.7±3.7; NCD=-0.0±4.4	MMAS-8	64.9%	β_{NCD}=0.32 (P<.001)
SY Yang & ZQ Lu (Feb-2016)	BMQ-S	Not reported	MMAS-8	80.6%	r_N=0.18 (P<.05); r_C=-0.17 (P<.05); r_{NCD}=0.24 (P<.05)
SY Yang et al. (Apr-2018)	BMQ-S	NCD=0.11±3.94	MMAS-8	Not reported	r_{NCD}=0.30 (P<.01); β_{NCD}=0.07, SE=0.02 (P=.008)
TT Chen et al. (Nov-2015)	BMQ-S	N=17.2±5.2; C=13.7±4.4	N/A	N/A	N/A
W Yan et al. (Apr-2015)	BMQ-S	N=19.0±2.8; C=16.3±4.3	MMAS-8	33.4%	r_N=0.38 (P<.01); r_C=-0.54 (P<.01); r_{NCD}=-0.40 (P<.01)
WY Ni et al. (Jun-2018)	BMQ-S	N+C=47.00±2.52	MMAS	Not reported	Not reported
X Liu et al. (Mar-2012)	BMQ-S	N=17.6±3.2; C=16.0±3.5	MMAS-8	72.2%	r_{NCD}=0.20 (P<.05)
X Wang (May-2018)	BMQ-S	N=16.26±1.96; C=15.48±2.08	N/A	N/A	N/A
XX Qiao et al. (Jul-2017)	BMQ-S	N=17.6±2.9; C=13.9±3.1	MMAS-8	67.8%	β_N=0.17 SE=0.02 (P<.001); β_C=-0.32 SE=0.02 (P<.01)
XX Zhang & DJ Ying (Sep-2016)	BMQ-S	N=17.3±3.2; C=13.1±2.9; NCD=4.2±0.4	N/A	N/A	N/A
XY Liu et al. (Nov-2015)	BMQ-S	N=17.2±3.3; C=13.0±2.9; NCD=4.2±0.4	N/A	N/A	N/A
XY Yu & W Zeng (Dec-2016)	BMQ-S	N=18.0±1.0; C=13.3±0.9	MMAS-8	54.4%	r_N=0.46 (P<.05); r_C=-0.34 (P<.05); r_{NCD}=0.06 (P<.05)
XY Zhao (May-2017)	BMQ-S	N=17.59±1.77; C=14.08±1.41; NCD=3.87±2.51	MMAS-8	41.5%	r_N=0.67 (P<.01); r_C=-0.37 (P<.01);r_{NCD}=0.68 (P<.01); β_{NCD}=0.18, SE=0.20 (P=.003)
Y Lu et al. (Feb-2016)	BMQ-S	N=17.1±3.6; C=14.9±3.4	MMAS-4	77.0%	β_N=1.25 (P<.001), OR=3.48 (1.89-6.42) β_C=-0.92 (P<.01), OR=0.40 (0.21-0.77)
Y Lu et al. (Apr-2014)	BMQ-S	Not reported	N/A	N/A	N/A
YF Wang (Nov-2013)	BMQ-S	Not reported	MMAS-8	43.7%	r_N=0.03 (P>.05); r_C=-0.41 (P<.01); r_{NCD}=0.38 (P<.01); β_C=-0.33 (P<.001)
YJ Zhu (May-2017)	BMQ-S	N=19.44 ± 2.90; C=12.27 ± 2.79	MMAS-4	84.7%	β=0.03 (P=.30)

Author and date	BMQ subscale	Beliefs about Medicine (Mean± SD)	Adherence Measure	Adherence (%)	Correlation between BMQ and Adherence
YS Zhao (Feb-2018)	BMQ-S	NCD=4.89±2.69	MMAS-4	Not reported	Not reported
YY Dong (Jun-2018)	BMQ-S	Not reported	Self-designed	23.4%	β=0.13, (P=.02)
YY Yao (Jun-2018)	BMQ-S	N=18.56±3.01; C=12.76±3.03 NCD=5.78±4.37	MCS	89.7%	r_N=0.33 (P<.01); r_C=-0.12 (P<.05) r_{NCD}=0.31 (P<.01)
ZX Si (May-2013)	BMQ-S	N=22.2±2.3; C=11.2±2.6; NCD=11.1± 3.9	MMAS-8	87.4%	r_N=0.46 (P<.01); r_C=-0.33 (P<.01) r_{NCD}=0.51 (P<.01); β_C=-0.14 (P=.03)
ZX Si et al. (Feb-2013)	BMQ-S	Not reported	N/A	N/A	N/A

1) Correlation between BMQ and adherence: r (p-value), β (p-value) or OR (95% CI); 2) N: Necessity, C: Concern, NCD: Necessity-Concern differential, H: Harm, O: Overuse, B: Benefit; 3) MMAS-4/-8: Morisky Medication Adherence Scale 4-/8-item version; MARS-5: 5-item Medication Adherence Report Scale; BAASIS: Basel Assessment of Adherence with Immunosuppressive medication Scales; VAS: Visual Analogue Scale; ED: Electronic device.

3.3.4. Medication adherence

Forty-one out of 58 studies measured participants' medication adherence using at least one self-reported scale. The majority of them (34/41) used a MMAS (Morisky et al., 1986). Two of them (Liu et al., 2016; Wu, 2013) combined a visual analogue scale (VAS) or an electronic monitoring device as additional measurements. The Basel Assessment of Adherence with Immunosuppressive medication Scales (BAASIS) (Dobbels et al., 2010), the 5-item Medication Adherence Report Scale (MARS-5) (Horne & Weinman, 1999), Medical Compliance Scale (Xu et al., 2008) and one self-designed questionnaire were also used in a small number of studies (Dong, 2018; Geng & Li, 2018; Guo, 2014; Teng, 2016; Teng et al., 2015; Wei et al., 2017; Yao, 2018). Total 41 studies measured participants' medication adherence, while 8 of them did not report the adherence rate. The proportions of adherent patients in the remaining 33 studies ranged from 33.4% to 100% (see ***Table 3-1*** **&** ***Table 3-3***).

3.3.5. Relationship between BMQ scores and adherence

Twenty-four studies reported associations between BMQ components and medication adherence with correlation coefficient r (16 studies), regression index β (13 studies), OR with 95% CI (4 studies), or both. Two studies were excluded due to missing the exact value (Ning et al., 2016) or inconsistence of the values reported in the text (Teng, 2016). More details can be found in ***Table 3-4***.

Table 3-4 The source of effect size

	r_N	r_C	r_{NCD}	$β_N$	$β_C$	$β_{NCD}$
C Rui (May-2017)				✓	✓	
H Jiang et al. (Feb-2017)	✓	✓				
HM Liu et al. (Jan-2016)			✓			
JL Shao et al. (Oct-2015)	✓	✓	✓	✓	✓	
LQ Ning et al. (Sep-2016)				✓		
M Yuan et al. (Oct-2018)	✓	✓	✓			
SH Liu et al. (Jan-2018)	✓	✓	✓			
SJ Zhao et al. (Feb-2017)				✓	✓	✓
SY Liu et al. (Aug-2017)						✓
SY Yang & ZQ Lu (Feb-2016)	✓	✓	✓			
SY Yang et al. (Apr-2018)			✓			✓
W Yan et al. (Apr-2015)	✓	✓	✓			
X Liu et al. (Mar-2012)			✓			
XX Qiao et al. (Jul-2017)				✓	✓	
XY Yu & W Zeng (Dec-2016)	✓	✓	✓			
XY Zhao (May-2017)	✓	✓	✓			✓
Y Lu et al. (Feb-2016)				✓	✓	
YF Wang (Nov-2013)	✓	✓	✓		✓	
YJ Zhu (May-2017)						✓
YY Dong (Jun-2018)						✓
YY Yao (Jun-2018)	✓	✓	✓			
ZX Si (May-2013)	✓	✓	✓		✓	

Figure 3-2 shows the significant positive correlations between adherence and necessity beliefs in overall meta-analysis (pooled effect size=0.32, 95% CI: 0.21, 0.43) and two subgroups (pooled r= 0.30, 95% CI: 0.16, 0.43; pooled β= 0.37, 95% CI: 0.17, 0.57). Negative correlations between specific concerns and adherence were observed in both overall meta-analysis (pooled effect size=-0.35, 95% CI: -0.42, -0.28)

and subgroup analyses (pooled r= -0.35, 95% CI: -0.43, -0.27; pooled β= -0.35, 95% CI: -0.49, -0.21) (see ***Figure 3-3***). Moreover, a weak significant positive correlation was found between the NCD score and adherence (pooled effect size=0.25, 95% CI: 0.15, 0.36) (see ***Figure 3-4***).

There was significant heterogeneity between studies for the Necessity belief analysis (Q (16) =232.60, P<.01, I^2=93%), the Concern analysis (Q (17) =101.37, P<.001, I^2=83%) and their differential score (Q (18) =336.55, P<.01, I^2=95%). We tested the influence of heterogeneity by excluding the most extreme outliers. After excluding 4 out 11 studies (Necessity), 2 out 11 studies (Concerns) and 4 out 13 studies (NCD) from three meta-analyses, heterogeneity reduced (I^2<50%). However, the effect direction and significance of correlation remained similar to the initial results. Moreover, we tested the influence of translation quality by excluding the studies which did not use a validated BMQ (Necessity/Concern 2 studies & NCD 5 studies). The effects sizes also were similar in these sensitivity analyses (see ***Table 3-5***).

Study or Subgroup	Correlation with Necessity	SE	Weight	Correlation with Necessity IV, Random, 95% CI
4.1.1 Correlation coefficient (r)				
11 JL Shao 2015	0.165	0.0794	5.9%	0.17 [0.01, 0.32]
13 W Yan 2015	0.375	0.0831	5.9%	0.38 [0.21, 0.54]
18 YF Wang 2013	0.031	0.0686	6.1%	0.03 [−0.10, 0.17]
26 H Jiang 2017	0.009	0.0803	5.9%	0.01 [−0.15, 0.17]
30 XY Yu 2016	0.463	0.0824	5.9%	0.46 [0.30, 0.62]
31 SY Yang 2016	0.179	0.0856	5.8%	0.18 [0.01, 0.35]
34 ZX Si 2013b	0.46	0.0586	6.3%	0.46 [0.35, 0.57]
54 XY Zhao 2017	0.67	0.0391	6.5%	0.67 [0.59, 0.75]
59 SH Liu 2018	0.31	0.0731	6.0%	0.31 [0.17, 0.45]
61 M Yuan 2018	0.22	0.0767	6.0%	0.22 [0.07, 0.37]
63 YY Yao 2018	0.33	0.0447	6.4%	0.33 [0.24, 0.42]
Subtotal (95% CI)			**66.8%**	**0.30 [0.16, 0.43]**
Heterogeneity: $Tau^2 = 0.05$; $Chi^2 = 124.07$, df = 10 ($P < 0.00001$); $I^2 = 92\%$				
Test for overall effect: Z = 4.28 ($P < 0.0001$)				
4.1.2 Regression coefficient (Beta)				
11 JL Shao 2015	0.13	0.0657	6.2%	0.13 [0.00, 0.26]
23 SJ Zhao 2017	0.16	0.05	6.4%	0.16 [0.06, 0.26]
32 LQ Ning 2016	0.278	0.0923	5.7%	0.28 [0.10, 0.46]
36 Y Lu 2016-China	1.247	0.129	5.0%	1.25 [0.99, 1.50]
37 XX Qiao 2017	0.173	0.024	6.6%	0.17 [0.13, 0.22]
53 C Rui 2017	0.44	0.22	3.3%	0.44 [0.01, 0.87]
Subtotal (95% CI)			**33.2%**	**0.37 [0.17, 0.57]**
Heterogeneity: $Tau^2 = 0.05$; $Chi^2 = 70.82$, df = 5 ($P < 0.00001$); $I^2 = 93\%$				
Test for overall effect: Z = 3.67 ($P = 0.0002$)				
Total (95% CI)			**100.0%**	**0.32 [0.21, 0.43]**
Heterogeneity: $Tau^2 = 0.05$; $Chi^2 = 232.60$, df = 16 ($P < 0.00001$); $I^2 = 93\%$				
Test for overall effect: Z = 5.64 ($P < 0.00001$)				
Test for subgroup differences: $Chi^2 = 0.37$, df = 1 ($P = 0.54$), $I^2 = 0\%$				

Correlation with Necessity
IV, Random, 95% CI

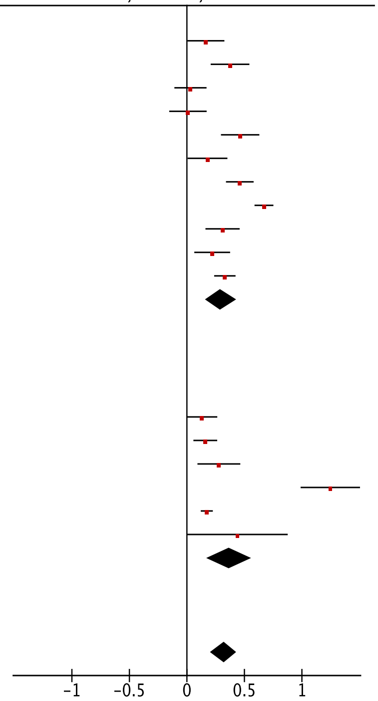


Figure 3-2 Forest plot of correlations between Necessity beliefs and medication adherence

Study or Subgroup	Correlation with Concern	SE	Weight	Correlation with Concern IV, Random, 95% CI
4.3.1 Correlation coefficient (r)				
11 JL Shao 2015	−0.479	0.0629	5.9%	−0.48 [−0.60, −0.36]
13 W Yan 2015	−0.542	0.0683	5.7%	−0.54 [−0.68, −0.41]
18 YF Wang 2013	−0.406	0.0574	6.1%	−0.41 [−0.52, −0.29]
26 H Jiang 2017	−0.47	0.0626	5.9%	−0.47 [−0.59, −0.35]
30 XY Yu 2016	−0.342	0.0926	4.9%	−0.34 [−0.52, −0.16]
31 SY Yang 2016	−0.166	0.086	5.1%	−0.17 [−0.33, 0.00]
34 ZX Si 2013b	−0.332	0.0661	5.8%	−0.33 [−0.46, −0.20]
54 XY Zhao 2017	−0.37	0.0612	6.0%	−0.37 [−0.49, −0.25]
59 SH Liu 2018	−0.38	0.0692	5.7%	−0.38 [−0.52, −0.24]
61 M Yuan 2018	−0.23	0.0763	5.4%	−0.23 [−0.38, −0.08]
63 YY Yao 2018	−0.12	0.0494	6.4%	−0.12 [−0.22, −0.02]
Subtotal (95% CI)			**62.8%**	**−0.35 [−0.43, −0.27]**
Heterogeneity: $Tau^2 = 0.02$; $Chi^2 = 45.79$, df = 10 ($P < 0.00001$); $I^2 = 78\%$				
Test for overall effect: Z = 8.17 ($P < 0.00001$)				
4.3.2 Regression coefficient (Beta)				
11 JL Shao 2015	−0.31	0.0737	5.5%	−0.31 [−0.45, −0.17]
18 YF Wang 2013	−0.331	0.0612	6.0%	−0.33 [−0.45, −0.21]
23 SJ Zhao 2017	−0.27	0.0592	6.0%	−0.27 [−0.39, −0.15]
34 ZX Si 2013b	−0.14	0.0747	5.5%	−0.14 [−0.29, 0.01]
36 Y Lu 2016-China	−0.916	0.087	5.1%	−0.92 [−1.09, −0.75]
37 XX Qiao 2017	−0.32	0.022	7.0%	−0.32 [−0.36, −0.28]
53 C Rui 2017	−0.03	0.21	2.1%	−0.03 [−0.44, 0.38]
Subtotal (95% CI)			**37.2%**	**−0.35 [−0.49, −0.21]**
Heterogeneity: $Tau^2 = 0.03$; $Chi^2 = 55.18$, df = 6 ($P < 0.00001$); $I^2 = 89\%$				
Test for overall effect: Z = 4.87 ($P < 0.00001$)				
Total (95% CI)			**100.0%**	**−0.35 [−0.42, −0.28]**
Heterogeneity: $Tau^2 = 0.02$; $Chi^2 = 101.37$, df = 17 ($P < 0.00001$); $I^2 = 83\%$				
Test for overall effect: Z = 9.82 ($P < 0.00001$)				
Test for subgroup differences: $Chi^2 = 0.00$, df = 1 ($P = 0.99$), $I^2 = 0\%$				

Correlation with Concern
IV, Random, 95% CI

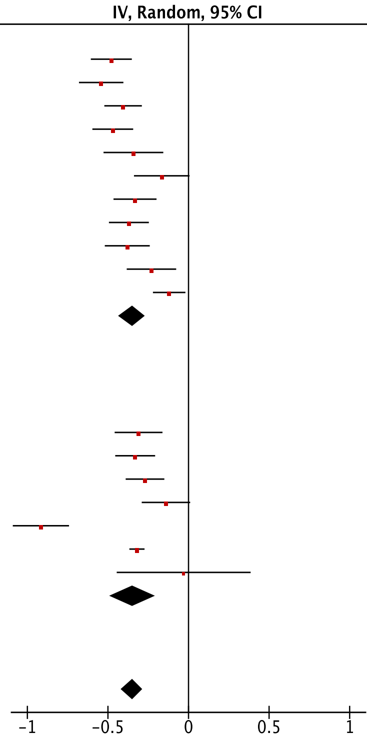


Figure 3-3 Forest plot of correlations between Concerns beliefs and medication adherence

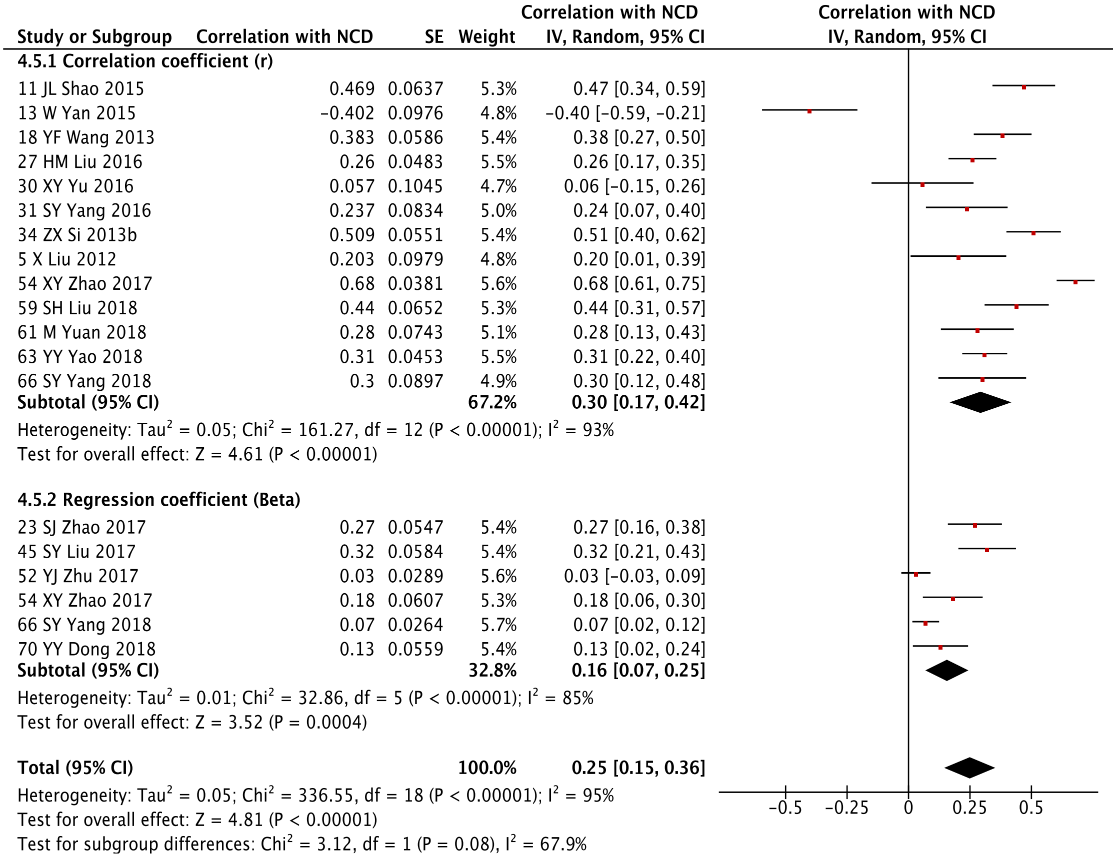


Figure 3-4 Forest plot of correlations between NCD scores and medication adherence

Table 3-5 Pooled effect sizes of meta-analyses before and after removing outliers

	Pooled r (95% CI)	Pooled β (95% CI)	Overall pooled effect size (95% CI)
Necessity			
Before	0.30 (0.16, 0.43)	0.37 (0.17, 0.57)	0.32 (0.21, 0.43)
After	0.28 (0.12, 0.45)	0.37 (0.17, 0.57)	0.32 (0.19, 0.44)
Concern			
Before	-0.35 (-0.43, -0.27)	-0.35 (-0.49, -0.21)	-0.35 (-0.42, -0.28)
After	-0.33 (-0.42, -0.23)	-0.35 (-0.49, -0.21)	-0.34 (-0.41, -0.26)
NCD			
Before	0.30 (0.17, 0.42)	0.16 (0.07, 0.25)	0.25 (0.15, 0.36)
After	0.37 (0.24, 0.49)	0.16 (0.06, 0.27)	0.29 (0.17, 0.42)

3.3.6. Research quality

The quality assessment indicated that twelve studies were rated as good quality, thirty-six as moderate quality, and ten as poor quality (see ***Table 3-1*** **&** ***Table 3-2***). The element of study quality, which seemed to be the weakest overall, was a lack of sample size calculation, with only sixteen studies including this information. Regarding participants, most studies clearly described the inclusion criteria of participants, except Yan's study (2015). The reported response rates varied between 77.7% and 100%. Eight studies did not report participants' response rate. Liu's study (2017) had a considerable dropout rate (>20%) but did not discuss the impact of these missing data. For sampling strategies, the majority of studies (41/58) applied a non-probability sampling method, such as convenient sampling, stratified sampling and opportunity sampling. Another 14 studies did not describe their sampling strategies. Only three studies (Wan et al., 2017; Yu & Zeng, 2016; Zhao, 2018) applied random sampling method. Around half of the studies (28/58) clearly defined how they had assessed beliefs about medicines and explained what they had measured. Eleven studies used self-translated versions of BMQ, and three most commonly cited versions were translated and validated following the appropriate guideline. However, another eleven studies did not provide any details of translation, meaning unable to detect whether they followed an appropriate methodology. Although items on general benefit beliefs had been added into BMQ since 2001 (Horne et al., 2001), few included study cited the new version, except Wan (Wan et al., 2017) and Wei (Wei et al., 2017). The funnel plots (see ***Figure 3-5***) showed that there was a slight publication bias (Sterne et al., 2011).

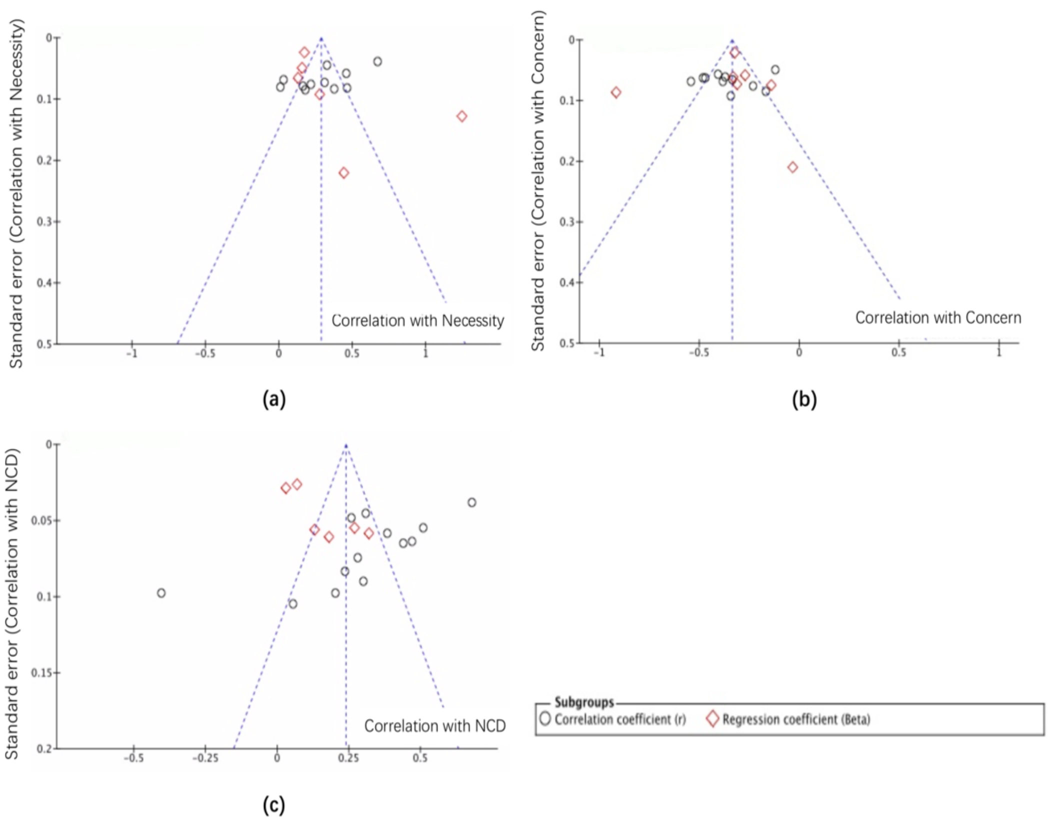


Figure 3-5 Panel (a): Funnel plot of studies for Necessity belief analysis. Panel (b): Funnel plot of studies for Concern analysis. Panel (c): Funnel plot of studies for NCD analysis.

3.4. Discussion

This was the first study systematically review studies which measured Chinese patients' beliefs about medicines using the BMQ. The results showed that the BMQ had been widely used in a wide range of Chinese patient groups. Several different versions of the BMQ had been used. The meta-analysis results indicated that the Chinese population had same cognitive and behavioural patterns with Western population: patients who believed that they needed their medication and had fewer concerns about potential risks of treatment were more likely to be adherent.

3.4.1. The use of BMQ in China

We found that the BMQ was first introduced and applied in the Chinese population in 2012 (Liu & Jiang, 2012), despite having been available from 1999 and widely used in different patient groups and cultures (Horne et al., 2013; Horne et al., 1999). Cardiovascular disease (16 out of 58) was the main focused condition in BMQ studies in China.

3.4.2. The reliability of translation of BMQ

A commonly accepted Cronbach's α indicate sufficient reliability for questionnaires is

0.7 (Cortina, 1993). Eight out of nine tested Cronbach's α of overall BMQ reported by studies were over than 0.7, indicating these Chinese versions had acceptable internal consistency reliability. However, nearly half (18 out of 43) reported Cronbach's α for subscales were lower than 0.7. It might be ascribed to a small number of items and heterogeneity of participants. The Cronbach's α is easily influenced by the size of the questionnaire; therefore, the reliability of subscales made up of 4 or 5 items was highly possible underestimated.

3.4.3. Correlation between beliefs about medicines and medication adherence

The results suggested that patients with stronger necessity beliefs about medication might adhere more to prescribed medication. Whereas patients who are more concerned about the potential risks of their medication might be less likely to adhere to treatment. With the significant positive correlation between adherence and the NCD score, these findings indicate that NCD seems to be a useful measure in predicting adherence behaviour. Our findings were consistent with previous reviews of studies using the BMQ (Horne et al., 2013). According to Cohen's recommendations (Cohen, 1992), the effect size of correlations (r) can be defined as small, medium and large if the absolute value of r falls between 0.1 and 0.3, between 0.3 and 0.5, and larger than 0.5, respectively. In Horne’s meta-analyses, the correlations between specific beliefs about medicines (Necessity and Concern) and medication adherence were both large (r_n=0.56, 95% CI: 0.45, 0.66; r_c=-0.69, 95% CI: -0.80, -0.58, respectively). The pooled correlations in the current meta-analyses (r_n=0.32, 95% CI: 0.21, 0.43; r_c=-0.35, 95% CI: -0.42, -0.28) showed the same direction as Horne’s finding but weaker, in the range of medium effect sizes. It suggests that compared with the western population, specific beliefs about medicines may not be strong predictors of medication adherence in the Chinese population. A weak effect size also suggested that Chinese patients' medication adherence and caused clinical outcomes may be hard to be improved solely by changing their specific beliefs about medicines. Some factors other than the specific beliefs are also important and need to be investigated.

Regarding heterogeneity, there was substantial heterogeneity among included studies across the three meta-analyses. However, this was expected due to the many complex factors that contribute to medication adherence behaviour (Horne et al., 2005). The effect direction and correlation significance remained similar after removing outlier cases, indicating that these outliers did not bias our estimates of the effects of beliefs on adherence.

3.4.4. Study quality

The majority of included studies (48 out of 58) had a moderate or good quality. However, there were several common limitations to study quality identified by our review. Firstly, more than half of the included studies (41 out of 58) applied a non-probability sampling method, such as convenience sampling, which is a simple and pragmatic way to recruit participants but could lead to sampling bias and harm both the internal and external validity of the study. Moreover, the response rate varied between studies and which indicates that selection bias may have influenced the findings of this review. These patients who were highly engaged with the survey might also be more likely to adhere to their treatment. The findings may not be generalisable to the whole population (Etikan et al., 2016; Sedgwick, 2013). In addition, most of the included studies measured participants' medication adherence with self-report scales, which may be influenced by recall bias, social desirability bias and errors in self-observation (Horne & Clatworthy, 2010). We also noted that the definition of non-adherence used varied across studies with different cut-off points and measurements being used, which might identify different groups of patients. Several of the studies did not report data clearly, with seven studies measuring but not reporting data on medication beliefs, and eight studies (Dong et al., 2017; Liu & Zhou, 2018; Ni et al., 2018; Wan et al., 2017; Wu, 2013; Xu & Wu, 2018; Yang & Lu, 2018; Zhao, 2018) also measuring but not reporting adherence.

3.4.5. Strengthens and limitations

This is the first study that systematically reviewed all studies using the BMQ to evaluate medication beliefs in China. The review not only focused the studies published conducted in databases in English indexing but also some Chinese databases as most of the studies published in Chinese. This review highlights that beliefs about medicine are associated with medication adherence in the Chinese population as has been found in other reviews. The results also offer targets for intervention. The associations were evaluated using both correlation coefficient and regression index. The latter one was adjusted by some confounding factors, which may contribute to the influence of beliefs about medicines on adherence and their correlation. Potentially, clinicians may be able to assess patients' beliefs about medicines in order to identify those at risk of non-adherence.

This review has several limitations. Firstly, although there were reasonable numbers of studies focused on participants' specific beliefs about medicines, there was a lack of evidence about the influence of general beliefs on medication adherence. Secondly, there was a limited range of patient groups/diseases meaning that the findings are not generalisable to the entire Chinese population. Also, adherence was assessed using self-reported scales in all included studies except one combining electronic monitoring and self-report (Liu et al., 2016). As I discussed in ***Chapter 1***, self-reported scales rely on memory recall and are often criticised as overestimating adherence (Sayner et al., 2015; Stirratt et al., 2015). Moreover, the accuracy of the self-reported adherence is also influenced by understanding and interpretation of scale options, such as the distinction between 'sometimes skip a dose' and 'often skip a dose'. Fourth, the majority of studies (18 of 22) included in the meta-analyses assessed self-reported adherence using the MMAS-4/-8. The scales consist of some items tapping reasons for not taking the medication, such as "When you feel better, do you sometimes stop taking your medicines?” and “Sometimes if you feel worse when you take the medicine, do you stop taking it?”. These items reflect links between non-adherence decision and perceived necessity and concerns that might lead to overestimating the correlations between BMQ scores and medication adherence. Lastly, due to the cross-sectional design nature, the results solely reflect the associations between beliefs about medicines and adherence at one time point so there is limited evidence about whether beliefs can be used to predict later adherence.

3.5. Conclusion

This review found that the BMQ has been increasingly used in the Chinese population in recent years. The NCF and specific beliefs about medicines appear to be a useful conceptual model to explain Chinese patients’ medication adherence behaviour, as has been found in previous reviews in other populations. Further high-quality studies examining medication-related beliefs and adherence in Chinese populations with a wide range of conditions are warranted. The next part of this thesis will explore these cognitive representations of medicines and investigate how these cognitions impact patient’s medication-taking behaviour from a qualitative perspective.

Part 2: Qualitative studies

This part consists of two qualitative studies:

1: A semi-structured interview aims to explore the beliefs about medicines, factors influencing the beliefs and links between these beliefs and medication-taking behaviour in Chinese patients.

2: A ‘think-aloud’ task aims to check Chinese people’s comprehension of an existing Chinese translation of the BMQ.

Chapter 4 Cognitive representations of medicines amongst Chinese patients with CHD, hypertension and T2DM

4.1. Background

Psychosocial factors such as patient's medical knowledge, illness perceptions, beliefs about medicines, and intention have been recognised as patient-related factors of medication non-adherence (WHO, 2003). And in the CSM (Leventhal et al., 2016) and its development – BMQ Model (Horne, 1997), cognitive representations of medicines (CRM) was highlighted as a key factor associated with medication-taking behaviour and has been intensively studied.

Horne and Weinman (Horne, 1997; Horne et al., 1999) summarised beliefs about medicines as specific and general aspects. In ***Chapter 3***, specific-necessity beliefs and specific-concerns showed significant correlations with medication adherence in the Chinese population. However, the correlations were weaker than those in western population. Moreover, the causal mechanism underpinning these associations was not clear. Since the healthcare system and culture in China are different from that in western countries, Chinese population may have some beliefs about medicines that different from those in the western populations. Whether these disparities impact Chinese people's medication-taking behaviour is also worthy of investigating. Therefore, I conducted a qualitative study to investigate Chinese patients' CRM and factors impacting it and to investigate how these cognitions influence medication-taking behaviour.

4.2. Methods

4.2.1. Ethical considerations

Ethical approval (6851/001) was obtained from the UCL Research Ethics Committee in July 2015 (***Appendix D. Ethics approval of qualitative study***). All data collected from participants was stored according to the UK Data Protection Act (1998, 2018).

4.2.2. Study design

A semi-structured interview method was selected for this study. Participants responded to questions following a pre-developed schedule (see ***section 4.2.3.2***). The semi-structured method is flexible to use and has several advantages (Clarke & Braun, 2013). First, unlike the structured interview which is somewhat similar to an in-person questionnaire survey, the semi-structured method allows participants to elaborate their views and insights even straying from topical trajectories if the interviewer thinks it is appropriate. It helps to obtain rich and complete insights from participant's perspective (Cohen & Crabtree, 2006). In comparison to an unstructured interview which usually has little interference from the interviewer during the conversation, the semi-structured interview allows the interviewer to have more control over the conversation and maintain focus on the topic of interest. Through following a clear set of instructions and asking questions in a particular order, the semi-structured method helps interviewers to obtain reliable and comparable qualitative data (Wilkinson et al., 2003).

4.2.3. Measures

4.2.3.1. Demographic and healthcare information

A basic information form was used to collect participants' demographic information (e.g. age, gender, education level and occupation) and health-related information, such as disease type, duration, healthcare insurance, current/previous medications and emergency contact information.

4.2.3.2. Interview schedule

The interview schedule was drafted in a semi-structured style (Fylan, 2005) and discussed with supervisors (LW & SC). All questions were written without leading and discriminatory statements. A bilingual test version was piloted with four student volunteers who were fluent in both Chinese Mandarin and English. There was no issue raised in the pilot test. All questions were clear and easily understood. LW checked the accuracy of the final translated version. The schedule consisted of six topics, including current health conditions, beliefs about medicines, medication-taking, medication adherence and barriers, social support from family and doctors, and beliefs about TCM. Six key questions and 23 probes on these topics were prepared to encourage participants to elaborate (see ***Appendix E. Interview schedule***).

4.2.4. Data collection

4.2.4.1. Setting

Participants were recruited from two tertiary hospitals in Xuzhou, Jiangsu province: 1) Xuzhou Central Hospital which is the largest and most technologically advanced general hospital in Jiangsu (Xuzhou Central Hospital, 2017); 2) Xuzhou City Hospital of TCM, the biggest TCM hospital in the north of Jiangsu province, offering about 1200 ward beds (Xuzhou City Hospital of TCM, 2014).

4.2.4.2. Sample size

A quota sampling strategy (Battaglia, 2008) was applied to decide the number of participants recruited in the initial phases. Participants' gender, condition and hospital were used as grouping criteria. To ensure each subgroup consisted of at least two participants, the minimum sample size was 24 (N=2 participants*2 genders*3 conditions*2 hospitals) (see **Table *4-1***). However, the final number of participants was guided by the principles of information saturation (Clarke & Braun, 2013), which means interviews would continue until no novel information was reported.

Table 4-1 The sampling frame

Diagnosis / Hospitals	CHD	Hypertension	T2DM
Central hospital	2 Males	2 Males	2 Males
	2 Females	2 Females	2 Females
TCM hospital	2 Males	2 Males	2 Males
	2 Females	2 Females	2 Females

4.2.4.3. Participants and recruitment

The inclusion criteria include 1) aged 18 years old or over; 2) diagnosed with one or more conditions of CHD, hypertension and T2DM; 3) had continued using pharmaceutical medication for the condition(s) above for three months or more so that have enough experience to share.

Local physicians initially identified 35 eligible patients from medical records of the departments of Cardiology, Endocrinology, Neurology and Geriatrics of the two collaborating hospitals. The physicians approached inpatients in the hospital wards and outpatients clinics with an introductory pack, containing a cover letter, an information sheet and a consent form. Thirty patients who showed interest in the study were introduced to BN after signing the consent forms. Data were collected between August and September 2015. All interviews were conducted and audio-recorded in doctors' offices and wards. It was decided that sufficient information had been collected after conducting the 28th interview. Each participant received a reward of ¥100 (about £11) after the interview.

4.2.5. Transcription and analysis

The audio records were transcribed verbatim. Hesitations and long pauses were represented using an ellipsis, and the short pauses were represented using commas. Full-stops indicated the end of a spoken sentence. The irrelevant comments between important quotes were shortened to ellipsis in square brackets (e.g. […]). Some lost semantic contents were added in brackets to keep the integrity of sentences. The quality of transcripts was checked by supervisor (LW).

The quantitative data were presented as Mean ± SD for continuous variables and numbers (%) for categorical variables. The qualitative data were coded using NVivo 11 (2015) and analysed following thematic analysis (TA) guideline (Braun & Clarke, 2013). The TA method was first developed by Gerald Holton (1975), and is extremely flexible, having been applied in almost all types of qualitative research (Braun and Clarke, 2013). The qualitative data were analysed and coded in five steps:

1) **Familiarisation with the data.** I repeatedly read transcripts and made notes of analytic observations. According to the research aims, contents relating to CRM and possible factors that might influence the CRM were noted down at this stage. Some possible themes were noted next to the relevant materials.

2) **Categorising data and generating initial codes.** Data were categorised in three main phases: 1) CRM, 2) factors influencing CRM, and 3) links between CRMs and medication taking.

In the first phase, contents about CRM were coded in both deductive and inductive ways. Deductive coding was conducted first, in which data were primarily coded based on the items and factor structure of BMQ (e.g. necessity, concern, benefit, harm and overuse). Statements which were similar to existing BMQ items were revised according to participants' language when codes were developed. For example, Item BG6 (Most medicines are poisons) was reworded as “All medicines are somewhat toxic (是药三分毒)” to code a general belief about medicine toxicity. After this, statements which seemed to reflect beliefs about medicines within the BMQ structure (e.g. beliefs about necessity, concerns, benefit, harm and overuse) but which were not incorporated in the original BMQ items were inductively coded. I then reflected on whether these statements could be incorporated within the existing BMQ constructs. For example, the statement “Bitter medicines benefit health (良药苦口利于病)” is not a BMQ-item, but was incorporated within the Benefit construct. If they did not fit with the existing BMQ structure, the statements were coded as additional cognitions (e.g. Western medicines treat the symptom, while TCM cleans the root of disease (西药治标，中药治本) and then formed new themes. Codes developed based on proverbs were presented with original Chinese translations in brackets.

In the second phase, I inductively coded factors influencing CRM but reflected on existing frameworks when considering relationships between these factors. For example, the links between illness perceptions and beliefs about medicines were initially explored according to Horne's description (Horne et al., 2019). Some additional codes, such as "coherence of illness and medicines (对症)" was inductively developed based on participants' language.

The links between CRMs and medication taking, including intention to take medication, use pattern and selection of medication were inductively analysed in the third phase based on participants' statements.

3) **Initial search and definition of themes.** Themes that fitted with the existing BMQ framework were named same as BMQ scales (e.g. specific beliefs about necessity, general beliefs about harm). Additional themes beyond the BMQ constructs were inductively developed by merging similar codes and collating frequent codes, such as trust in medicines.

4) **Checking and refining the themes.** The initial theme/code list formed in the previous step were checked by supervisors (LW & SC). Disagreements were discussed and solved at this stage. Some adaptations were conducted, such as discarding unnecessary themes which did not address the research questions and merging similar themes. The final themes were clearly defined and described at this stage. Quotations from participants were used to illustrate these themes.

5) **Mapping themes and addressing the research questions.** At the final stage, I mapped themes onto the study aims. Specifically, themes about CRM were used to describe how Chinese patients think about medicines. Arrows in the theoretical map described relationships between themes. They answered the research questions "What are influential factors of CRM?" and "How CRM impacts taking medication?".

4.3. Results

4.3.1. Overview of interviews and thematic framework

All interviews were conducted face to face, of which the average time was 39.9 ±16.78 minutes. Identified CRM include five BMQ-based beliefs (necessity, concern, benefit, harm & overuse), beliefs about TCM and trust in medicines. Participants' illness perceptions, information/knowledge of medicine, views on healthcare providers and drug quality were identified as four influential factors impacting CRM. Relations between CRM, influential factors and medication taking were described in a thematic map (see ***Figure 4-1***). Participants' responses and statements relating to the above themes were extracted and cited as quotes. The quotes were labelled with participants' numbers, gender, age and conditions. The definitions of themes and codes were summarised in the tables at the beginning of each relevant section.

