

# **Behavioral Aspects of HIV Prevention in China**

From Determinants to Interventions

**Xiaona Liu**

## COLOFON

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# Behavioral Aspects of HIV Prevention in China

From Determinants to Interventions

Gedragmatige Aspecten van HIV Preventie in China

Van determinanten naar interventies

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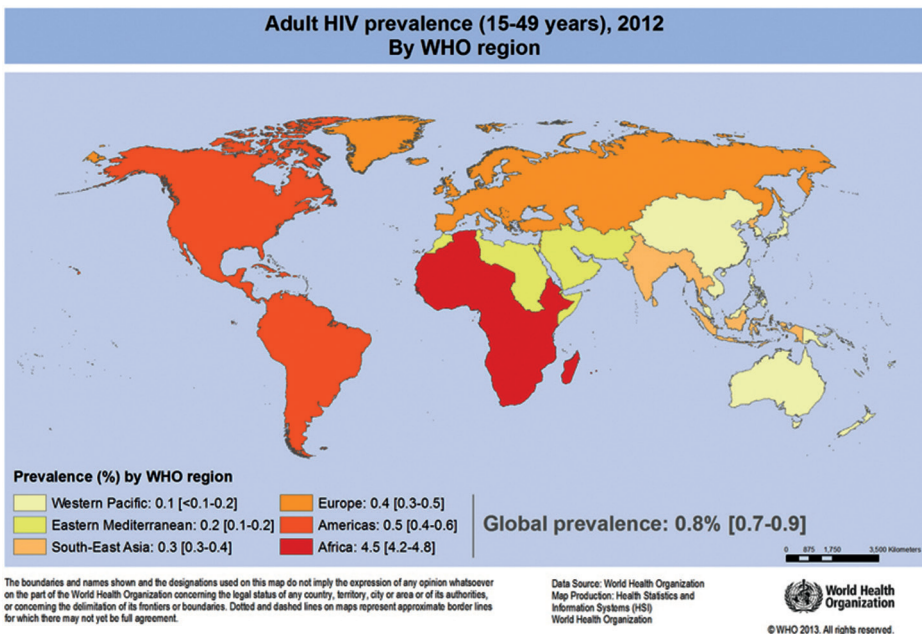
# Chapter 1

## General introduction



## 1.1 | HIV/AIDS EPIDEMIOLOGY

The Human Immunodeficiency Virus (HIV) is a lentivirus (a subgroup of retrovirus) that causes Acquired Immunodeficiency Syndrome (AIDS), a fatal disease in which progressive failure of the immune system allows life-threatening opportunistic infections and cancers to thrive.<sup>1,2</sup> The term HIV/AIDS represents the entire range of the infection caused by HIV.<sup>3</sup> HIV/AIDS is a global pandemic and has been recognized as a major public health problem.<sup>4</sup> As of 2012, approximately 35.3 million people were living with HIV with the number of new infections that year being about 2.3 million worldwide.<sup>5</sup> Sub-Saharan Africa remains the region most affected (Figure 1.1), with nearly 1 in every 20 adults (aged 15–49) living with HIV and accounting for 71% of all HIV cases worldwide in 2012.<sup>6</sup> Although China has not yet what many would consider a widespread AIDS epidemic, approximately 0.1% of the adult population is infected,<sup>7</sup> and the incidence rate has risen sharply over the past decade: the number of annual new cases has risen from 10,742 in 2007 to 39,183 newly diagnosed HIV cases in 2011. At the end of 2011, there were about 780,000 people living with HIV in China.<sup>8</sup>



**Figure 1.1** | Global HIV prevalence in adults (15-49 years), 2012, by World Health Organization (WHO) region. Source: WHO.<sup>6</sup>

HIV transmission dominantly occurs through unprotected sexual acts worldwide, but can also be transmitted from mother to child during pregnancy or breast feeding, through



needle sharing for medical purposes or injecting drugs, and blood transfusion with infected blood.<sup>9</sup> In China, traditionally HIV transmission has been particularly high among injecting drugs users (IDUs), men who have sex with men (MSM) and former plasma donors (as “conventional high risk populations”, see below). However, in recent years HIV has bridged to the general population, and now unprotected heterosexual sex has become the dominant transmission route.<sup>8</sup> Nearly half of all people living with HIV at the end of 2011 were infected through unprotected heterosexual transmission, whilst injecting drug use and unprotected sex between men accounted for just over 25% and nearly 20% of infections, respectively.<sup>8</sup> Other transmission routes included former blood donors or transfusion recipients (7%) and mother-to-child transmission (1%).<sup>8</sup> In this thesis, we will focus primarily on the sexual (heterosexual and homosexual) transmission of HIV.