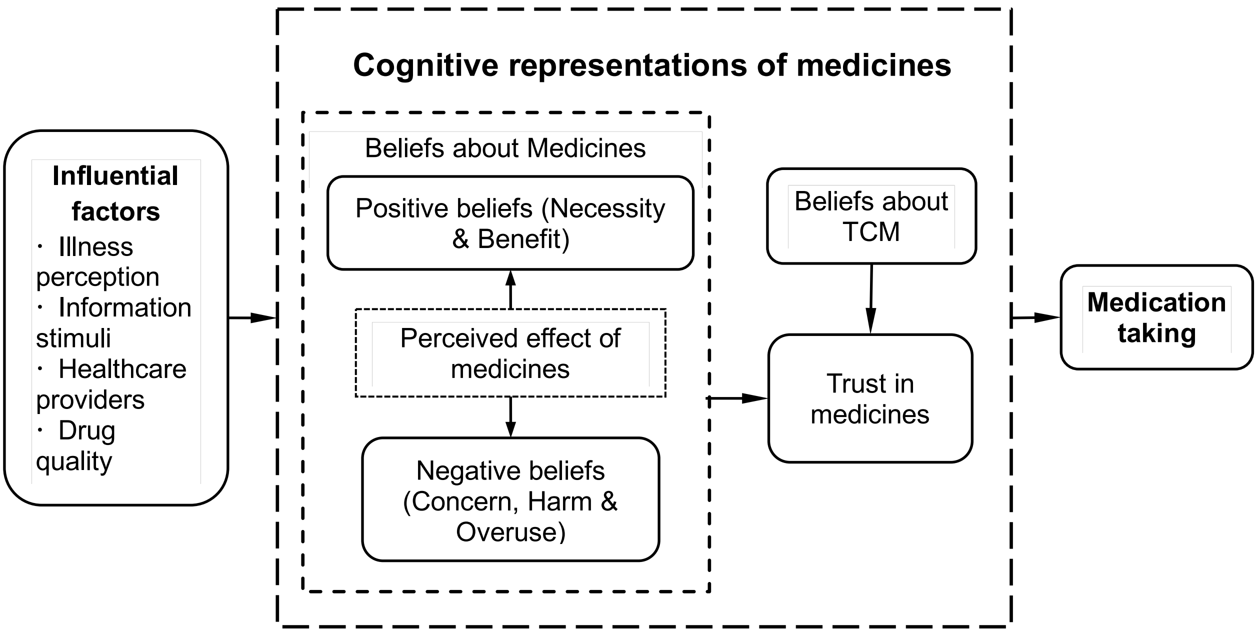


Figure 4-1 Thematic map of interactions between CRMs, factors influencing CRMs and medication taking

4.3.2. Characteristics of the participants

Twenty-eight participants were recruited for the present study. The participant's characteristics are presented in **Table *4-2***. There were 12 (42.9%) females and 16 (57.1%) males with a mean age of 65.9 ± 11.1 years, ranged from 45 to 87 years old. Most participants (23/28) had secondary school education or above. 21 out of 28 participants were retired, and the remainder consisted of two farmers, one engineer, one teacher, one cashier, one athlete and one self-employed retailer. For medical insurance, 23 of 28 participants accessed the Basic Medical Insurance for Urban Employee (BMIUE). One woman accessed the Basic Medical Insurance for Urban Resident (BMIUR) which serves unemployed urban residents with a lower reimbursement rate than the BMIUE. Two farmers accessed the New Rural Cooperative Medical System (NRCMS), in which rural residents can enjoy a high reimbursement rate if using local medical services. Two retired civil servants enjoyed free medical services which are only specific to soldiers and civil servants. Moreover, six participants bought commercial medical insurance as a supplement of their basic medical insurance.

Half of the participants were recruited from the Central Hospital and the others from the TCM hospital. Thirteen participants had one of the conditions that were the focus of this study (2 with CHD, 4 with Hypertension & 7 with T2DM). The remaining participants had one or two comorbidities of CHD, hypertension and T2DM (see **Table *4-2***). The duration of the above diseases varied between 3 months and 46 years. The participants consumed a mean of 3.6 ± 1.7 pharmaceutical medicines. More than half of the participants were currently using or previously used TCM or proprietary Chinese medicines (see **Table *4-2*** & **Table *4-3***).

Table 4-2 Demographic and clinical characteristics of the participants

Demographic/clinical characteristics	No. of participants
Mean age *	65.9±11.1
Gender	
Male	12
Female	16
Education level	
High	9
Medium	14
Low	5
Retired	
Yes	21
No	7
Basic Medical Insurance	
BMIUE	23
BMIUR	1
NRCMS	2
Free Medical Services for Civil Servants and Soldiers	2
Recruitment	
From the Central Hospital	14
From the TCM Hospital	14
Condition #	
Single condition	13
CHD	2
Hypertension	4
T2DM	7
Two conditions	9
CHD & Hypertension	5
CHD & T2DM	2
Hypertension & T2DM	2
Three conditions	6
Symptom control	
Well controlled	20
Not controlled	8
Average number of medicines currently taking *	3.6 ± 1.7
TCM use	
Current	13
Past	3
Never	12

*: Data is presented by numbers and Mean ± SD. #: The conditions here only refer to CHD, hypertension and T2DM. Other comorbidities beyond the above three conditions were not included. BMIUE: Basic Medical Insurance for Urban Employee; BMIUR: Basic Medical Insurance for Urban Resident; NRCMS: New Rural Cooperative Medical System. TCM: Traditional Chinese Medicine, including herb decoction and proprietary Chinese medicines.

Table 4-3 Demographic characteristics and treatment regimen of participants

No.	Age	Sex	Education level	Occupation	Hospital	Year of diagnosis			Uncontrolled disease	No. of med currently using		Pharmaceutical medicines Current (*Previous*)	TCM/proprietary Chinese medicines Current (*Previous*)
						CHD	HTN	T2DM		WM	TCM		
1	61	M	High	Retired	T	N/A	N/A	2003		2	N/A	Metformin, injected insulin	
2	63	F	Medium	Retired	T	2010	2010	N/A		3	N/A	Fluvastatin, aspirin, amlodipine	
3	62	M	High	Retired	T	N/A	N/A	2009	T2DM	3	N/A	Acarbose, repaglinide, glargine (*Etformin, glimepiride*)	
4	80	F	Low	Retired	T	N/A	1994	2007	HTN	4	N/A	Amlodipine, irbesartan and two unknown antidiabetic drugs (*Nitrendipine, valsartan, bayaspirin*)	
5	64	M	High	Retired	C	N/A	N/A	2015	T2DM	1	N/A	One unknown antidiabetic drug (*Metformin*)	
6	85	M	Medium	Retired	C	N/A	N/A	2006		1	N/A	Metformin	
7	58	M	Medium	Retired	C	1995	2015	1995	T2DM	4	N/A	Aspirin, injected insulin, one unknown cardiovascular drug and one unknown stroke drug (*Metformin*)	(*XIAOKE Pill*)
8	52	M	Medium	Farmer	C	2015	2010	2013		3	N/A	Amlodipine, metformin, one unknown cardiovascular drug (*Compound reserpine-triamterene tablet*)	
9	78	F	Low	Retired	C	2009	N/A	1990s		3	1	Aspirin, acarbose, injected insulin	NAOXINTONG Capsule
10	58	F	Low	Farmer	C	2015	2005	N/A		6	N/A	Unknown	
11	65	M	High	Retired	C	N/A	N/A	2015		1	1	Injected insulin	DANSHEN dripping Pill, MUDAN Granule
12	65	F	Medium	Retired	C	2008	N/A	2000	T2DM	6	1	Metoprolol, fluvastatin, bayaspirin, acarbose, metformin hydrochloride, injected insulin (*Glibenclamide*)	DANSHEN Dripping Pill
13	70	F	Medium	Retired	C	1992	1970s	1998	HTN & T2DM	5	4	Metoprolol, bayaspirin, valsartan, acarbose, amlodipine	DANSHEN Dripping Pill, XINKANG Capsule, SHEXIANG BAOXIN Pill, TANGLINING Capsule (*Herb decoction*)
14	62	M	High	Retired	T	N/A	N/A	2002		7	1	Mitiglinide, metformin, injected insulin, epalrestat, beraprost sodium tablet, pancreatic kininogenase enteric-coated tablet, mecobalamin (*Acarbose, glimepiride, repaglinide*)	MUDAN Granule (*XIAOKE Pill*)
15	58	M	Medium	Engineer	T	N/A	2013	N/A		2	N/A	Irbesartan, diosmin (*Metoprolol*)	

No.	Age	Sex	Education level	Occupation	Hospital	Year of diagnosis			Uncontrolled disease	No. of med currently using		Current pharmaceutical medicines (*Previous medicines*)	Current TCM/proprietary Chinese medicines (*Previous medicines*)
						CHD	HTN	T2DM		WM	TCM		
16	63	F	Medium	Retired	T	1995	1995	N/A		4	N/A	Benazepril hydrochloride, metoprolol, amlodipine, bayaspirin (*Digoxin, nitroglycerin, captopril*)	(*XINBAO Pill, DANSHEN Dripping Pill, FUXINKANG Capsule*)
17	55	F	Medium	Cashier	T	2013	2013	1998		6	N/A	Metoprolol, simvastatin, acarbose, glibenclamide hydrochloride, injected insulin, one unknown cardiovascular drug	(*Herb decoction*)
18	62	M	Medium	Retired	T	2012	1972	2002		6	1	Captopril, nitrendipine, aspirin, simvastatin, acarbose, metformin, injected insulin (*Clopidogrel hydrogen sulphate tablet*)	ZHENYUAN Capsule (*Herb decoction*)
19	68	M	Medium	Retired	C	N/A	2003	N/A		2	N/A	Felodipine, indapamide	
20	75	F	Medium	Retired	C	2002	N/A	N/A	CHD	4	1	Isosorbide mononitrate, aspirin, nitrendipine, one unknown hypolipidemic drug	WENXIN Granule
21	75	M	High	Retired	C	2008	1992	N/A		4	1	Aspirin, benazepril hydrochloride, captopril, one unknown antihypertensive drug (*Clopidogrel hydrogen sulfate, compound reserpine-triamterene tablet*)	DANSHEN Dripping Pill (*NAOXINTONG Capsule*)
22	45	M	Medium	Retailer	C	2015	2013	N/A	HTN	4	1	Metoprolol, aspirin, one unknown cardiovascular drug, one unknown diuretic	YIXINKANG Tablet
23	65	F	High	Retired	C	N/A	1994	N/A		2	1	Valsartan, aspirin (*Fluvastatin*)	XUEZHIKANG Capsule (*Herbal TCM*)
24	86	M	Low	Retired	T	N/A	2000	2012		3	1	Acarbose, compound Irbesartan-hydrochlorothiazide tablet, one unknown hypoglycemic drug	SHENSONG YANGXIN Capsule
25	48	F	High	Teacher	T	N/A	N/A	2009		2	1	Acarbose, mecobalamine (*Metformin, glimepiride, injected insulin*)	Herb decoction (*MUDAN Granule*)
26	57	M	Medium	Athlete	T	2014	N/A	N/A		5	N/A	Not reported	
27	78	F	Low	Retired	T	N/A	2000	N/A		2	N/A	Nitrendipine, captopril	
28	87	M	High	Retired	T	2009	1975	2005		6	3	Fluvastatin, aspirin, amlodipine, valsartan, glimepiride, acarbose	JINSHUIBAO Capsule, SHENSONG YANGXIN Capsule, YINDAN XINTAI Dripping Pill (*Herb decoction*)

M: Male; F: Female. High: college study/degree education or over; Middle: middle school, high school or secondary school; Low: Primary school/ illiteracy. C: recruited from the Central Hospital; T: recruited from the TCM Hospital. HTN: hypertension. Self-reported disease control was based on patient's personal feeling and feedback that patients got from their healthcare providers. The medicines currently using include pharmaceutical medications, TCM and proprietary Chinese medicines.

4.3.3. Cognitive representations of medicines

Eight CRM were identified, including five existing beliefs in the BMQ framework (necessity, concern, harm, benefit and overuse) and two additional cognitions (t[[rust in medicines and beliefs about TCM) (***Table 4-4***).

Table 4-4 Themes and codes relating to CRM

Themes and definitions	**Codes**
Specific necessity beliefs: Beliefs relevant to the personal need of medication for maintaining health and perceived positive effects of particular medication	· Patients cannot live without the medicines; · The medicines make patients feel better; · The medicines improve patients' future health; · The medicines increase the quality of life; · Unsatisfactory effects may cause low necessity.
Specific concerns: Concerns about the adverse consequence of medication and disturbing medication-taking behaviour	· The medicines cause damage to bodies; · The medicines cause bad reactions; · Destabilising effect of the medicine is dangerous; · The medicines may cause addiction; · Taking medicines dominates people's lives; · Taking medicines disturbs social life; · Taking medicines causes stigma experience.
General benefit beliefs: Beliefs that medicines are beneficial to patients.	· Medicines are (not) beneficial in general; · If people have diseases, they should take the medicines; · Bitter medicines benefit health (良药苦口利于病).
General harm beliefs: Beliefs that medicines are harmful in general, and inappropriate use is harmful.	· All medicines are somewhat toxic (是药三分毒); · Taking wrong medicine is dangerous.
General overuse beliefs: Perceived notions that medicines are excessively taken by patients or overprescribed by doctors	· Patients have taken too much medicine; · Doctors overprescribed medicines.
Beliefs between TCM and WM: Comparisons of effectiveness between two kinds of medicines	· TCM is (in)effective; · TCM is (not) safer than WM; · WM treats the symptom, while TCM cleans the root of disease (西药治标，中药治本); · TCM has better effectiveness under some circumstances; · WM works faster than TCM; · WM is more convenient to use than TCM.
Trust in medicines: Confidence that the medicines are effective and safe to use	· Only trust the medicines given by doctors; · Distrust unfamiliar medicines; · Trust TCM more/less than WM.

4.3.3.1. Specific beliefs about medicines' necessity

- ***Personal need***

Some participants stated that they had relied on their medicines and could not live without them.

> *"It's impossible for me to live without these medicines. I must take them."* (***Participant 3, male, 62 years old, T2DM***)

> *"I have diabetes, and I have to inject (the insulin). I am relying on this medicine now"* ***(Participant 7, male, 58 years old, CHD, HYPERTENSION& T2DM)***

- ***Perceived positive effects***

The perceived positive effect is another origin of the necessity belief. Many participants reported the observations of the positive effects of the given treatments on managing the conditions, which reinforced the personal need of the treatments.

> *"This medicine is good for my health. (It makes me) feel good……My BP is not high after taking medicine."* ***(Participant 8, male, 52 years old, CHD, hypertension & T2DM)***

> *"I sometimes feel tired after having this disease. (My condition) has been controlled by the treatment, and I am feeling better after the blood glucose is controlled."* ***(Participant 1, male, 61 years old, T2DM)***

> *"My condition got worse in last June, the June of the solar calendar I mean. I suddenly started to sweat and got out of breath. So, I went to our primary clinic for intravenous drip. I immediately felt much better after the first injection."* (***Participant 10, female, 58 years old, CHD & hypertension)***

Participants also thought their treatment would benefit them in the future, such as preventing complications or a recurrence of the conditions. One elderly female participant believed that her medicines could prevent the second attack of the MI.

> *"I am currently taking some oral medications and one medicine through the intravenous drip. The condition is better now. […] The medicines (I am taking) stabilise my BP and improve the condition of MI. Moreover, they can prevent the recurrence of a heart attack."* ***(Participant 2, female, 63 years old, CHD & hypertension)***

Through improving the symptoms of their condition, some participants noted that medication improved other aspects of lives, such as providing convenience to daily life, increasing life expectancy and helping patients to be healthier for longer. One male diabetic participant stated that his blurred vision was improved after the antidiabetic medication controlled his BG. The improved vision enabled him to complete some delicate motor tasks. He could read small characters in the package of food and instructions of medicine that avoid him taking the food outdated or wrong medication.

> *"I can feel the condition was significantly improved after getting the treatment. My vision was blurred (before the treatment). But I can clearly see almost all the normal-sized characters now."* ***(Participant 5, male, 64 years old, T2DM)***

> *"These medicines allow me to enjoy a happy life with my family a few years*

longer.” ***(Participant 8, male, 52 years old, CHD, hypertension & T2DM)***

However, some participants also reported that their treatments had been less effective at controlling conditions than they anticipated, making them doubt whether needed to continue the treatment. One elderly female participant thought her hypertension was stubborn; thus, the treatment was ineffective. Similar doubts can also be seen in the response from a younger male patient with diabetes who seemed to have tried a number of treatments with his doctors.

> *“I think this medicine ... my illness seems stubborn. (The effects of) these medicines were insignificant. Yes, the effectiveness was not significant.”* ***(Participant 13, female, 70 years old, CHD, hypertension & T2DM)***

> *“No, the level (of BG) did not dropdown. (The BG) was not controlled well. I have tried some other drugs for a few years, but (the level of BG) did not decrease, either.”* ***(Participant 7, male, 58 years old, CHD, hypertension & T2DM)***

What is more, some participants even thought that the medicines had made their condition worse rather than improving it.

> *“To be honest, it was nothing to do with easing the symptoms, but even aggravated them.”* ***(Participant 14, male, 62 years old, T2DM)***

4.3.3.2. Specific concerns about medicines

Participants described concerns about medicine’s adverse effects and also about disturbing outcomes caused by medication-taking behaviour.

- ***Concerns about medicine's adverse effects***

Many participants worried that the long-term use of medication would cause damage to their bodies. Hepatic and renal toxicities were often mentioned as worries for participants.

> *"Yes, people all said taking too many medicines will damage the liver. […] There is no barrier to stick to my prescription except for the concerns about the potential damages to the liver and kidney caused by medicines."* ***(Participant 2, female, 63 years old, CHD & hypertension)***

> *"I think I am afraid of the side-effect of acarbose. […] Yes, that is why I sometimes don't want to take them now - the toxins (in medicines)."* ***(Participant 25, female, 48 years old, T2DM)***

> *"Initially, what I kind of worried about was medicines' harm to the kidney. That was my top concern. Moreover, it's harmful to the liver too."* ***(Participant 18, male, 62 years old, CHD, hypertension & T2DM)***

Also, a lot of participants reported that they experienced some bad reactions after taking the medicines, such as gastrointestinal upset, constipation, allergy, dizziness and oedema. These unpleasant experiences reinforced patients' concern about the adverse effects of medicines.

> *"The side effect was certain, as I felt sick and occasionally vomited...that was caused by my Metformin. […] The glucose (I guess she meant 'the*

hypoglycaemic drug') causes bloating. I often burped or farted.” ***(Participant 12, female, 65 years old, CHD & T2DM)***

“I told my doctor that these medicines made my abdomen very uncomfortable and sometimes caused a terrible stomach-ache. […] I don’t want to eat them. It’s harmful to my stomach and may cause pain around the abdomen. […] This medicine was not helpful to my disease but hurt my stomach. […] I always worried that the medicines cause serious irritation to my stomach.” ***(Participant 13, female, 70 years old, CHD, hypertension & T2DM)***

Participants were also worried that their medication would have a destabilising effect on their body which would be dangerous. For example, some participants said that the effects of their medicines were very unstable, leading to a fluctuation of BP/BG. One elderly female stated that she might feel uncomfortable if she took an excess dosage.

“You see, (the effect of my medicine) is very unstable. Every time I received inpatient treatment, my BP always fluctuated fiercely. […] I would be very uncomfortable even only take a little bit excess dosage or additional medicines.” ***(Participant 13, female, 70 years old, CHD, hypertension & T2DM)***

“I think the medicine given by Dr Liu works, but (the effect) is unstable.” ***(Participant 4, female, 80 years old, hypertension & T2DM)***

Participants also expressed concerns about becoming dependent on their medicines. One diabetic participant said he once resisted using the insulin as he was worried about getting addicted.

> *"I was afraid that the injected insulin might be addictive. Now I know this is a misunderstanding."* ***(Participant 14, male, 62 years old, T2DM)***

- ***Concerns about disturbing outcomes caused by medication-taking behaviour***

Besides the potential adverse effects on the individual's health, many participants also reported that taking medication was an ongoing burden that sometimes felt as if it dominated their lives. One male diabetic participant complained that remembering to take the medicines significantly disturbed his daily life. Another male diabetic participant even felt the medicine had dominated his mind and life.

> *"It brings much inconvenience and decreases the quality of my life. […] Yes, it is very annoying now. You must remember (to take these medicines)."* ***Participant 14, male, 62 years old, T2DM***

> *"I don't hope these medicines rule my life. It (the medicines) dominates my mind and my life. I must get rid of this domination."* ***(Participant 11, male, 65 years old, T2DM)***

Moreover, stick with the treatment regimen may influence social life and even cause social isolation. Some participants stated that their daily treatment made them miss a lot of opportunities for social activities.

> *"My friend once invited me for dinner together, but I rejected it because I did not bring my insulin with me. I had to go home, and that made us both disappointed.*

[…] I sometimes feel that (taking the medicines) is very inconvenient and annoying, especially when travelling outside.” ***(Participant 25, female, 48 years old, T2DM)***

“I feel (taking medicines) affects (my social life). For instance, when my friends or colleagues invite me to travel, I cannot join them because I don't want to bother them although they promise to look after me. Thus, normally I do not participate (the social activities), such as having dinner with friends. […] I feel that if I take medicines every day, people will regard me as a sick man and alienated me. That is what I feel. [...] (I am afraid that) they regard me as a sick woman. That will make me uncomfortable." ***(Participant 16, female, 63 years old, CHD & hypertension)***

Furthermore, taking medication, especially in front of other people, was regarded as a stigma experience. Several participants described how taking medicines had changed how people viewed them and led people to regard them as ‘a sick man/woman’ and avoid them. A female participant with CHD and hypertension did not want other people to know she was taking treatment and described an example of stigma where one of her neighbours started to avoid her after knowing her diagnosis.

“I have a best friend living in the same village. We used to get along very well. After I was diagnosed with CHD, she still came to visit with gifts initially. […] However, last time, when I passed by her home, she hid into the room. I supposed that she worried I might suddenly have MI attack and bother her. I felt very upset. I don’t want other people to detest me. So, I don’t want other people to know I am taking a treatment, as they may stay away from me and talk behind

me" ***(Participant 10, female, 58 years old, CHD & hypertension)***

4.3.3.3. General beliefs about medicines' benefit

Besides necessity beliefs specific to particular medicines, participants were also encouraged to talk about benefits about medicines in general. However, since the participants were all patients, most of them inevitably tended to talk about the benefits of their own medications rather than medications in general. Only a few participants directly answered whether they believe the medicines are generally beneficial or not.

> *"People will finally realise the medicines' benefits as time passes."* ***(Participant 18, male, 62 years old, CHD, hypertension & T2DM)***

> *"I sometimes feel that taking (medicine) is not beneficial (to people's health)."* ***(Participant 22, male, 45 years old, CHD & hypertension)***

More participants provided statements reflecting medicine's general benefits indirectly. One example of these statements is 'If people have diseases, they should take the medicines.'

> *"We all know that people need to take medicines if they have diseases, isn't it? […] Once you fall ill, you must take medicines. There are no other options."* ***(Participant 14, male, 62 years old, T2DM)***

> *"Your disease decides whether you need to take medicines or not. (If we are healthy) we don't have to take any medicines; otherwise, we must take. It's quite simple."* ***(Participant 18, male, 62 years old, CHD, hypertension & T2DM)***

Some participants made other statements based on old proverbs. For example, ‘Bitter medicines benefit health (良药苦口利于病)’, which is a famous Chinese proverb describing the medicines may taste bitter but are beneficial for health. In the present study, four participants mentioned this proverb.

> *“No, I don’t think (medicines are) too bitter (to take). People all say that ‘Bitter medicines benefit health.”* ***(Participant 17, female, 55 years old, CHD, hypertension & T2DM)***

4.3.3.4. General beliefs about medicines’ harm

In contrast to the specific concerns, the general beliefs about medicine’s harm all focus on medicine’s toxicity rather than negative outcomes caused by medication-taking behaviour. The most common belief was “All medicines are somewhat toxic (是药三分毒)”, which is also a well-known old proverb in China. In the present study, some participants cited this proverb to present their general belief about medicine’s harm. Another two participants ***(Participant 19, Male, 68 years old, hypertension; Participant 21, male, 75 years old, hypertension)*** gave a similar statement and believed all medicines would cause side-effects more or less.

> *“All medicines are harmful as ‘All medicines are somewhat toxic’. I want to control (the usage) and don’t want to take too much… I want to stop using or take as little as possible. That is what I think.”* ***(Participant 20, female, 75 years***

old, CHD)

"People all say that 'All medicines are somewhat toxic'. To be honest, no matter (whether the medicine) is effective or not… its effects may include some adverse effects." ***(Participant 14, male, 62 years old, T2DM)***

Participant's general concern about toxicity also reflects on perceived consequences after using medicines. In the present study, one participant shared her experience of taking the wrong medicine and thought that the incorrect medication would kill her. A similar statement from another female participant also argued that taking the wrong medicine will make people ill.

"I was almost killed in the Fourth Hospital last time. [...] A trainee nurse gave me an intravenous drip when I was sleeping. Although I cannot clearly see the words (on the bottle), I felt that the liquid (the nurse injected) seemed different (from my previous medicine). So, I called my daughter and found (the medicine) was wrong. [...] An old man said it was his medicine. And I asked him to take his medicines away. If I was injected with that medicine, I must have died." ***(Participant 4, female, 80 years old, hypertension & T2DM)***

"…I think the medicines are dangerous. You may get sick immediately if you take or inject a wrong medicine." ***(Participant 13, female, 70 years old, CHD, hypertension & T2DM)***

4.3.3.5. Beliefs about the overuse of medicine

In the BMQ model, beliefs about overuse are categorised into general beliefs aspect.

However, our participants talked about the overuse of both overall medicines and the particular medicines currently using. In this section, issues of overuse were analysed from patient's perspective (e.g. 'I have taken too much medicine') and doctor's perspective (e.g. 'Doctors overprescribe the medicine'), respectively.

In a personal level, some participants felt they had taken too much medicine. Three specific reported types of overuse include taking too many kinds of medicines in a period, taking an overdose of particular medicines in a period, and taking the same medicines for an overlong period.

> *"One more issue is I have taken too many kinds of medicines, and I don't want to take more."* ***(Participant 13, female, 70 years old, CHD, hypertension & T2DM)***
>
> *"I know the anti-hypertension medicine is necessary to me. So, I have to continue (taking them), although I have taken enough……I really feel I have taken too much."* ***(Participant 28, male, 87 years old, CHD, hypertension & T2DM)***
>
> *"I don't know whether you know a medicine called amiodarone. It's a pharmaceutical medicine and not for long-term use. The instruction said it might increase the level of thyroid in my body if I continue using for more than three months. I had no idea about that…… I followed (doctor's instruction) to decrease the intake dosage from one tablet to half tablet per day, but continued using for another several months, at least four or five months I remembered."* ***(Participant 16, female, 63 years old, CHD & hypertension)***

Regarding the doctor's role in medicine overuse, one male diabetic participant stated that his doctor kept adding new medicines to get a better outcome, leading him to be concerned that he was being prescribed too many medications. Some patients also reported that their doctors had made an error and overprescribed their medicines. For example, they just forgot to decrease the dosage or to remind the patients to stop. Or, some inexperienced doctors might not realise some medicines were unsuitable for long-term use.

> *"The doctors prefer their patients to take more medicines rather than less. No one dares to ask me to stop any kind of medicines, no one. If (the effects) started to wear off, they would simply add another one, (but would not ask to stop the previous one)."* ***(Participant 14, male, 62 years old, T2DM)***

> *"The instruction of mecobalamin warns that this medicine can be continuously used for one month maximum. Users should stop once the effects start to wear off. However, no doctor highlighted this to me. So, I think I have taken too much."* ***(Participant 14, male, 62 years old)***

4.3.3.6. Beliefs between TCM and WM

In the present study, a lot of participants previously used or were currently using TCM (including proprietary Chinese medicines). Most of them were satisfied with the effectiveness, while others felt the effects of TCM were insignificant.

> *"I started to take the TCM once I had the disease…diabetes and hypertension.*

I have taken these medicines since then. I tried TCM first. I can remember it worked. However, I was young at that time, so I did not adhere to (the prescription) after feeling better. The BP raised again and lost control after stopped using the TCM. So, I went to the hospital. […] I felt the effectiveness (of TCM) is good at that time. It's fantastic." ***(Participant 18, male, 62 years old, CHD, hypertension & T2DM)***

"I took some TCMs after I came here. Many people came to try the TCM just like me. However, I saw (the TCM) did not solve their problems either. So, (I) should not stop WM. […] I took (some TCM) before…tried some TCM, but I could realise neither good (effects) nor bad (effects)." ***(Participant 28, male, 87 years old, CHD, hypertension & T2DM)***

During the interviews, I encouraged all participants to elaborate on their beliefs about both WM and TCM. Some participants who never used TCM also provided their personal opinions about TCM. Five most common statements of comparison between the TCM and WM are summarised as below.

- ***TCM is (not) safer than WM***

A commonly discussed comparison was the belief that TCM is safer than WM because TCM is more natural. These participants also believed that compared with WM, TCM causes fewer burdens on the body and had fewer adverse effects.

"From my point of view, taking TCM is a safer (choice). I always feel WM is dangerous. […] TCM has smaller adverse effects than WM." ***(Participant 13, female, 70 years old, CHD, hypertension & T2DM)***

"If you want me to compare TCM and WM, I would say the TCM causes less burden to my body." ***(Participant 17, female, 55 years old, CHD, hypertension & T2DM)***

However, not everyone agreed with this statement. One participant with CHD and hypertension worried about the safety of TCM because its ingredients are unpurified.

"I feel WM has fewer adverse effects." ***(Participant 24, male, 86 years old, CHD, hypertension & T2DM)***

"How can I drink this decoction without any purification? It is not safe." ***(Participant 22, male, 45 years old, CHD & hypertension)***

- ***WM treats symptoms, while TCM cleans the root of disease***

When comparing the effectiveness of TCM and WM, several participants believed that WM only temporally controls the symptoms, while TCM treats the cause ("西药治标,中药治本"). Some participants felt that their insulin and antihypertensive drugs did not give a permanent cure, as the BG/BP would increase again once they stopped taking the medicines.

"Yes, I always believe that taking TCM solves the deeper problem, while WM only solves the superficial ones." ***(Participant 16, female, 63 years old, CHD & hypertension)***

"I have some opinions about TCM. It's good despite works slowly. It cures my disease, while the WM only eliminates (the symptoms) temporally. Yes, that is what I think. WM is good as well, however (the effect) is not lasting long. For

example, when my BP raised (the WM) could reduce BP immediately. However, (once stopped the medicine, the BP) would raise again, right? […] Despite the TCM works slowly and tastes terrible, my disease did not recur again. It has not recurred for more than one year. […] WM just helps you solve (the problem) temporally." ***(Participant 4, female, 80 years old, hypertension & T2DM)***

- ***TCM has better effectiveness under some circumstances***

Participants also talked about the perceived effects of TCM on diseases other than CHD, hypertension and T2DM. TCM is usually considered having strengths above those for WM for diseases, such as chronic pain, hot flushes or some other medically unexplained symptoms. Moreover, some participants also believed that TCM has advantages in disease prevention than WM.

"In my opinion, (if anyone has) pain symptoms, such as low back pain and leg pain, (he/she) needs to seek help from TCM doctors. […] I think (people) need to see the TCM doctor if (they) have low back pain." ***(Participant 9, female, 78 years old, CHD & T2DM)***

"I used to have very serious internal heat. TCM calls 'hepatic fire'. The TCM doctor suggested to 'extinguish the fire' using a herbal formula containing processed Coptis Chinensis. It could ease the internal heat. The effect of the first dose was insignificant. My hand still burned. The doctor gave me one more dose and asked me to continue. It worked. I thought I found (the treatment of) the disease. My internal heat disappeared at all and has not recurred until now. I continued drinking (the herb decoction) for one week, and the ''fire" disappeared. ***(Participant 4, female, 80 years old, hypertension & T2DM)***

"I previously took the LIUWEI DIHUANG Pill…not for treating the disease, but for preventing the disease. Someone told me it is beneficial and highly recommended me to take. I didn't mind whether to take or not, but I believed the long-term use (of TCM) could bring some benefits." ***(Participant 11, male, 65 years old, T2DM)***

- ***WM is quicker in demonstrating effect than TCM***

The participants also talked about the advantages of WM and perception that WM has an effect more quickly than TCM. This belief seemed deeply rooted regardless of whether the participant had ever tried TCM or not. Some participants highlighted the immediate effects of antihypertensive drugs on BP control. However, slow-onset was not always viewed as something bad. Some participants perceived that TCM was slower acting and so would have more stable and gentler effects on their body.

"In my opinion, TCM works slowly while WM works faster. […] For example, injected insulin can immediately decrease my blood sugar, but TCM needs a longer time. […] Proprietary Chinese medicines do not work as quickly as WM, either." ***(Participant 12, female, 65 years old, CHD & T2DM)***

"WM works faster. […] My father was a TCM doctor; thus, I prefer TCM. However, WM works faster. TCM takes a longer time to show effects. […] WM works faster (than TCM), so, I do not take TCM anymore." ***(Participant 6, male, 85 years old, T2DM)***

"TCM's effects are gentler. […] In my mind, the effects of TCM are more stable (than those of WM). […] (The effects of WM) are not as gentle as TCM." ***(Participant 24, male, 86 years old, hypertension & T2DM)***

- ***WM is more convenient to use than TCM decoction***

Participants also reflected on how convenient both WM and TCM were with TCM decoction was criticised for poor usability by many participants. Normally, TCM herbs need to be pre-soaked in the water for more than 30 minutes and repeatedly boiled using a special gallipot for one to two hours. Although many TCM hospitals provide the service for processing, the decoction is inconvenient to store and carry. Many participants reported this issue is the major barrier for using TCM.

> *"I don't have a strong preference (between TCM and WM) but like WM more. Why? Because it's difficult to keep cooking and drinking herb decoction every day...that is what I think. (Using herb decoction) is not as convenient as (taking) tablets."* ***(Participant 12, female, 65 years old, CHD & T2DM)***

4.3.3.7. Trust in medicines

Personal trust in medicine was a recurring theme with many participants discussing whether they believed that the medicine is safe and effective to them.

- ***General trusts in medicines***

Unlike talking about the beliefs about medicines about specific beliefs, few participants preferred to talk about their personal trust in one specific medicine. However, many of them presented opinions about the overall trust/distrust in particular types of medicines. For example, several participants said that they only trust the medicines recommended by doctors, not by advertisement or door-to-door salesmen.

> *"There are too many drugstores selling health products and drugs. We don't trust these stuff…I don't want to be duped by them. (These people) boasted their medicines could make people healthy. They also provided some petty favours to old men and women, such as organising free short tourists. (All these methods) all aim to sell more medicines. We never trust them."* ***(Participant 19, male, 68 years old, hypertension)***

> *"I only trust (medicines) from hospitals and never buy any health products. I don't trust (the products) that other people advertised to me. I might challenge them why hospitals don't sell (your products) if they are effective?" (**Participant 3, male, 62 years old, T2DM**)*

Moreover, some participants said they distrust unfamiliar medicines. One hypertensive male participant said he always buy the same medicines produced by the same company.

> *"I dare not blindly take a medicine if unfamiliar with it. I don't trust (it) and use for a long term…I won't use." (**Participant 22, male, 45 years old, CHD & hypertension)***

> *"When my medicines ran out, (my wife) would refill (the prescription) in pharmacies or hospitals. Sometimes I found it was different from the previous medicines. Take my anti-hypertension drugs as an example; they may have different trade names, dosage form, colour and packaging. [...] So, I only trust this medicine and always ask my wife to buy the same medicine when refilling*

the prescription. Yes, it must be the same Metformin produced by this company; otherwise, I won't buy. Its effectiveness is excellent.” ***(Participant 8, Male, 52 years old, CHD, hypertension & T2DM)***

- ***Trust in TCM versus WM***

A large number of participants talked about their trusts in TCM versus WM. Some of them showed trust in TCM and believed it would benefit in treating diseases. Contrarily, some other participants distrusted TCM. One mid-aged male participant criticised TCM for lacking a scientific basis.

“Actually, I always acknowledge, trust and admire TCM…I trust it very much. I trust the TCM prescribed by my doctor and believe it cures my disease. […] If you ask me how I think about TCM, I will say it is one of Chinese culture essence and worthy trust.” ***(Participant 25, female, 48 years old, T2DM)***

“I think the prospect of TCM is gloomy. […] The theory of TCM is vague. It has no scientific basis at all and is difficult to practise…lacks standardisation. I suppose (TCM) just use these abstruse and incredible theories to hide its unscientific nature. It’s unconvincing.” ***(Participant 22, male, 45 years old, CHD & hypertension)***

Compared with participants who showed clear responses to trust in TCM versus WM, more participants believed that both TCM and WM had their own advantages and are applicable for different scenarios.

“I don’t have a preference between them (TCM and WM). The patient had better no preference.” ***(Participant 3, male, 62 years old, T2DM)***

"Both of them have their own advantages." ***(Participant 26, male, 57 years old, CHD)***

4.3.4. Factors influencing CRM

Four themes were associated with participants' CRM, including illness perceptions, information and knowledge healthcare provider and drug quality (see ***Table 4-5***).

Table 4-5 Themes and codes relating to factors influencing CRM

Themes and definitions	**Codes**
Illness perception: Cognitive representations of illness	· Coherence of illness and medicines (对症) is the prerequisite of effectiveness; ·People who felt they had more disease symptoms and that these symptoms had greater effects on their lives were more likely to say that they needed medicines; ·People who controlled conditions well were more likely to have a high perceived effect of medicines.
Information stimuli: include external stimuli (e.g. information from books/media, health education, peer experience) and internal stimuli (e.g. knowledge, memory, personal experience)	· Information, knowledge and experience impact necessity beliefs; · Lacking information and understanding of medication's active ingredient and mechanism may cause concerns; · Lacking understanding may damage trust in treatment.
Healthcare provider: Interactions with and trusts in healthcare providers, including doctors, nurses and other healthcare professionals.	· Effectiveness of treatment depends on doctors' quality and experience; · Insufficient communication may cause confusion and concerns about treatment; · Trust in healthcare providers is associated with trusts in treatments.
Drug quality: Degree of safety and effectiveness of medication	· Drug quality impacts trust in medicines; · Drug quality impacts the perceived effects of medicines.

4.3.4.1. Illness perceptions

The links between cognitive representations of illness and medicine were reflected in the impacts of illness perceptions on necessity beliefs about medicines.

- ***Coherence of illness and medicines and necessity beliefs***

In the present study, some participants mentioned a concept of ‘对症’ which means the degree of medication fitting with a disease. These participants believed that the coherence between illness and medication’s function is the prerequisite to getting satisfactory effectiveness and consequently decides whether the medicine is necessary. In participants’ words, the same medication might not suitable for everyone, and people need to select medication matching personal situation.

> *“Some patients asked what antihypertension medicines I used. I said it is hard to recommend, because the (same) medication may be suitable for my condition but not effective to you. There are different types of hypertension. It makes no sense to recommend (my medicines) to you. Some patients asked could they try my medicines. I said no because my medicines might be ineffective or even harmful to them.”* ***(Participant 4, female, 80 years old, hypertension)***

- ***Illness identity, consequences, disease control and personal need***

We found participants’ illness identity could decide the personal need of medicines. For example, participants might feel unnecessary to take treatment if they did not realise symptom or denied the illness. One male diabetic participant reported he denied the doctor’s diagnosis and refused to take treatment.

> *“It was in autumn 2002. I tested the blood sugar when accompanying a colleague for a health screen. Dr Xie thought I highly possible had diabetes and*

suggested me to test again. […] However, I did not believe (I was ill) at all since I did not realise any symptom…I didn't feel anything wrong. Thus, I did not take any treatment or use medication after the doctor told me (I was ill). (I thought) I was healthy as there was no symptom at that time." ***(Participant 14, male, 62 years old, T2DM)***

Contrarily, if perceived consequences without medicines were severe, patients would regard the treatment as necessary. In the present study, some participants believed that their conditions would lose control or even die without medicines.

"I can't stop (the medicine); otherwise, the BP and blood sugar will rise again." *(**Participant 28, male, 87 years old, CHD, hypertension & T2DM**)*

"I have to take these anti-hypertension medicines; otherwise, I may fall ill due to failing control (the BP) and consequently get a stroke." ***(Participant 18, male, 62 years old, CHD, hypertension & T2DM)***

However, we also noted that there was no monotonic association between the severity of the consequence and the necessity beliefs as people might also feel unnecessary to take the treatment if the disease was too severe to cure (low disease control).

"Medicines only treat fake disease. If I had cancer, the medicines won't help. However, if I had some other diseases, medicine might cure them. So, curable diseases are all not severe." ***(Participant 5, male, 64 years old, T2DM)***

- ***Treatment control and perceived effects***

The third link was between perceptions of treatment control and perceived effects of medicines. These two cognitions conceptually overlapped, as both reflect how confident people believe that medicine will treat the disease/be effective. Some participants attributed not falling ill to taking particular medicines.

> *"Yes, there must be some relations between taking medicines and not getting ill. That is my opinion."* ***(Participant 24, male, 86 years old, CHD, hypertension & T2DM)***

4.3.4.2. Information stimuli

- ***Information, knowledge, experience and necessity beliefs***

Information stimuli were reported as an important factor associated with beliefs about medicines. Depending on the source where information is obtained, the stimuli can be divided into external (e.g. information from books/media, health education, peer experience) and internal (e.g. knowledge, memory, personal experience). Many participants felt that the correct information/knowledge is beneficial to patients and treatment, and nine of them obtained disease-/medicine-related information from different sources. Besides, some other participants thought getting relevant information only has limited benefits to treatment or no benefit at all.

"I think I know (my condition) well … There are some books on diabetes in my home. I have started to read the relevant books about diet treatment, drug treatment and psychology since being diagnosed with diabetes. I also talked with my son of law, who is a doctor. […] I think the information is beneficial (to my treatment). For example, obtaining knowledge allows me to know (which medicine) is suitable for me." ***(Participant 12, female, 65 years old, CHD & T2DM)***

"I don't think (the information) benefits me a lot. The benefits were insignificant… So, I never bought the relevant books. I only briefly skimmed the relevant information and then forgot several days later. That's it." ***(Participant 16, female, 63 years old, CHD & hypertension)***

Besides books and media, communicating with other people was another important approach to obtain relevant information and knowledge. Some participants adjusted their beliefs about medicines and therapeutic regimen according to other people's experience. One male participant with CHD said he would like to try some medicines/health products which were recommended by other people.

"My teacher had heart disease. He told me he was using an American health product which made him feel good and allowed him to play basketball. […] I am planning to try it. […] My friend's father of law also used some TCM which appeared to be effective. I want to try as well." ***(Participant 26, male, 57 years old, CHD)***

- ***Information, understanding and concerns***

Contrarily, lacking information and understanding may cause concerns about potential risks after using medicines. In the present study, several participants said they had no idea about the components and action mechanism of the medicines, which consequently caused concerns about using them. Therefore, adequate information and better understanding are helpful to eliminate these concerns.

> *"I think WM had stronger adverse effects…because their components are unclear…I have no idea about them and worry about (using) them."* ***(Participant 27, female, 78 years old, hypertension)***

> *"(Getting relevant information) is helpful because it allows me to understand what the medicines are about. I always read the instructions carefully once got a new medication. […] I am not worried anymore because I have known how to use (these medicines)."* ***(Participant 14, male, 62 years old, T2DM)***

- ***Information, understanding and trust in medicines***

Not only causes concerns about medication use, lacking understanding also damages patients' trusts in their therapeutic regimen. One participant said that if he does not understand the medicine well, he will not trust it.

> "If I have no idea about one medicine and don't know its effects, I will not select it blindly. I can't trust it and won't use for a long term. I dare not use." ***(Participant 22, male, 45 years old, CHD & hypertension)***

4.3.4.3. Healthcare providers

- ***Healthcare providers' experience and perceived effects***

There were also several links between the healthcare provider and CRM. Firstly, some participants believed that the effectiveness of treatment largely depends on doctors' quality and experience.

> "If a doctor treated this disease before, his medicine would cure your disease for sure. However, if he does not have relevant experience, his medicine will be unlikely effective." ***(Participant 15, male, 58 years old, hypertension)***

> *"I am more trusting of the effects of WM because there are few high-level TCM doctors. I am not saying I distrust TCM's effects, but it works slowly, and most TCM doctors' proficiency is questionable."* ***(Participant 11, male, 65 years old, T2DM)***

- ***Communication with healthcare providers and concerns***

Communication with health providers is associated with patient's beliefs about treatment. In the present study, half of the participants were satisfied with the communication with their healthcare providers. The remainders were unsatisfied with the communication or avoided communication with doctors due to several reasons, such as not known doctors well or felt doctors were busy or unknowledgeable. Insufficient communication may cause confusion and concerns about medicine use. Therefore, adequate communication is crucial for reducing patients' concerns about using medicines. A diabetic participant said he won't be worried about taking medicines as long as a doctor advised him before taking it.

*"I don't want to communicate with my doctors. They won't communicate as we do. They don't have time. Oh, my god, they are too busy. See the queue (of waiting patients). They need to treat a lot of patients." (**Participant 13, female, 70 years old, CHD, hypertension & T2DM**)*

"I won't be worried as long as advised with my doctor before taking medicine." ***(Participant 3, male, 62 years old, T2DM)***

- ***The trust in healthcare providers and the trust in medicines***

Similar to trust in medicine, people also have trust in their healthcare providers. According to the participants' responses, there seemed some positive associations between the two trusts. High trust in healthcare providers was associated with high trust in medicines.

"I am glad to talk with Dr. Zhou. He is a nice person. I trust him and admire him, also trust his skill and the medicines he prescribed. He is very responsible." ***(Participant 25, female, 48 years old, T2DM)***

"I never doubt (my medicine). I always respect and trust hospitals and doctors. Normally, I took medicines without any doubt, as long as (the medicines are) prescribed by doctors." ***(Participant 15, male, 58 years old, hypertension)***

Contrarily, scepticism of healthcare providers may damage patients' trust in given treatments. One female participant with CHD and T2DM doubted that some doctors prescribe expensive or unnecessary medicines to patients for kickbacks from pharmaceutical companies.

"Some doctors have moral defects. They illegally prescribe medicines for kickbacks. For example, when both a cheap medicine and an expensive medicine treat my disease, the doctor will prescribe the expensive one to me. They can get kickbacks. One of my relatives is a doctor, so I know these secrets. So, I may not trust the medicines from an unfamiliar doctor.” ***(Participant 12, female, 65 years old, CHD & T2DM)***

4.3.4.4. Drug quality

- ***Drug quality and trust in medicines***

When talked about the preference of medicines, several participants showed a higher trust in particular types of medicines which were characterised by fine quality. One female participant with CHD believed that the medicines bought in hospitals have better quality and are more reliable. Contrarily, the medicines produced by small companies might be thought to have poor-quality and thus unsafe to use. One mid-aged male participant said he distrusted the medicines from small companies and preferred imported foreign medicines rather than domestic products.

“There is a difference between medicines bought in big hospitals and small clinics. People all think so. It’s about drug quality. The medicines from hospitals are more reliable.” ***(Participant 20, female, 75 years old, CHD)***

“I never bought medications from those small pharmaceutical companies allocated in Henan, Anhui, or Shanxi Province. They were all sub-quality products. […] I did not trust these medicines and never allowed my children to use them. […] I trust Japanese products, especially medical products. […] My

current medicines and health supplements are all bought from Canada and Australia. I don't need to worry about their quality or safety. I can use it without concern." ***(Participant 22, male, 45 years old, CHD & hypertension)***

- ***Drug quality and perceived effects***

Moreover, from some participants' points of view, expensive medicines have higher quality and better effectiveness. One female hypertensive participant attributed her wardmate controlled BP better than her to used expensive antihypertensive medicines.

"My salary was low and could only afford cheap medicines. Thus, the symptoms were not controlled well. The old lady who lived in the same wardroom with me was a teacher. She always bought the ¥80-medicines (about £9). Her (BP) was never lost control." ***(Participant 4, female, 80 years old, hypertension)***

However, some other participants disagreed with this argument. They felt that the expensive medicines are not always effective. One male participant stated that cheap medicines might have equal effectiveness with expensive ones.

"The expensive medicines maybe not effective to this disease. I only took the cheap drug… Other medicines are not suitable to me and sometimes made me feel uncomfortable." ***(Participant 19, male, 68 years old, hypertension)***

"Some cheap medicines are also effective. For example, if I have a cold, I will take some paracetamol, a very basic and cheap medicine. The young man like you may not know this medicine. It has an immediate effect and allows me to recover within four tablets." ***(Participant 5, male, 64 years old, T2DM)***

4.3.5. Links between CRM and medication use

This section talks about the relations between CRM, intention to take medication, medication use pattern and TCM/WM use (see **Table *4-6***).

Table 4-6 Links between CRM and medication use

Themes	**Codes**
Links between CRM and intention to take medication	· Positive CRMs reinforce the intention; · Negative CRMs weaken the intention.
Links between CRM and medication use pattern	· CRM impacts the timeline of treatment implementation; · CRM impacts intake dosage of medication; · CRM impacts place of treatment implementation.
Links between CRM and TCM/WM use	· CRM impacts the combination use of TCM and WM; · CRM impacts the selection between WM and TCM.

4.3.5.1. Intention to take medication

Generally, positive CRM (e.g. necessity beliefs, benefit beliefs, trust) normally reinforces the intention to take medicine. On the contrary, patients held a low level of positive CRM might have low intention. Some of our participants stated that they wanted to stop the treatment once perceived effects wore off.

> *"I am willing to take these medicines as they treat my disease."* ***(Participant 23, female, 65 years old, hypertension)***
>
> *"If (these medicines) make me comfortable, I would like to continue taking (them)."* ***(Participant 10, female, 58 years old, CHD & hypertension)***
>
> *"Its effect was unsatisfactory. (My) BP was still high after using many such medicines. […] Sometimes, I wanted to stop my medicine as it didn't work. […] I don't want to take these ineffective medicines."* ***(Participant 13, female, 70 years old, CHD, hypertension & T2DM)***

People who expressed concerns, general-harm beliefs, overuse, sensitivity to medicines, distrust were also less likely to intend to take their medicines. For example, one female participant with CHD and T2DM expressed reluctance about continuing to take her treatment as the medicines made her uncomfortable.

> *"I really don't want to take these medications. The only word describing my mind was helpless…I don't want to take them. They are harmful to my body."* ***(Participant 12, female, 65 years old, CHD & T2DM)***

> *"I am worried about the side-effects caused by my Acarbose. I sometimes intend to stop taking the medicines due to their toxic components.* ***(Participant 25, female, 48 years old, T2DM)***

4.3.5.2. Medication use pattern

Same to the intention to take medication, people with positive CRM tend to select approaching strategies of treatment. Contrarily, low-level positive and negative CRM is associated with avoidant strategies. According to participants' responses, the specific influences were summarised as three aspects, including the timeline of treatment implementation, intake dosage and place of implementation.

- ***Timeline of treatment implementation***

Once diagnosed with the disease, patients need to decide when to initiate the treatment. Some participants believed it is better to start the treatment as early as possible. One male diabetic participant believed that implementing insulin therapy at the early stage of diabetes would increase the possibility of recovery. However, some other participants did not initiate the treatment until the disease got worse.

> *"According to the existing evidence, injecting insulin since the beginning (of disease) is beneficial to the patients, especially to those patients in the early stage. The earlier (patients) use the insulin, the more likely (they are) to recover."* ***(Participant 14, male, 62 years old, T2DM)***

> *"I felt the symptoms were very mild, so I did not take my medicine at the beginning."* ***(Participant 6, male, 85 years old, T2DM)***

- ***Take more/less medication than instructed***

Patients may also adjust intake dosage of medication according to their beliefs. For example, a female participant with CHD and hypertension reported that she only took the minimum dose of medication required due to worrying about potential harm.

> *"I don't want to take too much medicine… I don't want. I just want to take the minimum dosage. Taking more medicines may get further damage from poison. So, maintaining the current situation is fine."* ***(Participant 16, female, 63 years old, CHD & hypertension)***

Moreover, if patients believe they have overused medicine, they may take less of their medication, as well. In the present study, two participants reported that taking an excess dosage of medication made them uncomfortable, and they consequently stopped or decreased intake dosage.

> *"I once took the cheap medicine in excess dosage. The BP sharply dropped down. I was temporarily blinded due to the hypotension. […] The doctor told me that the hypotensive pressure was also deadly. So, I decreased the dosage after that."* ***(Participant 18, male, 62 years old, CHD, hypertension & T2DM)***

However, we also found that due to concerns about decreased effects, some participants increased the intake dosage for a better effect.

> *"I have taken the Acarbose for more than ten years. Then (my doctor) switched to the metformin hydrochloride enteric-coated tablets. However, the effectiveness (of the medication) became weaker. Increasing dosage did not help. Therefore, I started to use the insulin that is the reason I stay in the hospital now."* ***(Participant 12, female, 65 years old, CHD & T2DM)***

- ***Place of treatment implementation***

Regarding the place of treatment implementation. Some participants felt that taking medication in front of other people is embarrassing and consequently avoided taking it in social situations. A diabetic male participant said he never takes his drug during the social events as did not want other people to know he was ill.

> *"To be honest, many patients like me need to take hypoglycemic drugs before meals. However, I would not bring the medicines to the restaurant because I know I won't have a chance to take (them). Other people might be uncomfortable when they saw me taking medicine. They might worry about my condition and guess whether I am very ill. So, I resist (taking medicines in front*

of others).” ***(Participant 14, male, 62 years old, T2DM)***

4.3.5.3. TCM and WM use

For people who combined TCM or was considering trying TCM, cognitive representations of TCM and WM were suggested to influence the use pattern and selection decision.

- ***Perceived effects of combination use of TCM and WM***

Participants in our sample had very different views on using both TCM and WM together. For some, combination use was perceived as being more effective.

> *“My current therapeutic regime combines WM and TCM. I think the combination maybe has a better effect than the single medicine.”* ***(Participant 3, male, 62 years old, T2DM)***

> *“I think the effectiveness (of combination) should be better… I suggested combining (TCM and WM) that is the reason I came to the TCM Hospital. […] I believe the combination is better.”* ***(Participant 25, female, 48 years old, T2DM)***

Second, a few of other participants worried that the combination use might diminish the effects of both medicines and cause some unexpected side-effects.

> *“The instruction said different medicines could not be used together, such as TCM and WM. Some medicines should be taken before meals, while some (should be taken) after meals. They should (be taken) separately; otherwise, the effectiveness will be diminished. […] I always separately take the MUDAN Granule and WM 30-minutes later and 60-minutes later after meals,*

respectively.” ***(Participant 14, male, 62 years old, T2DM)***

More participants were uncertain whether the combination is helpful or not. For example, a senior male hypertensive participant thought patients had better advise with doctors before using.

> *“I want to enquire (the doctors) can I take the NAOXINTONG with WM together? The NAOXINTONG is a proprietary Chinese medicine for hypertension, cerebral palsy and hemiplegia. My WMs have the same function in controlling BP. Their functions overlap. So, I am not sure whether should combine the two kinds of medicines?”* ***(Participant 21, male, 75 years old, CHD & hypertension)***

- ***Selection between WM and TCM***

Although TCM was criticised as lacking scientific evidence basis, some participants still want to use TCM due to unsatisfaction of the effectiveness of WM. One participant with hypertension reported that after experiencing several (treatment) failures in WM hospitals, her BG was finally controlled by TCM. Another elderly male participant stated that he wanted to replace WM with TCM but was refused by his doctor.

> *“My blood sugar was not controlled well in local hospital and (WM) hospital here. So, I came to TCM Hospital and sought help from Dr. Wang and Dr. Zhou. They cured my disease.”* ***(Participant 17, female, 55 years old, CHD, hypertension & T2DM)***

> *“I have been fed up with WM. I am considering replacing (WM) with TCM. But*

my doctors didn't suggest doing so. […] I wanted to stop my WMs and wished to solve my problem using TCM after came to the TCM Hospital." ***(Participant 28, male, 87 years old, CHD, hypertension & T2DM)***

However, some TCM users did not regard TCM decoction as their first choice. One elderly male participant with several diseases stated he would use TCM only if WMs were no use.

"I won't drink (the TCM decoction) unless there is no other option. […] Proprietary Chinese medicines are okay, but (I) can't accept herb decoction." ***(Participant 24, male, 86 years old, CHD, hypertension & T2DM)***

Besides, a large number of participants in the present study held a pragmatic view that patients had better not stick to personal preference and should adhere to doctor's advice. A diabetic male participant stated he was willing to try any medicine as long as it works.

"I don't care how good or bad effect is. I am willing to try any treatment; even there is only a 1% chance (to be cured)." ***(Participant 11, male, 65 years old, T2DM)***

*"I accept both (WM and TCM). I will use medicine which benefits me. That is my attitude." (***Participant 17, female, 55 years old, CHD, hypertension & T2DM***)*

"All selections should base on the actual demand. I don't have a preference and will take the medication prescribed by the doctor." ***(Participant 19, male, 68 years old, hypertension)***

4.4. Discussion

This qualitative study investigated Chinese patients' CRM and factors influencing it and also investigated how these cognitions influence medication-taking behaviour. As the most common measure for assessing beliefs about medicine, BMQ was initially designed for the western population. However, all five constructs of BMQ were mentioned in the present interviews, suggesting that many of the perceptions about medicines held by Chinese patients were similar to those that have been reported in studies with western samples. The previous meta-analysis (Horne et al., 2013; Nie et al., 2019) also found that the associations between BMQ factors and medication adherence in Chinese population are similar to those in the western populations (see ***Chapter 3***). However, some disparities between the two populations were also identified during interviews, such as how Chinese patients think about the combination of TCM and WM, how views of healthcare providers influence CRM.

4.4.1. Specific beliefs about medicines and trust in medicines

As one additional CRM beyond BMQ constructs, there are several links between trust in medicines and specific beliefs about medicines. Firstly, both specific beliefs about medicines and trust in medicines are determined by perceived effectiveness. For specific beliefs, the positive perceived effect is one of the reasons why a patient feels the medicine is necessary. Likewise, the negative perceived effect is one of the origins causing concerns about using the medicines. The results in the present study suggested that the participants with great trusts in medicines tended to adhere to doctor's prescription. That is similar to the associations between the specific beliefs about medicines and medication-taking (see ***Chapter 3***), in which the positive specific beliefs are associated with good adherence, while the negative specific beliefs contribute to poor adherence (Horne et al., 2013; Nie et al., 2019).

Conceptually, there are some overlaps between beliefs about medicines and trusts in medicines. However, there is no necessary correspondence between necessity beliefs and trust in the effectiveness, and concerns and distrust in safety. People may hold beliefs about the medicines contradicting with the trust in the medicines. For example, patients who trusted a medicine would work to the condition might not urgently need it, as they had taken too many other medicines. Moreover, the trust in medicines defined in the present study solely focused on the clinical performance of medication, while the specific beliefs in BMQ also talked about psychological and social impacts of medication-taking behaviour on daily life. For example, some participants reported that taking medication disturbed their social lives. However, it does not mean these participants distrust their medicines.

4.4.2. Impacts of beliefs about TCM on WM use

The beliefs about TCM is another key finding beyond the BMQ structure. Different from western countries where the TCM only accounts for a small proportion of clinical use, the TCM is more common in China. In 2018, there were 177 million outpatient visits for TCM treatments, which accounted for 16.1% of total outpatient visits in that year (National Health and Family Planning Commission of the PRC, 2019). More than half of our participants reported once used or currently using TCM. All current TCM users combined with one or more WMs. Therefore, investigating the beliefs about both TCM and WM is crucial for understanding the treatment management of these people.

In the present study, our participants compared TCM and WM from several perspectives, including effect onset speed, usability, therapeutic effects and safety.

Among these comparisons, ‘WM is quicker in demonstrating effects than TCM’ seems to have become a consensus in not only TCM users but also many non-users. A similar stereotype was also common amongst people from ethnic Chinese societies outside mainland China, such as Hong Kong and Taiwan (Chung et al., 2014; Kang et al., 1994; Lam, 2001; Lee, 1980). Another weakness of TCM decoction was difficult to cook, which was commonly reported by previous studies (Chung et al., 2014; Lam, 2001).

Moreover, some statements against common sense were also reported, such as “WM treats the symptoms, while TCM cleans the root of disease”. In a previous telephone survey study involving 1517 participants from Taiwan, 62.3% of responses agreed or somewhat agreed that “WM can only deal with the symptoms rather than the causes of the diseases” (Lew-Ting, 2005). Moreover, our participants also mentioned TCM’s strengths in providing tonic care and treating some diseases which WM is ineffective. These beliefs were identified as motivations of some patients to use TCM service in previous studies (Chung et al., 2014; Huang et al., 2007; Sun et al., 2017).

Regarding the safety of TCM, participants’ views were inconsistent. Some participants distrusted and concerned about the unpurified compounds of TCM. Although some herb medicines were criticised can cause nephrotoxicity (Yang et al., 2018), some participants still believed that the TCM had fewer side-effects than WM. The similar belief was identified in previous studies (Chung et al., 2014; Lam, 2001). In BMQ, item BG4 (Natural remedies are safer than medicines) assesses people’s belief about the perceived safety of natural remedies versus pharmaceutical medicines. Likewise, attitudes of whether should combine WM and TCM were also divided into two groups. In a qualitative study exploring the perspectives and experiences of Chinese cancer patients, participants believed that combing with TCM reduced side-effects of chemotherapy (Xu et al., 2006). In another study of patients with cardiovascular disease, some patients reported that drinking herb tea enhanced the effects of warfarin (Wong et al., 2003). However, interactions between WM and TCM are not all beneficial to treatment. A review study (Chua et al., 2015) reviewed the possible effects of 44 commonly consumed TCM on warfarin and strongly suggested both patients and doctors need to consider potential side-effects of combing two types of medicines.

These comparisons and beliefs not only influenced trusts in TCM and WM but also impacted engagement of treatment (Chung et al., 2014). In a previous study of diabetic outpatients from Taiwan, patients made the selection of medicine and adjustment of use pattern according to their beliefs about the superiority of TCM versus WM (Hung et al., 2012).

4.4.3. Illness perceptions and CRM

When asking a patient why he takes medicines, one of the most common answers is 'because I am ill'. Two implicit logical suppositions are underlying this statement. First, the disease/condition needs to be treated. Second, medicine fits the disease/condition (Horne et al., 2019). As one of the cognitive origins of necessity beliefs, illness perceptions show very close relations with beliefs about medicines. In the present study, participants talked about links between identity, consequence, control beliefs and necessity beliefs, which were consistent with findings of previous studies (Horne, 2003; Horne & Weinman, 2002). However, in a recent study of Chinese patients with ischemic stroke, illness perceptions were not significantly correlated with necessity belief but other BMQ components (e.g. concern, harm, overuse). These associations were not talked by our participants and worthy further being investigated in future studies.

4.4.4. Healthcare provider and CRM

The role of the healthcare provider had been suggested as an important factor that influences both trust and beliefs about medicines in China. The relationship between patient and healthcare provider is very delicate. On the one hand, patients rely on healthcare providers and expect to get help from them. These patients are usually willing to adhere to the doctor's instructions. On the other hand, some patients have a lack of trust in their doctors and their given treatment. Their sceptical attitudes may further cause medical disputes. Some recent studies (He & Qian, 2016) found that various forms of medical disputes are disturbingly widespread and reported in China. Between 2013 and 2016, there were 459 criminal cases involving violence against healthcare professionals being reported in China (Cai et al., 2019).

There are several reasons for this phenomenon. Firstly, due to the disparity of health literacy, it is difficult to make all patients understand the mechanism of treatment and risk of potential failure. Some patients might be wary of the therapeutic regimen's validity and any unsatisfied outcome associated with the treatment that may be attributed to a lack of responsibility and skill from the doctor (Sen & Honavar, 2019). Secondly, in the past twenty years, the workload of Chinese health professionals has significantly increased (Fu et al., 2018). This heavy workload led to doctor-patient communication being rushed and low satisfaction of medical services (Dugdale et al., 1999; Wen et al., 2016). In the present study, half of the participants were unsatisfied with communication with their healthcare providers. Inadequate communication between patient and healthcare providers may cause negative CRM and non-adherence of treatment (Zolnierek & Dimatteo, 2009). Thirdly, after commercialisation reform, most hospitals had to cover operation management costs by themselves (Herd et al., 2010). The direct link between income and treatment charges became a perverse incentive for doctors to prescribe unnecessary medical tests and medicines to patients (Tucker et al., 2015). One of our participants mentioned this phenomenon and stated it not only harmed her trust in healthcare providers and necessity beliefs about treatment but also reinforced the belief about the overuse of drugs. Therefore, a clear understanding of the interactions between healthcare providers and Chinese patients will be needed to deliver efficient interventions to improve both satisfaction and treatment adherence.

4.4.5. Limitations

This study has several limitations. Due to the nature of the qualitative design, the causal inferences between CRM and medication-taking behaviour and associations between CRM and factors influencing CRM need to be confirmed by statistical evidence. Our participants were all from one city in Jiangsu province, one of the developed areas in mainland China. These results may be not generalisable to some undeveloped areas. In addition, the present study only focused on patients with CHD, hypertension and T2DM that were more common in the elderly population. The potential disparities of beliefs in the younger population and patients with other conditions are worthy of investigating in the future study. Lastly, as our participants were all patients, they preferred to share views about their own prescriptions rather than the overall medications. Therefore, a healthy population should also be involved in a future study to draw a complete picture of general beliefs about medicines.

4.5. Conclusion

This study explored Chinese patients' CRMs and identified some unique beliefs which differ from the western population. The CRMs comprised all five components of the BMQ framework. Moreover, trust in medicines and beliefs about TCM were identified as two additional CRMs associated with medication-taking behaviour. Illness perceptions, information stimuli, healthcare providers and drug quality were suggested as factors impacting CRMs. Since this study only analysed qualitative data collecting from a small sample group, the associations between CRMs and medication adherence should be further investigated using quantitative analysis methods.

Chapter 5 Checking people's comprehension of a Chinese translation of the BMQ

5.1. Background

The official Chinese translation of the BMQ was generated in 2015 and has been applied in stroke, diabetes and rheumatoid arthritis patient groups (Wei et al., 2017). Some previous Chinese studies also translated the questionnaire for specific audiences, such as patients with cardiovascular disease, depression and breast cancer. The translation and back-translation were completed by researchers or medical staffs (e.g. clinicians or nurses) who have prior medical knowledge. However, as many chronic patients are elderly and may have low literacy and medical knowledge, it is worth checking lay people's understanding of the questionnaire items before launching the assessment. This short section reports additional work after the previous qualitative study (***Chapter 4***), which aims to check the participants' comprehension of an existing Chinese translation of the BMQ (Wei et al., 2017).

5.2. Methods

5.2.1. Study design

A 'think-aloud' methodology (Ericsson & Simon, 1980), which was initially used to verbalise information attending in people's short-term memory, was employed in this study.

5.2.2. Measures

The tested version of the BMQ includes BMQ-G and BMQ-S (Wei et al., 2017). The BMQ-G consists of three constructs (Harm, Benefit and Overuse), and each comprises four items. The BMQ-S consists of two constructs comprising five items (Necessity) and six items (Concern), respectively. The translation followed a standard cross-cultural adaptation process (Beaton et al., 2007).

5.2.3. Procedure

The data was collected from 28 participants in the semi-structured interview (***Chapter 4***). According to Ericsson and Simon (Ericsson & Simon, 1993), there are two basic types of think-aloud protocols: 1) the concurrent 'think-aloud', in which participants verbalise their thoughts during task execution; 2) the retrospective 'think-aloud', in which participants were asked to do so after task completion. In this task, we mainly employed the former method to avoid potential retroactive interference, in which the participant's responses and memory of the former constructs may be interfered by the later constructs (Strack, 1992). Participants were asked to read the questionnaire and say out loud what they were thinking and feeling, but I did not ask participants to complete the questionnaire or give commentary on these thoughts (Darker & French, 2009). Ericsson and Simon suggested combining the two techniques (Ericsson & Simon, 1980), so, at the end of the task, I also encouraged participants to summarise any issues they had on reading or understanding.

A briefing and a warm-up task were given prior to the formal task to get familiar with the procedures (Darker & French, 2009). The questions in the warm-up task were selected from the original BMQ-item pool (Horne et al., 1999), in which the items had same response format and similar content with BMQ, but did not form part of the final version. These questions were translated by BN and checked by LW. After the task started, I sat out of the participants' line of sight to minimise the disturbance. The participants were not promoted unless falling in a pause longer than 10 seconds, in which case I reminded them to 'keep talking' (Darker & French, 2009; French & Hevey, 2008).

5.2.4. Analysis

The participants' responses in 'think-aloud' task, including language pause, repetition and body language were transcribed according to video records and randomly checked by supervisor LW. Four transcripts (participants 7, 14, 16 & 21) were randomly selected for developing a coding frame (Darker & French, 2009). I initially coded the issues by reviewing the samples of transcripts and then discussed the coding frame with supervisor (SC).

After the disagreements were resolved through discussion, a final coding frame was formed and applied to the remaining 24 participants. It categorised problems into four main types: 1) Reading issues (e.g. misreading and stumble in reading); 2) Comprehension issue (e.g. difficulty in understanding the item and unable to recognise the word in the item); 3) Interpretation issue (e.g. misinterpreting and misunderstanding the item meaning); 4) Questioning the item (e.g. questioning the grammar, translation, understandability or contents of the items). The coding framework was similar with it in the previous study, in which the researcher also identified the problems of rereading question, floundered in answering item, difficulty in understanding item and questioning item (Darker & French, 2009).

The frequencies of the four types of problems overall and for each item were counted. Items for which problems were identified more than five times were labelled as improvable, otherwise as unproblematic. The insufficient think-aloud responses, such as silent reading and reading without think-aloud, were not analysed.

5.3. Results

Overall, 18 participants reported problems when completing the think-aloud task. The number of problems per person ranged from 1 to 9. Seven items did not yield any problems. Another twelve items showed slight problems and were also labelled as unproblematic. Only four items were identified with five problems (Item BG5 & BG8), six problems (Item BG4) and eleven problems (Item C3), respectively (see ***Table 5-1***).

The most problematic item was C3 (These medicines are a mystery to me). Nine participants reported that the word 'mystery' is confusing and difficult to understand. For example, a hypertensive participant said *"This does not run smoothly. What does the word 'mystery' mean?"* (participant 21, male, 75 years old, hypertension). Moreover, two participants misunderstood or misinterpreted the meaning of the sentence. For example, a participant asked "*What does 'mystery' mean? Does it mean being fascinated by taking medication?"* (participant 4, female, 80 years old, hypertension & T2DM). Likewise, some participants had no idea about natural remedies (BG4 Natural remedies are safer than medicines) and misinterpreted as palliative care or no medication. *"Does natural remedies mean palliative care?"* (participant 4, female, 80 years old, hypertension & T2DM). For Item BG5 (Medicines do more harm than good), three participants did not understand the meaning of the Chinese character '弊', which can be interpreted as harm, disadvantage or cheat. *"What is this character? I can't recognise this character."* (participant 17, female, 55 years old, CHD, hypertension & T2DM). For the last improvable item (BG8 If doctors had more time with patients, they would prescribe fewer medicines), two participants were confused about the words 'with patients'. *"I don't understand what 'with patients' means."* (participant 12, female, 65 years old, CHD & T2DM). Moreover, another two participants misinterpreted 'prescribe fewer medicines' as 'modify the prescription' or 'giving oral prescription instead of written prescription'. *"Does it mean the doctor gives oral prescriptions instead of written prescriptions?"* (participant 16, female, 63 years old, CHD & hypertension).

Table 5-1 Summary of issues identified in the 'think-aloud' task

BMQ Items	Reading issue	Understanding issue	Interpretation issue	Questioning the wording of questionnaire	Overall
BG1 Doctors use too many medicines				participant 16	Unproblematic
BG2 People who take medicines should stop their treatment for a while every now and again		participant 17			Unproblematic
BG9 Medicines help many people to live better live				participant 16	Unproblematic
BG3 Most medicines are addictive		participant 4 & 7			Unproblematic
BG4 Natural remedies are safer than medicines		participant 5 & 14	participant 4, 8 & 14	participant 16	Improvable
BG11 In most cases the benefits of medicines outweigh the risks	participant 7				Unproblematic
BG10 In the future medicines will be developed to cure most diseases		participant 16 & 21		participant 16 & 21	Unproblematic
BG6 Most medicines are poisons				participant 14	Unproblematic
BG5 Medicines do more harm than good	participant 11	participant 4, 8 &17		participant 21	Improvable
BG12 Medicines help many people to live longer					Unproblematic
BG7 Doctors place too much trust on medicines			participant 4	participant 16	Unproblematic
BG8 If doctors had more time with patients, they would prescribe fewer medicines	participant 19	participant 4, 12	participant 6 & 16		Improvable
N1 My health, at present, depends on these medicines					Unproblematic
C1 Having to take these medicines worries me					Unproblematic
N2 My life would be impossible without these medicines					Unproblematic
C2 I sometimes worry about long-term effects of these medicines	participant 26	participant 21		participant 26	Unproblematic
N3 Without these medicines I would be very ill					Unproblematic
C3 These medicines are a mystery to me		participant 2, 4, 6, 14, 17, 21, 26, 27 & 28	participant 4 & 9		Improvable
N4 My health in the future will depends on these medicines		participant 27		participant 16	Unproblematic
C4 These medicines disrupt my life					Unproblematic
C5 I sometimes worry about becoming too dependent on these medicines					Unproblematic

BMQ Items	Reading issue	Understanding issue	Interpretation issue	Questioning the wording of questionnaire	Overall
N5 These medicines protect me from becoming worse	participant 7 & 21				Unproblematic
C6 These medicines give me unpleasant side effects				participant 3, 6 & 16	Unproblematic

Reading issues include stumble in reading and rereading; Understanding issues include confusion about the sentence and unable to recognise the word in the sentence; Interpretation issues include misinterpreting and misunderstanding.

Table 5-2 Summary of modifications of three improvable items

No.	Original item (English) (Horne et al., 2001; Horne et al., 1999)	Tested version (Chinese) (Wei et al., 2017)	Our suggested version (Chinese)	Modifications
C3	These medicines are a mystery to me	这些药对我来说是个谜	这些药对我来说很神秘	The modified translation revised 'a mystery' into an adjective form (mysterious).
BG4	Natural remedies are safer than medicines	自然疗法是比药物更安全	中药比西药更安全	The modified translation revised 'natural remedies' as 'TCM' and 'medicines' as 'western medicines'.
BG8	If doctors had more time with patients, they would prescribe fewer medicines.	如果医生有更多的时间见病人，他们会减少病人的处方药	如果医生有更多的时间与病人相处，他们会少给病人开些药	The modified translation revised 'with patients' as 'to get along with patients' and 'decrease prescription' as 'prescribe fewer medicines'.

5.4. Discussion

As the first study investigating the comprehension of the BMQ in the Chinese population using ‘think-aloud’ technique, this study found that the majority of participants had a proper overall understanding of the tested Chinese translation of the BMQ. Some issues raised in the ‘think-aloud’ task helped to reflect on possible confusion on readers’ side and proposes a preferable translation.

As the most problematic item, the Chinese ambiguity of the word ‘mystery’ (‘谜’) in C3 confused many participants. It can be interpreted as enigma, conundrum, mystification or brainteaser in Chinese semantics. The similar issue was identified in some Scandinavian translations of the BMQ (Granas et al., 2014). Moreover, the quotes from participant 4 showed that she mistook the word ‘谜’ (mystery) as ‘迷’ which means being/getting fascinated by something. In an existing Chinese translation of BMQ specific to patients after heart valve replacement, the author used an adjective form (mysterious) instead of the noun (mystery) and obtained a good validity (Si et al., 2013a). Therefore, I suggest revising the translation of C3 as ‘这些药对我来说很神秘’ (These medicines are mysterious to me) (see ***Table 5-2***).

For Item BG8, two identified issues consisted of confusion about the definition of 'with patients' and misinterpretation of 'prescribe fewer medicines'. In an existing Chinese translation of BMQ specific to breast cancer patients, the author translated the words 'had more time with patients' as 'spend more time on understanding patient's condition' (如果医生能够多花时间了解病情) (Wu et al., 2014). However, I think it over-interprets and alters the meaning of the original item. Therefore, I suggest translating as '更多时间与病人相处', which means 'had more time to get along with patients'. Regarding the latter part of the item, different from our tested version, which translated as '减少病人的处方药' (decrease the prescription), Wu's version (Wu et al., 2014) translated as '少开药' (prescribe fewer medicines). I think the later translation appropriately expresses the meaning of the original item. Thus the BG8 is revised as '如果医生有更多时间与病人相处，他们会少给病人开些药' (If doctors had more time to get along with patients, they would prescribe fewer medicines) (see ***Table 5-2***).

For Item BG4, the concept of natural remedies was not clearly defined and consequently confused some participants. For most Chinese people, TCM is one of the most familiar and commonly used natural remedies. Therefore, I suggest replacing the words ‘natural remedies’ by ‘TCM’ and the word ‘medicines’ by ‘western medicines’.

For the last improvable item BG5, some participants had no idea about the Chinese character of harm (弊), and one of them even cannot recognise the character. However, the issue is nothing to do with translation quality but participants’ literacy. For our prospective participants who approached via online survey are expected to have adequate literacy to complete the questionnaire. For other participants who are unable to use the smartphone will complete the questionnaire under our assistance. More details will be introduced in Chapter 6. Therefore, it is not expected to be a big issue. Moreover, another existing Chinese translation of BMQ also translated harm using the character ‘弊’ (Wu et al., 2014). Therefore, I do not make any modification to this item.

In addition, some participants also provided specific suggestions for remaining items. However, since these suggestions were just from a limited number of participants who did not equip professional knowledge, most of the suggestions lack experimental support and with a strong subjective bias. These suggestions may be investigated in the future study.

This preliminary study has several limitations. First, due to the limited number of participants, we do not have sufficient data to quantify meaningfully the problems encountered. Second, some participants reread the item or stumbled when thinking-aloud. However, it did not always indicate the difficulty in understanding. Participants might be just organising the response to the questions. Therefore, the interpretation of the reading issue may influence our judgement of whether a participant understands the questionnaire. Third, since I only asked participants to read the questionnaire instead of completing it, therefore, I did not obtain clear answers to all items from every participant and were consequently unable to investigate the associations between identified problems and answers toward each BMQ item. Luckily, the majority of participants provided useful information helped us check their understanding of the questionnaire and appropriate translation. Fourth, some participants insufficiently though-aloud while reading some items. Thus, more prompting is needed to reduce the silent reading in the future study.

5.5. Conclusion

In conclusion, the majority of items in Wei’s translations did not yield significant problems when reading them. The results of ’think-aloud’ task indicated Wei’s Chinese translation of the BMQ was a good version and can be used in our following online survey with very slight modification.

Part 3: Quantitative studies

This part consists of two quantitative studies:

1: A cross-sectional online survey aims to assess beliefs about medicines in the Chinese population and to investigate the influential factors of medication non-adherence in Chinese patients with CHD, hypertension and T2DM.

2: A factorial analysis study aims to validate an expanded version of BMQ (e-BMQ) and to evaluate the predictive effects of constructs in the e-BMQ on medication adherence.

Chapter 6 Associations between beliefs about medicines, perceived sensitivity to medicines, illness perceptions and medication adherence: A cross-sectional online survey in China

6.1. Background

Chronic diseases, such as CHD, hypertension and diabetes mellitus, affect 260 million people and contribute to approximately 8.8 million deaths annually in China (WHO, 2017). In the medication management of CHD, hypertension and diabetes, the effectiveness of drug therapy highly depends on good adherence to medications, which was defined as 'the extent to which the patient follows medication instructions' (WHO, 2003). Medication non-adherence rate among Chinese population varied in a wide range from 22-48.9% for CHD patients, 15.0-67.6% for hypertensive patients and 32.2-49.3% for diabetic patients (Ni et al., 2019; Nie et al., 2019; M. C. Wong, W. W. Tam, et al., 2015; M. C. Wong, C. H. Wu, et al., 2015; Xin et al., 2015).

Among many factors influencing medication adherence, beliefs about medicines have been proposed as one of the crucial patient-related determinants (Berglund et al., 2013; Horne et al., 2013). Horne's BMQ (1999) was used as a common measurement and applied in studies across different disease and cultural backgrounds (Horne et al., 2013). My previous meta-analysis (***Chapter 3***) found that the BMQ was first introduced to China in 2012, and more studies have been published since then (Nie et al., 2019). However, many of these had small sample sizes. Moreover, few studies used the updated version of BMQ (Horne et al., 2001).

This study firstly aimed to assess beliefs about medicines in Chinese population, and secondly aimed to investigate associations between medication adherence and predictors, such as beliefs about medicines, PSM and illness perceptions, in Chinese patients with CHD, hypertension and T2DM.

6.2. Methods

6.2.1. Study design

A cross-sectional online survey study was conducted via Qualtrics software between March and October 2017 in Jiangsu province, China. I developed an online survey tool and used this tool to conduct the study. This was because the online survey has become more popular in a survey study following the IT development in recent decades. Compared with traditional survey methods, it has many advantages such cheaper, quick, easy, convenient, accessible and anonymous.

6.2.2. Ethical considerations

Ethical approval (Project ID 6851/002) was obtained from the UCL Research Ethics Committee in January 2017 (***Appendix F. Ethics approval of online survey***). The methodological procedure was clearly explained in the application, and the risk assessment was obtained before survey occurring. All participants were recruited voluntarily. A cover letter and a consent form were showed and confirmed before the survey starting. The data and patients' privacy were protected following the UK Data Protection Act (1998, 2018).

6.2.3. Participants and sample size

The eligible patients were included if they were: 1) 18 years old or over; 2) taking medicines for CHD, hypertension or T2DM; 3) residents in China. However, since the online survey was accessible to all Internet users, healthy individuals were also welcomed to participate in the survey, and their data were used for the analyses in ***Chapter 7***.

The sample size was calculated using G*Power software (Version 3.1.9.2) (Buchner et al., 2014) to ensure enough power for statistical analyses. According to previous findings of the association between BMQ and adherence (Rodriguez Del Aguila &

Gonzalez-Ramirez, 2014; Wei et al., 2017), the target minimum sample sizes with α=0.05, Power (1-β) =0.8 in two tails were 127 (CHD), 87 (hypertension) and 93 (T2DM), respectively.

6.2.4. Measures

The online survey collected participants' background information (e.g. demographic/socioeconomic characteristics and clinical information) and measured beliefs about medicines, perceived sensitivity to medicines, illness perception and self-reported medication adherence. The used measurements and relevant variables were summarised in ***Table 6-1***.