The history of the HIV epidemic in China can be traced back to 1985, when the first AIDS case was reported in Beijing.<sup>10</sup> In the following five years a small number of further cases were reported among foreigners and Chinese, who were infected overseas or by imported blood products. In 1989, 146 IDUs in Southwest Yunnan were identified as HIV positive. By the end of the year the total number of infected people was reported as 153 Chinese and 41 foreigners. By late 1994 it was clear that the reported AIDS cases amongst IDUs in Yunnan had signaled the beginning of an epidemic amongst drug users.<sup>11</sup> National figures for HIV infection were growing quickly – in 1996 the Ministry of Health put the number of infections at between 50,000 and 100,000 – and new cases were being reported in more regions.<sup>12</sup> By 1998, HIV infections had been reported in all 31 provinces, autonomous regions and municipalities, with drug users accounting for 60-70% of reported infections. The sharp increase of AIDS cases in China in the 1990s was also attributed to a large number of people infected through blood donation, as well as transmission through heterosexual sex.<sup>13</sup> Notably, raising concerns on the danger of the epidemic spreading further into the general population persist since 2009, when China reported that AIDS had become the country’s leading cause of death among infectious diseases for the first time ever, surpassing both tuberculosis and rabies.<sup>14</sup>

## 1.2 | HIV PREVENTION FROM A BEHAVIORAL PERSPECTIVE

HIV prevention alone is neither simple nor simplistic. To be able to effectively reduce incidence, it is important to achieve radical behavioral changes – both between individuals and across large groups of people at-risk. A multilevel approach for HIV prevention encompasses behavioral strategies, together with biomedical and structural approaches, and treatment for HIV infection. Specific goals for a behavioral HIV prevention strategy involve knowledge, stigma reduction, access to services, delay of onset of first intercourse, decrease in number of partners, increase in condom use, and decreases in exploring of contaminated objects.<sup>15</sup>

### 1.2.1 Sexual risk reduction

In China, sexuality is generally not openly discussed in society and is considered neither easily targeted by health promotion campaigns, nor has it traditionally been taught in most schools.<sup>16</sup> Even among college students, levels of HIV-related knowledge and risk perception are alarmingly low.<sup>17</sup> On the other hand, attitudes towards sex are becoming increasingly more liberal and, as a result, premarital and extramarital sex are more commonly practiced.<sup>18</sup> Although they are widely available, condoms are rarely used.<sup>19</sup> The rural focus of the HIV epidemic and low levels of sexual mixing might in the past have prevented rapid spread of HIV, but sexual behaviors are rapidly changing among a growing floating population.<sup>20</sup> In this thesis, we investigate several aspects of sexual behavior among college students and internal migrants, including HIV-related knowledge and attitude, access to services, onset of first intercourse, number of partners, and condom use.

To date, besides national and local public health authorities, there are two national governmental organizations and seventy-three domestic non-governmental organizations (NGOs) working on HIV/AIDS prevention and control in China.<sup>21</sup> A great effort in the development and implementation of sexual risk reduction strategies has been made in recent years.<sup>22</sup> Among all strategies, promotion of condom use has been a mainstay of HIV prevention policy worldwide, including China.<sup>23</sup> Past evidence shows that condoms are protective against HIV infection, reducing the probability of HIV transmission per sex act by as much as 95% and reducing the annual HIV incidence in serodiscordant couples by 90-95% when used consistently.<sup>24</sup> This thesis assesses the effect of past behavioral HIV prevention interventions on the increase of condom use, and focuses on the development of a successful condom promotion intervention, with the ultimately goal of preventing HIV transmission among internal migrants in China.