Table 6-1 Measured variables and measurements included in survey

The Category	Assessed variables	Measurements
Demographic /Socioeconomic information	Age, Gender, Place of residence, Education level. Occupation, Retirement, Income level, Medical insurance.	Questions on background information
Clinical information	Diagnosis, Duration, Hospitalization, TCM use, Height, Weight, Blood pressure, Subtype of disease (Specific to CHD patients), HbA1c (Specific to T2DM patients)	
Beliefs about medicines	Necessity, Concern, Harm, Overuse and Benefit	BMQ
Perceived sensitivity to medicines	Perceived sensitivity to medicines	PSM scale
Illness perception	Identity, Cause, Timeline, Consequences, Concern, Understanding, Personal control, Treatment control, and Emotional representation	B-IPQ
Medication adherence	Medication adherence	MARS-5

TCM: Traditional Chinese Medicine; BMQ: Beliefs about Medicines Questionnaire; PSM: Perceived sensitivity to medicines; B-IPQ: Brief Illness Perception Questionnaire; MARS-5: 5-item version of Medicine Adherence Report Scale

6.2.4.1. Demographic and clinical information

Several questions on participants' background information described their demographic/socioeconomic characteristics, including age, gender, education, medical insurances, whether retired, occupation before retirement and income level. Questions on clinical information include hospitalisation (inpatient or outpatient), disease duration, number of conditions and BMI (height & weight). Whether the participant combined TCM as a complementary treatment was also investigated.

6.2.4.2. Beliefs about Medicines Questionnaire

The BMQ in the present study contains a BMQ-G and a BMQ-S. The BMQ-G (Horne et al., 2001; Horne et al., 1999) assesses medicine-related beliefs in general, including medicine's benefit (Benefit, 4 items), addiction and toxicity (Harm, 4 items), and whether overused or over-trusted by clinicians (Overuse, 4 items). The BMQ-S (Horne, 1997; Horne et al., 1999) assesses perceptions of patients' personal need and perceived effects of a particular treatment (Necessity, 5 items) and concerns about the potential adverse effects of using this medicine (Concern, 6 items). All answers scored on Likert-type scales from 1 (Strongly disagree) to 5 (Strongly agree). A mean score of a subscale was calculated as the sum score of the items in each subscale divided by the number of items belonging to that subscale. For example, $\bar{X}_{necessity}$=(N1+N2+N3+N4+N5)/5. An NCD score was used to present the patient's overall attitude to the medicines that he/she were currently on. According to whether the Necessity and Concerns scored above or below the midpoint (score=3), participants were categorised into four attitudinal groups: sceptical, ambivalent, accepting and indifferent. The Chinese version of the BMQ used in the present study was translated by Wei (Wei et al., 2017). The internal reliabilities of scales reported by Wei were 0.64 (Necessity), 0.75 (Concern), 0.58 (Benefit), 0.55 (Harm) and 0.54 (Overuse), respectively (Wei et al., 2017). Translations of Item BG4, BG8 and C3 were modified based on the results of 'think-aloud' task (see ***Chapter 5***).

6.2.4.3. Perceived Sensitivity to Medicines scale

The PSM scale assessing patients' beliefs about how sensitive they were to the effects of medicines consists of 5 items which are answered on the same 5-point Likert-type scale as the BMQ (Horne et al., 2013b). The items are summed to result in potential scale scores ranging from 5 to 25. Higher scores indicate patients believe they are more sensitive to the effects of medicines. Wei translated the questionnaire into Chinese (Wei et al., 2017). The tested internal reliability (Cronbach's α) of the PSM in the present study was 0.88.

6.2.4.4. Illness Perception Questionnaire

The original IPQ (1996) is a validated assessment based on SRM (Leventhal & Cameron, 1987). As the original version is too long for an online survey, I used a 9-item brief version of the BMQ (B-IPQ) (Broadbent et al., 2006) for my study. The first five items assess participants' cognitive representations of consequences, timeline, personal control, treatment control and illness identity. The following three items assess participants' emotional representations (concerns and emotions) and illness comprehensibility. The last item is an open-ended question, asking participants to list the three most critical causal factors to their conditions. Besides the last item, the former eight items all assess with 0-to-10 response scales. A meta-analysis (Broadbent et al., 2015) showed that the B-IPQ had a satisfied concurrent, predictive and discriminant validity. A Chinese study showed the B-IPQ had acceptable test-retest reliability and internal consistency (Cronbach α ranged from 0.54 to 0.76) in patients with CHD (Lin et al., 2011). The Chinese version of B-IPQ used in the present study was cross-culturally adapted (Xue & Lin, 2017). To make the questionnaire more disease-specific, I followed the adaption method of a study validating a Chinese IPQ in women with stress urinary incontinence (Fan et al., 2017). In the current study, the word ‘illnesses’ was specified as CHD, hypertension or T2DM, and the word ‘treatment’ was replaced with ‘heart attack drug’, ‘antihypertensive drug’ and ‘antidiabetic drug’, respectively (Leysen et al., 2015). The tested Cronbach’s α of the first eight items in the present study was 0.67.

6.2.4.5. Medication Adherence Report Scale

In the present study, a Chinese translated 5-item version of Medication Adherence Report Scale (MARS-5) was used to measure patients’ self-reported adherence of medication treating CHD, hypertension or T2DM (Horne & Weinman, 1999; Wei et al., 2017). Since I did not assess the adherence of each kind of medication, the results only represented an overall adherence in the past one month. The answers are scored on Likert-type scales from 1 (Always) to 5 (Never). Patients were defined as ‘high adherent’ if they had a sum score higher than 20 of 25 (i.e. 80%) and 80% adherence is a commonly used cut-off to define adherence, especially in medicine benefit/safety studies, otherwise as ‘low adherent’. The internal consistency (Cronbach α) of a Chinese version of MARS-5 was reported as 0.72 (Guo, 2014). In the present study, the tested Cronbach’s α was 0.87.

6.2.5. Development and pilot of the online survey

The online survey was developed in Qualtrics software. The whole survey takes around 15 minutes. The test version was developed and checked by a pilot study in May 2016. Eight Chinese international students and six collaborating researchers from China checked the accuracy and understandability of the instructions and contents. Several optimisations were conducted according to feedbacks:

1. Gave options to some fill-in questions (e.g. date of birth (DoB) and place of residence);

2. Adjusted the order of questions. For example, some less important demographic questions and sensitive socioeconomic questions (e.g. income level) were moved to the end of the survey;

3. Set some important questions as compulsory questions (e.g. gender & DoB). The

system would not skip these questions if any of them were missed and would remind the participants.

6.2.6. Survey Procedure

The whole procedure of the survey is shown in ***Figure 6-1***. The survey formally started after confirming the consent (see ***Appendix K & L***). The questions on demographic and clinical information (see ***Appendix M & N***), BMQ-G and PSM were applicable to all participants (see ***Appendix O & P***). Patients were required to complete the subsequent BMQ-S, MARS-5 and B-IPQ according to their conditions (see ***Appendix Q & R***). The different versions of the survey were presented to participants according to the following principles:

1. The participants who had only one of the three conditions (CHD, hypertension and T2DM) were directed to the subsequent disease-specific questions.

2. Participants who had more than one conditions were asked to select the most severe or primary condition and then complete the disease-specific questions.

3. The healthy participants skipped the BMQ-S, B-IPQ and MARS-5.

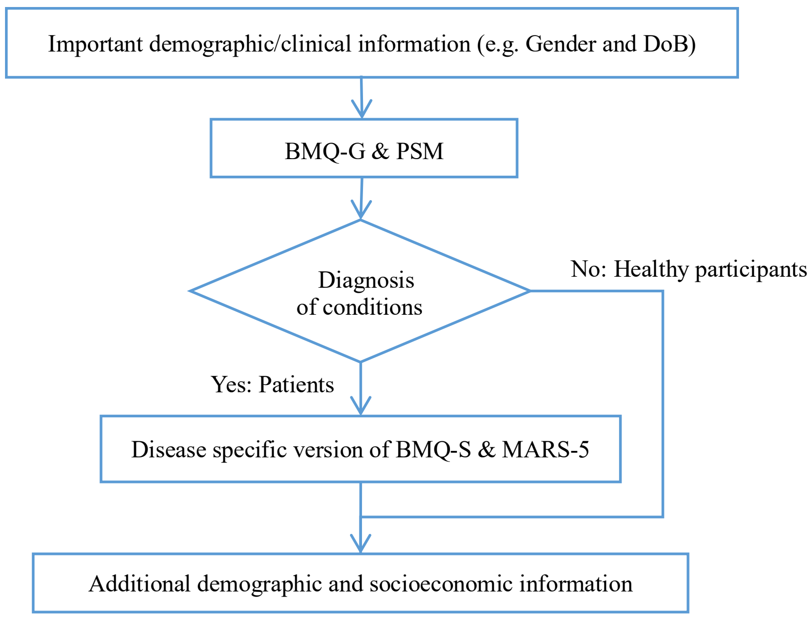


Figure 6-1 Flowchart of online survey procedure

6.2.7. Recruitment and data collection

Data collection was conducted from March 2017 until October 2017. A web link and a QR code (see ***Appendix H***) for smartphone scanning were circulated via WeChat, the most popular social media platform in China. The printed materials for recruitment (see ***Appendix I & J***) were distributed to three hospitals, three universities and a community clinic in Jiangsu province. Patients were invited to participate in the survey and to share the link/QR code to their social media.

However, the initial recruitment period did not collect enough data from patients with targeting conditions. Most responses were from healthy participants. Therefore, face-to-face recruitment in the hospital waiting room was adopted. Twenty pre-trained student volunteers were sent to hospitals weekly for recruiting and providing face-to-face assistance. The surveys were completed using either patient's personal equipment or our supplied tablet. Hard copies were also applicable to two hundred and forty-two participants who said that they would rather complete in hard copy. Data from hard copies were transcribed into the online system manually by me and marked for distinguishing from online collected data. The potential influence of data collection methods was adjusted in the regression analysis as a covariable. All hard copies were securely stored in the locked cabinet following data protection guideline.

6.2.8. Volunteer training

Twenty volunteers were recruited from the Department of Public Health of Xuzhou Medical University and School of Healthcare Management of Nanjing University of Chinese Medicine between April and June 2017. A training session was delivered to the volunteers before they went to the hospitals. The 2-hour training session introduced the background and action point of the study. Some useful tips, such as how to identify and approach patients, were provided (see ***Appendix S. Volunteers training slides***). Two senior volunteers were selected as the team leaders, and they took charge of the fieldwork and organised the dates and times for data collection. I regularly contacted the student volunteers and helped to solve the onsite problems. Progress was monitored weekly.

6.2.9. Raffle and bonus

A raffle was set for encouraging people to participate and complete the study. Participants who completed the whole survey and were willing to join a raffle obtained a chance to win 200 RMB (about £23). The winning rate was set at 2%. The raffle was randomly drawn from a participant pool after data clean. The winners were informed via their preferred approach (email, telephone or post).

6.2.10. Data analysis

6.2.10.1. Data cleaning and quality control

The raw data was downloaded from Qualtrics and analysed using SPSS Statistics 22. The data was removed if:

1. Null login record which did not formally start the survey (N=1026);
2. Submitted within 200 seconds (N=72);

3. Only filled some demographic questions but did not answer the questionnaire (N=185);
4. The tested data for training purposes (N=7);
5. Suspect data. For example, straight-line data and patterning data for single choice questions and all-selected answers for multiple-choice questions (N=3);
6. Duplicate data from the same IP address and name (N=13).

Data were checked and cleaned. Thirty occupation data and five education level data were complemented according to participants' qualitative data. Some participants mistook the unit of weight 'Kg' (公斤) as 'Jin' (斤), which was commonly used in China and equals to ½ Kg. A mean value imputation method was used for handling missing data of continuous and ordinal variables. For data collected via hardcopy, I randomly checked approximately 10% of them (N=25) against the original hardcopies.

6.2.10.2. Statistical analysis

Data were analysed using SPSS Statistics 24 (IBM Corp, 2016). Descriptive statistics were presented as Mean ± SD for continuous variables, and frequencies (%) for categorical variables. The Kolmogorov–Smirnov test was used to test the normality of continuous data. Chi-square, Kruskal-Wallis H tests and ANOVA were used to detect the difference in variables between groups. Spearman rank-order correlations and point-biserial correlations described associations between variables. Multivariable logistic regression analyses were used to investigate the predictive effects of BMQ/PSM-factors on low medication adherence. Demographic/clinical variables significantly associated with MARS scores and data collection method (online survey vs hardcopy) were adjusted in the logistic regression model as covariables. Results were presented as adjusted ORs with 95% CI. P-values less than 0.05 were considered to be statistically significant.

6.3. Results

In total, data from 1390 participants remained after data cleaning, including 555 healthy participants, 742 patients with target conditions and 93 patients with other conditions. This chapter only reports patients with CHD (N=191), hypertension (N=310) and T2DM (N=241). For missing data, the annual income had the largest proportion (24.1%), while those in other variables were all less than 7.7%. All missing data of continuous and ordinal variables were imputed using the series mean value.

6.3.1. Demographic/clinical characteristics

Table *6-2* shows the socio-demographic characteristics and clinical information by condition groups. All characteristics differed by condition groups, except for the gender, TCM usage, medical insurance and BMI. There were 54.4% men and 45.6% women. The overall mean age of the patients was 59.9±13.0 years old (64.2±12.2 for CHD, 57.9±12.6 for hypertension and 58.9±13.3 years old for diabetes, $p<0.01$). Also, the CHD group had the highest proportion (74.3%) of retirement compared to the other two groups. For education level, hypertension group had the largest proportion (31.1%) of people with a college education or above. The top four common occupations were worker/builder (27.8%), company staff/clerk (15.0%) and farmer (11.9%). The vast majority of participants (88.1%) came from Jiangsu province, in which the most of collection settings located. Overall, appropriate 20% of the participants had income less than ¥10,000 (about £1,150) annually. Participants in the hypertension groups were more affluent than patients in other groups.

Regarding the clinical information, 57.1% of participants were inpatients overall. The majority of participants had only one condition (79.0%). About one-third (31.8%)

patients had suffered from the condition for more than ten years. 86.9% of patients had medical insurance and 5.7% of patients had to pay their medication costs themselves. Around 10% of patients used TCM as a complementary treatment.

Table 6-2 Participants' characteristics by conditions

	Total 742(100%)	CHD 191(100%)	Hypertension 310(100%)	T2DM 241(100%)	P value
Age (Mean ± SD)	59.9 ±13.0	64.2±12.2	57.9±12.6	58.9±13.3	**<.001[a]**
Gender					.05[b]
Male	404 (54.4)	112 (58.6)	176 (56.8)	116 (48.1)	
Female	338 (45.6)	79 (41.4)	134 (43.2)	125 (51.9)	
Education level #					**<.001[b]**
Primary school or below	164 (22.1)	54 (28.3)	51 (16.5)	59 (24.5)	
Middle school	158 (21.3)	51 (26.7)	49 (15.8)	58 (24.1)	
High school or equivalent	170 (22.9)	39 (20.4)	82 (26.4)	49 (20.3)	
College or degree education	175 (23.6)	32 (16.8)	97 (31.3)	48 (19.1)	
Unknown	75 (10.1)	15 (7.8)	31 (10.0)	29 (12.0)	
Occupation before retirement #					**.001[b]**
Worker/builder	206 (27.8)	60 (31.4)	78 (25.2)	68 (28.2)	
Farmer	88 (11.9)	38 (19.9)	24 (7.7)	26 (10.8)	
Company staff/clerk	111 (15.0)	16 (8.4)	56 (18.1)	39 (16.2)	
Self-employed	51 (6.9)	7 (3.7)	29 (9.4)	15 (6.2)	
Civil service/Soldier	38 (5.1)	9 (4.7)	19 (6.1)	10 (4.1)	
Unemployed	44 (5.9)	7 (3.7)	20 (6.4)	17 (7.1)	
Other	144 (19.4)	43 (22.5)	60 (19.4)	41 (17.0)	
Unknown	60 (8.1)	11 (5.8)	24 (7.7)	25 (10.4)	
Retirement #					**<.001[b]**
Yes	434 (58.5)	142 (74.3)	154 (49.7)	138 (57.3)	
No	251 (33.8)	35 (18.3)	135 (43.5)	81 (33.6)	
Unknown	57 (7.7)	14 (7.3)	21 (6.8)	22 (9.1)	
Annual income #					**<.001[b]**
< ¥10,000 (£1,150)	146 (19.7)	68 (35.6)	36 (11.6)	42 (17.4)	
¥10,000- ¥30,000	89 (12.0)	25 (13.1)	29 (9.3)	35 (14.5)	
¥30,000- ¥50,000	135 (18.2)	25 (13.1)	65 (21.0)	45 (18.7)	
¥50,000- ¥100,000	103 (13.9)	14 (7.3)	60 (19.4)	29 (12.0)	
> ¥100,000	90 (12.1)	13 (6.8)	59 (19.0)	18 (7.5)	
Unknown	179 (24.1)	46 (24.1)	61 (19.7)	72 (29.9)	
Hospitalisation #					**<.001[b]**
Inpatient	424 (57.1)	164 (85.9)	103 (33.2)	157 (65.1)	
Outpatient	282 (38.0)	22 (11.5)	189 (61.0)	71 (29.5)	
Unknown	36 (4.9)	5 (2.6)	18 (5.8)	13 (5.4)	
Duration of disease #					**<.001[b]**
≤3 month	86 (11.6)	47 (24.6)	17 (5.5)	22 (9.1)	
3-12 months	42 (5.7)	17 (8.9)	15 (4.9)	10 (4.1)	
1-5 years	210 (28.3)	52 (27.2)	92 (29.7)	66 (27.4)	

	Total 742(100%)	CHD 191(100%)	Hypertension 310(100%)	T2DM 241(100%)	P value
5-10 years	139 (18.7)	31 (16.2)	70 (22.6)	38 (15.8)	
>10 years	236 (31.8)	39 (20.4)	103 (33.2)	94 (39.0)	
Unknown	29 (3.9)	5 (2.6)	13 (4.2)	11 (4.6)	
TCM users	80 (10.8)	26 (13.6)	31 (10.0)	23 (9.5)	.34[b]
Medical insurance #					.11[b]
Free medical services	26 (3.5)	5 (2.6)	10 (3.2)	11(4.6)	
BMIUE	401 (54.0)	103 (53.9)	172 (55.5)	126 (52.3)	
BMIUR	119 (16.0)	24 (12.6)	53 (17.1)	42 (17.4)	
NRCMS	99 (13.3)	40 (20.9)	32 (10.3)	27 (11.2)	
Pure self-pay	42 (5.7)	8 (4.2)	20 (6.5)	14 (5.8)	
Unknown	55 (7.4)	11 (5.7)	23 (7.5)	21 (8.7)	
Number of conditions					**<.001[b]**
One	586 (79.0)	116 (60.7)	263 (84.8)	207 (85.9)	
Two	120 (16.1)	55 (28.8)	39 (12.6)	26 (10.8)	
Three and above	36 (4.9)	20 (10.5)	8 (2.6)	8 (3.3)	
Data collected via hardcopy	242 (32.6)	69 (36.1)	112 (36.1)	61 (25.3)	**.01[b]**
BMI (Mean ± SD)	24.4±3.21	24.3±3.38	24.7±3.1	24.1±3.2	.08[c]

Categorical variables were presented as N (%), and continuous variable was present as Mean ± SD. a: Kruskal-Wallis H tests; b: Chi-Square test; c: ANOVA; #: Analysis excluded missing data; Significant results are presented in bold. BMIUE: Basic Medical Insurance for Urban Employee; BMIUR: Basic Medical Insurance for Urban Resident; NRCMS: New Rural Cooperative Medical System.

6.3.2. BMQ and PSM results

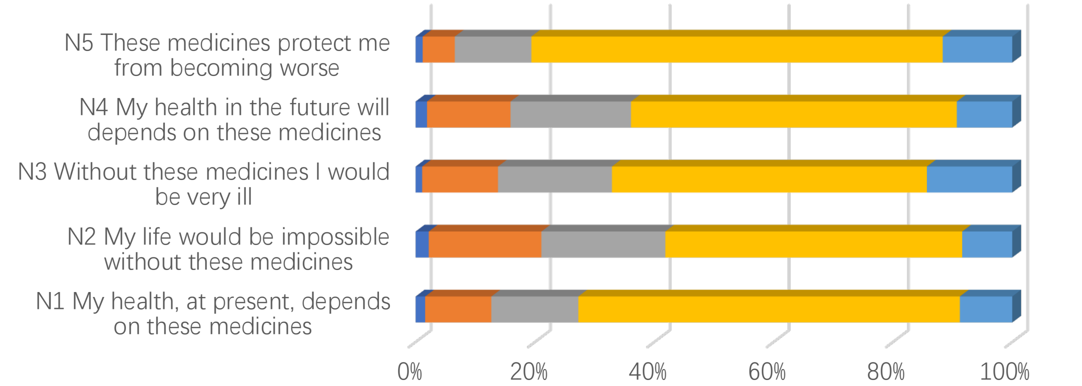
The mean scores of BMQ and PSM were 3.62±0.62 (Necessity), 3.27±0.66 (Concern), 0.34±0.74 (NCD), 3.06±0.60 (Harm), 3.35±0.55 (Overuse), 3.63±0.54 (Benefit) and 2.60±0.83 (PSM) (see ***Table 6-3***). Overall, there were no significant differences in these scores between the disease groups, except for the significantly higher Harm (3.15±0.61) and PSM (2.73±0.80) scores in the hypertension group.

Table 6-3 Mean scores of BMQ and PSM by conditions

Assessed variables	Total (N=742)	Condition groups			
		CHD (N=191)	hypertension (N=310)	T2DM (N=241)	P value [a]
Necessity	3.62±0.62	3.65±0.60	3.57±0.62	3.65±0.63	.11
Concern	3.27±0.66	3.28±0.67	3.28±0.64	3.27±0.68	.97
NCD	0.34±0.74	0.38±0.73	0.29±0.75	0.39±0.73	.39
Harm	3.06±0.60	3.00±0.59	3.15±0.61	2.99±0.58	**.007**
Benefit	3.63±0.54	3.67±0.60	3.62±0.49	3.62±0.56	.67
Overuse	3.35±0.55	3.28±0.60	3.39±0.49	3.35±0.59	.23
PSM	2.60±0.83	2.52±0.88	2.73±0.80	2.49±0.82	**.001**

a: Kruskal-Wallis H tests. Significant results are presented in bold.

Figure 6-2 to ***Figure 6-7*** show the distributions of answers of each BMQ/PSM item. About 82.3% of participants believed that medicines protected them from becoming worse (N5). Moreover, 72.8% of participants believed their health depends on the medicines (N1). The overall agreement rates of other three statements were 58.2% (N2), 67.1% (N3) and 63.9% (N4), respectively (see ***Figure 6-2***).

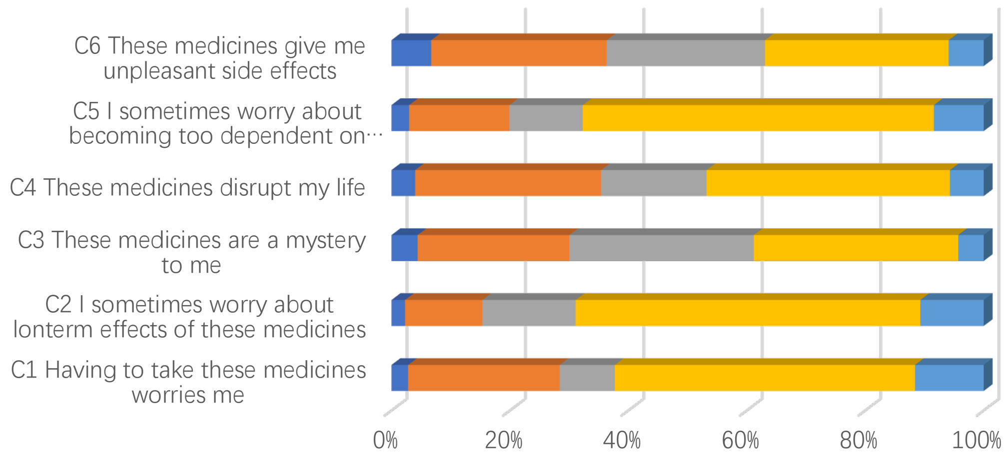


	N1 My health, at present, depends on these medicines	N2 My life would be impossible without these medicines	N3 Without these medicines I would be very ill	N4 My health in the future will depends on these medicines	N5 These medicines protect me from becoming worse
Strongly Disagree	1.6	2.2	1.1	1.9	1.2
Disagree	11.1	18.9	12.7	14.0	5.5
Unvertain	14.6	20.8	19.1	20.2	13.1
Agree	64.0	49.8	52.8	54.6	70.4
Strongly Agree	8.8	8.4	14.3	9.3	11.9

Figure 6-2 Participants' agreement with specific necessity items

Although there were more agreements than disagreements in all statements on specific-concerns, the odds between agreement and disagreement were not as one-sided as those in Necessity-items (see ***Figure 6-3***). There were almost equal proportions (36.3% versus 36.9%) of patients held the opposite point of view on whether medicines caused unpleasant side effects (C6). Also, 31.1% of patients were uncertain whether medicines were a mystery to them (C3). The two most common concerns were the uncertain long-term effects (C2) and potential dependence (C5), which worried 69.6% and 68.4% of participants, respectively. For the inconvenience caused by medicines, 62.3% of patients felt taking medicines worried them (C1), and

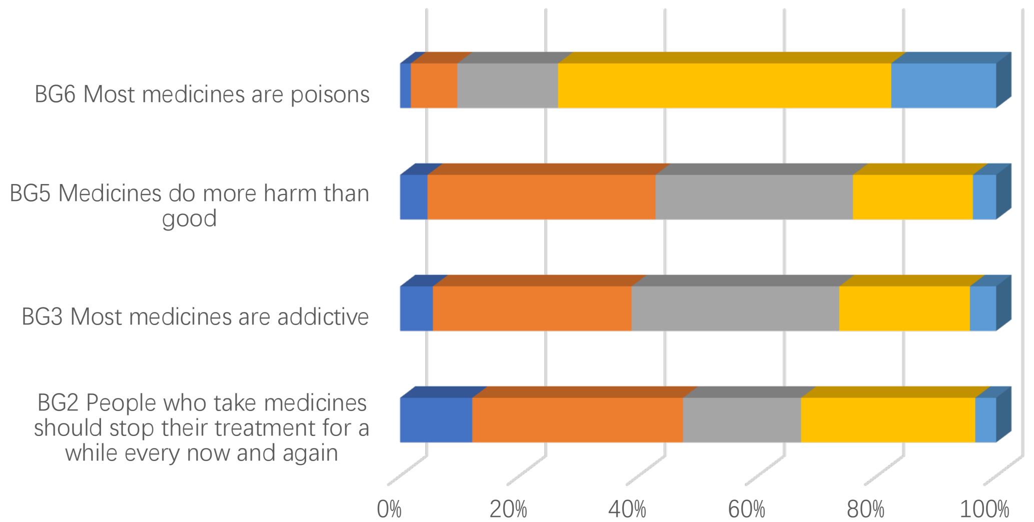
46.8% of patients felt medicines disrupted their lives (C4).



	C1 Having to take these medicines worries me	C2 I sometimes worry about lonterm effects of these medicines	C3 These medicines are a mystery to me	C4 These medicines disrupt my life	C5 I sometimes worry about becoming too dependent on these medicines	C6 These medicines give me unpleasant side effects
Strongly Disagree	2.8	2.3	4.4	4.0	3.0	6.7
Disagree	25.6	13.2	25.6	31.4	17.1	29.6
Unvertain	9.3	15.9	31.1	17.8	12.5	26.7
Agree	50.7	58.8	34.5	41.1	59.9	31.0
Strongly Agree	11.6	10.8	4.3	5.7	8.5	5.9

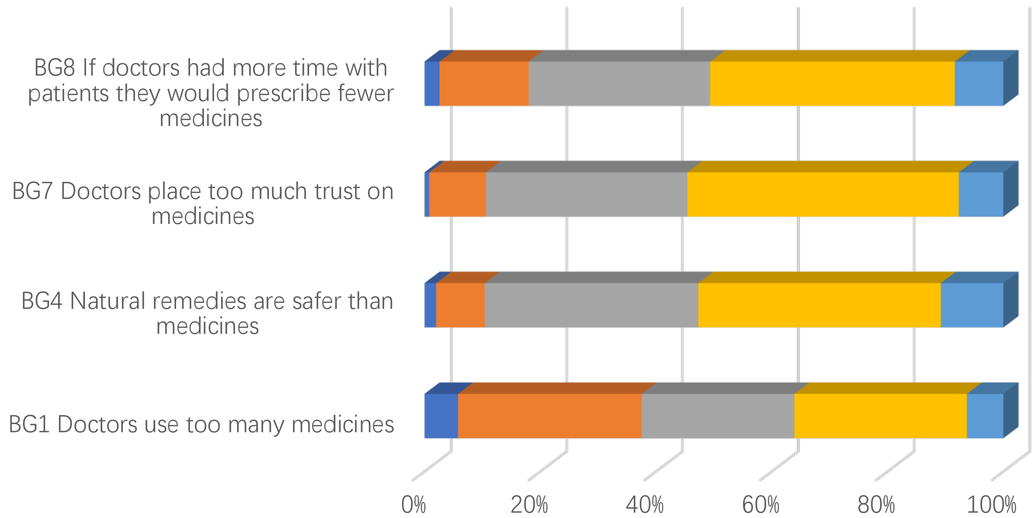
Figure 6-3 Participants' agreement with specific concern items

Regarding the general-harm beliefs, the majority of patients (73.5%) believed that the most medicines are poisons (BG6), which was the only item had more agreement answer than disagreement answers in this domain (see ***Figure 6-4***). For overuse, more than half of patients agreed doctors placed too much trust on medicines (BG7) and believed the doctors would prescribe fewer medicines if had more time with patients (BG8). However, whether doctors overprescribed medicines was a controversial statement (BG1) as both sides had a roughly equal number of supporters (about 36%). Compared with pharmaceutical medicines, more than half of patients (52.7%) believed the natural remedies were safer (BG4) (see ***Figure 6-5***). Similar to specific-necessity beliefs, far more patients agreed or strongly agreed with statements on medicines' benefit, reflecting the majority of patients believed the medicines are beneficial in general (see ***Figure 6-6***). For PSM, only less than a third of patients expressed sensitivity to the medicines. The overall agreement proportions of five items were between 17.4% and 32.2% (see ***Figure 6-7***).



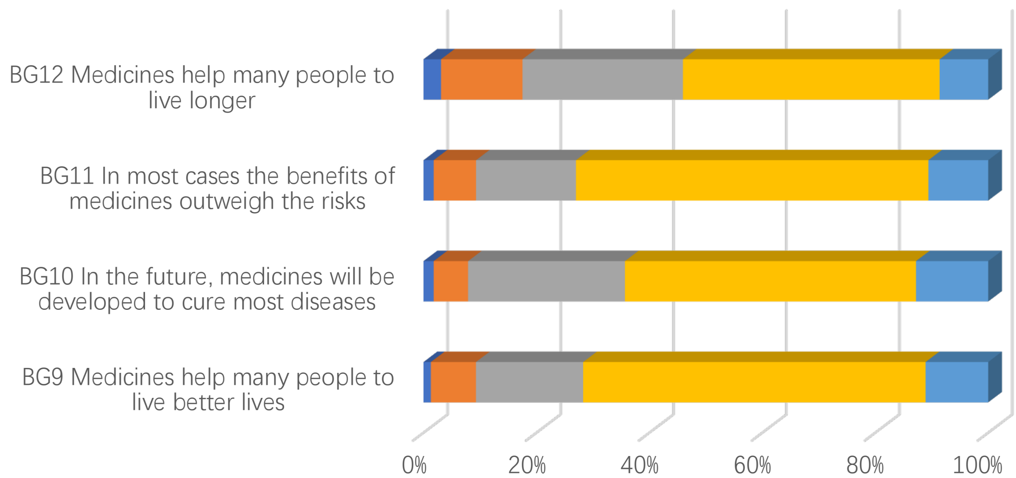
	BG2 People who take medicines should stop their treatment for a while every now and again	BG3 Most medicines are addictive	BG5 Medicines do more harm than good	BG6 Most medicines are poisons
Strongly Disagree	12.1	5.5	4.6	1.8
Disagree	35.3	33.3	38.2	7.8
Unvertain	19.8	34.8	33.1	16.9
Agree	29.2	21.9	20.1	55.9
Strongly Agree	3.5	4.4	3.9	17.6

Figure 6-4 Participants' agreement with general harm items



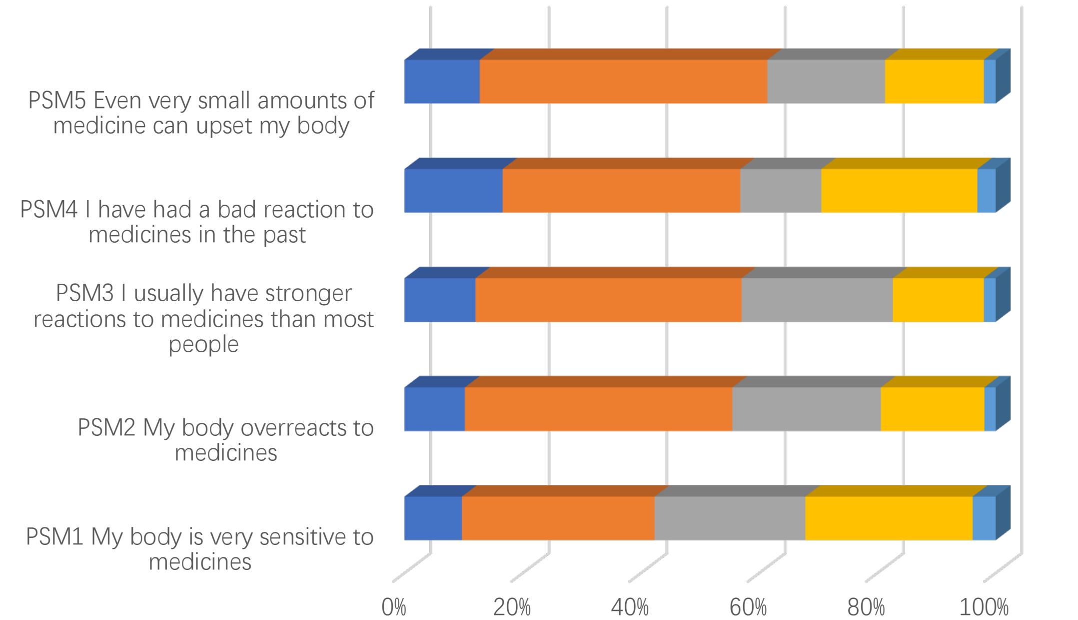
	BG1 Doctors use too many medicines	BG4 Natural remedies are safer than medicines	BG7 Doctors place too much trust on medicines	BG8 If doctors had more time with patients they would prescribe fewer medicines
Strongly Disagree	5.8	2.0	0.8	2.6
Disagree	31.7	8.4	9.8	15.4
Unvertain	26.4	36.9	34.8	31.4
Agree	29.8	41.9	46.9	42.3
Strongly Agree	6.3	10.8	7.7	8.4

Figure 6-5 Participants' agreement with general overuse items



	BG9 Medicines help many people to live better lives	BG10 In the future, medicines will be developed to cure most diseases	BG11 In most cases the benefits of medicines outweigh the risks	BG12 Medicines help many people to live longer
Strongly Disagree	1.3	1.8	1.8	3.1
Disagree	8.0	6.1	7.5	14.4
Unvertain	19.0	27.8	17.7	28.4
Agree	60.7	51.6	62.4	45.4
Strongly Agree	11.1	12.8	10.6	8.6

Figure 6-6 Participants' agreement with general benefit items



	PSM1 My body is very sensitive to medicines	PSM2 My body overreacts to medicines	PSM3 I usually have stronger reactions to medicines than most people	PSM4 I have had a bad reaction to medicines in the past	PSM5 Even very small amounts of medicine can upset my body
Strongly Disagree	9.7	10.2	12.0	16.6	12.7
Disagree	32.6	45.2	45.0	40.2	48.6
Unvertain	25.5	25.1	25.6	13.7	19.9
Agree	28.3	17.5	15.4	26.4	16.7
Strongly Agree	3.9	1.9	2.0	3.1	2.0

Figure 6-7 Participants' agreement with PSM items

6.3.2.1. Attitude analysis

According to the scores of Necessity and Concern, 495 (66.7%) patients were categorised as ambivalent, followed by accepting group (N=115, 20.9%). The indifferent and sceptical groups consisted of 51 (6.9%) and 41 (5.5%) patients, respectively. The accepting group had the lowest score of Harm (2.83±0.54), Overuse (3.12±0.51), PSM (2.32±0.80), low-adherent rate (22.6%) and the strongest general benefit belief (3.72±0.53) (see ***Figure 6-8***).

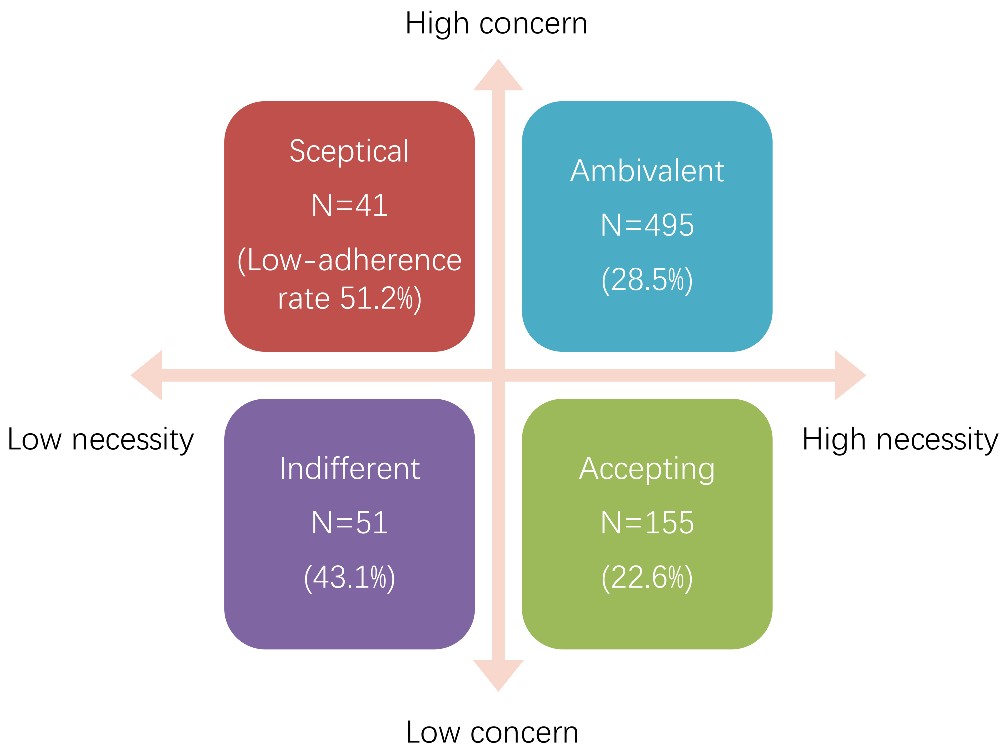


Figure 6-8 Low-adherence rates by attitudinal groups

6.3.2.2. Correlations among factors of BMQ and PSM

Table *6-4* summarises correlations among BMQ factors and PSM. The positive pairwise correlations were observed between factors with the same directions, such as Necessity versus Benefit (Spearman rank correlation coefficients 0.31, P<.001), Concerns versus Harm (0.31, P<.001) and Overuse versus PSM (0.28, P<.001). However, a positive correlation between Necessity and Concern (0.30, P<.001) was observed in the present study, which was usually reported to be negative in many previous studies. As a parameter interpreting patients' overall attitude to particular medicines, NCD showed extremely significant correlations with all BMQ-factors and

PSM.

Table 6-4 Correlation matrix between BMQ/PSM-factors

	Necessity	Concern	NCD	Harm	Overuse	Benefit	PSM
Necessity	1.00						
Concern	.30***	1.00					
NCD	.52***	-.59***	1.00				
Harm	.05	.31***	-.23***	1.00			
Overuse	.14***	.33***	-.18***	.43***	1.00		
Benefit	.31***	.07	.19***	-.01	.16***	1.00	
PSM	-.05	.25***	-.26***	.28***	.28***	-.02	1.00

*: P<0.05, **:P <0.01, ***:P <0.001

6.3.3. Illness perceptions

Table 6-5 shows the IPQ results by groups. The IPQ scores in overall samples were 6.14±2.58 (Consequences), 7.55±2.57 (Timeline), 6.06±2.30 (Personal control), 6.96±2.01 (Treatment control), 5.78±2.45 (Identity), 7.50±2.44 (Illness concern), 6.57±2.58 (Understanding) and 5.64±2.80 (Emotional representation). All results significantly varied between condition groups, except for the treatment control (P=.99) and illness concerns (P=.14).

Specifically, the CHD group had the most explicit perceptions of disease consequences (6.99±2.53), treatment control (7.06±1.84), identity (6.74±2.39) and emotional representation (6.32±2.55). Compared to the other two groups, the patients with T2DM had the longest perceived timeline (8.04±2.47) and clearest understanding (6.75±2.60) and strongest concern about illness (7.66±2.44). The hypertension participants only showed stronger confidence in their personal control (6.32±2.14).

In 390 valid responses of the IPQ9, the top-five reported causes were unhealthy diet/overweight (29.2%), heredity (19.0%), psychological factors (9.5%), unhealthy lifestyle (7.7%) and overwork (7.2%). Some common causes in other chronic diseases, such as tobacco/alcohol use, inadequate sleep, and insufficient physical exercises were mentioned in only 3.6%, 2.8% and 2.6% of responses.

Table 6-5 Mean scores of IPQ by conditions

Assessed variables	Total (N=742)	Condition groups			
		CHD (N=191)	Hypertension (N=310)	T2DM (N=241)	P value [a]
IPQ1 (Consequences)	6.14±2.58	6.99±2.53	5.38±2.34	6.43±2.66	**<.001**
IPQ2 (Timeline)	7.55±2.57	7.20±2.61	7.40±2.56	8.04±2.47	**<.001**
IPQ3 (Personal control)	6.06±2.30	5.60±2.43	6.32±2.14	6.08±2.36	**.003**
IPQ4 (Treatment control)	6.96±2.01	7.06±1.84	6.95±2.02	6.90±2.11	.99
IPQ5 (Identity)	5.78±2.45	6.74±2.39	5.47±2.16	5.43±2.65	**<.001**
IPQ6 (Illness concern)	7.50±2.44	7.56±2.45	7.34±2.44	7.66±2.44	.14
IPQ7 (Understanding)	6.57±2.58	6.14±2.56	6.69±2.54	6.75±2.60	**.02**
IPQ8 (Emotional representation)	5.64±2.80	6.32±2.55	5.44±2.71	5.37±3.02	**.001**

a: Kruskal-Wallis H tests. Significant results are presented in bold.