### 1.2.2 Stigma and discrimination

HIV-related stigma and discrimination pose a major barrier for HIV prevention and care in China, as in many other countries. Health professionals themselves are not free of stigmatizing their patients.<sup>25</sup> In health care settings, stigma has emerged in various manners including refusal of care, suboptimal services, excessive precautions, isolation, mandatory testing, breach of confidentiality, humiliation, and blaming, which discourages people from seeking HIV testing and counselling and accessing treatment and care.<sup>26</sup> Misconceptions about the disease, fears related to its incurability, and prejudice toward risky behaviors have been identified as contributing factors for stigmatizing and discriminatory responses.<sup>27</sup> Also, concerns about occupational infection and a lack of self-protection knowledge and support have also been associated with health care providers' stigmatizing attitudes and behaviors.<sup>28</sup> In this thesis, we study the infection risk of occupational exposure to blood borne viruses (BBV), including HIV, and compliance with standard precautions (SP) as a protective strategy, among health care workers (HCWs). We also inspect the attitude of HCWs' attitude towards their patients and colleagues with HIV in hospital settings.

### 1.3 | POPULATIONS AT RISK OF HIV INFECTION IN CHINA

China knows a number of risk population groups for HIV infection, namely conventional high risk population groups and general population groups who are at risk yet have been less concerned in HIV prevention. In this thesis we focus on some of the neglected general population groups, but we also give a brief introduction to conventional high risk population groups as an overview of the populations at risk of HIV infection in China.

#### 1.3.1 Conventional high risk population groups

**Injection Drug Users (IDUs):** HIV prevalence among this group was 6.4% in 2009, and there were 1.4 million registered IDUs in 2010.<sup>29</sup> In 2011, although 38.5% of IDUs were reached by HIV prevention programs, 75% of the drug users used unsterile injection equipment the last time they injected drugs, and 67% of people who inject drugs still used contaminated injecting equipment.<sup>8</sup> IDUs are not a study subject in this thesis.

**Blood donors:** Following a ban on imported blood products in the 1980s, thousands of blood and plasma donation sites were established across China. Most operated illegally and collected blood from rural, impoverished areas in China. The unsafe collection method, and the reuse of needles and syringes, facilitated the transmission of HIV through blood and the outbreak of HIV in central China.<sup>30</sup> Since the mid-1990s, authorities have acted to improve the safety of China's blood supply by banning the most dangerous practices and closing illegal blood collection agencies. The Ministry of Health reported that the total number of former commercial plasma donors living with HIV/AIDS declined from 199,000 in 2003 to 55,000 in 2005 and further to 51,000 in 2011.<sup>8</sup> In this thesis, former commercial plasma donors are not the study focus.

**Men who have sex with men (MSM):** Gay and bisexual MSM are the most severely affected population. One in 6 people living with HIV was infected through sex between men. More than half reported that they do not use condoms consistently or know their HIV status, although almost all were reached by HIV prevention programs.<sup>8</sup> As homosexuality is not largely accepted in China, and due to traditional culture and values many MSM have frequent sexual relationships with women to hide their homosexual orientation. There is increasing concern that MSM will serve as key driver of the HIV epidemic and bridge the epidemic to the general heterosexual population.<sup>31</sup> This thesis concerns primarily in internal migrants, and homosexual acts that the migrants might have are discussed. But MSM is not studied as a key group in this thesis.

**Female sex workers (FSWs):** Commercial sex is illegal in China, but it has thrived since the economy reform in the late 1970s due to rapidly widening income disparities, increasing population mobility, and changing norms of sexuality. It has also been driven by surplus rural labor and limited employment opportunities for women during the past three decades.<sup>32</sup> It

is estimated that there are between 1 and 4 million FSWs in China, in both low end (e.g. on the street, hair salons, and temporary small clubs) and high end venues (e.g. karaoke clubs, night clubs, and hotels).<sup>33</sup> Facing fear of losing clients or desire of receiving extra payment for unprotected sex, many FSWs engage in unprotected sex, avoid HIV tests, and thus contact and spread sexually transmitted diseases (STD) and HIV.<sup>34</sup> Although the prevalence of HIV among FSWs remains low at a stable level of about 0.5% in China, the risk of an epidemic among FSWs and a further transmission to the general population continues to be a major concern.<sup>35</sup> This thesis concerns primarily in internal migrants, and commercial sex acts that the migrants might have are discussed. But FSWs are not a direct study subject in this thesis.