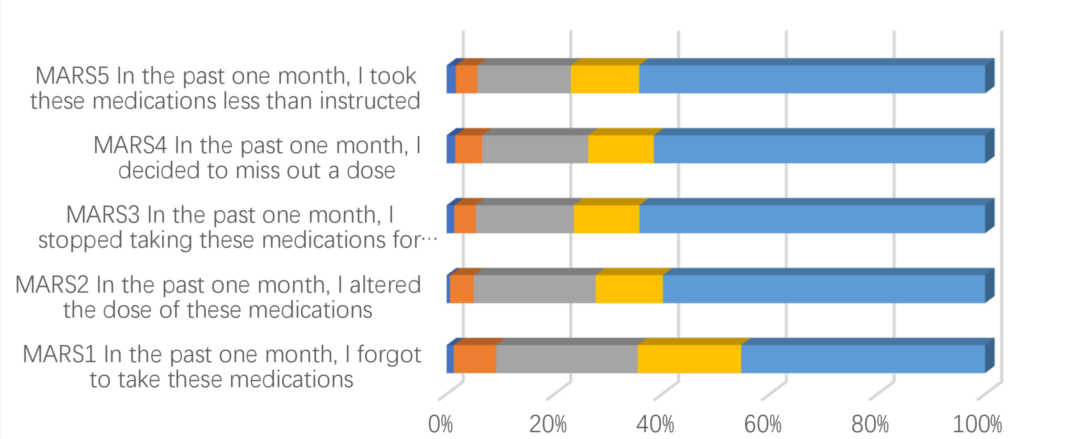
6.3.4. Self-reported medication adherence

The mean score of MARS in the overall samples was 21.21±4.03. Total 219 patients (29.5%) reported low adherence in the past one month, including 55 CHD patients, 89 hypertension patients and 75 T2DM patients. No significant difference was observed in the MARS score and dichotomising adherence status between the three condition groups (see ***Table 6-6***). More than half of patients (54.7%) once forgot to take the medication in the past month, which was the most common adherence barrier in the present study. Meanwhile, 59.9%-64.3% of participants never had any other four types of non-adherence behaviour in the past one month (see ***Figure 6-9***). Since the distribution of MARS scores was skewed, dichotomising adherence as high- and low-adherence and analysing using logistic regression model were appropriate for this study.

Table 6-6 Mean scores of MARS and low-adherence rates by conditions

Item	Total	Condition groups			
		CHD (N=191)	Hypertension (N=310)	T2DM (N=241)	P value
MARS 1	3.99±1.05	4.09±1.08	3.95±1.02	3.98±1.05	.25 [a]
MARS 2	4.27±0.97	4.30±1.02	4.30±0.86	4.20±1.05	.50 [a]
MARS 3	4.34±0.97	4.38±0.99	4.31±0.95	4.34±1.00	.39 [a]
MARS 4	4.27±1.01	4.31±0.99	4.24±1.03	4.29±1.01	.46 [a]
MARS 5	4.34±0.98	4.33±1.02	4.31±0.98	4.38±0.95	.51 [a]
Sum score	21.21±4.03	21.41±4.31	21.11±3.83	21.18±4.05	.16 [a]
Low-adherence rate	29.5%	28.8%	28.7%	31.1%	.80 [b]

a: Kruskal-Wallis H tests; b: Chi-Square test.



	MARS1 In the past one month, I forgot to take these medications	MARS2 In the past one month, I altered the dose of these medications	MARS3 In the past one month, I stopped taking these medications for a while	MARS4 In the past one month, I decided to miss out a dose	MARS5 In the past one month, I took these medications less than instructed
Always	1.3	0.6	1.4	1.6	1.7
Often	7.9	4.4	4	5	4
Sometimes	26.3	22.7	18.2	19.7	17.4
Rarely	19.2	12.5	12.2	12.2	12.7
Never	45.3	59.9	64.2	61.6	64.3

Figure 6-9 Proportion of five non-adherence behaviours assessed by MARS

6.3.4.1. Self-reported medication adherers and determinates

The MARS scores were significantly correlated with age (r=0.15, P<.001), retirement (r=-0.11, P=.003) and data collection method (online versus hardcopy) (r=0.11, P=.004), which were adjusted as covariables in the multivariable logistic regression models. **Table 6-7** shows the ORs of low medication adherence in the overall sample and each condition group. For beliefs about medicines, after adjusting for covariables, Necessity belief (adjusted OR 0.60, 95% CI 0.46 to 0.79) and NCD (adjusted OR 0.64, 95% CI 0.50 to 0.81) showed to be associated with good adherence. The Harm (adjusted OR 1.36, 95% CI 1.02 to 1.81) and PSM (adjusted OR 1.27, 95% CI 1.03

to 1.55) were associated with low adherence. Specifically, there was a discrepancy in beliefs about medicines on medication adherence between the three condition groups. In the CHD group, NCD (adjusted OR 0.53, 95% CI 0.31 to 0.92), Harm (adjusted OR 1.99, 95% CI 1.10 to 3.60) and Overuse (adjusted OR 1.90, 95% CI 1.03 to 3.52) were associated with low adherence. In the hypertension group, Necessity beliefs (adjusted OR 0.43, 95% CI 0.28 to 0.66), NCD (adjusted OR 0.55, 95% CI 0.37 to 0.80) and PSM (adjusted OR 1.60, 95% CI 1.14 to 2.25) showed significant predictive effects on low adherence. However, the low adherence of patients in the T2DM group only significantly associated with Benefit (adjusted OR 0.44, 95% CI 0.26 to 0.76). Unexpectedly, Concern did not show a significant association with low medication adherence in any of the condition groups (see **Table 6-7**).

For illness perceptions, Consequences (adjusted OR 0.92, 95% CI 0.87 to 0.99), Illness concern (adjusted OR 0.89, 95% CI 0.83 to 0.95) and Understanding (adjusted OR 0.92, 95% CI 0.87 to 0.98) were three significant risk factors associated with low adherence overall. In the CHD and hypertension groups, the strong illness concern was significantly correlated with low adherence (adjusted OR, 0.81 (0.70, 0.92) for

CHD and 0.88 (0.79, 0.97) for hypertension). In the T2DM group, treatment control was the only IPQ factor associated with low adherence (adjusted OR 0.85, 95% CI 0.74 to 0.98) (see **Table 6-7**).

Also, the influence of some other predictors was detected, such as attitudes to medicines and TCM use. Compared with the accepting group, participants who were indifferent (adjusted OR 2.26, 95% CI 1.12 to 4.57) or sceptical (adjusted OR 3.30, 95% CI 1.57 to 6.94) to their medicines were more likely to be low adherent. The TCM use did not manifest the significant influences on pharmaceutical medicine use in the majority of samples. However, what interested us was the hypertensive patients who took TCM were more than double likely to be low adherent than non-users (adjusted OR 2.43, 95% CI 1.11 to 5.33).

Table 6-7 ORs (95% CI) of low adherence by conditions

	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Overall patient (N=724)		
Necessity	**0.56 (0.43, 0.72)**	**0.60 (0.46, 0.79)**
Concerns	1.10 (0.86, 1.40)	1.08 (0.83, 1.40)
NCD	**0.59 (0.47, 0.75)**	**0.64 (0.50, 0.81)**
Harm	**1.38 (1.06, 1.79)**	**1.36 (1.02, 1.81)**
Overuse	1.24 (0.93, 1.66)	1.21 (0.89, 1.65)
Benefit	0.85 (0.64, 1.13)	0.82 (0.61, 1.12)
PSM	**1.25 (1.03, 1.51)**	**1.27 (1.03, 1.55)**
Consequences	**0.91 (0.86, 0.97)**	**0.92 (0.87, 0.99)**
Timeline	0.98 (0.92, 1.04)	0.98 (0.92, 1.05)
Personal control	0.96 (0.90, 1.03)	0.96 (0.90, 1.03)
Treatment control	**0.91 (0.84, 0.98)**	0.92 (0.85, 1.00)
Identity	0.94 (0.88, 1.00)	0.96 (0.90, 1.03)
Illness concern	**0.88 (0.83, 0.94)**	**0.89 (0.83, 0.95)**
Understanding	**0.92 (0.86, 0.97)**	**0.92 (0.87, 0.98)**
Emotional representation	0.98 (0.92, 1.03)	0.98 (0.92, 1.04)
Ambivalent †	1.37 (0.89, 2.09)	1.35 (0.87, 2.11)
Sceptical †	**3.60 (1.75, 7.39)**	**3.30 (1.57, 6.94)**
Indifferent †	**2.60 (1.33, 5.08)**	**2.26 (1.12, 4.57)**
TCM users #	1.33 (0.81, 2.17)	1.38 (0.81, 2.32)
CHD patients (N=191)		
Necessity	0.78 (0.46, 1.30)	0.84 (0.49, 1.43)
Concerns	1.52 (0.93, 2.49)	1.60 (0.93, 2.76)
NCD	**0.57 (0.35, 0.92)**	**0.53 (0.31, 0.92)**
Harm	**2.01 (1.13, 3.57)**	**1.99 (1.10, 3.60)**
Overuse	**1.82 (1.04, 3.18)**	**1.90 (1.03, 3.52)**
Benefit	1.49 (0.86, 2.56)	1.63 (0.92, 2.91)
PSM	1.21 (0.84, 1.74)	1.37 (0.92, 2.03)
Consequences	0.90 (0.80, 1.02)	0.89 (0.78, 1.02)
Timeline	0.95 (0.84, 1.07)	0.95 (0.84, 1.07)
Personal control	1.05 (0.92, 1.20)	1.08 (0.94, 1.23)
Treatment control	0.98 (0.83, 1.17)	1.00 (0.84, 1.19)
Identity	0.94 (0.83, 1.07)	0.93 (0.81, 1.07)
Illness concern	**0.82 (0.73, 0.94)**	**0.81 (0.70, 0.92)**
Understanding	0.88 (0.78, 1.00)	0.90 (0.79, 1.02)
Emotional representation	0.95 (0.84, 1.07)	0.94 (0.83, 1.07)
Ambivalent †	1.86 (0.79, 4.39)	2.01 (0.81, 4.98)
Sceptical †	2.83 (0.40, 19.87)	2.89 (0.38, 21.72)
Indifferent †	2.55 (0.72, 9.10)	2.69 (0.72, 10.03)
TCM users #	0.90 (0.36, 2.28)	0.98 (0.38, 2.55)
Hypertension patients (N=310)		
Necessity	**0.45 (0.30, 0.67)**	**0.43 (0.28, 0.66)**
Concerns	1.05 (0.72, 1.55)	0.94 (0.63, 1.43)
NCD	**0.53 (0.36, 0.76)**	**0.55 (0.37, 0.80)**
Harm	1.14 (0.69, 1.88)	1.45 (0.92, 2.27)
Overuse	1.10 (0.66, 1.83)	1.05 (0.62, 1.81)
Benefit	0.85 (0.52, 1.38)	0.77 (0.46, 1.29)
PSM	**1.65 (1.20, 2.27)**	**1.60 (1.14, 2.25)**
Consequences	0.93 (0.84, 1.04)	0.93 (0.83, 1.04)
Timeline	0.95 (0.86, 1.04)	0.94 (0.85, 1.04)
Personal control	0.94 (0.84, 1.06)	0.97 (0.86, 1.09)
Treatment control	0.93 (0.82, 1.05)	0.95 (0.84, 1.08)
Identity	0.91 (0.81, 1.02)	0.92 (0.81, 1.03)
Illness concern	**0.85 (0.77, 0.93)**	**0.88 (0.79, 0.97)**
Understanding	**0.90 (0.82, 0.99)**	0.92 (0.84, 1.02)

	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Emotional representation	0.94 (0.86, 1.03)	0.94 (0.85, 1.03)
Ambivalent †	1.44 (0.71, 2.92)	1.41 (0.67, 2.99)
Sceptical †	**5.20 (1.89, 14.28)**	**5.57 (1.93, 16.01)**
Indifferent †	**3.71 (1.28, 10.76)**	**3.71 (1.24, 11.06)**
TCM users #	**2.24 (1.05, 4.77)**	**2.43 (1.11, 5.33)**
T2DM patients (N=241)		
Necessity	**0.57 (0.37, 0.88)**	0.62 (0.37, 1.02)
Concerns	0.92 (0.62, 1.37)	0.93 (0.59, 1.44)
NCD	0.69 (0.47, 1.02)	0.78 (0.52, 1.17)
Harm	1.02 (0.64, 1.62)	0.94 (0.57, 1.57)
Overuse	1.07 (0.65, 1.76)	1.02 (0.61, 1.70)
Benefit	**0.53 (0.32, 0.88)**	**0.44 (0.26, 0.76)**
PSM	0.96 (0.69, 1.35)	0.94 (0.65, 1.35)
Consequences	**0.89 (0.80, 0.98)**	0.91 (0.81, 1.01)
Timeline	1.05 (0.94, 1.18)	1.09 (0.96, 1.24)
Personal control	0.90 (0.81, 1.02)	0.89 (0.78, 1.01)
Treatment control	**0.86 (0.75, 0.97)**	**0.85 (0.74, 0.98)**
Identity	0.96 (0.87, 1.07)	1.00 (0.89, 1.12)
Illness concern	0.97 (0.87, 1.09)	0.96 (0.85, 1.08)
Understanding	0.96 (0.86, 1.06)	0.94 (0.84, 1.06)
Emotional representation	1.03 (0.94, 1.13)	1.03 (0.94, 1.13)
Ambivalent †	1.05 (0.53, 2.09)	0.97 (0.47, 2.00)
Sceptical †	2.06 (0.54, 7.77)	1.96 (0.47, 7.88)
Indifferent †	1.85 (0.55, 6.25)	1.03 (0.25, 4.24)
TCM users #	0.97 (0.38, 2.45)	0.67 (0.21, 2.16)

Adjusted for age, retirement and data collection method. †: Compared with Accepting group; #: Compared with TCM nonusers. Significant results are presented in bold.

6.4. Discussion

This is the first study assessing beliefs about medicine in Chinese patients with CHD, hypertension and T2DM via an online platform. It investigated the associations between medication-related beliefs and self-reported medication adherence. These associations varied across condition groups. The beliefs about medicine's necessity, harm, NCD, PSM and illness perceptions were significant predictors of low adherence in overall samples.

6.4.1. Medication adherence and determinants

Due to the difference in adherence measurements, treatment regimen and sample characteristics, there was a big variation in adherence rate in patients with CHD, hypertension or T2DM in the literature (Ni et al., 2019; Nie et al., 2019; Wu & Liu, 2016; Xu et al., 2018; Y. Zhang et al., 2018). Need to note, the high/low-adherence defined in the present study was not full adherence/non-adherence, which means people reported to be high adherent sometimes not strictly follow doctor's instruction in reality (Tommelein et al., 2014). However, some previous studies (Horne & Weinman, 2002; Jonsdottir et al., 2010; Nguyen et al., 2014) have verified MARS's result is comparable to other medication adherence measurements. Thus, the low-adherence rate (around 30%) in the present study was at a medium level. In five assessed non-adherence behaviours, forgetting to take medicine was the most common and serious issue. WHO (2003) and previous studies (Ali et al., 2017; Hsu et al., 2010; Liau et al., 2019; Tang et al., 2013) also marked the forgetfulness as the leading cause of non-adherence.

In a recent meta-analysis of Chinese BMQ studies (Nie et al., 2019), specific-necessity belief and specific-concern about medicine showed moderate associations with low adherence. However, the specific-concern did not statistically correlate with MARS score across all groups in the present study. It seemed contrary to the results reported in another recent Chinese BMQ study (Wei et al., 2017), in which the Concern was identified as a significant predictor of non-adherence while Necessity belief was not. It might be because compared with potential adverse effects, the present participants more cared about perceived treatment effect. As a parameter presenting people's 'cost-benefit' analysis, the positive NCD scores indicated the present patients held overall positive beliefs to their medication (Horne, 1997; Horne et al., 1999).

Besides beliefs about medicines, illness perceptions were correlated with medication adherence. Overall, participants who perceived severe consequences, seriously concerned about disease, or clearly understood their illnesses, were more likely to adhere to their medications. It is in line with the findings of many previous studies (Hagger & Orbell, 2003; Ross et al., 2004; van Puffelen et al., 2015). However, the CIs of OR of low-adherence by IPQ factors were close to 1.00, indicating the predictive effects of these perceptions on low adherence were weak. Moreover, I also noted that the predictive effects of illness perceptions varied across condition groups. For example, the perception of treatment control showed a significant correlation with low-adherence in T2DM group only, but not in CHD and hypertension groups.

6.4.2. Correlations among beliefs about medicines

The present study also examined the intercorrelations among BMQ/PSM-factors. Commonly, positive beliefs (Necessity & Benefit) are considered to be negatively associated with negative beliefs (Concerns, Harm, Overuse & PSM) (Horne & Weinman, 1999; Horne et al., 1999). In the present study, the majority of results were in line with the previous findings, except for the positive correlation between Necessity and Concern. It may be due to the high-level of necessity belief and concerns reported at the same time, reflecting patients' ambivalent attitudes to their prescribed medicines. This finding was consistent with those in our previous qualitative study, in which participants reported their worries about medicines' adverse effects and did not want to take them. However, if they want to survive, there was no choice. Moreover, the present reported a higher level of concern than those in most of the previous

Chinese BMQ studies (Nie et al., 2019). Not only Concern, the scores of Harm and Overuse were also higher than those reported in a similar study (Wei et al., 2017). On the one hand, the phenomenon of medication overuse was more common in China than in western countries (Sun et al., 2015). On the other hand, it might be due to the fully anonymous environment where patients were more easily to confide negative beliefs and talk some sensitive issue (Colineau & Paris, 2010).

6.4.3. Online survey

As the first study assessing beliefs about medicines via an online platform in China, the application of online survey was also a key research method I am interested in. Compared with the traditional method, the online survey saves time and materials that enable researchers to collect a large amount of data in a short period with low cost (Moorhead et al., 2013; Shrank et al., 2011). Moreover, the online survey is not restricted by distance. Participants can complete the survey with mobile devices in a flexible time and place. The large-scale construction and application of the 5G network in China make the remote assessment and collecting/monitoring large samples from multi-areas possible. In addition, compared with hardcopy, the characters in the digital questionnaire can be easily zoomed in or out. It is user-friendly to the elderly or people with a vision issue.

However, two potential issues also drew our attention. The first issue was the number of participants who did not complete the survey. One thousand two hundred and eighty-three login records were non-response or partial response with very limited completeness, accounting for 47.6% of total login records. These participants closed the survey soon or even did not start the survey. Therefore, I did not impute these records as missing data. Although I hardly characterised these participants and distinguished from other participants basing on the limited information they left, they may have been uninterested in the topic of the study or lost patience after answering a few questions. Therefore, a potential selection bias raised. It may explain why there were only a few participants were indifferent with their medications because many participants with indifferent attitudes might have been excluded before the attitudinal analyses. High dropout rates are a common issue for almost Internet-based studies, and the rate in the present study was comparable with previous studies (Melville et al., 2010). Besides excluding incomplete responses, possible sampling bias might be caused by unequal accessibility of the survey as well. The online survey could be criticised as not being applicable to some population groups, such as the elderly, low-educated, low-income and rural population (Liljas et al., 2017). However, our results were similar to a previous BMQ study conducted using the paper questionnaire method in China (Wei et al., 2017), and this means the results observed from the online survey appear to be valid. With the popularisation of the mobile intelligent device, such as smartphone and tablet PC, and internet coverage in China (China Internet Network Information Center, 2018), the online survey may be the most promising survey method applying in the large population.

6.4.4. Strengths and limitations

This study has some strengths. Firstly, the study focused on three common chronic conditions in China and confirmed BMQ is an appropriate tool in assessing medication-related beliefs. Secondly, this study involved a relatively larger sample size than most of the existing Chinese BMQ studies (Nie et al., 2019).

This study also has some limitations: 1) Similar to other self-reported measurements, MARS might also be criticised as overestimating adherence (Sayner et al., 2015;

Stirratt et al., 2015). Patients might provide an overestimated answer intentionally and unintentionally due to being embarrassed to admit the non-adherent behaviour, the poor/incomplete memory recall, or other reasons. In future studies, objective measurements should be combined to diminish the bias. 2) Since there was no certain definition, the interpretation of the frequency of non-adherent behaviour (e.g. ‘sometimes’ and ‘often’) highly depended on patients’ personal understanding. Therefore, it could significantly influence the MARS results. Moreover, the frequency is not equal to the severity, as we cannot assert a patient who often took five pills less had better adherence than who always took one pill less. Therefore, more clearly defined answers may be helpful. 3) Our participants were mainly from Jiangsu Province, one of the most developed areas in China. The results may not be generalisable to some undeveloped areas. Further studies, of which sample from other regions of China are needed. 4) Due to the cross-sectional design, I need to be very careful when interpreting associations between risk factors (e.g. BMQ and IPQ factors) and outcome (e.g. medication adherence). There is a possible ‘reverse causality’ in cross-sectional studies, in which the outcome influences the measurements of risk factors (Kleinbaum et al., 1982). For example, a patient who forgot one dose of medicine, but did not feel anything different. This patient might consequently believe it is unnecessary to stick with the prescription, whereby instead of the cause, the decrease of necessity belief actually being the consequence of forgetting taking medication. 5) The assessment span of MARS was one month, while the IPQ and BMQ only reflected the situation at one particular time point. Therefore, whether participants were in a steady-state during that period decided the representativity of cross-sectional data and reliability of results. In a previous meta-analysis of 94 BMQ studies (Horne et al., 2013), the predictive effects of BMQ-S factors (Necessity and Concern) on medication adherence were investigated in cross-sectional and prospective/longitudinal studies, separately, and no significant heterogeneity was observed. More follow-up and longitudinal studies are needed to draw a confident conclusion about relationships between risk factors and medication adherence.

6.5. Conclusion

In conclusion, there were some disparities of beliefs about medicines and medication adherence between Chinese patients with CHD, hypertension and T2DM. The online survey was a practical method in the Chinese population. BMQ, PSM and B-IPQ may be useful tools to identify patients at risk of low adherence who had a chronic condition of CHD, hypertension and T2DM. Taking account of correlations between BMQ/PSM factors, illness perceptions and self-reported medication adherence help clinicians to understand patients' perspectives on prescribed medicines and support optimal adherence to appropriate prescriptions. However, since the BMQ was initially designed for the western population, some medication-related beliefs specific to Chinese population have not been incorporated in it. An expanded version was developed and preliminarily validated in the next chapter.

Chapter 7 A factor analytic validation of an extended Chinese version of the Beliefs about Medicines Questionnaire

7.1. Background

The BMQ was initially designed for the western population but has been widely used in numerous studies across different cultural backgrounds (Horne et al., 2013). The initial BMQ contains two subscales (BMQ-G & BMQ-S) with four factors (Necessity, Concern, Harm & Overuse). In an updated version, belief about medication's benefit (Benefit) was incorporated into BMQ-G (Horne et al., 2001). After being introduced to China in 2012, it has drawn increasing interest in different sample groups (Nie et al., 2019). However, there was no standard official translated version until Wei's study (Wei et al., 2016). I reviewed the studies included in ***Chapter 3*** and found 21 studies reported internal consistency reliability of BMQ tested in Chinese participants (see ***Table 7-1***). Five of them (Cai et al., 2019a; Dong, 2018; Lu et al., 2014; Si, 2013; Wu et al., 2014) examined the construct validity of Chinese BMQ using factorial analysis. However, none assessed beliefs about benefit. Three most commonly used Chinese versions were translated specifically for cardiovascular disease (Si, 2013), depression (Lu et al., 2014) and breast cancer (Wu et al., 2014), respectively.

I used the Chinese version of BMQ (Wei et al., 2016), with additional items I identified from the qualitative study of interview (***Chapter 4***). The present BMQ-S was updated with an additional item on specific concerns (‘These medicines give me unpleasant side effects’). To our knowledge, there is no existing publication examining the validity of this updated version of BMQ and its postulated five-factor structure by a factor analytic approach in the Chinese population. Furthermore, our previous qualitative study (see ***Chapter 4***) suggested some additional medication-related cognitions which were not reflected in the BMQ theoretical structure. Therefore, this chapter aimed to validate an expanded BMQ (e-BMQ) and to evaluate the predictive effects of constructs in the e-BMQ on medication adherence.

Table 7-1 Reliabilities of Chinese translated versions of BMQ in previous studies

Author and date	Used version	Translation method	Condition	Tested internal consistency reliability (Cronbach α)	Other reliabilities
ZX Si (2013)	10-item BMQ-S	Standard method	Heart-valve replacement	BMQ: 0.77, Necessity: 0.92, Concern: 0.67	**Test-retest reliability:** BMQ: 0.83 ($P<0.01$), Necessity: 0.94 ($P<0.01$), Concern: 0.79 ($P<0.01$) **Interrater reliability:** BMQ: 0.93 ($P<0.01$), Necessity: 0.95 ($P<0.01$), Concern: 0.83 ($P<0.01$)
LQ Ning et al. (2016)	10-item BMQ-S	Cited existing translation [1]	Deep venous thrombosis	Necessity: 0.79, Concern:0.82	
H Jiang et al. (2017)	10-item BMQ-S	Cited existing translation [1]	Primary glaucoma	Necessity: 0.60, Concern: 0.64	
XY Zhao (2017)	10-item BMQ-S	Cited existing translation [1]	Ischemic stroke	BMQ: 0.77, Necessity: 0.81, Concern: 0.72	
XX Qiao et al. (2017)	10-item BMQ-S	Cited existing translation [1]	Chronic diseases	BMQ: 0.74	
SH Liu (2018)	10-item BMQ-S	Cited existing translation [1]	Heart-valve replacement	BMQ: 0.80	
Y Lu (2014)	10-item BMQ-S & 8-item BMQ-G	Standard method	Depression	Necessity: 0.81, Concern: 0.71	**Test-retest reliability:** Necessity: 0.74 ($P<0.01$), Concern: 0.79 ($P<0.01$)
S Teng et al. (2015)	10-item BMQ-S & 8-item BMQ-G	Cited existing translation [2]	Renal transplant	Necessity: 0.77, Concern: 0.77, Harm: 0.67, Overuse: 0.76	
S Teng (2016)	10-item BMQ-S	Cited existing translation [2]	Liver transplant	Necessity: 0.87, Concern: 0.85	**Test-retest reliability:** Necessity: 0.90, Concern: 1
YJ Zhu (2017)	10-item BMQ-S	Cited existing translation [2]	AIDS	Necessity: 0.83, Concern: 0.63	
CY Du et al. (2017)	10-item BMQ-S & 8-item BMQ-G	Cited existing translation [2]	Liver transplant	Necessity: 0.83, Concern: 0.86, Harm: 0.73, Overuse: 0.79	
MB Wu (2014)	10-item BMQ-S & 8-item BMQ-G	Standard method	Breast cancer	BMQ: 0.74, Necessity: 0.76, Concern: 0.58, Toxicity: 0.65, Overuse: 0.47, Long-term effect: 0.57	
J Zhang et al. (2016)	10-item BMQ-S & 8-item BMQ-G	Cited existing translation [3]	Breast cancer	Necessity: 0.84, Concern: 0.79, Harm: 0.69, Overuse: 0.71	
SJ Zhao et al. (2015)	9-item BMQ	Not reported	Atrial fibrillation	BMQ: 0.64	
HZ Zhang et al. (2017)	9-item BMQ	Cited existing translation [4]	Asthma & COPD	BMQ: 0.70	
SL Guo (2014)	10-item BMQ-S & 8-item BMQ-G	Standard method	Lung or colorectal cancer	BMQ: 0.79, BMQ-S: 0.69, BMQ-G: 0.71	
TT Chen (2015)	10-item BMQ-S	Not reported	Anxiety	Necessity: 0.71, Concern: 0.74	
BKF Wan et al. (2017)	10-item BMQ-S & 12-item BMQ-G	Not reported	Chronic diseases	Necessity: 0.79, Concern: 0.73, Harm: 0.57, Overuse: 0.61, Benefit: 0.51	
L Wei (2017)	11-item BMQ-S & 12-item BMQ-G	Standard method	Stroke, diabetes & rheumatoid arthritis	Necessity: 0.64, Concern: 0.75, Harm: 0.55, Overuse: 0.54, Benefit: 0.58	
YY Dong (2018)	10-item BMQ-S	Not reported	Allergic rhinitis	BMQ: 0.94, Necessity: 0.91, Concern: 0.91	
QQ Cai (2019)	10-item BMQ-S	Standard method	Asthma	Necessity: 0.78, Concern: 0.70	**Test-retest reliability:** BMQ:0.76

BMQ-S: Specific subscale of Belief about Medicines Questionnaire; BMQ-G: General subscale of Belief about Medicines Questionnaire; COPD: chronic obstructive pulmonary disease; AIDS: acquired immune deficiency syndrome; 1:translated by ZX Si (2013); 2: translated by Y Lu (2014); 3: translated by MB Wu (2014); 4: translated by SJ Zhao (2015).

7.2. Methods

7.2.1. Participants and sample size

The present study comprised 1297 data from the online survey study in ***Chapter 6***, including 555 healthy people and 742 patients (191 CHD, 310 hypertension and 241 T2DM). The sampling strategies, source population and inclusion/exclusion criteria were the same as the parent study (see ***Chapter 6***). A minimum sample size of 100 is recommended to achieve adequate power in factor analyses (Hair et al., 2006). Kline (2011) suggested that the sample size of factor analysis should be 10-15 times as the number of items. Thus, the minimum samples sizes for BMQ-G (12 original items plus 13 candidate items) and BMQ-S (11 original items plus 10 candidate items) were estimated to be 250 and 210, respectively. Some researchers even suggested that the sample size larger than 300 is good (Comrey & Lee, 1992; Tabachnick & Fidell, 2012). The amount of available data obtained from the parent study were much more than the required sample size, should be adequate for factor analyses. The adequacy of the sample size was double-checked using a Kaiser-Meyer-Olkin (KMO) test (Williams et al., 2010).

7.2.2. Measures

The 23-item BMQ was same as that in the parent study (see ***Chapter 6***), consisting of a BMQ-S and a BMQ-G. All answers scored on Likert-type scales from 1 (Strongly disagree) to 5 (Strongly agree). For 742 patients who were currently medication users, both specific and general beliefs were assessed. For another 555 healthy participants who did not take medication, only the general beliefs were assessed using BMQ-G.

The previous semi-structured interview (see ***Chapter 4***) suggested that some cognitions seemed to be additional constructs but were not reflected by the existing BMQ, such as the beliefs about TCM and the trust in medicines. After discussing with my supervisors (LW and SC), 23 common statements were selected as candidate items for validating an e-BMQ which was specific to the Chinese population (see ***Table 7-2***). The Chinese translation was checked by a nurse and a clinician from a Chinese hospital. The accuracy of the English translation was checked by a bilingual researcher (LW). Same as the original BMQ items, the candidate items were also categorised into specific (N=10) and general (N=13) aspects. Both candidate and original items were assessed in the same sample groups.

Table 7-2 Pool of candidate items

Candidate items for BMQ-G
GAD1 Doctors prescribe expensive medicines to earn the return commission.
GAD2 Patients should only take the necessary dosage to maintain the condition.
GAD3 Taking wrong medication is very dangerous.
GAD4 If I have a disease, I should take medicine.
GAD5 Medicines treat symptoms, but do not cure diseases.
GAD6 Western medicine works more quickly than traditional Chinese medicines (TCM).
GAD7 The combination of western medicines and TCM weakens the effectiveness.
GAD8 Patients only use TCM when western medicines are ineffective.
GAD9 The combination of western medicines and TCM causes some unexpected side effects.
GAD10 Imported medicines are better than ones made in China.
GAD11 Expensive medicines are better than cheap ones.
GAD12 I trust medicines prescribed by only hospital doctors.
GAD13 Frequently Changing medicine's type or brand is risky.
Candidate items for BMQ-S
SAD1 I am willing to try any medicine as long as it works.
SAD2 Taking an excess dosage of these medicines, even very small amounts, is very dangerous.
SAD3 I do not need to take these medicines if my symptoms have not been serious yet.
SAD4 Taking these medicines makes me feel different from others.
SAD5 The earlier I start to use these medicines, the more likely I will be cured.
SAD6 These medicines are expensive.
SAD7 I should take less medicine, once achieving remission.
SAD8 Taking these medicines harms my quality of life.
SAD9 I have no choice but to take these medicines.
SAD10 I trust these medicines provided by my healthcare team.

7.2.3. Data analysis

Descriptive statistics were presented as Mean ± SD for continuous variables. Two-tailed Spearman rank-order correlation test described the correlations among items. Values of r greater than 0.3 and 0.5 were taken to indicate the medium and large effect size for correlations, respectively (Cohen, 1988). The internal consistency reliability of each construct was evaluated using Cronbach's alpha. The item leading to a decrease of Cronbach's alpha was suggested to remove. The value of

Cronbach’s alpha lower than 0.5 is unacceptable and greater than 0.7 is adequate (Cronbach, 1951; George & Mallery, 2018). The significance level for all tests was set as 0.05. As for the parent study (see ***Chapter 6***), medication adherence was assessed using MARS-5. Participants whose sum score was lower than 20 out of 25 were classified as ‘low adherent’. Univariable logistic regression analyses were used to test the predictive effect of BMQ-factors to low-adherence. As the specific beliefs about medicines were depended on the therapeutic regimen, the effects of beliefs on medication adherence may vary across different conditions. Thus, I conducted separate logistic regression analyses in CHD, hypertension, T2DM and TCM user groups. Results were presented as OR and 95% CI.

7.2.3.1. Exploratory factor analysis

Exploratory factor analysis (EFA) was conducted using SPSS Statistics 24 (IBM Corp, 2016) to detect additional latent variables outside the existing BMQ constructs. Before performing the EFA, candidate items were pre-analysed using KMO and Bartlett's tests. The KMO value (> 0.5) and the Bartlett sphericity value with statistical significance (P<.05) suggested the items are appropriate for analysing. Candidate items which were not correlated with any original BMQ items and other candidate items (|r| < 0.3) were excluded before EFA. Because the BMQ scores were not normally distributed, the factor extraction was conducted using a Principal Axis method. Additional factors with an eigenvalue greater than 1.0 (Kaiser criterion) (Kaiser, 1974) in the Principal Component Analysis (PCA) were extracted. A corresponding scree plot was considerate as additional proof for deciding the number of extracted factors. To easier interpret the results, data were rotated using a Direct Oblimin method with default Delta value of 0 (Field, 2014). The items were excluded if cross-loaded (factor loading ≥ 0.4) onto more than one factor or weakly loaded (factor loading < 0.4) onto all factors (Hair et al., 2006). If a factor only consisted of two items or fewer, the comprised items were omitted according to the factor loading from high to low. The PCA was repeated with omitting one item each time until the structure became stable and made sense. Since the BMQ is a validated questionnaire, the factor extraction and labelling were mainly based on the original theoretical framework. The newly identified latent factors were labelled according to the items included. Cases with missing data were replaced with series mean values.

7.2.3.2. Confirmatory factor analysis

The EFA is used to detect latent variables and to build a preliminary structural model when there is no firm idea about the number of factors that will encounter. However, these results are imprecise; thus, the obtained model needs to be further investigated using confirmatory factor analysis (CFA). In the present study, the construct validity of the e-BMQ was analysed using software AMOS 23 (Arbuckle, 2006). The software automatically checked the multivariate normality of the data using a Mardia's multivariate kurtosis coefficient (Mardia, 1970). The coefficients of expended BMQ-S (e-BMQ-S) and BMQ-G were 26.86 and 34.17, suggesting that the non-normality of data was minor and the factor loadings estimated using a maximum likelihood method were unbiased (Gao et al., 2008). The goodness-of-fit was presented using Chi-square/degree of freedom (χ^2/df) and root mean square error of approximation (RMSEA). Previous literature recommended different cut-off values for the above two indexes. For χ^2/df, values less than 3.0 indicates a good fit. For RMSEA, values less than .06 reflect good fit, whereas values less than .08 reflect adequate fit (Schreiber et al., 2006). The fitness difference between the original BMQ and e-BMQ were examined using a χ^2-difference test (Byrne, 2010).

7.3. Results

Since the factor structure derived from an EFA will always fit well in a CFA using the same data, the EFA and CFA need to be conducted in different data sets. I randomly split 1297 data from the parent study into two groups (N_{EFA}=649 & N_{CFA}=648). The mean age of the overall samples was 59.86±12.98 years old. Fewer men were involved in the study than women (44.0% versus 56.0%). More than half of participants (52.4%) had a college-level education or above. About 37.6% of participants had retired. Only a few patients (12%) had more than one condition. Apart from the healthy cases, 57.1% of participants were inpatients, and 10.8% of participants used TCM. In the previous parent study, 242 data were collected via hard copies and manually transcribed into the online survey system. The mean scores of specific beliefs about medicines in patient samples were 3.62±0.62 (Necessity), 3.27±0.66 (Concern) and 0.34±0.74 (NCD). The mean scores of general beliefs about medicines in overall samples were 3.14±0.61 (Harm), 3.10±0.66 (Overuse) and 3.60±0.56 (Benefit). All these variables were not statistically different between the EFA group and CFA group (see **Table *7-3***).

Table 7-3 Demographic characteristics, BMQ scores and their differences between EFA and CFA sample groups

	Overall (N=1297)	EFA group (N=649)	CFA group (N=648)	Difference (P value)
Age	59.86±12.98	59.21±13.31	60.46±12.65	.27
Gender (% Male)	571 (44.0)	289 (44.5)	282 (43.5)	.71
Educational level				.36
Primary school or below	168 (13.0)	78 (12.0)	90 (13.9)	
Middle school	166 (12.8)	76 (11.7)	90 (13.9)	
High school or equivalent	201 (15.5)	107 (16.5)	94 (14.5)	
College or degree education	680 (52.4)	348 (53.6)	332 (51.2)	
Unknown	82 (6.3)	40 (6.2)	42 (6.5)	
Retired	463 (37.6)	228 (36.8)	235 (38.4)	.57
No. of condition				.71
Healthy	555 (42.8)	287 (44.2)	268 (41.4)	
One	586 (45.2)	286 (44.1)	300 (46.3)	
Two	120 (9.2)	57 (8.8)	63 (9.7)	
Three or more	36 (2.8)	19 (2.9)	17 (2.6)	
Condition #				.57
CHD	191 (25.7)	96 (26.5)	95 (25.0)	.81
Hypertension	310 (41.8)	147 (40.6)	163 (42.9)	
T2DM	241 (32.5)	119 (32.9)	122 (32.1)	
TCM users #	80 (10.8)	38 (10.5)	42 (11.1)	.81
Inpatient #	424 (57.1)	212 (61.1)	212 (59.1)	.58
Collected via hardcopy	242 (18.7)	121 (18.6)	121(18.7)	.65
Necessity #	3.62±0.62	3.64±0.60	3.60±0.64	.37
Concerns #	3.27±0.66	3.30±0.66	3.25±0.66	.37
NCD #	0.34±0.74	0.34±0.77	0.35±0.71	.78
Harm	3.14±0.61	3.15±0.62	3.14±0.61	.78
Overuse	3.10±0.66	3.09±0.66	3.12±0.67	.42
Benefit	3.60±0.56	3.60±0.59	3.60±0.54	.80

Categorical variables were presented as N (%), and continuous variables were presented as Mean ± SD. #: not available in healthy cases.

The mean scores of candidate items were between 2.82 (GAD7) and 4.30 (GAD3) (see **Table *7-4***). According to the results of correlation matrixes (see ***Table 7-5*** & **Table *7-6***), four candidate items on specific beliefs (SAD1, SAD2, GAD5 & GAD6) and four candidate items on general beliefs (GAD2, GAD3, GAD6 & GAD13) were excluded before EFA due to their negligible correlations (|r| < 0.3) with others.