### 1.3.2 Neglected high risk general population groups

The current efforts dominantly targeting conventional high risk populations are insufficient for preventing HIV transmission in China.<sup>14</sup> New data suggest that China is following the path of some of the other Asian countries where HIV infection is no longer confined to conventional high risk populations, and has advanced into the general population.<sup>36</sup> Concern is raising about HIV spreading from conventional high risk population groups to the general population groups.<sup>37</sup> In this thesis we call these groups neglected high risk groups.

**Health care workers (HCWs):** Health services play a vital role in HIV prevention, treatment and care. In health care settings, HCWs have to face people with HIV, including both HIV-infected co-workers and HIV-infected patients, influencing their work practices and routines. HIV-related stigma is often documented among HCWs worldwide. It frequently leads to discriminatory practices while discrimination reinforces or creates social and economic inequalities, which then reinforce stigma in a vicious circle.<sup>38</sup> To prevent stigma and discriminatory practices in hospital settings, we investigate attitudes of HCWs' towards their patients and colleagues with HIV, and explore opinions of HCWs on employment and management of HIV-infected colleagues in this thesis. On the other hand, following standard precautions (SP) has been regarded as fundamental in preventing occupation exposure to blood borne viruses (BBV) infection, including HIV. Despite the fact that Chinese SP has been issued since 2004, evidence suggests that the adherence to SP may still be low in China, and compliance varies along different aspects of SP.<sup>39</sup> To prevent HCWs from BBV transmission in hospital settings, we will also investigate the extent of occupational blood exposure and compliance with SP of HCWs and identify correlates of compliance in this thesis.

**Youth:** Young people are at substantial risk for HIV infection. In China, people aged 20-39 account for 70% of the total reported number of HIV infection. When the group is narrowed to include only those aged 20-29, this figure is 34.2%.<sup>40</sup> College students in China, who generally are aged 18-24, are especially vulnerable to HIV transmission. Particular HIV risk behaviors among college students are unprotected sex, regardless of the gender of sexual

partner, and sex with multiple partners.<sup>41,42</sup> Compounding this vulnerability is premarital sex has become widely accepted among youth, including Chinese youth, and has occurred more often due to changing attitudes towards sexual intercourse.<sup>43</sup> The lack of information on HIV infection and sexual behavior among college students makes it difficult to develop well-informed HIV prevention strategies for this important population. In this thesis, we explore sexual behaviors and condom use among Chinese college students, and investigate socio-environmental and socio-cognitive determinants associated with their sexually risk behaviors.

**Internal migrants/floating population:** The emergence of large population movement patterns to find better employment opportunities, higher income, and a more attractive lifestyle in cities was driven by large economic disparities since the implementation of the ‘Open Door’ policy in China in 1978.<sup>44</sup> In Gladwell’s book *The tipping point*,<sup>45</sup> pivotal events tend to have a point at which some factor intervenes to raise them from the ordinary to the extraordinary; for example something that causes a disease to progress from a widespread problem to a true epidemic. In the case of China’s battle with HIV/AIDS, the ‘tipping point’ may well be the social and behavioral dynamics of its internal migrant or ‘floating’ population.<sup>46</sup> The term ‘floating’ was used not only reflecting a location move between the place of household registration and living, but also embodying the history of moving along the Yangtze River and the Yellow River, two so-called “mother rivers” in China.<sup>47</sup> The phrase internal migrants regularly refers to Chinese citizens living in an area different from their household registration (the ‘hukou’ system) within China.<sup>48</sup> Official estimates place the size of this population within a range of 200 to 210 million people at the end of 2010, including 160 million rural-to-urban migrants.<sup>49</sup> Internal migrants generally fall into one of the two subgroups when it comes to HIV prevention: (1) overlapped conventional HIV high risk subgroups (as described previously); (2) general subgroups who are not registered or recognized as any of the conventional high risk groups at the moment, and being called traditionally as migrant workers (*Nong Min Gong* in Chinese). In the past decade, a great effort has centered on preventing HIV among conventional high risk internal migrants (e.g., migrant MSM<sup>50</sup> and migrant FSW<sup>51</sup>). However, as the majority of internal migrants, an estimate of 75%<sup>52</sup>, general internal migrants are being overlooked in the battle against HIV in China. Past studies provide evidence that general internal migrants face challenges of limited access to health care services, compared to permanent residents and conventional HIV high risk subgroups<sup>53</sup>, a potential risk of becoming conventional high risk subgroup over time (e.g., selling or buying sex)<sup>54</sup>, and a substantial risk of acquiring HIV as a conventional high risk subgroup (e.g., misconceptions about HIV/AIDS, and low rates of condom use)<sup>55</sup>. The general internal migrants deserve rigorous, in-depth and continuing scrutiny so that effective HIV prevention and control strategies can be formulated, given its sheer size, breadth of movement, and internal complexity of behavior. This thesis mainly contributes to the development of effective and efficient HIV prevention interventions targeting this