Table 7-4 Mean and stantard diviation of candidate items

Candidate items ($N_{BMQ\text{-}G}$=1297, $N_{BMQ\text{-}S}$=742)	Mean ±SD
GAD1 Doctors prescribe expensive medicines to earn the return commission.	3.07±1.03
GAD2 Patients should only take the necessary dosage to maintain the condition.	3.39±0.96
GAD3 Taking wrong medication is very dangerous.	4.30±0.75
GAD4 If I have a disease, I should take medicine.	3.19±1.07
GAD5 Medicines treat symptoms, but do not cure diseases.	3.35±1.00
GAD6 Western medicine works more quickly than TCM.	3.74±0.80
GAD7 The combination of western medicines and TCM weakens the effectiveness.	2.82±0.75
GAD8 Patients only use TCM when western medicines are ineffective.	2.85±0.99
GAD9 The combination of western medicines and TCM causes some unexpected side effects.	3.16±0.74
GAD10 Imported medicines are better than ones made in China.	3.17±0.91
GAD11 Expensive medicines are better than cheap ones.	2.88±0.92
GAD12 I trust medicines prescribed by only hospital doctors.	3.44±1.01
GAD13 Frequently changing medicine's type or brand is risky.	3.54±0.85
SAD1 I am willing to try any medicine as long as it works.	3.30±1.06
SAD2 Taking an excess dosage of these medicines, even very small amounts, is very dangerous.	3.76±0.80
SAD3 I do not need to take these medicines if my symptoms have not been serious yet.	2.98±1.06
SAD4 Taking these medicines makes me feel different from others.	2.85±1.01
SAD5 The earlier I start to use these medicines, the more likely I will be cured.	3.35±0.99
SAD6 These medicines are expensive.	3.42±1.02
SAD7 I should take less medicine, once achieving remission.	3.27±1.02
SAD8 Taking these medicines harms my quality of life.	3.24±1.01
SAD9 I have no choice but to take these medicines.	3.75±0.94
SAD10 I trust these medicines provided by my healthcare team.	3.99±0.69

Table 7-5 Correlation matrix of specific items

	SAD1	SAD2	SAD3	SAD4	SAD5	SAD6	SAD7	SAD8	SAD9	SAD10
SAD1	1	.07	.10*	.09	.20**	.13*	.11*	.14**	.10	.20**
SAD2	.07	1	.06	-.04	.003	.22**	.19**	.08	.25**	.22**
SAD3	.10*	.06	1	.33**	.21**	.05	.44**	.23**	.15**	.05
SAD4	.09	-.04	.33**	1	.26**	.16**	.22**	.38**	.24**	-.002
SAD5	.20**	.003	.21**	.26**	1	.20**	.21**	.24**	.08	.28**
SAD6	.13*	.22**	.05	.16**	.20**	1	.04	.28**	.24**	.19**
SAD7	.11*	.19**	.44**	.22**	.21**	.04	1	.24**	.21**	.09
SAD8	.14**	.08	.23**	.38**	.24**	.28**	.24**	1	.42**	.03
SAD9	.10	.25**	.15**	.24**	.08	.24**	.21**	.42**	1	.17**
SAD10	.20**	.22**	.05	-.002	.28**	.19**	.09	.03	.17**	1
N1	.22**	.29**	.05	.03	.26**	.16**	.08	.14**	.14**	.30**
C1	.12*	.18**	.08	.22**	.15**	.23**	.14**	.41**	.34**	.10
N2	.11*	.15**	-.02	.16**	.12*	.18**	.04	.18**	.18**	.16**
C2	.10	.24**	.13*	.19**	.15**	.18**	.13*	.28**	.37**	.11*
N3	.22**	.21**	-.09	.01	.16**	.23**	-.01	.18**	.18**	.38**
C3	.13*	-.02	.04	.15**	.26**	.18**	.03	.13*	-.004	.06
N4	.21**	.11*	.05	.14**	.29**	.13*	.01	.20**	.16**	.26**
C4	.10	.07	.17**	.36**	.26**	.21**	.11*	.50**	.26**	.09
C5	.11*	.22**	.04	.25**	.15**	.10	.20**	.35**	.32**	.05
N5	.12*	.16**	.07	.04	.17**	.18**	.02	.17**	.11*	.28**
C6	.08	.13*	.16**	.40**	.25**	.24**	.13*	.48**	.23**	.01

Significant medium and great correlations are highlighted in green colour. *: P<0.05, **:P <0.01, ***:P <0.001

Table 7-6 Correlation matrix of general items

	GAD1	GAD2	GAD3	GAD4	GAD5	GAD6	GAD7	GAD8	GAD9	GAD10	GAD11	GAD12	GAD13
GAD1	1	.18**	.08*	-.18**	.12**	.06	.16**	.08	.13**	.03	-.02	-.18**	.01
GAD2	.18**	1	-.004	.04	.28**	.07	.11**	.02	.03	.04	.05	.06	.03
GAD3	.08*	-.004	1	-.06	.07	.20**	-.06	.01	.08*	.07	-.05	.05	.16**
GAD4	-.18**	.04	-.06	1	.19**	.07	.15**	.21**	-.08	.12**	.27**	.38**	.15**
GAD5	.12**	.28**	.07	.19**	1	.14**	.23**	.15**	.10*	.04	.11**	.20**	.14**
GAD6	.06	.07	.20**	.07	.14**	1	.02	.14**	.08	.15**	.06	.20**	.12**
GAD7	.16**	.11**	-.06	.15**	.23**	.02	1	.21**	.31**	-.01	.19**	.11**	.11**
GAD8	.08	.02	.01	.21**	.15**	.14**	.21**	1	.30**	.24**	.23**	.21**	.19**
GAD9	.13**	.03	.08*	-.08	.10*	.08	.31**	.30**	1	.15**	.13**	.04	.19**
GAD10	.03	.04	.07	.12**	.04	.15**	-.01	.24**	.15**	1	.39**	.14**	.07
GAD11	-.02	.05	-.05	.27**	.11**	.06	.19**	.23**	.13**	.39**	1	.23**	.09*
GAD12	-.18**	.06	.05	.38**	.20**	.20**	.11**	.21**	.04	.14**	.23**	1	.16**
GAD13	.01	.03	.16**	.15**	.14**	.12**	.11**	.19**	.19**	.07	.09*	.16**	1
BG1	.30**	.07	.02	-.18**	.12**	.07	.07	.02	.11**	.06	.02	-.10*	.01
BG2	.25**	.17**	-.11**	-.06	.14**	-.02	.14**	.05	.05	.03	.09*	-.04	-.06
BG9	-.13**	-.08	.06	.21**	-.09*	.17**	-.11**	.13**	.02	.15**	.12**	.14**	.06
BG3	.26**	.18**	-.01	.09*	.28**	.01	.26**	.11**	.12**	.05	.12**	.04	.03
BG4	.18**	.22**	-.004	.09*	.32**	.08	.16**	.04	-.01	.03	.09*	.09*	-.03
BG11	-.02	.02	.12**	.03	-.03	.15**	-.08	.07	-.001	.10**	.07	.07	.17**
BG10	-.01	-.04	.20**	.003	-.08	.18**	-.04	.05	.07	.11**	.07	-.05	.10*
BG6	.12**	.13**	.09*	.004	.24**	.17**	.12**	.03	.08*	.05	-.01	.12**	.04
BG5	.22**	.15**	-.11**	.01	.23**	.01	.22**	.14**	.17**	.06	.080*	.08*	.04
BG12	-.06	-.03	-.11**	.22**	.04	.11**	.03	.20	.004	.10*	.20**	.16**	.05
BG7	.19**	.15**	.07	-.04	.20**	.14**	.17**	.14**	.19**	.10*	.02	.06	.05
BG8	.26**	.15**	.06	-.03	.09*	.15**	.07	.12**	.12**	.17**	.11**	.03	.08*

Significant medium and great correlations are highlighted in green colour. *: P<0.05, **:P <0.01, ***:P <0.001

7.3.1. Exploratory factor analysis

The KMO measure for two extended subscales were 0.797 (e-BMQ-S) and 0.728 (e-BMQ-G), confirming the adequacy of sample size. The statistical significance of Bartlett's Test of Sphericity suggested the correlations between items were sufficiently large for a PCA (see ***Table 7-7***). The communalities of items were presented in **Table *7-8***.

Table 7-7 KMO and Bartlett's test for e-BMQ subscales

		e-BMQ-S	e-BMQ-G
KMO Measure of Sampling Adequacy.		.797	.728
Bartlett's Test of Sphericity	Approx. Chi-Square	1194.821	1799.974
	df	78	171
	Sig.	<.001	<.001

Table 7-8 Communalities of items in e-BMQ

	Initial	Extraction		Initial	Extraction
e-BMQ-S			e-BMQ-G		
N1	.300	.373	BG1	.194	.317
C1	.322	.367	BG2	.215	.325
N2	.396	.408	BG9	.228	.296
C2	.334	.315	BG3	.291	.368
N3	.438	.565	BG4	.246	.362
C3	.156	.092	BG11	.185	.367
N4	.416	.470	BG10	.182	.307
C4	.438	.522	BG6	.154	.157
C5	.341	.367	BG5	.280	.347
N5	.195	.144	BG12	.213	.356
C6	.366	.406	BG7	.192	.235
SAD4	.269	.231	BG8	.126	.165
SAD8	.396	.437	GAD4	.261	.401
			GAD5	.276	.388
			GAD7	.256	.310
			GAD8	.230	.296
			GAD9	.275	.684
			GAD11	.188	.236
			GAD12	.237	.350

Extraction Method: Principal Axis Factoring.

For e-BMQ-S, the eigenvalue (see ***Table 7-9***) and the scree plot (see ***Figure 7-1***) suggested a four-factor structure and a three-factor structure, respectively. However, since the third (Eigenvalue=1.04) and the fourth factor (Eigenvalue=1.01) only explained little variance and did not make sense, the original two-factor structure of the BMQ-S was maintained and explained 45.2% of the variance (see ***Table 7-9***).

Table 7-9 Eigenvalues and explained variances of the two-factor e-BMQ-S structure

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings [a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	3.701	28.469	28.469	3.095	23.811	23.811	2.831
2	2.176	16.742	45.211	1.602	12.324	36.136	2.274
3	1.042	8.018	53.229				
4	1.007	7.744	60.973				
5	.840	6.460	67.433				
6	.757	5.824	73.257				
7	.659	5.073	78.330				
8	.563	4.330	82.659				
9	.532	4.092	86.752				
10	.508	3.911	90.663				
11	.477	3.669	94.332				
12	.390	3.003	97.335				
13	.346	2.665	100.000				

Extraction Method: Principal Axis Factoring.
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

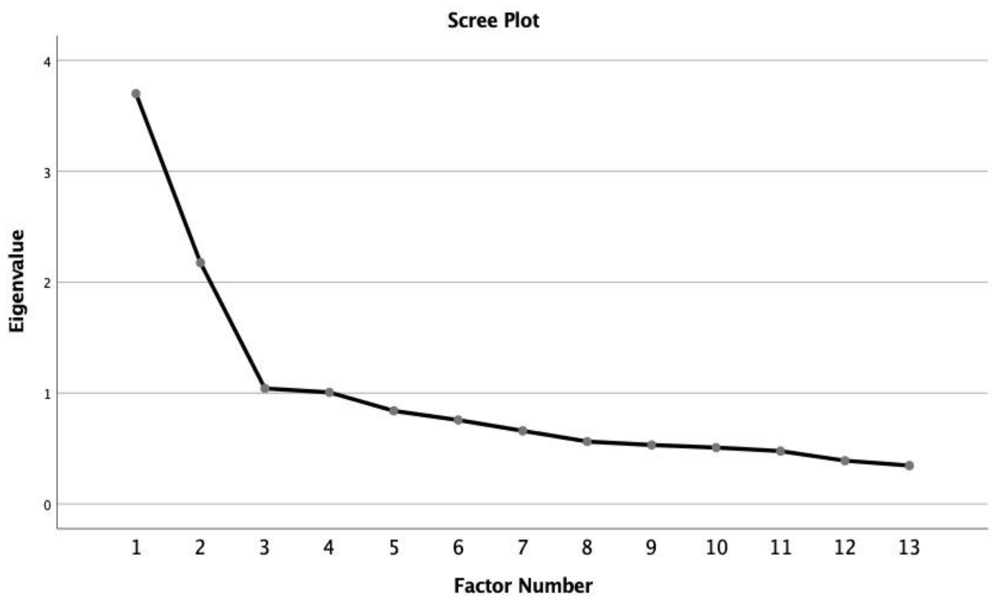


Figure 7-1 Scree plot for the e-BMQ-S

Two candidate items with acceptable factor loading (SAD4: 0.479; SAD8: 0.631) were suggested being incorporated by the Concern construct (see ***Table 7-10***). The Item C3 (These medicines are a mystery to me) which did not load onto any factor was excluded in the following CFA.

Table 7-10 Pattern matrix of factor loading for e-BMQ-S

	Concern	Necessity
C4 These medicines disrupt my life.	.692	
SAD8 Taking these medicines harms my quality of life.	.631	
C6 These medicines give me unpleasant side effects.	.625	
C1 Having to take these medicines worries me.	.623	
C5 I sometimes worry about becoming too dependent on these medicines.	.612	
C2 I sometimes worry about long-term effects of these medicines.	.579	
SAD4 Taking these medicines makes me feel different from others.	.479	
N3 Without these medicines I would be very ill.		.777
N4 My health in the future will depends on these medicines.		.674
N2 My life would be impossible without these medicines.		.638
N1 My health, at present, depends on these medicines.		.634
N5 These medicines protect me from becoming worse.		.319
C3 These medicines are a mystery to me.		

Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization. Rotation converged in 4 iterations. Factor loadings >0.3 are reported.

For general subscale, the scree plot suggested a six-factor structure (see ***Figure 7-2***). However, since the eigenvalue of the sixth factor was less than 1, I chose a five-factor structure, which explained 49.7% of the variance (see ***Table 7-11***). As I expected, the beliefs about TCM and the trust in medicines were identified as two additional factors.

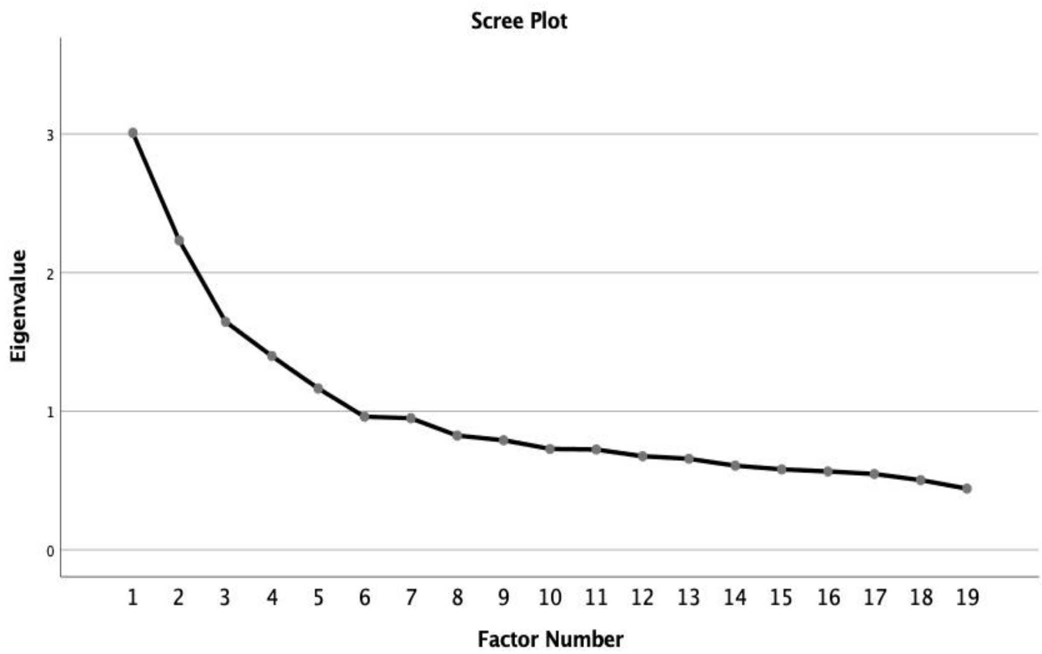


Figure 7-2 Scree plot for the e-BMQ-G

Table 7-11 Eigenvalues and explained variances of the five-factor e-BMQ-G structure

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings [a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	3.009	15.835	15.835	2.347	12.354	12.354	1.701
2	2.232	11.749	27.584	1.562	8.222	20.576	1.445
3	1.646	8.662	36.246	.990	5.211	25.787	1.069
4	1.398	7.358	43.604	.868	4.568	30.355	1.542
5	1.164	6.127	49.730	.500	2.630	32.985	1.584
6	.960	5.055	54.785				
7	.949	4.997	59.781				
8	.824	4.336	64.118				
9	.791	4.162	68.280				
10	.728	3.830	72.109				
11	.723	3.807	75.917				
12	.675	3.553	79.470				
13	.657	3.456	82.926				
14	.607	3.196	86.123				
15	.581	3.056	89.179				
16	.565	2.975	92.154				
17	.547	2.879	95.033				
18	.503	2.645	97.679				
19	.441	2.321	100.000				

Extraction Method: Principal Component Analysis.
a: When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

The factor loadings of items belonged to beliefs about TCM were -0.454 (GAD7), -0.455 (GAD8) and -0.859 (GAD9). The trust in medicine comprised three candidate items: GAD4 (factor loading 0.603), GAD11 (0.401) and GAD12 (0.546). Item GAD4 assessed participants' overall trust in medicines' treatment effect. Items GAD11 and GAD12 assessed personal tendency of trust between particular medicines. Item BG12 showed an acceptable factor loading (0.479) to Trust but was retained in Benefit construct for the following CFA.

The Pattern Matrix (***Table 7-12***) shows the majority of the original BMQ-items followed the initial structure, except Item BG2 and BG4. Item BG5, BG6 and BG8 still loaded onto the factors initially belonged to, but with very low factor loadings (<0.4). The Item BG3 showed identical factor loadings (±0.35) onto Harm and Overuse constructs and was retained in the following CFA. The candidate item GAD5 also loaded on the Harm with acceptable factor loading (0.551).

Table 7-12 Pattern matrix of factor loading for e-BMQ-G

	Harm	Trust	Benefit	TCM	Overuse
BG4 Natural remedies are safer than medicines.	.595				
GAD5 Medicines treat symptoms, but do not cure diseases.	.551				
BG6 Most medicines are poisons.	.359				
BG5 Medicines do more harm than good.	.345				
GAD4 If I have a disease, I should take medicine.		.603			
GAD12 I trust medicines prescribed by only hospital doctors.		.546			
BG12 Medicines help many people to live longer.		.479			
GAD11 Expensive medicines are better than cheap ones.		.401			
BG11 In most cases the benefits of medicines outweigh the risks.			.617		
BG10 In the future, medicines will be developed to cure most diseases.			.553		
BG9 Medicines help many people to live better lives.			.402		
GAD9 The combination of western medicines and TCM causes some unexpected side effects.				-.859	
GAD8 Patients only use TCM when western medicines are ineffective.				-.455	
GAD7 The combination of western medicines and TCM weakens the effectiveness.				-.454	
BG1 Doctors use too many medicines.					-.554
BG2 People who take medicines should stop their treatment for a while every now and again.					-.548
BG7 Doctors place too much trust on medicines.					-.412
BG3 Most medicines are addictive.	.349				-.352
BG8 If doctors had more time with patients they would prescribe fewer medicines.					-.325

Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization. Rotation converged in 11 iterations. Factor loadings >0.3 are reported

7.3.2. Confirmatory factor analysis

Figure 7-3 and ***Figure 7-4*** showed that the majority of e-BMQ items loaded onto the latent variables they belonged to with acceptable factor loadings (>.50), except for Item BG7(.38), BG10 (.29), BG11 (.32) and BG12 (.38).

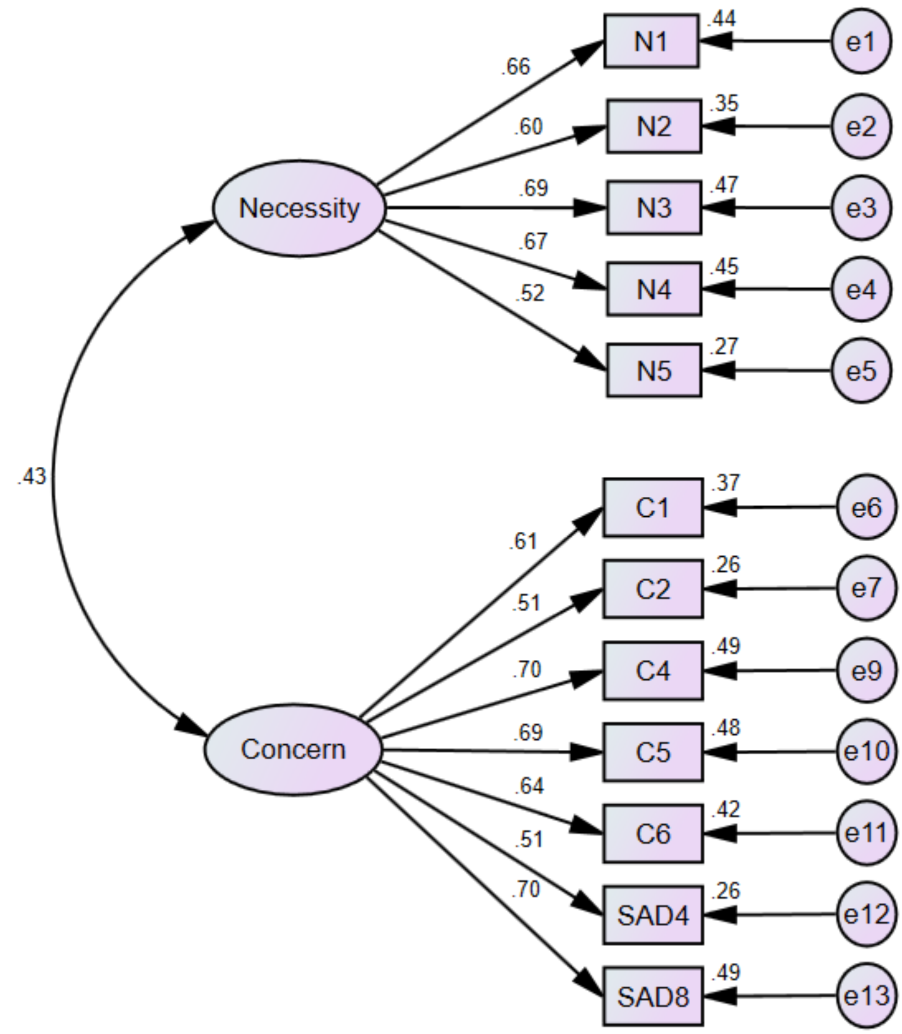


Figure 7-3 Standard factor loadings and residuals of items in e-BMQ-S

The ellipses denote the latent variables. The abbreviations in rectangles are item NO. The circles denote the residuals of indicators (items). The numbers and two-way arrows linking ellipses present the correlations between latent variables. The numbers over the one-way arrows pointing from the ellipses to the rectangles are factor loadings values of items. The numbers over the one-way arrows pointing from the circles to the rectangles are values of residuals.

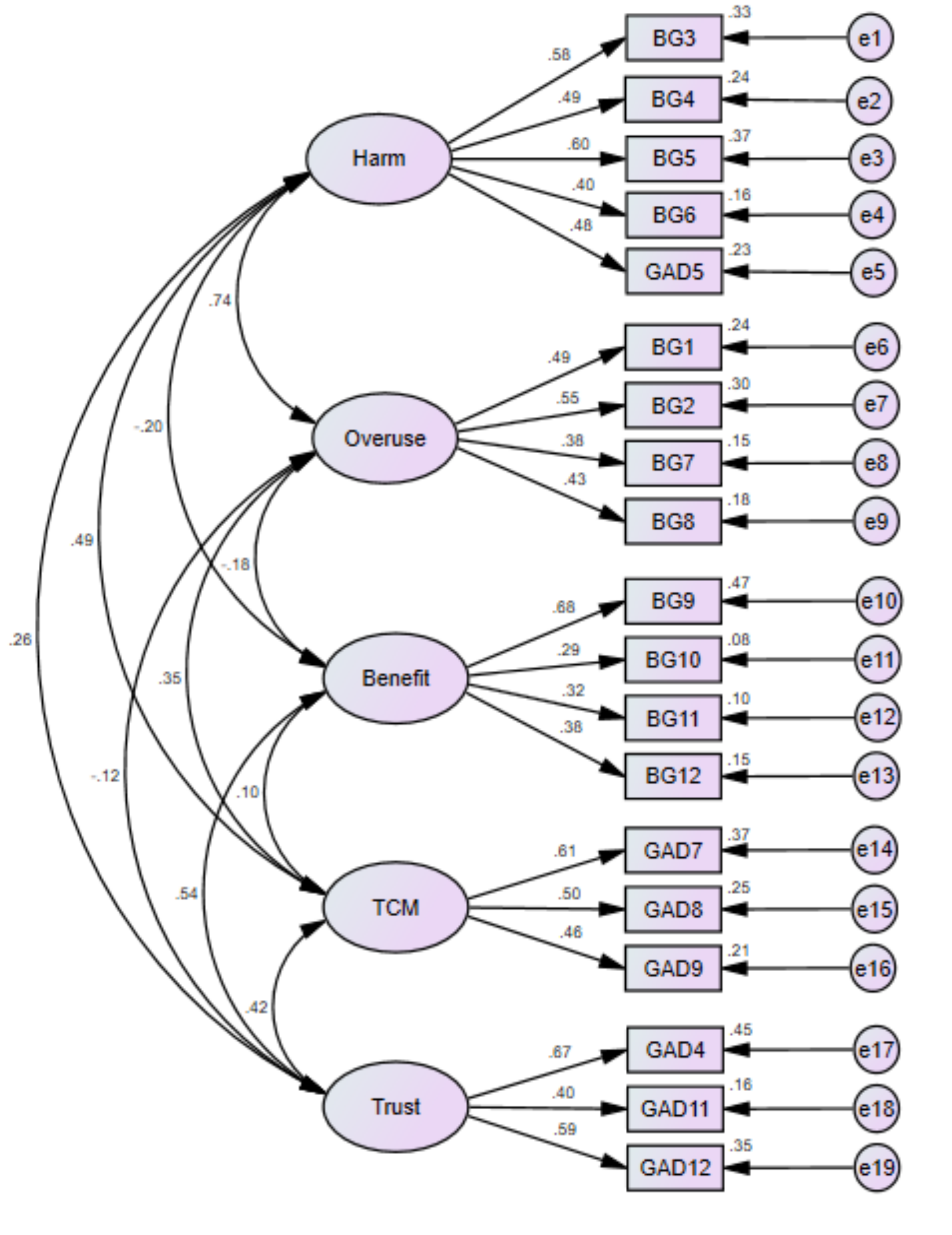


Figure 7-4 Standard factor loadings and residuals of items in e-BMQ-G

The ellipses denote the latent variables. The abbreviations in rectangles are item NO. The circles denote the residuals of indicators (items). The numbers and two-way arrows linking ellipses present the correlations between latent variables. The numbers over the one-way arrows pointing from the ellipses to the rectangles are factor loadings values of items. The numbers over the one-way arrows pointing from the circles to the rectangles are values of residuals.

Table 7-13 reports the good-of-fit indexes of the original BMQ and the e-BMQ. Overall, the fitness of factor structures in general and specific subscales both slightly improved after modification. The χ^2/df and RMSEA of the general subscale decreased from 3.43 to 3.13 and from .061 to .057, respectively. Likewise, the χ^2/df and RMSEA of the specific subscale decreased from 3.18 to 2.62 and from .076 to .065, respectively. However, different from e-BMQ-G where I added new constructs, the models of BMQ-S and e-BMQ-S are similar. Both maintained the two-factor structure. The χ^2-difference between the original BMQ-S and e-BMQ-S was not statistically significant ($\Delta\chi^2(\Delta df) = 2.07\ (10)$, $P>.05$) (see ***Table 7-13***).

Table 7-13 Goodness-of-fit of factor structures in BMQ and e-BMQ

Model (target value)	χ^2/df (<3.0)	RMSEA (<.08)	$\Delta\chi^2(\Delta df)$
BMQ-S	136.69/43=3.18	**.076**	2.07 (10), p>.05
e-BMQ-S	**138.76/53=2.62**	**.065**	
BMQ-G	175.12/51=3.43	**.061**	269.48 (91), **p<.001**
e-BMQ-G	444.60/142=3.13	**.057**	

Indexes reaching the recommended cut-off are presented in bold.

7.3.3. Internal consistency reliability

Internal consistency reliabilities of the e-BMQ subscales were presented in ***Table 7-14***. Overall, the internal consistency of e-BMQ-S was higher than those in e-BMQ-G. The Cronbach's α of Necessity and Concern constructs were both higher than 0.70, reflecting an adequate internal consistency of specific subscales (see ***Table 7-14***). However, the internal consistency of some constructs in general subscale seemed problematic. The Cronbach's α of Benefit construct was only 0.47, which did not reach the acceptable level. Likewise, the Cronbach's α of Overuse (0.52) and TCM (0.51) were just over the minimum acceptable criteria (see ***Table 7-14***). Apart from Item C3 (These medicines are a mystery to me), no item caused the internal consistency increasing after being excluded. The Cronbach's α of Concern subscale increased from 0.80 to 0.82 by removing C3, reflecting that the Item C3 is heterogeneous from other items in Concern construct. It is consistent with the results of EFA, in which Item C3 did not load onto Concern and was suggested to be removed.

Table 7-14 Internal consistency of the e-BMQ constructs

	Necessity	Concern	Harm	Overuse	Benefit	TCM	Trust
Cronbach's α if Item deleted							
N1	0.71						
N2	0.74						
N3	0.70						
N4	0.71						
N5	0.75						
C1		0.78					
C2		0.79					
C3		0.82					
C4		0.76					
C5		0.77					
C6		0.77					
SAD4		0.79					
SAD8		0.77					
BG3			0.58				
BG4			0.58				
BG5			0.57				
BG6			0.62				
GAD5			0.58				
BG1				0.40			
BG2				0.46			
BG7				0.50			
BG8				0.44			
BG9					0.33		
BG10					0.38		
BG11					0.42		
BG12					0.45		
GAD7						0.37	
GAD8						0.50	
GAD9						0.39	
GAD4							0.39
GAD11							0.56
GAD12							0.43
Overall Cronbach's α	0.76	0.80	0.64	0.52	0.47	0.51	0.57

The increasing Cronbach α caused by item deleting is highlighted in red colour.

7.3.4. Comparison of predictive effects of constructs in BMQ and e-BMQ on low medication adherence

Since no modification was conducted in the constructs of Necessity and Benefit, the predictive effects of the above two factors on low adherence were not reported in this section. ***Table 7-15*** shows the ORs of low medication adherence in the participants with CHD, hypertension and T2DM, and TCM users. The Overuse became a significant risk factor of low adherence in overall samples (OR 1.38, 95% CI 1.07 to 1.79), hypertensive participants (OR 1.60, 95% CI 1.02 to 2.49) and TCM users (OR 2.49, 95% CI 1.07 to 5.77) after modification. The NCD of e-BMQ was also identified as a significant predictor of low adherence in the diabetic group (OR 0.62, 95% CI 0.42 to 0.91). However, I also noted that the correlation between Harm and low adherence became non-significant after modification (see ***Table 7-15***). Regarding the two newly added constructs, strong trust in medicine showed a negative association with low adherence in overall samples (OR 0.76, 95% CI 0.60 to 0.96) and T2DM group (OR 0.65, 95% CI 0.42 to 0.99). For patients who used TCM, the negative beliefs about TCM showed a significantly positive association with low medication adherence (OR 2.15, 95% CI 1.02 to 4.53).

Table 7-15 Comparisons of predictive effects of low-adherence between original BMQ and e-BMQ by sample groups

	OR (95% CI) in BMQ	OR (95% CI) in e-BMQ
Overall patient (N=724)		
Concern	1.10 (0.86,1.40)	1.22 (0.96,1.53)
NCD	**0.59 (0.47,0.75)**	**0.57 (0.45,0.71)**
Harm	**1.38 (1.06,1.79)**	1.08 (0.81,1.45)
Overuse	1.24 (0.93,1.66)	**1.38 (1.07,1.79)**
TCM	N/A	1.05 (0.81,1.37)
Trust	N/A	**0.76 (0.60,0.96)**
CHD patients (N=191)		
Concern	1.52 (0.93,2.49)	1.56 (0.97,2.52)
NCD	**0.57 (0.35,0.92)**	**0.57 (0.36,0.91)**
Harm	**2.01 (1.13,3.57)**	**1.96 (1.06,3.65)**
Overuse	**1.82 (1.04,3.18)**	**1.75 (1.07,2.88)**
TCM	N/A	0.99 (0.58,1.69)
Trust	N/A	1.00 (0.61,1.64)
Hypertensive patients (N=310)		
Concern	1.05 (0.72,1.55)	1.16 (0.80,1.69)
NCD	**0.53 (0.36,0.76)**	**0.52 (0.37,0.74)**
Harm	1.14 (0.69,1.88)	0.89 (0.57,1.41)
Overuse	1.10 (0.66,1.83)	**1.60 (1.02,2.49)**
TCM	N/A	1.27 (0.84,1.91)
Trust	N/A	0.72 (0.50,1.03)
T2DM patients (N=241)		
Concern	0.92 (0.62,1.37)	1.08 (0.74,1.57)
NCD	0.69 (0.47,1.02)	**0.62 (0.42,0.91)**
Harm	1.02 (0.64,1.62)	0.91 (0.54,1.53)
Overuse	1.07 (0.65,1.76)	1.04 (0.69,1.56)
TCM	N/A	0.86 (0.54,1.37)
Trust	N/A	**0.65 (0.42,0.99)**
TCM users (N=80)		
Concern	1.57 (0.76,3.24)	1.80 (0.87,3.76)
NCD	**0.35 (0.16,0.80)**	**0.27 (0.11,0.69)**
Harm	1.98 (0.93,4.21)	1.18 (0.52,2.69)
Overuse	3.09 (0.99,9.67)	**2.49 (1.07,5.77)**
TCM	N/A	**2.15 (1.02,4.53)**
Trust	N/A	1.32 (0.62,2.82)

Significant results are presented in bold.

7.4. Discussion

This study describes the preliminary validation of an e-BMQ. Belief about TCM and trust in medicines were identified as two latent variables predicting medication adherence and were incorporated into e-BMQ.

The e-BMQ-S showed an identical two-factor structure as the original BMQ-S. Item C3 (These medicines are a mystery to me) showed a far low loading (<0.3) on both Necessity and Concern constructs. It might be because the translation did not present the accurate meaning of the word ‘mystery’. Some previous Chinese BMQ studies translated the word 'mystery' as the Chinese word ‘谜’ (Cai et al., 2019a; Lu et al., 2014), which can be interpreted as ‘mystification’ or ‘riddle’ in the Chinese linguistic culture. The same issue was reported in ***Chapter 4*** and was also found in some previous western translations (Fall et al., 2014; Gatt et al., 2017; Granas et al., 2014). Some previous Chinese versions translated as ‘I don’t understand what these medicines are for’ (Zhu, 2017) or ‘I don’t understand the medicines I currently taking’ (Wu et al., 2014) and reported acceptable factor loadings. Moreover, the Cronbach's α of the Concern construct increased via removing the Item C3, indicating the item may assess different phenomena from other items do. More specifically, different from long-term effect and dependence, feeling medicines are mysterious is not a representational concern.

PCA and EFA suggested a five-factor structure of the e-BMQ-G. However, an extremely high correlation estimate (r=.96) between Harm and Overuse suggested a potential multicollinearity issue (Hair et al., 2006). Samalin’s study (2017) even suggested merging Harm and Overuse as a single factor for assessing overall negative belief about medicine. However, as our study only involved a limited number of Chinese patients with three conditions, while BMQ has been validated in numerous populations, I suggest respecting the existing structure and maintaining the Harm and Overuse as two independent parameters.

However, some modifications may be applied in the items of the above two constructs. Item BG2 (People who take medicines should stop their treatment for a while every now and again) was suggested being moving to the Overuse construct due to the high factor loading. The similar result was reported by a previous Maltese study (Gatt et al., 2017). Likewise, the Item BG4 (Natural remedies are safer than medicines), which showed a higher factor loading onto Harm than Overuse, was suggested being moved to the Harm construct. Our findings are in line with previous studies (Chapman et al., 2014; Conn et al., 2019; Komninis et al., 2013). Apart from the original items, I augmented the Harm construct with an additional item GAD5 (Medicines treat symptoms, but do not cure diseases). The similar statements were sometimes presented as ‘the pharmaceutical medicines do not clear the root of the disease’ or ‘Western medicines do not provide permanent cure’ in some previous studies (Chung et al., 2014; Harmsworth & Lewith, 2001).

Although no modification was conducted in the Benefit construct, a considerable variance of factor loadings between items of the construct was observed. Only Item BG9 (Medicines help many people to live better lives) showed medium factor loading (=.68) to the construct, while the other three items (BG10, BG11 & BG12) did not adequately load onto the construct (<.40). It suggested there might be more than one underlying construct. However, as the subscale of general-Benefit only applied in a few Chinese populations, further studies with more condition groups are needed.

For additional constructs, the trust in medicine was identified as a predictor of low adherence in overall samples and T2DM group, where patients trust medicine tended to have better self-reported adherence. It is consistent with the results in Brown’s study (Brown & Calnan, 2011).

Beliefs about TCM is another additional factor, which only provided an indication for low adherence in the TCM-user group. A recent study (Johnson et al., 2018) found that patients who received complementary medicine were more likely to refuse other conventional treatments. Some previous studies (Andersson Sundell & Jonsson, 2016; Green et al., 2013; O'Connor & White, 2009; Xiao & Luo, 2018) reported several possible motivations for pharmaceutical medicine users switching to TCM. Firstly, patients interested in trying TCM if their pharmaceutical/western medicines were of no use. Secondly, TCM is cheaper than most pharmaceutical medicines. A lower cost of TCM is attractive to long-term users, especially who have to pay the medication bills themselves. Thirdly, some people believe herbal medicines are more natural and less harmful than pharmaceutical medicines. However, it was unexpected that the Item BG4, which assessed personal feeling of natural remedies' safety, did not load onto the factor 'beliefs about TCM'. It is probably because the present participants were unfamiliar with the word 'natural remedies'. In our previous qualitative study in ***Chapter 4***, many interviewees were confused by this terminology. However, since there were only around 10% of participants taking TCM in the present study, the association between medication adherence and beliefs about TCM need to be further investigated in more studies.

7.5. Limitations

Same as ***Chapter 6***, the limitations of cross-sectional data and overestimated adherence were also applicable in the present study. Moreover, the study has additional limitations. Firstly, I noticed that the communalities of many items were quite low, indicating the variance in the variables was inadequately explained. Some underlying constructs might not be identified because they did not comprise enough items (Hogarty et al., 2005). Further research is required to confirm this. Secondly, I noted that neither additional nor original constructs in general subscale showed good internal consistency reliability, which might be due to the limited items contained in these subscales. A recent Chinese BMQ study (Wei et al., 2016) reported similar consistency reliability of BMQ-G tested in Chinese patients with diabetes, stroke and rheumatic arthritis. Thirdly, the values of Cronbach's α of the modified version fell within the ranges of the original BMQ (Horne et al., 2001; Horne et al., 1999), indicating our results are comparable and acceptable.

7.6. Conclusion

In conclusion, the present study confirmed the psychometric properties of the original BMQ structures and identified two additional latent variables specific to the Chinese population. Internal consistency reliability and goodness-of-fit of the questionnaire both slightly improved after modification. The predictive effects of Overuse on low adherence improved in overall samples, hypertension group and TCM-user group. The assessments of beliefs about TCM and trust in medication provided additional perspectives to understand how general cognitions towards medication impact medication adherence in patients with CHD, hypertension and T2DM.

Chapter 8 Overall discussion

This PhD thesis focused on the CRM of the Chinese population and their influence on medication-taking behaviour in patients with CHD, hypertension and T2DM. In the meta-analysis study (***Chapter 3***), I systematically reviewed all BMQ studies conducted in China and found the significant but weak associations between specific beliefs about medicines (Necessity and Concern) and medication adherence in Chinese patients with several conditions. In the semi-structured interview study (***Chapter 4***), I explored CRM in 28 Chinese patients with CHD, hypertension and T2DM. The data suggested that in addition to the beliefs of Necessity, Concern, Harm, Benefit and Overuse, additional cognitions might also influence WM use, such as beliefs about TCM and trusts in medicines. I checked Chinese patients' comprehension of an existing Chinese translation of BMQ and made some adaptions (***Chapter 5***). The associations between low medication adherence, CRMs and illness perceptions were investigated using an online-survey (***Chapter 6***), in which two beliefs about medicines (Necessity & Harm), three illness perceptions (Consequences, Illness concerns & Understanding) and trust in medicine showed significant correlations with low adherence. According to the data obtained by the online survey, I validated an expanded version of BMQ using factor analysis (***Chapter 7***). In this chapter, I reflected on the implications of these findings in CRM assessment and understanding how Chinese patients with CHD, hypertension and T2DM adhere to their prescriptions. Also, I discussed the strengths and limitations of this PhD work.

8.1. Implications of findings and challenges

The findings of this PhD work have some implications. Firstly, my study contributed to assessing Chinese people's CRMs and understanding how these cognitions influence medication use. The qualitative study in ***Chapter 4*** suggested that the Chinese population have a cognitive pattern basically similar to it in the western population. The medication-related beliefs in Chinese people could be divided into general and specific aspects and were also predominantly structured around positive beliefs (e.g. Necessity, Benefit) and negative beliefs (e.g. Concern, Harm, Overuse). In line with the previous finding (Horne et al., 2013), the positive beliefs might reinforce Chinese patient's intention to persist the given prescription; contrarily, the negative beliefs might weaken the intention. However, the low explained variances of BMQ factors (***Chapter 6***) suggested that the factors of the original BMQ might be not all of the underlying dimensions of CRMs influencing medication-taking. Moreover, the weaker correlation effect sizes identified in my meta-analysis (***Chapter 3***) than those in a previous meta-analysis (Horne et al., 2013) suggested that compared with the western population, the Chinese population might be less likely to improve medication adherence via solely changing their specific beliefs about medicines. Some features outside the BMQ structure need to be taken into consideration. Such as the trust in medication, which reflects the overall judgements of the perceived effect and safety of medications. Also, views about TCM appeared to influence cognitive representations and use of WM. In a previous study of 7,099 respondents, herbal remedies users showed stronger beliefs about medicines being harmful and overused than non-users (Andersson Sundell & Jonsson, 2016). For WM user, disappointing effective of WM and positive beliefs about TCM overweigh WM might lead to switching to the TCM or other types of non-adherence of the WM (Chung et al., 2014; Johnson et al., 2018; O'Connor & White, 2009).

Secondly, through assessing patients' CRMs, clinicians may be able to identify patients at high risk of low adherence. In my online survey study (***Chapter 6***), CHD patients with strong negative general beliefs (Harm and Overuse), hypertensive patients with strong positive specific beliefs (NCD), and diabetic patients with strong general-benefit beliefs toward medicines were more likely to show low adherence. Therefore, the assessment of CRMs provided theoretical guidance and statistic evidence to clinic practitioners for developing and delivering adherence promoting interventions. Of the previous studies reviewed in (***Chapter 3***), ten attempted to enhance Chinese patients' medication adherence by improving beliefs about medicines (Dong et al., 2017; Ni et al., 2018; Sun, 2017; Wang, 2015; Wu, 2013; Xie et al., 2016; Xie et al., 2018; Xu & Wu, 2018; Yuan, Yin, Liang, Liu, et al., 2018; Q. X. Zhang et al., 2018). The reported interventions included health education, counselling (e.g. motivational interview, home visit), cognitive behavioural therapy by professionals, peer support programme, and daily treatment support (e.g. telephone monitoring, message reminding). The intervention session usually lasted for 30-60 minutes, and the span of subsequent follow-up ranged between four weeks (Q. X. Zhang et al., 2018) and three years (Ni et al., 2018). Both beliefs about medicines and medication adherence in the above studies were reported to be significantly improved after interventions.