important population, by investigating the populations' psychosocial force and sexual behavior, as well as examining past and innovative intervention strategies.

#### 1.4 | PLANNING MODELS FOR HEALTH EDUCATION AND PROMOTION

No single theory can completely explain or predict health behavior. Correspondingly, many behavioral interventions are complex, and need to be accustomed to a particular setting and population. This is why effective planning of behavior health education and promotion is greatly aided by a framework that systematically guides developers to choose and combine theories that can describe problems and help develop interventions. Intervention Mapping (IM) is one of the planning models that provides such a framework,<sup>56</sup> and the planning model centered in this thesis for the development of a behavioral intervention to prevent HIV transmission among internal migrants in China.

Besides IM, there are a number of planning models that are very useful for health education and promotion interventions. For examples, Strategic Planning Process (Bryson, 1995); Precede-Proceed (Green and Kreuter, 1999); and Needs/Impact-Based Planning Model (Metro Toronto District Health Council, 1996). To date, PRECEDE-PROCEED is the best known and most commonly used planning model in health education and promotion programs.<sup>57</sup> The IM framework (Figure2) integrates the assessment framework of PRECEDE-PROCEED in a planning model that guides steps towards intervention development, and directs the focus towards the intervention.<sup>58</sup> IM is unique among the planning models in that it provides a framework that guides program development step by step applying theory and evidence systematically at each phase of the development process. Applying theory in intervention development is made explicit in IM. Since IM was introduced in 2001, many successful behavioral interventions have been developed based on the IM framework across different diseases and fields, including HIV prevention.<sup>59</sup>

In more details, IM maps the path from recognition of a need or problem to the identification of a solution. It describes the process of health promotion program development in six steps. The following section gives a short overview of each step.

**Step 1: Needs assessment.** A need assessment is a systematic study of the discrepancy between the actual situation and the desired situation in a group of interest – 'what is and what should be'. This step ends by defining the most distant objectives in the IM model: the desired outcomes, behavioral and environmental. For this purpose, in this thesis, we assess the HIV epidemic, the role of general internal migrants in HIV prevention in China, and the currently available resources and needs to develop an HIV prevention intervention in the general internal migrant population in China. Moreover, we investigate risky behavioral issues and determinants of behavior and environmental causes in the population.

**Step 2: Identify performance objectives, determinants and finally change objectives.** This step produces a set of matrices of selected ecological levels that combines performance objectives (PO) for each level with selected personal and external determinants to produce behavior change objectives (BO), the most immediate target of an intervention, which in this case is the correct and consistent use of condoms. We also prioritize determinants by evaluating their importance and changeability in making the matrix.