However, in another big review of 182 RCTs (Nieuwlaat et al., 2014), the effects of interventions to improve medicine adherence were conflicting and varied among studies. Only a few studies improved both medicine adherence and clinical outcomes. Molloy and O'Carroll (2017) reflected on the issues of using psychological approaches to improve medication adherence and clinical outcomes and summarised as six challenges. 1) There is a lack of a 'gold standard' measurement of adherence which performs well on all criteria. The disparities of classification criteria, delivery method and assessment span all may cause possible heterogeneity of results (Lam & Fresco, 2015; Nguyen et al., 2014). 2) Many ageing people have multimorbidity and accept polypharmacy treatment, and the adherence may vary across different medications even they treat the same disease (Inauen et al., 2017). Thus, the tested associations between determinants (e.g. illness perceptions) and adherence performance may be conflicting and difficult to interpret. 3) The existing theoretical models and conceptual frameworks suggest diverse modifiable psychological targets for intervention, but the effectiveness and feasibility of intervention link to these targets are discrepant. Therefore, some researchers attempted to link specific intervention techniques with specific constructs or mechanisms of adherence behaviour (Michie et al., 2018). 4) There is lacking a robust evidence base of adherence enhancing intervention (Nieuwlaat et al., 2014). The low-quality studies may provide biased evidence and mislead audiences. Thus, an international initiative provided a series of guidelines aiming to improve the reliability and value of published health research literature (Moher et al., 2014). 5) The improvement of the clinical outcome depends on multiple factors. For example, solely enhancing medication adherence may not be effective on BG control if diabetic patients ignore healthy diet and exercise practice (American Diabetes Association, 2017a). The future study should systematically assess the comparative effectiveness of adherence intervention and other behavioural interventions. 6) The psychological barriers/motivations for adherence seem to vary in different stages of lifespan (Dima et al., 2013; Spekhorst et al., 2016). Therefore, more theory and evidence from lifespan perspectives should be incorporated into understanding adherence to treatment (Molloy & O'Carroll, 2017).

8.2. Strengths of the PhD work

This PhD work has filled a research gap in BMQ research in China. It has some strengths.

1. The systematic review (***Chapter 3***) was the first study reviewing BMQ studies in databases in both English and Chinese language. It identified all Chinese BMQ studies predominantly published after a recent meta-analytic review in 2013 (Horne et al., 2013).
2. The meta-analysis (***Chapter 3***) was the first study investigating the correlations between Chinese patients' specific beliefs about medicines and medication adherence systematically. The sensitivity analysis confirmed that the people with low necessity beliefs or great concerns tended to report low adherence to medication.
3. The qualitative study in ***Chapter 5*** was the first study checking Chinese people's comprehension of the BMQ using a 'think-aloud' technique. Using this

technique, I found that the tested version of BMQ is a well-translated Chinese version and only needed very slight modification. For example, I revised the translation of Item C3 (These medicines are a mystery to me) as ‘These medicines are mysterious to me’ to avoid misunderstanding. I also specified the translation of ‘doctors had more time with patients’ in Item BG8 as ‘doctors had more time to get along with patients'.

4. None of the existing Chinese studies identified used an online survey to assess beliefs about medicines and medication adherence. The quantitative study in ***Chapter 6*** was the first large study investigating the associations between psychological determinants and low adherence, in which two beliefs about medicines, PSM, three illness perceptions and trust in medicines showed significant correlations with low adherence in the overall participants. The study confirmed that the online-survey method is practical in the Chinese population and has advantages of lower cost and better convenience to distribute in a large sample than the traditional survey method.
5. This study confirmed that the e-BMQ was a validated and applicable measure for Chinese population and had a broader application scope than the original BMQ. For example, the e-BMQ allowed researchers investigating how people think about TCM and combination use with WM. It is meaningful for patients who consider switching from WM to TCM or are combining both medicines.
6. In general, this PhD work took a deeper look at the medication-related beliefs in the Chinese population, especially patients with CHD, hypertension and

T2DM, and provide statistic evidence and frame of reference for future interventions enhancing medication adherence among these particular patient groups.

8.3. Limitations of the PhD work

The present PhD work also has several limitations. I have discussed the individual study limitations in the relevant chapters. In this section, I highlight the key limitations which may influence the implications of the findings.

1. Medication adherence investigated in my online survey (***Chapter 6***) and the existing studies reviewed in my meta-analysis (***Chapter 3***) was assessed using self-reported measures. This type of measure relies on accurate recall and is usually criticised as overestimating adherence (Sayner et al., 2015; Stirratt et al., 2015). According to the guidelines for best practice in adherence measurement (De Geest et al., 2018; Moher et al., 2014), multiple measures (e.g. electronic monitoring, clinician assessment and prescription refill record) were suggested to be combined in future studies to increase the accuracy of the results. Moreover, as alluded to earlier, the adherence may vary across different medications which treat the same disease. However, I only assessed the overall adherence of all given medications that could not reflect the specific adherence performance of each medication.
2. Although the present online study has the largest sample size in the existing Chinese BMQ studies so far, it only involved participants predominantly from Jiangsu Province that would have led to selection bias. As one of the most

developed areas in mainland China, residents in Jiangsu Province have a higher degree of wealth and educational attainment than people in many other areas in China. In 2018, the disposable income per capita in Jiangsu Province was ¥38,096 (about £4,170), while that in nationwide was ¥28,228 (about £3,090) (National Health and Family Planning Commission of the PRC, 2019). In 2018, Jiangsu had 1,806,277 students enrolled in regular higher education (college education or over), the fourth largest group of enrolment of higher education, accounting for 6.4% of overall enrolment in China. The proportion of higher education students in Jiangsu was 3,143 per 100,000 people, which was much higher than the nationwide level (2,658 per 100,000 people) (National Bureau of Statistics of China, 2019). In 2017, the proportion of residents who completed higher education was 17.3% in Jiangsu Province that was higher than the average level nationwide 13.9% (Jiangsu Provincial Bureau of Statistics, 2019). Ten Chinese studies involved in my previous systematic review (***Chapter 3***) investigated the associations between demographic characteristics and BMQ scores. Six of them reported significant correlations between education level and beliefs about medicines (Guo, 2017; H. B. Jin et al., 2015; Liu et al., 2015; Yen et al., 2014; Yuan & Luang, 2018; Zhang & Ying, 2016), and eight of them reported that the wealthy Chinese people were less likely to show negative beliefs about medicines (Guo, 2017; H. B. Jin et al., 2015; Lu et al., 2014; Wu et al., 2016; Yen et al., 2014; Ying & Zhang, 2015; Yuan & Luang, 2018; Zhang & Ying, 2016).

Therefore, whether my study over- or under-represented participants' demographic characteristics and CRM need to be further investigated.

3. The accessibility of online survey seemed to vary across participants from different backgrounds. This issue has been largely addressed by combing online-survey and traditional paper questionnaire. However, the usability of the online survey needs to be further improved. For example, although I have selected short versions of the questionnaire, it seemed still too long for some participants. A further simplified questionnaire may avoid visual fatigue, decrease the dropout rate and consequently dismiss the bias caused by missing data. Moreover, improving engagement may also benefit to the future intervention delivered via the online system.
4. The candidate items of e-BMQ were formed based on the statements reported in the semi-structured interview (***Chapter 4***). The low communalities of items in e-BMQ suggested that there was a lot of information not being extracted, and some underlying constructs might fail to be identified in the factorial analyses. The possible reasons causing this failure might be the items prepared for initial analysis were inappropriate, or the underlying constructs did not comprise enough items. A refined and broader range of items might have facilitated the emergence of additional dimensions.

8.4. Implications for further research

Future studies can address the following concerns:

1. The present study mainly focused on the cognitive representations and adherence

of oral medication. The future study may broaden the research scope into other treatment forms, such as surgery, inhaler and alternative medicine (e.g. acupuncture). These treatments are different from oral medication in delivery method, onset time, benefit-cost expectation and consequent cognitive pattern; thus, they are worth exploring in future studies.

2. Since both qualitative and quantitative studies in this PhD work were cross-sectional, the data only reflected the situations of participants at single timepoint. More longitudinal data are needed to describe the dynamic interactions between CRMs and medication adherence over time (Kleinbaum et al., 1982). Prospective cohort studies would also help to confirm the predictive effects of CRMs on non-adherence. Based on these findings, an intervention study aiming to improve medication adherence will be the next step of my study in the future.
3. Although items in BMQ-S, Harm and Overuse subscales were not presented in 'conceptual order'. However, the Benefit and two additional subscales of my e-BMQ have not considered potential ordering effects on participants' response (Sheeran & Orbell, 1996). The future study should optimise the presenting order of items to avoid hinting participants that the questionnaire is assessing particular views.
4. Due to the workload, some data have not been analysed. For example, some qualitative data obtained in the semi-structured interview described the influential factors of adherence. Also, the association between the multiple prescriptions and

medication adherence has not been investigated, either. These data are worth being further analysed in the future.

8.5. Overall conclusion

In conclusion, this PhD work filled several research gaps identified s. It confirmed that the e-BMQ appeared to be a reliable tool in assessing beliefs about medicines and medication adherence in the Chinese population. The assessments could be conducted via an online survey. The qualitative study and the e-BMQ drew attention to the cognitive differences between western and Chinese populations, such as trusts in medicines and beliefs about TCM. Taking into account the associations between CRM and reported adherence could help clinicians to understand patients' cognitive process and identify patients who are at a high risk of low-adherence.

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Appendices

Appendix A. Search strategies and searching results

Appendix A.1 Search strategy and searching results in PubMed

No.	Search term	Result of single search term	Result of combined search terms
#1	"China" [Mesh]	163,095	
#2	"Taiwan" [Mesh]	33,702	170,674
#3	China [Text Word]	209,324	220,970
#4	Chinese [Text Word]	213,762	350,269
#5	Taiwan [Text Word]	46,923	359,916
#6	Taiwanese [Text Word]	9,415	361,591
#7	Hong Kong [Text Word]	21,642	365,694
#8	Macao [Text Word]	283	365,751
#9	Macau [Text Word]	324	365,772
#10	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9)		413,279
#11	"medicine" [Mesh]	1,060,607	
#12	medicine$ [Text Word]	789,887	1,412,351
#13	medication$ [Text Word]	222,203	1,598,281
#14	drug$ [Text Word]	5,353,008	6,428,996
#15	(#11 OR #12 OR #13 OR #14)		6,767,845
#16	"perception" [Mesh]	404,614	
#17	belief$ [Text Word]	30,394	409,040
#18	perception$ [Text Word]	332,401	494,179
#19	(#16 OR #17 OR #18)		527,809
#20	(#15 AND #19)		75,912
#21	"beliefs about medicine" [Text Word]	65	
#22	BMQ [Text Word]	200	188
#23	(#20 OR #21 OR #22)		76,075
#24	"Surveys and Questionnaires" [Mesh]	939,504	
#25	questionnaire$ [Text Word]	364,457	1,004,749
#26	scale$ [Text Word]	640,779	1,461,580
#27	(#24 OR #25 OR #26)		1,621,859
#28	(#10 AND #23 AND #27)		306

Appendix A.2 Search strategy and searching results in EMBASE and PsycINFO

No.	Search term	EMBASE	PsycINFO
#1	exp China/	193,219	N/A
#2	exp Chinese/	53,194	N/A
#3	exp Han Chinese	4,508	
	exp Chinese Cultural Groups/		6,075
#4	exp Taiwan/	43,161	N/A
#5	exp Taiwanese/	2,437	N/A
#6	exp Hong Kong/	20,310	N/A
#7	exp Macao/	356	N/A
#8	China.sh,mp.	265,575	26,867
#9	Chinese.sh,mp.	262,619	47,318
#10	Taiwan.sh,mp.	58,611	10,949
#11	Taiwanese.sh,mp.	12,105	4,702
#12	Hong Kong.sh,mp.	27,369	10,592
#13	Macau.sh,mp.	288	252
#14	Macao.sh,mp.	543	172
#15	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 #12 OR #13 OR #14	529,026	73,472
#16	exp medicine/	2,868,523	274,420
#17	exp medication/	2,372,064	136,949
#18	exp drug/	2,644,073	
	exp drugs/		297,022
#19	medicine$.sh,mp.	1,113,530	66,032
#20	medication$.sh,mp.	483,869	84,314
#21	drug$.sh,mp.	9,712,890	370,435
#22	#16 OR #17 OR #18 #19 OR #20 OR #21	12,514,847	773,399
#23	belief$.sh,mp.	95,069	132,595
#24	exp perception/	299,942	321,104
#25	perception$.sh,mp.	370,595	450,065
#26	#23 OR #24 OR #25	581,698	647,046
#27	#22 AND #26	156,584	56,545
#28	BMQ.sh,mp.	482	67
#29	#27 OR #28	156,644	56,552
#30	exp questionnaire/	626,004	17,859
#31	questionnaire$.sh,mp.	839,832	378,710
#32	scale$.sh,mp.	1,095,661	633,228
#33	#30 OR #31 OR #32	1,747,647	845,670
#34	#15 AND #29 AND #33	1,124	340

Appendix A.3 Search term in Chinese databases

CNKI: (((TI=‘药物’+‘药品’+‘服药’+‘用药’) OR (AB=‘药物’+‘药品’+‘服药’+‘用药’)) AND (TI=‘信念’ OR AB=‘信念’) AND ((TI=‘量表’+‘问卷’) OR (AB=‘量表’+‘问卷’))) OR (FT= 'BMQ'+'belief about medicine'+'beliefs about medicine'+'belief about medicines'+'beliefs about medicines')

WANFANG: ((题名或关键词:("用药"+"药品"+"药物"+"服药") OR 摘要:("用药"+"药品"+"药物"+"服药")) AND (题名或关键词:("量表"+"问卷") OR 摘要:("量表"+"问卷")) AND ((题名或关键词:"信念") OR 摘要:("信念"))) OR 全部:("BMQ"+"belief about medicine"+"beliefs about medicine"+"belief about medicines"+"beliefs about medicines")

Appendix A.4 Search strategy and the number of results in ZHIWANG and WANFANG

No	Search term	CNKI	WANFANG
#1	TI/AB =‘药物’	851,943	1,128,762
#2	TI/AB =‘药品’	90,574	183,182
#3	TI/AB =‘服药’	51,397	61,188
#4	TI/AB =‘用药’	346,652	413,487
#5	#1 OR #2 OR #3 OR #4	1,138,804	1,545,959
#6	TI/AB =‘信念’	5,264	101,716
#7	TI/AB =‘问卷’	194,332	639,969
#8	TI/AB =‘量表’	180,193	283,713
#9	#7 OR #8	337,079	848,577
#10	#5 AND #6 AND #9	381	370
#11	FT=‘BMQ’	184	179
#12	FT=‘belief about medicine’	1	4
#13	FT=‘beliefs about medicine’	15	24
#14	FT=‘belief about medicines’	1	8
#15	FT=‘beliefs about medicines’	76	155
#16	#10 OR #11 OR #12 OR #13 OR #14 OR #15	555	646

Appendix B. Quality assessment tool

<table>
<tr><td colspan="3">Sampling & Participants (/5)</td></tr>
<tr><td colspan="3">Questions 1. Were the characteristics of the participants included in the study clearly described? (Inclusion and/or exclusion criteria should be listed, and answered the questions of who, where, and when)</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Questions 2. Were the characteristics of participants with missing, incomplete, and/or invalid data been described? (This should be answered yes where the rate of exclusions based on missing or poor data was less than 20%. This should be answered no, where a study did not describe or report the number of participants excluded based on missing or poor data)</td></tr>
<tr><td>Yes (1)</td><td>No</td><td>Unable to determine</td></tr>
<tr><td colspan="3">Questions 3. How did authors sampling?</td></tr>
<tr><td>Probability sampling (e.g. random sampling) (2)</td><td>Non-probability sampling (e.g. convenience sampling) (1)</td><td>No description of the sampling</td></tr>
<tr><td colspan="3">Questions 4. Was a sample size justification, or variance and effect estimates provided?</td></tr>
<tr><td>Study had a clear calculation/explanation, and a satisfied sample size (1)</td><td>The authors gave the estimates of variance and/or estimates of effect size (1)</td><td>No sample size calculation/explanation, or did not recruit enough participants</td></tr>
<tr><td colspan="3">Beliefs about medicines (/6)</td></tr>
<tr><td colspan="3">Questions 5. Were the beliefs about medicines clearly defined, and implemented consistently across all participants?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Questions 6. Did author cite the original reference of the BMQ?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Questions 7. Did authors translate the BMQ following a standard translation method (e.g. Brislin's translation model)? (If study cited the translated BMQ the question should be answered as yes)</td></tr>
<tr><td>Yes (1)</td><td>No</td><td>Unable to determine</td></tr>
<tr><td colspan="3">Questions 8. Did authors report the reliability/validity coefficient of the version they used?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Questions 9. Were the methods of data reduction for BMQ clearly described?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Questions 10. Did authors clearly report the BMQ scores for overall and each subgroup?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Medication adherence (/4)</td></tr>
<tr><td colspan="3">Questions 11. Were the medication/treatment adherence defined in detail, and implemented consistently across all participants?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Questions 12. Did authors use an objective measurement?</td></tr>
<tr><td>Objective method (e.g. pill count or prescription-refill records) (2)</td><td>Subjective tools (e.g. self-reported scale) (1)</td><td>No description of measure tools, or used inaccurate method</td></tr>
<tr><td colspan="3">Questions 13. Did authors clearly report the adherence results for overall and each subgroup?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Statistical analysis (/5)</td></tr>
<tr><td colspan="3">Questions 14. How was the statistical power of the study?</td></tr>
<tr><td>≥ 80% (1)</td><td><80%</td><td>No discussion of power calculation</td></tr>
</table>

<table>
<tr><td colspan="3">Questions 15. Were principal confounders clearly measured and described? (Distributions of sex, age et al should be presented)</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Questions 16. Were principal confounders adjusted statistically for their impact on the relationship between independent variable(s) and outcome(s)?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Questions 17. Did authors select accurate statistical methods to solve the research questions?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
<tr><td colspan="3">Questions 18. Have limits of agreement and/or confidence intervals been reported for the main analyses?</td></tr>
<tr><td>Yes (1)</td><td>No</td><td></td></tr>
</table>

Appendix C. Quality assessment results

Study ID	Sampling section score (%)	BMQ section score (%)	Adherence section score (%)	Statistics section score (%)	Overall score (%)	Overall quality Evaluation
BKF Wan et al. (2017)	3/5 (60.00%)	5/6 (83.3%)	3/4 (75.0%)	4/5 (80.0%)	15/20 (75.0%)	Moderate
C Rui (2017)	4/5 (80.0%)	6/6 (100.0%)	3/4 (75.0%)	4/5 (80.0%)	17/20 (85.0%)	Good
CF Yen et al. (2014)	2/5 (40.00%)	4/6 (66.7%)	N/A	4/5 (80.0%)	10/16 (62.5%)	Moderate
CM Geng et al. (2018)	3/5 (60.0%)	2/6 (33.3%)	2/4 (50.0%)	3/5 (60.0%)	10/20 (50.0%)	Poor
CY Du et al. (2017)	3/5 (60.0%)	6/6 (100.0%)	N/A	3/5 (60.0%)	12/16 (75.0%)	Moderate
DJ Ying et al. (2015)	2/5 (40.00%)	5/6 (83.3%)	N/A	3/5 (60.0%)	10/16 (62.5%)	Moderate
F Xu et al. (2018)	2/5 (40.0%)	2/6 (33.3%)	2/4 (50.0%)	2/5 (40.0%)	8/20 (40.0%)	Poor
H Jiang et al. (2017)	1/5 (20.00%)	4/6 (66.7%)	3/4 (75.0%)	4/5 (80.0%)	12/20 (60.0%)	Moderate
H Sun (2017)	4/5 (80.0%)	5/6 (83.3%)	3/4 (75.0%)	4/5 (80.0%)	16/20 (80.0%)	Good
HB Jin et al. (2015)	2/5 (40.00%)	6/6 (100.0%)	N/A	3/5 (60.0%)	11/16 (68.8%)	Moderate
HD Tian et al. (2018)	3/5 (60.0%)	4/6 (66.7%)	3/4 (75.0%)	4/5 (80.0%)	14/20 (70.0%)	Moderate
HF Xie et al. (2016)	3/5 (60.0%)	4/6 (66.7%)	2/4 (50.0%)	3/5 (60.0%)	12/20 (60.0%)	Moderate
HF Xie et al. (2018)	3/5 (60.0%)	4/6 (66.7%)	2/4 (50.0%)	2/5 (40.0%)	11/20 (55.0%)	Poor
HM Liu et al. (2016)	2/5 (40.00%)	2/6 (33.3%)	4/4 (100.0%)	3/5 (60.0%)	11/20 (55.0%)	Poor
J Chen (2015)	2/5 (40.00%)	5/6 (83.3%)	N/A	3/5 (60.0%)	10/16 (62.5%)	Moderate
J Zhang et al. (2016)	3/5 (60.00%)	5/6 (83.3%)	N/A	4/5 (80.0%)	12/16 (75.0%)	Moderate
JL Shao et al. (2015)	3/5 (60.00%)	6/6 (100.0%)	2/4 (50.0%)	3/5 (60.0%)	14/20 (70.0%)	Moderate
JW Wu et al. (2016)	2/5 (40.0%)	5/6 (83.3%)	N/A	4/5 (80.0%)	11/16 (68.8%)	Moderate
L Dong et al. (2016)	2/5 (40.0%)	4/6 (66.7%)	1/4 (25.0%)	4/5 (80.0%)	11/20 (55.0%)	Poor
L Wang (2015)	3/5 (60.00%)	3/6 (50.0%)	3/4 (75.0%)	4/5 (80.0%)	13/20 (65.0%)	Moderate
L Wei et al. (2017)	4/5 (80.0%)	6/6 (100.0%)	3/4 (75.0%)	4/5 (80.0%)	17/20 (85.0%)	Good
L Yuan et al. (2018)	3/5 (60.0%)	5/6 (83.3%)	N/A	4/5 (80.0%)	12/16 (75.0%)	Moderate
L Zhang et al. (2018)	2/5 (40.0%)	5/6 (83.3%)	N/A	4/5 (80.0%)	11/16 (68.8%)	Moderate
LQ Ning et al. (2016)	2/5 (40.00%)	2/6 (33.3%)	2/4 (50.0%)	4/5 (80.0%)	10/20 (50.0%)	Poor
M Yuan et al. (2018a)	4/5 (80.0%)	6/6 (100.0%)	3/4 (75.0%)	3/5 (60.0%)	16/20 (80.0%)	Good
M Yuan et al. (2018b)	2/5 (40.0%)	6/6 (100.0%)	3/4 (75.0%)	2/5 (40.0%)	13/20 (65.0%)	Moderate
MB Wu (2013)	4/5 (80.00%)	4/6 (66.7%)	3/4 (75.0%)	4/5 (80.0%)	15/20 (75.0%)	Moderate
MB Wu et al. (2014)	3/5 (60.00%)	5/6 (83.3%)	N/A	3/5 (60.0%)	11/16 (68.8%)	Moderate
Q Guo et al. (2017)	3/5 (60.0%)	5/6 (83.3%)	N/A	3/5 (60.0%)	11/16 (68.8%)	Moderate

Study ID	Sampling section score (%)	BMQ section score (%)	Adherence section score (%)	Statistics section score (%)	Overall score (%)	Overall quality Evaluation
QQ Cai et al. (2019)	2/5 (40.0%)	6/6 (100.0%)	3/4 (75.0%)	3/5 (60.0%)	14/20 (70.0%)	Moderate
QX Zhang et al. (2018)	3/5 (60.0%)	5/6 (83.3%)	2/4 (50.0%)	1/5 (20.0%)	11/20 (55.0%)	Poor
S Teng (2016)	4/5 (80.00%)	6/6 (100.0%)	3/4 (75.0%)	4/5 (80.0%)	17/20 (85.0%)	Good
S Teng et al. (2015)	3/5 (60.00%)	6/6 (100.0%)	2/4 (50.0%)	3/5 (60.0%)	14/20 (70.0%)	Moderate
SH Liu et al. (2018)	3/5 (60.0%)	3/6 (50.0%)	2/4 (50.0%)	4/5 (80.0%)	12/20 (60.0%)	Moderate
SJ Zhao et al. (2017)	4/5 (80.00%)	5/6 (83.3%)	3/4 (75.0%)	5/5 (100.0%)	17/20 (85.0%)	Good
SL Guo (2014)	4/5 (80.00%)	6/6 (100.0%)	2/4 (50.0%)	5/5 (100.0%)	17/20 (85.0%)	Good
SY Liu et al. (2017)	2/5 (40.0%)	4/6 (66.7%)	3/4 (75.0%)	4/5 (80.0%)	13/20 (65.0%)	Moderate
SY Yang & ZQ Lu (2016)	4/5 (80.00%)	4/6 (66.7%)	2/4 (50.0%)	3/5 (60.0%)	13/20 (65.0%)	Moderate
SY Yang & ZQ Lu (2018)	4/5 (80.0%)	4/6 (66.7%)	3/4 (75.0%)	4/5 (80.0%)	15/20 (75.0%)	Moderate
TT Chen et al. (2015)	3/5 (60.0%)	3/6 (50.0%)	N/A	4/5 (80.0%)	10/16 (62.5%)	Moderate
W Yan et al. (2015)	1/5 (20.00%)	3/6 (50.0%)	3/4 (75.0%)	3/5 (60.0%)	10/20 (50.0%)	Poor
WY Ni et al. (2018)	3/5 (60.0%)	1/6 (16.7%)	2/4 (50.0%)	1/5 (20.0%)	7/20 (35.0%)	Poor
X Liu et al. (2012)	3/5 (60.00%)	3/6 (50.0%)	2/4 (50.0%)	2/5 (40.0%)	10/20 (50.0%)	Poor
X Wang (2018)	3/5 (60.0%)	5/6 (83.3%)	N/A	4/5 (80.0%)	12/16 (75.0%)	Moderate
XX Qiao et al. (2017)	3/5 (60.00%)	6/6 (100.0%)	3/4 (75.0%)	4/5 (80.0%)	16/20 (80.0%)	Good
XX Zhang & DJ Ying (2016)	2/5 (40.00%)	5/6 (83.3%)	N/A	4/5 (80.0%)	11/16 (68.8%)	Moderate
XY Liu et al. (2015)	2/5 (40.00%)	6/6 (100.0%)	N/A	3/5 (60.0%)	11/16 (68.8%)	Moderate
XY Yu & W Zeng (2016)	4/5 (80.00%)	6/6 (100.0%)	2/4 (50.0%)	3/5 (60.0%)	15/20 (75.0%)	Moderate
XY Zhao (2017)	4/5 (80.0%)	6/6 (100.0%)	3/4 (75.0%)	4/5 (80.0%)	17/20 (85.0%)	Good
Y Lu et al. (2014)	4/5 (80.00%)	4/6 (66.7%)	N/A	4/5 (80.0%)	12/16 (75.0%)	Moderate
Y Lu et al. (2015)	2/5 (40.00%)	5/6 (83.3%)	3/4 (75.0%)	4/5 (80.0%)	14/20 (70.0%)	Moderate
YF Wang (2013)	1/5 (20.00%)	4/6 (66.7%)	3/4 (75.0%)	4/5 (80.0%)	12/20 (60.0%)	Moderate
YJ Zhu (2017)	4/5 (80.0%)	6/6 (100.0%)	3/4 (75.0%)	4/5 (80.0%)	17/20 (85.0%)	Good
YS Zhao (2018)	4/5 (80.0%)	5/6 (83.3%)	3/4 (75.0%)	3/5 (60.0%)	15/20 (75.0%)	Moderate
YY Dong (2018)	4/5 (80.0%)	3/6 (50.0%)	3/4 (75.0%)	4/5 (80.0%)	14/20 (70.0%)	Moderate
YY Yao (2018)	4/5 (80.0%)	5/6 (83.3%)	3/4 (75.0%)	4/5 (80.0%)	16/20 (80.0%)	Good
ZX Si (2013)	3/5 (60.00%)	6/6 (100.0%)	3/4 (75.0%)	4/5 (80.0%)	16/20 (80.0%)	Good
ZX Si et al. (2013)	3/5 (60.00%)	5/6 (83.3%)	N/A	3/5 (60.0%)	11/16 (68.8%)	Moderate

Appendix D. Ethics approval of qualitative study

UCL RESEARCH ETHICS COMMITTEE
ACADEMIC SERVICES

9 July 2015

Dr Li Wei
School of Pharmacy UCL

Dear Dr Wei

Notification of Ethical Approval
Project ID: 6851/001: A qualitative study of beliefs about medicines and barriers to medication adherence in Chinese patients with chronic diseases

I am pleased to confirm in my capacity as Chair of the UCL Research Ethics Committee (REC) that your study has been approved by the REC for the duration of the project, until July 2016, on condition that local approval is obtained from the Jiangsu Province of People's Republic of China Teaching Hospital Ethics Committee.

Approval is also subject to the following conditions:

1. You must seek Chair's approval for proposed amendments to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form':

2. It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. Both non-serious and serious adverse events must be reported.

Reporting Non-Serious Adverse Events

For non-serious adverse events you will need to inform Helen Dougal, Ethics Committee Administrator (ethics@ucl.ac.uk), within ten days of an adverse incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair or Vice-Chair of the Ethics Committee will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

<u>Reporting Serious Adverse Events</u>

The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. The adverse event will be considered at the next Committee meeting and a decision will be made on the need to change the information leaflet and/or study protocol.

On completion of the research you must submit a brief report (a maximum of two sides of A4) of your findings/concluding comments to the Committee, which includes in particular issues relating to the ethical implications of the research.
With best wishes for the research.

Yours sincerely

Professor John Foreman
Chair of the UCL Research Ethics Committee

Cc: Dr Sarah Chapman & Bo Nie, Applicants
Dr Brian Pearce

Appendix E. Interview schedule

Interview length: 40-60 minutes

Interviewer: Bo Nie

Introduction:

Thank you for being willing to take part in an interview of this research. My name is Bo Nie. I am a PhD student in UCL School of Pharmacy and am the interviewer today. Before we start, if you wish, I can restate that we are an independent third party that does not have any interest relationship with hospital. Your participation would have no bearing on your consultation and would not bring any distress or harm to you. Your participation is voluntary, and you have the right to withdraw at any stage with no penalty. However, the remuneration will only be paid off after finishing whole interview. If you quit from the study, the data collected from you will be destroyed and not be included in our report. Additionally, I would like to ask your permission to video/audio record this interview to facilitate the analysis of the data. So please speak as clearly as possible.

Likewise, I need to confirm that you have read the information sheet carefully, filled out the information form and signed consent form already. If you do not have any further question, I would like briefly to introduce you to the procedure of this interview. The interview has two tasks.

In the first part, we will do an oral interview, which aims to know your beliefs to medication taking. Then, we will have a brief break.

After that, I will give you a translated questionnaire. We want to check the understanding of each item. Therefore, I want you to tell me everything that you are thinking as you read each question and decide how to answer it. I would like you to talk constantly, instead of planning what you say or try to explain the reasons. If you keep silent for more than 10 second, I will remind you to keep talking. Before formal task, you will have a warm-up practice to get familiar with the procedure. Any questions will be dealt with at this time. I may also ask you to provide feedback about questionnaire. For example, ‘Is there any item that you cannot understand or make you confused?’, ‘What do you think about the questionnaire? Could you give some comments on it?’ No right or wrong answers to this questionnaire, we are only interested in your personal attitude.

Now, let us start the interview. (The questions will be adapted to be appropriate to each individual participant).

Topics	Questions & probes
1. Current condition	I saw on your information form that you have__________ disease. How is your condition now? Probe What do you think about your daily life after diagnosed as this disease?
2. Perceptions about current medication	What do you think about the current medicine that you are taking? Probe How is the effect of the medicines? What is your attitude to the long-term medicine treatment? What is your felling when you taking the medicine? Do you appear any outcome after taking medicine, including psychological distress and physical symptom?
3. Medication-taking	How do you take your medications? Probe How long have you taken the current medicine? How many kinds of medication you are taking now? How often do you take them?
4. Medication adherence and barriers	Do you have any problems taking your medications and, if so, what are they? Probe What is the most thing you may concern when you taking the medicine? Is there any factor might make it difficult for you to take your medicine in correct doses on time? How do you cope with these problems? Is there any factor help you to take your medicine? I saw on your information form that you are using ______insurance. How heave of the financial burden caused by treatment to you?

5. Social interaction	How is your relationship with others, including peers, family, and health care providers? Probe What is your family's attitude to the treatment? What is your felling when you socializing with others? Would you mind talking about your condition with others? Would you mind taking the medication in front of others? How do you communicate with doctors? What do you think your knowledge to diseases? What do you think about the communication between patients and doctors?
6. Beliefs about TCM	What do you think about the traditional medicine? Probe Do you receive any Chinese medicine therapy? What do you think the difference between traditional medicine and western medicine? Do you have the preference to these two medicines? What is the reason?
Closing	We have discussed about what stops you from taking your medication. Are there any other factors that not covered in this interview?

Appendix F. Ethics approval of online survey

UCL RESEARCH ETHICS COMMITTEE
ACADEMIC SERVICES

30th January 2017

Dr Li Wei
School of Pharmacy UCL

Dear Dr Wei

Notification of Ethical Approval
Re: Ethics Application 6851/002: Beliefs about medicines and medication adherence. An online survey study of Chinese patients with chronic conditions

I am pleased to confirm in my capacity as interim Chair of the UCL Research Ethics Committee that I have ethically approved your study until 30th January 2018.

Approval is also subject to the following conditions:

Notification of Amendments to the Research
You must seek Chair's approval for proposed amendments (to include extensions to the duration of the project) to the research for which this approval has been given. Ethical approval is specific to this project and must not be treated as applicable to research of a similar nature. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing the 'Amendment Approval Request Form': http://ethics.grad.ucl.ac.uk/responsibilities.php

Adverse Event Reporting – Serious and Non-Serious
It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator (ethics@ucl.ac.uk) immediately the incident occurs. Where the adverse incident is unexpected and serious, the Chair or Vice-Chair will decide whether the study should be terminated pending the opinion of an independent expert. For non-serious adverse events the Chair or Vice-Chair of the Ethics Committee should again be notified via the Ethics Committee Administrator within ten days of the incident occurring and provide a full written report that should include any amendments to the participant information sheet and

study protocol. The Chair or Vice-Chair will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Final Report

At the end of the data collection element of your research we ask that you submit a very brief report (1-2 paragraphs will suffice) which includes in particular issues relating to the ethical implications of the research i.e. issues obtaining consent, participants withdrawing from the research, confidentiality, protection of participants from physical and mental harm etc.

Yours sincerely

Professor Raymond MacAllister
Interim Chair, UCL Research Ethics Committee

Cc: Bo Nie & Dr Sarah Chapman

Appendix G. Experience certificate for student volunteers

UNIVERSITY COLLEGE LONDON
SCHOOL OF PHARMACY
TAVISTOCK SQUARE

UCL

Experience Certificate

This is to certify that Miss/Mr _____________has been working with us as a data-collecting volunteer in the programme: ***Beliefs about Medicines and Medication Adherence: An Online Survey Study of Chinese Patients with Chronic Conditions*** from _____to _____. She/he is very sincere, hardworking and keen to learn further.

Primary Investigator Dr. Li Wei

Signature: ___________________

Date: ____________________

Department of Practice & Policy,
UCL School of Pharmacy,
XXXXXXXX
London XXX XXX
Telephone: XXXXX
Email: XXXXXX

Appendix H. QR code of online survey

Appendix I. Information Sheet for Study (Chinese)

SCHOOL OF PHARMACY

伦敦大学学院(UCL)药学院

此研究已获得伦敦大学学院(UCL)研究伦理委员会审批

审批编号： 6851/002

研究发起单位: 伦敦大学学院(UCL)

关于中国慢性病患者药物信念及药物依从行为的调查

(博士学位课题)

研究团队：韦丽 博士，莎拉·查普曼 博士，聂博 硕士
研究主管: 韦丽 博士
研究团队联系人: 聂博
博士研究生: 聂博

地址:伦敦大学学院药学院 行为医学研究中心
伦敦 XXXXXXXX
邮编：XXX XXX
联系电话：XXXXXX
电子邮箱：XXXXXXX

尊敬的参试者：

您好！十分感谢您参与由英国伦敦大学学院 (UCL)药学院聂博同学实施，由韦丽博士及莎拉·查普曼博士共同指导的关于药物服用情况的调查。本研究旨在调查中国人群对药物治疗的态度，以及医嘱的执行情况。这将有助于我们了解和帮助中国的慢性病患者更好地进行疾病管理。在回答问题之前，请您阅读研究介绍中提供的相关说明，并确认知情同意。您的所有数据都将严格依法保密，相关数据仅供学术研究使用。如您有任何疑问，可通过问卷提供的联系方式与我们联系，我们将会负责解答您对本次调查的疑问。

感谢您的配合。

此致

敬礼！

研 究 介 绍

为何我会被邀请参与研究？

此次研究目标人群为江苏、上海以及中国其他地区 18 岁以上所有人口，重点关注被确诊为冠心病、高血压或 2 型糖尿病的患者。

参加研究对我有何好处？

1) 在您完整填写问卷之后，有机会参与我们最终的抽奖活动，奖品是 200 元现金或手机充值卡。
2) 如您感兴趣，我们可通过电子邮件向您提供本次研究的成果简报。

参加研究对我有无潜在的不良影响或风险？

本研究旨在了解您对药物治疗的态度及看法。我们不会给出具体的用药指导。所有问卷均经过专家组审核通过，不会对您的治疗造成任何负面影响。所有数据均会被严格保密并仅供科学研究使用。包括您的主治医生/介绍人在内均无法获知您的填写结果。

参与研究需要我做些什么？

请您在阅读完本介绍后，签署知情同意书并填写您的基本信息以便在您获奖后与您取得联系。之后请按照问卷上的指示依照您的实际情况填写问卷。完成问卷表大约需要 10-15 分钟。

我是否必须参与此研究?

我们非常期待您的参与，但此研究完全基于自愿参与的原则。如您不想继续参与研究，可以随时选择退出调查。

我参与研究的话隐私会得到保护吗？

我们被要求严格遵守医学伦理学及数据保密法案保障参试者的隐私。数据分析完成后，将依据伦敦大学学院(UCL)安全数据处理指南来进行处理。最终的报告中不包含可识别个人信息的材料。

研究结果将会如何使用？

研究结果将以科技期刊论文或者博士学位论文的形式发表。匿名处理后的数据可能会用于进一步的研究。

此研究通过了谁的审查？

为了保障您的权益，本研究项目由伦敦大学学院伦理审查委员会审核及批准（项目审查编号：6851/002）。伦敦大学学院（UCL）负责管理监督该研究项目。

如果您对本次研究有任何其他疑问，请及时与研究团队联系。联系方式为：.

聂博:　电话: XXXXXXX;　Email: XXXXXXX
韦丽博士:　电话: XXXXXXX;　Email: XXXXXXXXXX
莎拉·查普曼博士:　电话: XXXXXXX;
Email: XXXXXXXXXX

Appendix J. Information Sheet for Study (English)

SCHOOL OF PHARMACY

This study has been approved by the UCL Research Ethics Committee
Reference number: 6851/002

Study Sponsor: University College London (UCL)

Beliefs about medicines and medication adherence: An online survey study of Chinese patients with chronic conditions

(PhD project)

Research team: Dr. Li Wei, Dr. Sarah Chapman, Bo Nie
Chief Investigator: Dr. Li Wei
Research team principal contact: Bo Nie
PhD Candidate: Bo Nie

Bo Nie
UCL School of Pharmacy – Centre for Behavioural Medicine, XXXXXXX, XXXXXXX,
London XXX XXX
Telephone: XXXXXX
Email: XXXXXXX

Dear participant,

Thank you for participating in our online survey on medication-taking behaviour in Mainland China. The study is conducted by Mr. Bo Nie, a PhD candidate from UCL School of Pharmacy, and supervised by Dr. Li Wei and Dr. Sarah Chapman. The study aims to investigate Chinese people's beliefs about medicines and medication adherence status. It will benefit us to understand Chinese patients with chronic diseases and to help them manage their diseases better. Before starting to fill the form, please read the following information sheet to get more detailed information. Then, please confirm your consent. All your personal data will be kept strictly confidential and will be used for academic purpose only. If you have any problems with this study, please contact us via the contact details provided. We will answer any questions you may have.

Thanks for your cooperation.

Yours sincerely,

The research team

Information Sheet for Study

Why have I been invited?

Our target population is any adults (18 years old or over) resident in Jiangsu province, Shanghai municipality and surrounding areas, particularly diagnosed with CHD, hypertension or T2DM.

What are the possible benefits of taking part?

1) After completing the survey, you will get a chance to win a ¥200 cash or top-up voucher for your mobile phone.
2) If you are interested, we are happy to provide a brief summary of our general findings via email.

What are the possible disadvantages and risks of taking part?

The study aims to understand your attitudes and opinions about medication treatment only. We neither provide advice on medications nor help you to make a decision. All questionnaires were reviewed and confirmed by the research team. Therefore, we do not anticipate any distress or harm to you. All your data will be kept strictly confidential and used for academic research only. Even your doctors/introducer will not be allowed to access your data.

What will happen to me if I take part?

After reading the information sheet, please tick the box to confirm your consent. Then, leave your basic information so that we can contact you if you win the prize of the raffle. After that, all you need to do is follow the instructions and complete the questionnaires. The whole survey will take about 10-15 minutes.

Do I have to take part?

While we are looking forward to your participation, you should only participate if you wish to. If you decide that you do no longer want to be involved in this research, you can quit the survey at any stage.

Will my taking part in this study be kept confidential?

We are required to keep your information strictly confidential according to ethical and legal practice. Once we finish the analysis, the data will be disposed of securely according to UCL secure data disposal guidelines. Our report will not name or single out any individual.