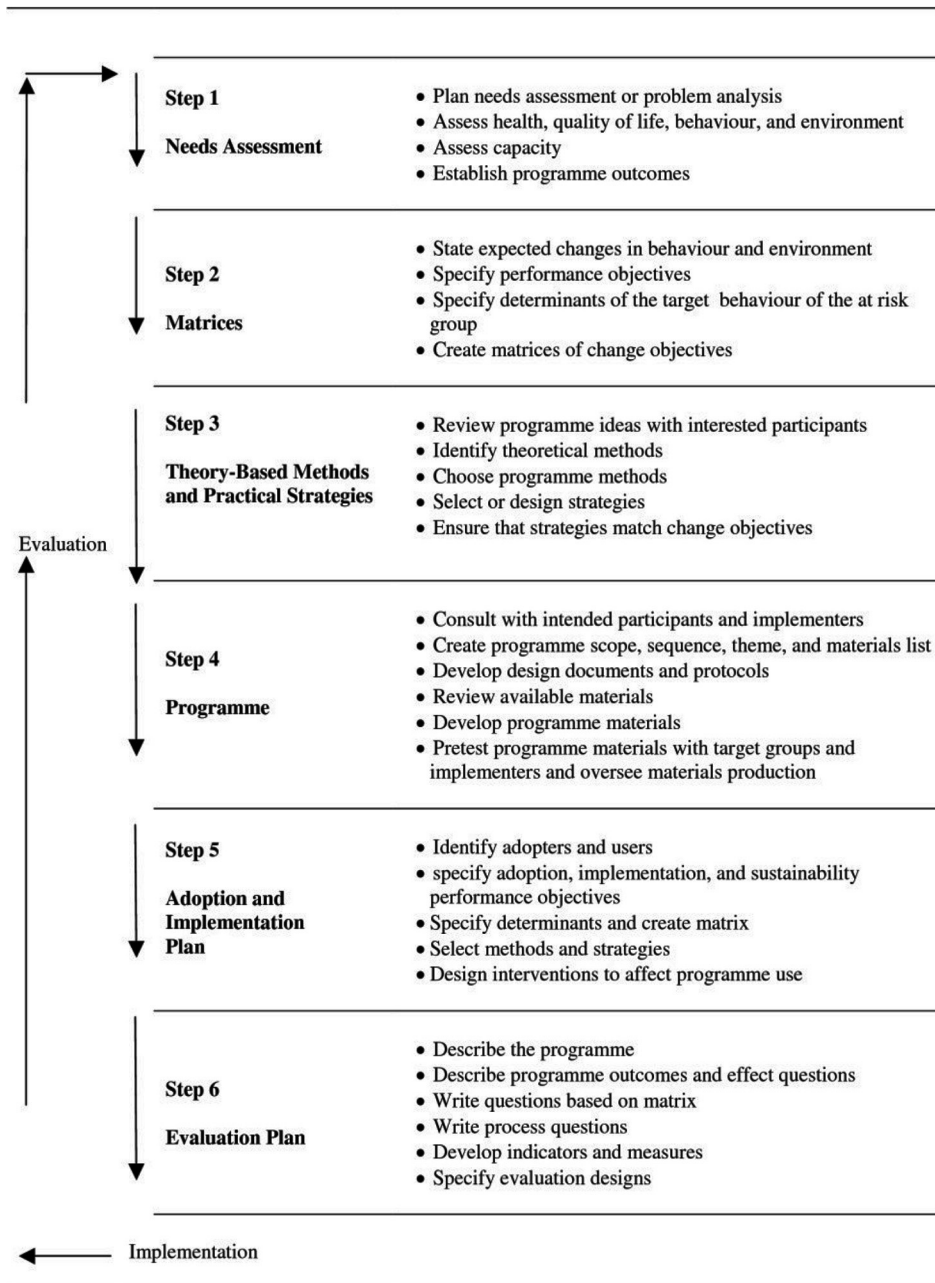
**Step 3: Theory-based methods and practical strategies.** This step seeks theory-informed methods and practical strategies to effect changes in the health behavior of individuals and related groups and to change organizational and societal factors to affect the environment. An intervention method is a defined process by which theory postulates and empirical research provides evidence for how change may occur in the behavior of individuals, groups, or social structures. Whereas a method is a theory-based technique to influence behavior or environmental conditions, a strategy is a way of organizing and operationalizing the intervention methods.<sup>59</sup> For this purpose, we systematically review behavioral HIV prevention interventions targeting internal migrants in the past decade, study strategies and techniques used in the past interventions, and evaluate the effectiveness and feasibility of used intervention strategies.

**Step 4: Intervention development.** The products in Step 4 include a description of the scope and sequence of the components of the intervention, completed program materials, and program protocols. This step gives specific guidance for communicating program intent to producers (e.g., graphic designers, videographers, and writers).

**Step 5: Adoption and implementation intervention.** This step focuses on program adoption and implementation (including consideration of program sustainability). Of course, considerations for program implementation actually begin as early as the needs assessment and are revisited in this step. The step requires the process of matrix development exactly like that in Step 2 except that these matrices are developed with adoption and implementation performance objectives juxtaposed to personal and external determinants.