What will happen to the results of the study?

We intend to publish the results of this study in a scientific journal and as part of a PhD thesis. The anonymous data may be used in future studies.

Who has reviewed this study?

To protect your interests, this study has been reviewed and given favourable opinion by the UCL Research Ethics Committee (Project ID number: 6851/002). University College London (UCL) is organizing and supervising this PhD programme.

If you have any further questions relating to this study, please do not hesitate to contact the research team.

Mr. Bo Nie: Tel: XXXXXX; Email: XXXXXXXXXX

Dr. Li Wei: Tel: XXXXXX; Email: XXXXXXXXXX

Dr. Sarah Chapman: Tel: XXXXXX; Email: XXXXXXXXXX

Appendix K. Consent form (Chinese)

SCHOOL OF PHARMACY

伦敦大学学院(UCL)药学院
行为医学研究中心
伦敦　XXXXXX XXXXXX
邮编：XXX XXX

研究发起单位：伦敦大学学院（UCL)

知情同意书

项目名称：关于中国人群药物信念及药物依从行为的调查

研究主管：**韦丽　博士**

博士研究生：**聂博**

此研究已获得伦敦大学学院(UCL)研究伦理委员会审批（审批编号：6851/002）

请在您阅读完研究介绍后勾选下方的确认选项，然后开始填写调查。

1. 我了解我是自愿参加并且可以随时无条件退出该研究的。
2. 我同意根据研究目的对采集到的信息进行分析处理。
3. 我了解相关信息及数据会被严格保密。

□ 我已阅读并同意
□ 不同意

Appendix L. Consent form (English)

SCHOOL OF PHARMACY

Centre for Behavioural Medicine
UCL School of Pharmacy
XXXXX, XXXXXXX
London, XXX XXX

Study Sponsor: University College London (UCL)

CONSENT FORM

Title of Project: **Beliefs about medicines and medication adherence: An online survey study of Chinese patients with chronic conditions**

Name of Chief Investigator: **Dr. Li Wei**

Name of PhD student: **Mr. Bo Nie**

This project has been approved by the UCL Research Ethics Committee (Reference number: 6851/002).

After reading the Information sheet, please tick the box below to confirm your consent, then start the survey.

1. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.
2. I consent to the processing of my personal information for the purpose of this research study.
3. I understand that such information will be treated as strictly confidential.

□ I have read the above and agree to participate.
□ I don't agree.

Appendix M. Questions on demographic and clinical information (Chinese)

SCHOOL OF PHARMACY

请填写您的姓氏或化名以便参与抽奖：__________

性别：□男 □女　　　　　出生年月：________年_____月

---

1. 您目前是否患有某种慢性疾病？（可多选）

□ 冠心病　□ 高血压　□ 2 型糖尿病　□ 其他慢性疾病 ______________

如多选，请在下列三种疾病中选出您认为您所患有的最严重或最主要的一种疾病。（单选）

□ 冠心病　　□ 高血压　　□ 2 型糖尿病

2. 该疾病被确诊多久了？

□ 未被专业医师确诊　　□ 少于 3 个月　　□ 3 个月-1 年

□ 1-5 年　　□ 5-10 年　　□ 久于 10 年

3. 您是否正在住院接受治疗？

□ 是　　□ 否

4. 您最近一次测量血压是在什么时候？

□ 24 小时内　□ 一周内　□ 一个月内　□ 一个月前　□ 未测过

5. 您最近一次测量的血压值是多少？（如未测过或已忘记，可不填）

收缩压（高压）____________mmHg　舒张压（低压）____________ mmHg

6. 您最近一次测量血糖是在什么时候？

□ 2 小时内　□ 6 小时内　□ 12 小时内　□ 24 小时内

□ 24 小时前　□ 未测过

7. 您最近一次测量的血糖值是多少？（如未测过或已忘记，可不填）

空腹血糖 ______________ mmol/L　餐后血糖 _______________ mmol/L

8. 您是否知道自己过去三个月的平均血糖值（HbA1c）？

□ 知道，_____________ mmol/L　□ 不知道、忘记数值

9. 请在下方填写您的身高和体重。请注意单位为厘米和公斤

身高 _____________厘米　　　体重 _____________公斤

10. 您目前的居住地归属于

□ 江苏省 □ 上海市 □ 浙江省 □ 其他省/自治区/直辖市 __________

11. 您的学历是？

□ 小学及以下 □ 初中 □ 高中/高职 □ 大学专科、大学本科或同等学历

□ 研究生及以上 □ 不便回答

12. 您是否已退休？

□ 已退休 □ 未退休

13. 您正在从事/退休前从事的职业是？

□ 工人 □ 农民 □ 公司职员 □ 个体经营业者 □ 国家公务人员/现役军人

□ 无业 □ 学生 □ 其他 _____________ □ 不便回答

14. 您目前使用何种方式支付治疗的费用？（可多选）

□ 城镇职工基本医疗保险 □ 新型农村合作医疗保险

□ 城镇居民基本医疗保险 □ 公务员公费医疗保险

□ 商业医疗保险 □ 慢性病专项补助 □自费 □ 其他 _____________

15. 您的年收入大致处于什么水平？

□ 1 万元以下 □ 1 万-3 万 □ 3 万-5 万

□ 5 万-10 万 □ 10 万以上 □ 不便回答

16. 您从何处得知我们的研究？ (单选)

□ 徐州医科大附属医院 □ 徐州市中心医院 □ 徐州市中医院 □ 江苏省人民医院

□ 江苏省中医院 □ 江苏省中西医结合医院 □ 南京市鼓楼医院 □ 南京中医药大学门诊部 □ 其他途径________________

17. 如您选择参与抽奖，请任选一项您觉得最方便的联系方式，以便在中奖后及时通知您。

□ 电子邮件_________________ □ 电话___________________

□ 微信___________________ □ 邮寄_____________________ □不参与最终抽奖

18. 我们可在研究完成之后向您反馈一份本次研究的简报。

□ 请通过前面留下的联系方式向我反馈研究结果

□ 谢谢，不需要知道结果

Appendix N. Questions on demographic and clinical information (English)

SCHOOL OF PHARMACY

Please leave your surname/pseudonym to participant the raffle: ______

Sex: □ Male □ Female Date of Birth: _____ Year ____ Month

1. Are you currently suffering from any chronic disease? (You may choose more than one options)

□ Coronary heart disease (CHD) □ Hypertension

□ Type 2 diabetes mellitus (T2DM) □ Other chronic disease _____________

If you have two or three diseases of CHD, hypertension and T2DM, please select the most severe or primary ***one*** condition to you. (Single option)

□ CHD □ Hypertension □ T2DM

2. How long have you been diagnosed with the disease?

□ Have not been diagnosed □ Within 3 months □ 3 months-1 year

□ 1-5 year □ 5-10 year □ More than 10 years ago

3. Are you an inpatient?

□ Yes □ No

4. When did you last measure your blood pressure?

□ Within 24 hours □ Within one week □ Within one month

□ More than 1 month ago □ Never measured

5. What is your latest blood pressure? (You may skip this question if you never measured your blood pressure or forget the value)

Systolic blood pressure (high pressure) ___________mmHg

Diastolic blood pressure (low pressure) ___________mmHg

6. When did you last measure your blood pressure?

□ Within 2 hours □ Within 6 hours □ Within 12 hours

□ Within 24 hours □ 24 hours ago or before □ Never measured

7. What is your latest blood glucose? (You may skip this question if you never measured your blood pressure or forget the value)

Before meal _____________ mmol/L After meal ______________ mmol/L

8. Do you know your average haemoglobinA1C(HbA1c) of the past three months?

□ Yes, it is ______________ mmol/L □ No, I have no idea or forget the value

9. Please tell us your height and weight. Please note the units are ***cm*** and ***Kg***.

Height: ____________cm Weight: ____________Kg

10. Where is your residential city?

□ Jiangsu □ Shanghai □ Zhejiang □ Other province/region __________

11. What is your highest qualification?

□ Primary school or below □ Middle school □ High school or equivalent □ College or undergraduate □ Postgraduate or above □ Don't want to say

12. Are you retired?

□ Yes □ No

13. Please indicate your current occupation or occupation before retired:

□ Worker/builder □ Farmer □ Company staff/clerk □ Self-employed □ Civil service/Soldier □ Unemployed □ Student □ Other _____________ □ Don't want to say

14. How do you pay for your treatments? (You may choose more than one options)

□ Basic Medical Insurance for Urban Employee □ New Rural Cooperative Medical System □ Basic Medical Insurance for Urban Resident □ Free medical services for civil service/soldier □ Commercial medical insurance □ Reimbursement scheme for chronic diseases □ Self-pay □ Other _____________

15. What is your annual income level?

□ < ¥10,000 □ ¥10,000 - ¥30,000 □ ¥30,000 - ¥50,000

□ ¥50,000 - ¥100,000 □ > ¥100,000 □ Don't want to say

16. How did you hear about this study? (Single option)

□ Affiliated Hospital of Xuzhou Medical University □ Xuzhou Central Hospital □ Xuzhou Hospital of TCM □ Jiangsu Province Hospital □ Jiangsu Province Hospital of TCM □ Jiangsu Province Hospital of ICWM □ Nanjing Drum Tower Hospital □ Outpatient department of Nanjing University of TCM □ Other________________

17. Please choose a convenient way to get in touch with you, if you win the raffle.

□ E-mail ______________ □ Tel _________________ □ WeChat _______________ □ Mail ___________________ □ I don't want to participate the raffle

18. We can provide you a brief summary of the study if you wish.

□ Yes, please send the summary to me via above contact details

□ No, thanks. I do not need the summary

Appendix O. General questionnaire for all participants (Chinese)

下表中列举了一些人对药物治疗的看法。我们想知道您在多大程度上同意或不同意他们的看法。请在空格中勾选最能反映您真实想法的答案。**答案没有对错之分**。

	非常不同意	不同意	不确定	同意	非常同意
1. 医生使用太多药物	❍	❍	❍	❍	❍
2. 病人应该间歇性地停止服用药物一段时间	❍	❍	❍	❍	❍
3. 药物帮助很多人生活的更好	❍	❍	❍	❍	❍
4. 大多数药物都会让人上瘾	❍	❍	❍	❍	❍
5. 中药比西药更安全	❍	❍	❍	❍	❍
6. 在大多数情况下，药物对我的帮助大过药物带来的风险	❍	❍	❍	❍	❍
7. 在未来，新药物将会治愈大多数疾病	❍	❍	❍	❍	❍
8. 大多数药物是有毒的	❍	❍	❍	❍	❍
9. 药物弊大于利	❍	❍	❍	❍	❍
10. 药物延长人的寿命	❍	❍	❍	❍	❍
11. 医生过于信任药物	❍	❍	❍	❍	❍
12. 如果医生有更多的时间与病人相处，他们会少给病人开些药	❍	❍	❍	❍	❍
13. 我的身体对药品很敏感	❍	❍	❍	❍	❍
14. 我的身体药物反应过大	❍	❍	❍	❍	❍
15. 我对药物的反应比大多数人强烈	❍	❍	❍	❍	❍
16. 我曾有过药物不良反应史	❍	❍	❍	❍	❍
17. 即使是极少量的药物也会引起我的身体不适	❍	❍	❍	❍	❍
18. 医生给患者开昂贵的药物以赚取提成	❍	❍	❍	❍	❍
19. 患者应服用能维持病情的最低剂量即可	❍	❍	❍	❍	❍
20. 吃错药非常危险	❍	❍	❍	❍	❍
21. 生病就应当吃药	❍	❍	❍	❍	❍
22. 药物治标，但不治本	❍	❍	❍	❍	❍
23. 西药比中药见效快	❍	❍	❍	❍	❍
24. 西药和中药一起吃会降低疗效	❍	❍	❍	❍	❍
25. 只有在西药无效的情况下才会考虑使用中药	❍	❍	❍	❍	❍
26. 西药和中药一起吃会产生未知的副作用	❍	❍	❍	❍	❍
27. 进口药物比国产药物更好	❍	❍	❍	❍	❍
28. 贵的药比便宜的药更好	❍	❍	❍	❍	❍
29. 我只信任医院里医生开的药	❍	❍	❍	❍	❍
30. 频繁更换药物的种类或品牌会有风险	❍	❍	❍	❍	❍

Appendix P. General questionnaire for all participants (English)

These are statements that other people have made about medicines in general. We are interested in how much you agree or disagree with them. Please choose the appropriate answer to reflect your personal views. ***There are no right and wrong answers.***

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1. Doctors use too many medicines	❍	❍	❍	❍	❍
2. People who take medicines should stop their treatment for a while every now and again	❍	❍	❍	❍	❍
3. Medicines help many people to live better live	❍	❍	❍	❍	❍
4. Most medicines are addictive	❍	❍	❍	❍	❍
5. Natural remedies are safer than medicines	❍	❍	❍	❍	❍
6. In most cases the benefits of medicines outweigh the risks	❍	❍	❍	❍	❍
7. In the future medicines will be developed to cure most diseases	❍	❍	❍	❍	❍
8. Most medicines are poisons	❍	❍	❍	❍	❍
9. Medicines do more harm than good	❍	❍	❍	❍	❍
10. Medicines help many people to live longer	❍	❍	❍	❍	❍
11. Doctors place too much trust on medicines	❍	❍	❍	❍	❍
12. If doctors had more time with patients they would prescribe fewer medicines	❍	❍	❍	❍	❍
13. My body is very sensitive to medicines	❍	❍	❍	❍	❍
14. My body over-reacts to medicines	❍	❍	❍	❍	❍
15. I usually have stronger reactions to medicines than most people	❍	❍	❍	❍	❍
16. I have had a bad reaction to medicines in the past	❍	❍	❍	❍	❍
17. Even very small amounts of medicine can upset my body.	❍	❍	❍	❍	❍
18. Doctors prescribe expensive medicines to earn the return commission	❍	❍	❍	❍	❍
19. Patients should only take the necessary dosage to maintain the condition	❍	❍	❍	❍	❍
20. Taking wrong medication is very dangerous	❍	❍	❍	❍	❍

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
21. If I have a disease, I should take medicine	❍	❍	❍	❍	❍
22. Medicines treat symptoms, but do not cure diseases	❍	❍	❍	❍	❍
23. Western medicine works more quickly than TCM	❍	❍	❍	❍	❍
24. The combination of western medicines and TCM weakens the effectiveness	❍	❍	❍	❍	❍
25. Patients only use TCM when western medicines are ineffective	❍	❍	❍	❍	❍
26. The combination of western medicines and TCM causes some unexpected side effects	❍	❍	❍	❍	❍
27. Imported medicines are better than ones made in China	❍	❍	❍	❍	❍
28. Expensive medicines are better than cheap ones	❍	❍	❍	❍	❍
29. I trust medicines prescribed by only hospital doctors	❍	❍	❍	❍	❍
30. Frequently changing medicine's type or brand is risky	❍	❍	❍	❍	❍

Appendix Q. Specific questionnaire for patients with CHD, hypertension or T2DM (Chinese)

➢ 请选出您正在服用的治疗冠心病的药物（可多选）：

□ 尼群地平	□ 哌唑嗪（脉宁平）	□ 辛伐他汀（舒降之）
□ 硝苯地平类（心痛定、促福达、拜新同）	□ 酒石酸/琥珀酸美托洛尔（倍他乐克）	□ 氟伐他汀（来适可）
□ 氨氯地平类（络活喜、施慧达、压释达）	□ 厄贝沙坦（伊贝沙坦、格平、安博维）	□ 洛伐他汀 （美降之、罗华宁）
□尼莫地平（尼莫同、尼达尔）	□ 普萘洛尔（心得安）	□ 阿伐他汀 （立普妥、力必妥）
□ 非洛地平（波依定）	□ 特拉唑嗪（高特灵、欧得曼）	□ 中药成分片剂/丸散/胶囊/冲剂
□ 卡托普利	□ 呋塞米（速尿）	□ 中药汤剂/膏方
□ 贝那普利（洛丁新）	□ 吲达帕胺（艾瑞泰、立舒平）	□ 其他药物 ____________
□ 氯沙坦氢氯噻嗪（海捷亚）	□ 硫酸氢氯吡格雷片（波立维）	□ 记不清药物的名字
□ 缬沙坦（缬克）	□ 阿司匹林类（拜阿斯匹灵）	

➢ 请选出您正在服用的治疗高血压的药物（可多选）：

□ 尼群地平	□ 厄贝沙坦（伊贝沙坦、格平、安博维）
□ 硝苯地平类（促福达、拜新同）	□ 普萘洛尔（心得安）
□ 氨氯地平类（络活喜、施慧达、压释达）	□ 特拉唑嗪（高特灵、欧得曼）
□ 尼莫地平（尼莫同、尼达尔）	□ 呋塞米（速尿）
□ 非洛地平（波依定）	□ 吲达帕胺（艾瑞泰、立舒平）
□ 卡托普利	□ 阿司匹林类（拜阿斯匹灵）
□ 贝那普利（洛丁新）	□ 中药成分片剂/丸散/胶囊/冲剂
□ 氯沙坦氢氯噻嗪（海捷亚）	□ 中药汤剂/膏方
□ 缬沙坦（缬克）	□ 其他药物 ____________
□ 哌唑嗪（脉宁平）	□ 记不清药物的名字
□ 酒石酸/琥珀酸美托洛尔（倍他乐克）	

➢ 请选出您正在服用的治疗 2 型糖尿病的药物（可多选）：

□ 二甲双胍 (格华止)	□ 格列美脲 (亚莫利、万苏平)	□ 甲钴胺片
□ 阿卡波糖 (拜糖苹、卡博平)	□ 格列吡嗪 (美吡达)	□ 中药成分片剂/丸散/胶囊/冲剂
□ 注射胰岛素 (诺和锐)	□ 格列齐特 (达美康、孚来迪)	□ 中药汤剂/膏方
□ 瑞格列奈 (诺和龙)	□ 格列本脲 (优降糖)	□ 其他药物______________
□ 那格列奈 (唐力)	□ 格列喹酮 (唐适平)	□ 记不清药物的名字

下表中列举了一些人对<u>降压药</u>治疗的看法。我们想知道您在多大程度上同意或不同意他们的看法。请在空格中勾选最能反映您真实想法的答案。**<u>答案没有对错之分</u>**。

	非常不同意	**不同意**	**不确定**	**同意**	**非常同意**
1. 我目前的健康状况取决于这些<u>降压药</u>	❍	❍	❍	❍	❍
2. 服用这些<u>降压药</u>让我感到担心忧虑	❍	❍	❍	❍	❍
3. 如果没有这些<u>降压药</u>我将不能正常生活	❍	❍	❍	❍	❍
4. 我有时会担心这些<u>降压药</u>的长期效果	❍	❍	❍	❍	❍
5. 如果没有这些<u>降压药</u>，我会病得很重	❍	❍	❍	❍	❍
6. 这些<u>降压药</u>对我来说很神秘	❍	❍	❍	❍	❍
7. 我未来的健康将取决于这些<u>降压药</u>	❍	❍	❍	❍	❍
8. 这些<u>降压药</u>扰乱了我的正常生活	❍	❍	❍	❍	❍
9. 我有时会担心过于依赖这些<u>降压药</u>	❍	❍	❍	❍	❍
10. 这些<u>降压药</u>阻止我病情加重	❍	❍	❍	❍	❍
11. 这些<u>降压药</u>给我带来不愉快的副作用	❍	❍	❍	❍	❍
12. 只要有效，不论哪种<u>降压药</u>我都愿意尝试	❍	❍	❍	❍	❍
13. 这些<u>降压药</u>如果使用过量，即使很少也非常危险	❍	❍	❍	❍	❍
14. 症状不显著时就不需服用这些<u>降压药</u>	❍	❍	❍	❍	❍
15. 服用这些<u>降压药</u>使我感觉异于常人	❍	❍	❍	❍	❍
16. 越早开始服用<u>降压药</u>，我的<u>高血压</u>越可能被治愈	❍	❍	❍	❍	❍
17. 这些<u>降压药</u>很贵	❍	❍	❍	❍	❍
18. 一旦症状得到缓解，我就该少服些<u>降压药</u>	❍	❍	❍	❍	❍
19. 服用这些<u>降压药</u>降低了我的生活质量	❍	❍	❍	❍	❍
20. 除了服用这些<u>降压药</u>，我别无选择	❍	❍	❍	❍	❍
21. 我很信任我的医疗团队给的这些<u>降压药</u>	❍	❍	❍	❍	❍

很多人都会找到适合他们自己的用药方式。这可能不同于从医生那里得到的医嘱。我们将会问您几个关于您如何服用<u>降压药</u>的问题。以下是一些用药方式的表述。请勾选最符合您实际情况的答案。**<u>答案没有对错之分</u>**。

	总是	**经常**	**有时**	**罕见**	**从不**
1. 在过去的一个月里，我曾忘记服用<u>降压药</u>	❍	❍	❍	❍	❍
2. 在过去的一个月里，我曾改变服用<u>降压药</u>的剂量	❍	❍	❍	❍	❍
3. 在过去的一个月里，我曾停用<u>降压药</u>一段时间	❍	❍	❍	❍	❍
4. 在过去的一个月里，我曾擅自决定少服一次<u>降压药</u>	❍	❍	❍	❍	❍
5. 在过去的一个月里，我服用的<u>降压药</u>的剂量少于医生指示的剂量	❍	❍	❍	❍	❍

请在以下表格中选择最能体现您对观点倾向程度的数字。**答案没有对错之分**。

1. 高血压对您生活的影响有多大？									
毫无影响									**严重影响**
1	2	3	4	5	6	7	8	9	10
2. 您认为您的高血压将持续多久？									
很短									**永远**
1	2	3	4	5	6	7	8	9	10
3. 您感觉您能在多大程度上控制住您的高血压？									
完全无法控制									**完全能控制住**
1	2	3	4	5	6	7	8	9	10
4. 您目前服用的药物对您的高血压的治疗有多大帮助？									
毫无帮助									**极有帮助**
1	2	3	4	5	6	7	8	9	10
5. 高血压给您带来的症状有多严重？									
毫无症状									**许多严重症状**
1	2	3	4	5	6	7	8	9	10
6. 您有多关切您的高血压？									
毫不关切									**极其关切**
1	2	3	4	5	6	7	8	9	10
7. 您有多了解自己的高血压？									
毫不了解									**非常了解**
1	2	3	4	5	6	7	8	9	10
8. 高血压在多大程度上影响您的情绪？（比如是否让您生气，害怕，沮丧或忧郁？）									
毫不影响									**极其影响**
1	2	3	4	5	6	7	8	9	10
9. 请按照次序列出三个对您来说最重要的病因：									

Appendix R. Specific questionnaire for patients with CHD, hypertension or T2DM (English)

➢ If you are currently taking any medication for CHD, please select the category(s) of the medicine(s).

□ Nitrendipine	□ Prazosin	□ Simvastatin
□ Nifedipine	□ Metoprolol	□ Fluvastatin
□ Amlodipine	□ Irbesartan	□ Lovastatin
□ Nimodipine	□ Propranolol	□ Atorvastatin
□ Felodipine	□ Terazosin	□ Proprietary Chinese medicines (include tablet, pill, pulvis, capsule, granules)
□ Captopril	□ Furosemide	□ Chinese herbal formula decoction/Herbal syrup formula
□ Benazepril hydrochloride	□ Indapamide	□ Other medications _______________
□ Losartan hydrochlorothiazide	□ Clopidogrel hydrogen sulfate	□ No idea or forget the name of medication
□ Valsartan	□ Aspirin	

➢ If you are currently taking any medication for hypertension, please select the category(s) of the medicine(s).

□ Nitrendipine	□ Irbesartan
□ Nifedipine	□ Propranolol
□ Amlodipine	□ Terazosin
□ Nimodipine	□ Furosemide
□ Felodipine	□ Indapamide
□ Captopril	□ Aspirin
□ Benazepril hydrochloride	□ Proprietary Chinese medicines (include tablet, pill, pulvis, capsule, granules)
□ Losartan hydrochlorothiazide	□ Chinese herbal formula decoction/Herbal syrup formula
□ Valsartan	□ Other medications _______________
□ Prazosin	□ No idea or forget the name of medication
□ Metoprolol	

➢ If you are currently taking any medication for T2DM, please select the category(s) of the medicine(s).

□ Metformin	□ Glimepiride	□ Mecobalamine
□ Acarbose	□ Glipizide	□ Proprietary Chinese medicines (include tablet, pill, pulvis, capsule, granules)
□ Injected insulin	□ Gliclazide	□ Chinese herbal formula decoction/Herbal syrup formula
□ Repaglinide	□ Glibenclamide	□ Other medications _______________
□ Nateglinide	□ Gliquidone	□ No idea or forget the name of medication

These are statements that other patients have made about antihypertensive drugs. We are interested in how much you agree or disagree with them. Please choose the appropriate answer to reflect your personal views. ***There are no right and wrong answers***.

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1. My health, at present, depends on these antihypertensive drugs	❍	❍	❍	❍	❍
2. Having to take these antihypertensive drugs worries me	❍	❍	❍	❍	❍
3. My life would be impossible without these antihypertensive drugs	❍	❍	❍	❍	❍
4. I sometimes worry about long-term effects of these antihypertensive drugs	❍	❍	❍	❍	❍
5. Without these antihypertensive drugs I would be very ill	❍	❍	❍	❍	❍
6. These antihypertensive drugs are a mystery to me	❍	❍	❍	❍	❍
7. My health in the future will depends on these antihypertensive drugs	❍	❍	❍	❍	❍
8. These antihypertensive drugs disrupt my life	❍	❍	❍	❍	❍
9. I sometimes worry about becoming too dependent on these antihypertensive drugs	❍	❍	❍	❍	❍
10. These antihypertensive drugs protect me from becoming worse	❍	❍	❍	❍	❍
11.These antihypertensive drugs give me unpleasant side effects	❍	❍	❍	❍	❍
12. I am willing to try any antihypertensive drug as long as it works	❍	❍	❍	❍	❍
13. Taking an excess dosage of these antihypertensive drugs, even very small amounts, is very dangerous	❍	❍	❍	❍	❍
14. I do not need to take these antihypertensive drugs if my symptoms have not been serious yet	❍	❍	❍	❍	❍
15. Taking these antihypertensive drugs makes me feel different from others	❍	❍	❍	❍	❍
16. The earlier I start to use these antihypertensive drugs, the more likely I will be cured	❍	❍	❍	❍	❍
17. These antihypertensive drugs are expensive	❍	❍	❍	❍	❍

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
18. I should take less antihypertensive drugs, once achieving remission	❍	❍	❍	❍	❍
19. Taking these antihypertensive drugs harms my quality of life	❍	❍	❍	❍	❍
20. I have no choice but to take these antihypertensive drugs	❍	❍	❍	❍	❍
21. I trust these antihypertensive drugs provided by my healthcare team	❍	❍	❍	❍	❍

Many people find a way of using their medicines that suits them. This may differ from the instructions on the label or from what their doctor has said. We would like to ask you a few questions about how you use your antihypertensive drugs. Here are some ways in which patients have said that they use their medicines. For each of the statements, please tick the box which best applies to you. ***There are no right and wrong answers***.

	Always	Often	Sometimes	Rarely	Never
1. In the past one month, I forgot to take these antihypertensive drugs	❍	❍	❍	❍	❍
2. In the past one month, I altered the dose of these antihypertensive drugs	❍	❍	❍	❍	❍
3. In the past one month, I stopped taking these antihypertensive drugs for a while	❍	❍	❍	❍	❍
4. In the past one month, I decided to miss out a dose of these antihypertensive drugs	❍	❍	❍	❍	❍
5. In the past one month, I took these antihypertensive drugs less than instructed	❍	❍	❍	❍	❍

For the following questions, please circle the number that best corresponds to your views. ***There are no right and wrong answers.***

1. How much does your hypertension affect your life?									
no affect at all									severely affects my life
1	2	3	4	5	6	7	8	9	10
2. How long do you think your hypertension will continue?									
a very short time									forever
1	2	3	4	5	6	7	8	9	10
3. How much control do you feel you have over your hypertension?									
absolutely no control									extreme amount of control
1	2	3	4	5	6	7	8	9	10
4. How much do you think your treatment can help your hypertension?									
not at all									extremely helpful
1	2	3	4	5	6	7	8	9	10
5. How much do you experience symptoms from your hypertension?									
no symptoms at all									many severe symptoms
1	2	3	4	5	6	7	8	9	10
6. How concerned are you about your hypertension?									
not at all concerned									extremely concerned
1	2	3	4	5	6	7	8	9	10
7. How well do you feel you understand your hypertension?									
don't understand at all									Understand very clearly
1	2	3	4	5	6	7	8	9	10
8. How much does your hypertension affect you emotionally? (e.g. does it make you angry, scared, upset or depressed?									
not at all affected emotionally									extremely affected emotionally
1	2	3	4	5	6	7	8	9	10
9. Please list in rank-order the three most important factors that you believe caused your illness.									

Appendix S. Volunteers training slides

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Beliefs about Medicines and Medication Adherence of Chronic patients in Xuzhou

Bo Nie
PhD candidate, MSc
School of Pharmacy, University College London (UCL)
July 2017

Agenda

UCL

- Basic Information
- Arrangements
- Preparation
- Data Collection
- Data Entry
- Workload Account
- Funding Management & Reimbursement

Basic Information

UCL

Introduction of University College London (UCL)

- One of the world's leading universities
- Established in 1826, the third old higher education institution in England
- Member of G5 lobby group
- 7th in 2018 QS World University Ranking
- 2nd in 2014 Research Excellence Framework Ranking
- 15th in 2017 Times Higher Education World University Ranking (THE)
- 32 Nobel laureates graduated from or worked in the UCL. 16 of them were in physiology or medicine area.

Basic Information

UCL

Introduction of Project

- The current project is one part of PhD program of UCL School of Pharmacy. The original title of project is *Beliefs about Medicines and Medication Adherence: An Online Survey Study of Chinese Patients with Chronic Conditions*. The Chinese translated title is《一项针对中国慢性病患者药物信念及药物依从行为的在线调查》.

Basic Information

Key conceptions

- **Medication adherence**: "The process by which patients take their medications as prescribed, composed of initiation, implementation and discontinuation." (Vrijens et al., 2012).
- **Nonadherence** including: 1) changing the dosage, 2) changing the frequency, 3) taking medication at the wrong times, 4) stopping the treatment too early, 5) delaying in following prescription
- Consequences of nonadherence including:
  1) more intense relapses,
  2) increased risk of dependence,
  3) increased risk of abstinence and rebound effect,
  4) increased risk of developing resistance to therapies,
  5) increased risk of toxicity,
  6) increased likelihood of accidents.

Basic Information

Key conceptions

- Impact factors of adherence:

1) social/economic factors, 2) health system/HCT-factors,

3) therapy-related factors, 4) condition-related factors,

5) patient-related factors.

- **Illness perception**: proposed by and his colleagues in Self-regulatory Model (Leventhal et al., 1987). It is significantly correlated with adherence to therapeutic regimens.

Basic Information

Key conceptions

- **Beliefs about medicines:**
  One of the major patient-related factors;
  A strong predictor of medication adherence;
  Including the **general beliefs** to overall medicine use and the **specific beliefs** to particular medicine (Horne et al., 2013).
- The specific beliefs is a stronger predictor of adherence than general beliefs. The specific beliefs including the beliefs about medication' s **necessity,** and the **concerns** about potential risks of taking medication. Patients made the decisions according to the judgment of them, named **Necessity-Concern Framework**.

Basic Information

Objectives

1. Investigating the beliefs about medicines of chronic patients in Xuzhou;
2. Investigating the adherence state of chronic patients in Xuzhou;
3. Investigating the illness perception and other potential impact factors to adherence of chronic patients in Xuzhou.

Basic Information

Questionnaires

Name	Variables	No. of items
Basic information form	Demographic data (gender, age, education level, occupation et al.) and basic clinical data (diagnosis, duration, BMI, physiological indexes, medical insurance).	21-23
BMQ	Beliefs about medicines	23+23
PSM	Perceived Sensitivity to Medicines	5
B-IPQ	Illness perception	9
MARS-5	Medication adherence	5

Basic Information

Questionnaires

- **Beliefs about Medicines Questionnaire (BMQ)**: Designed by Prof. Robert Horne in 1999, including two subscales (BMQ-G & BMQ-S). The BMQ-G assesses beliefs about general benefit, general harm and overuse. The BMQ-S assessed beliefs about necessity and concern.
- Perceived Sensitivity to Medicines scale (PSM): Designed by Prof. Robert Horne in 2013, and often combined with BMQ.
- BMQ and PSM are all 5-Likert scales. The answers ranges from 1 (Strongly disagree) to 5 (Strongly agree).

Basic Information

Questionnaires

- **Illness Perception Questionnaire (IPQ)**: Designed by Prof. Weinman in 1996. The original version has 80 items. We will use a 9-item brief version (B-IPQ) which assesses five dimensions of illness perceptions, including identity, timeline, cause, consequences and cure-control.
- **Medication Adherence Report Scale (MARS)** : Designed by Thompson in 2000. The original version has 10 items. We will use a 5-item brief version (MARS-5). The answers ranges from 1 (Always) to 5 (Never). The patients with overall score 20 or more have a good adherence.

Arrangements

- The current project is supervised by Dr. Li Wei from UCL School of Pharmacy, and Dr. Sarah Chapman from University of Bath, and conducted by Mr. Bo Nie. The part of data collection work in Xuzhou area is entrusted to Department of Public Health, Xuzhou Medical University (XMU), and will be finished as a summer social practice project. Mr. Chao Shen and Miss Yiqing Lv will be responsible for organizing and conducting.
- Date: 9th – 12th July
- Location: First Affiliated Hospital of XMU, Second Affiliated Hospital of XMU, Xuzhou Hospital of Traditional Chinese Medicine (TCM), Xuzhou Central Hospital, Xuzhou Geriatrics Hospital and gerocomium.

Arrangements

9th July (Sunday)	
• Materials preparation • Team member registration	• First meeting • Training lecture
10th July (Monday)	
• Inpatient department of Xuzhou Geriatrics Hospital (7 volunteers)	• Inpatient department of Xuzhou Hospital of TCM (6)
11th July (Tuesday)	
• Outpatient department of Xuzhou Central Hospital (4) • Outpatient department of Xuzhou Hospital of TCM (2)	• Inpatient department of First Affiliated Hospital of XMU (7)
12th July (Wednesday)	
• Inpatient department of First Affiliated Hospital of XMU (4)	• Gerocomium (9)

Preparation

- Ethics approval: This study has been reviewed and approved by the UCL Research Ethics Committee (Project ID number: 6851/002) .
- Reference letter: Certificated by Department of Public Health, XMU
- Online survey: Qualtrics provides technical support https://uclpharmacy.eu.qualtrics.com/jfe/form/SV_0JI4s5TNFLsPTDL?from=timeline&isappinstalled=0
- Hard copy questionnaires include three versions specific to CHD, HTN and T2DM patients.

Preparation

Checklist for volunteers

- ✓ Mobile device: We suggest volunteers collect data with iPad
- ✓ Uniform or white coat if applicable
- ✓ Student ID
- ✓ Pens
- ✓ Notebook: Recording the number of people approached and the questions participants asked
- ✓ Printed QR code

Data Collection

- Finding the doctor or nurse contacted in advance
  - ➢ Introduce yourself;
  - ➢ Ask them where is your work station;
  - ➢ Confirm if they already arranged any patients for survey.
- Inclusion criterial:
  - a) Aged 18 years old or over;
  - b) Diagnosed with Coronary heart disease (CHD), Hypertension or Type 2 diabetes mellitus (T2DM);
  - c) Continued taking Western Medicine (WM) or TCM for more than 1 month.

Data Collection

UCL

- **Tips for different participants**

➢ Inpatients

- Do not disturb patients, if they are sleeping.
- Do not disturb doctors/nurses' treatment.
- Do not leave more than two volunteers in the same ward room.
- Do not miss any ward room
- Knock the door before enter, and close the door when you leaving.

Data Collection

UCL

➢ Outpatients

- Do not disturb patients if they will enter the consulting room soon;
- Do not disturb doctors' consultation.

➢ People from gerocomium

- Bring some sympathy gifts
- Be patient to the old people

Data Collection

UCL

- **Self introduction**

"Good morning, I am a student from Xuzhou Medical University. We are conducting a survey on patients' medication taking behaviour, and need to invite some patients with heart disease, hypertension or type 2 diabetes to fill a questionnaire. Do you have any of these problems? The questions are all very simple. After finishing that, you will get a chance to win a raffle. The price is ¥200 cash."

Data Collection

UCL

- **If patient agree to participate you need briefly introduce the questionnaire:**

"Thanks for participating. Please tick the most appropriate answer according to your personal beliefs. There are no right or wrong answers. We are interested in your personal views. It' s not compulsory to leave your full name in the questionnaire. You can use an abbreviation of family name so that we can distinguish your answers with others' . If you don' t want to participate the raffle, please thick the option and leave the contact information blank."

Data Collection

- **If participants find it difficult/cannot understand or confused about the questions, please explain the items or read out the items for them.**

"I am sorry, maybe the characters are too small to read. If you feel hard to read the items, I can read for you."

- **If participants miss one question, please politely remind him/her.**

"Hi, it seems you miss one question here. Could you please fill it in for me"

Data Collection

- **FAQ**

Q1: "**Are you the staff of this hospital?"**

A1: "No, we are not doctor. We are student of XMU. This is a social practice project for our summer holiday. We have no relationship with this hospital."

Q2: "**When can I receive the money if I win?"**

A2: "After finishing all the data collection in this September, we will draw the raffle in a same time so that all eligible participants have equal chance to win. We will contact you according to the contact details you left, if you win."

Data Collection

- **FAQ**

Q3: "**I don' t want to participate as you may give out my personal information."**

A3: "No worry. Our survey is supervised by university. Your information will be kept strictly confidential. You can leave it blank if feeling sensitive, such as contact details."

Q4: "**I don' t have time now."**

A4: "That' s fine, no worry. May I ask when will you be available? I can go to somewhere else, then return."

Data Collection

The things don' t forget after the work:

- Express your gratitude to participants.
- Give a brief feedback to the doctor/nurse of the department you contacted, and thanks for their supports.

Data Entry

- We highly recommend to collect the data via online system. If collect the data with hard copy, you need to transcribe the answers and use a lowercase 'z' to distinguish with other online collected data.
- If participants only tell the age, but do not tell the accurate date of birth, please infer the year of birth and choose June as the default answer.

Data Entry

- I added two questions about pre/after-meal blood sugar specific to T2DM patients. Please enter the data in the fields for hemoglobin (HbA1c), and indicate them in bracket. For example:

您过去三个月平均血糖值（HbA1c）是多少?

- 请在后方空格中填写

  6.7(pre) 14.2(after) 11
- 不清楚

Data Entry

- If you make any mistake and cannot correct it. You can skip the rest of questions and submit directly. Then reenter the system. Record the name and the time of wrong case in your workload account sheet. I will check it regularly and delete the wrong one from the system.

Data Entry

Quality Control

- If participants missed any question, please **DO NOT** complete on behalf of them, except for their gender.
- Take the photo of each page of the hard copy. Save all pictures in a separate folder and rename the pictures as ***Date-Location-Volunteer' s name-Participants' name***. Then upload to the public chat group of QQ

Data Entry

Quality Control

- Mr. Bo Nie will compare the answers in hard copies and online questionnaires randomly.
- Once found anyone make up data or enter the fake data, I will stop his/her work immediately. This person will not be able to get the certificate of Summer Holiday Practice from XMU and the volunteer proof from UCL team.

Workload Account

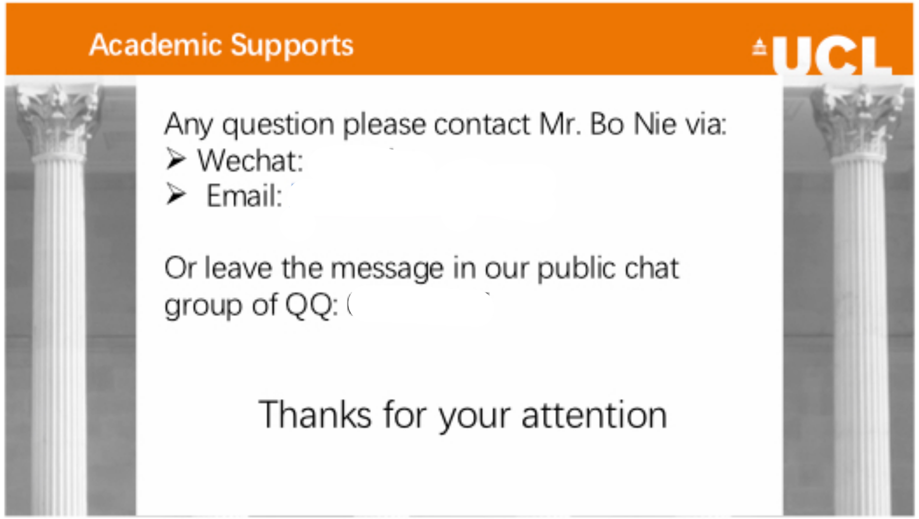
- After the work, finish a short daily report according to your note, indicating the number of people you approached, the number of participants, the number of completed questionnaires, and the issues you identified during collection.
- Finish the ***Workload Account Sheet,*** and upload to the public chat group of QQ.
- Mr. Shen and Miss Lv will check the contents in the sheet, and account volunteers' workload.

Workload Account

- After the project, all volunteers can get a certificate of Summer Holiday Social Practice from Department of Public Health, XMU.
- The outstanding volunteers can also get a volunteer proof signed by UCL research team, prove taking part in our data collection work.

Funding Management & Reimbursement

- Miss Lv will take the charge of printing documents and paying transportation fees.
- Keep the receipts and fill the financial claim sheet. Upload the pictures and the sheet to the public chat group of QQ.
- The funding does not cover the volunteers' personal exposure.
- All reimbursements will be awarded after the project.


Academic Supports
UCL
Any question please contact Mr. Bo Nie via:
➢ Wechat:
➢ Email:
Or leave the message in our public chat group of QQ: (
Thanks for your attention