**Step 6: Evaluation intervention.** This step finalizes an evaluation plan that has actually started in the needs assessment and is developed along with the intervention map. In the process of Intervention Mapping, planners make decisions about change objectives, methods, strategies, and implementation. The decisions, although informed by theory and evidence from research, may still not be optimal. Through effect and process evaluation, planners can determine whether decisions were correct or could be improved at each mapping step. To evaluate the effect of an intervention, researchers analyze the change in health and quality of life problems, behavior and environment, and determinants of performance objectives. All these variables have been defined in a measurable way during the preceding steps. This

thesis focuses on the development of a behavioral HIV prevention intervention, i.e. up to Step 4. Step 5 and Step 6 are not conducted within the scope of this thesis.



**Figure 1.2** | Intervention Mapping protocol. (source: ref. <sup>59</sup>)



## 1.5 | STUDY FIELDS ACROSS MAINLAND CHINA

The current HIV epidemic comprises largely of two affected populations: former blood and plasma donors in Henan and neighboring provinces,<sup>40</sup> and intravenous drug users in Yunnan, Guangxi and along drug-trafficking routes (Figure 1.3).<sup>60</sup> China functions as a transit route for drug smuggling in Asia due to its geographic location. Opium, heroin and other illicit drugs enter mainland China from the Golden Triangle region, Golden Crescent and other borders.<sup>61</sup> The trafficking routes of Golden Triangle lead out of Myanmar into Yunnan, and then go east to Nanning and Guangzhou or Hong Kong, or north to Urumchi through Sichuan. Also, new data suggest that HIV infection is dramatic increase in populated cities in China, where a big proportion of the general population is internal migrants originate from geographically disparate rural areas, and where open dialogue on sexual issues is much more common than most conservative parts of the country<sup>36</sup>.

In this thesis, the field studies firstly start among health care workers in two tertiary hospitals in Beijing. As the capital of China, Beijing contains a great number of health care facilities and resources, including health care workers. A great number of individuals from both rural and other urban areas circumvent the paramedical, or barefoot doctor, stage and go directly to tertiary hospital or above (e.g., VIP Gao Gang) to ensure receiving good-quality care in big cities like Beijing.<sup>62</sup> As such, we selected Beijing as our study location as many health care workers in Beijing face the challenge of protecting themselves from occupational BBV infection while under the great labor load of dealing with a high number of patients with different background, including HIV. The second field study on college students was conducted across Mainland China, involving Beijing, Gansu, Shaanxi, Henan, Yunnan, Guangxi, Guangdong, Shanghai, Zhejiang, and representing all regions, i.e., East, North, Northeast, Northwest, South Central, Southwest of China. We achieved stratified cluster sampling by collaborating with on average three colleges from each province. Lastly, the field study on general internal migrants was piloted in Shenzhen city, Guangdong province. Shenzhen is one of China's biggest export cities where internal migrants account for the great majority (70%-80%) of the labor force.<sup>63</sup> As China's first special economic zone and the second busiest port in mainland China (after Shanghai), Shenzhen city has attracted abundant people from both inner rural areas and less developed cities in China, to pursue a better life with higher income. This migration population constitutes the majority of the over 10 million registered Shenzhen inhabitants. Although great effort has been made by local governmental and non-governmental organizations to prevent conventional high risk subgroups within internal migrants (e.g., migrant MSM and migrant FSW), the information on sexual behavior and HIV prevention reaching among general internal migrants in Shenzhen is important as described before, and still lacking, which is why this group is also included in the work described in this thesis.



**Figure 1.3** | The geographic distribution of cumulative reported HIV infection in mainland China, 2007 (source: ref.<sup>40</sup>).

## 1.6 | THE AIM AND OUTLINE OF THIS THESIS

The overall aim of this thesis is to contribute to the development of effective preventive measures against HIV infections in different neglected high risk populations in China (i.e., health care workers, college students and general internal migrants). The specific research questions addressed are:

1. What are risk factors of HIV infections in health care settings?
2. What are important determinants of sexual risk behaviors leading to HIV infections in high-risk general population groups?
3. What can be learnt from evaluations of previous HIV prevention interventions?
4. Which elements should effective and practical behavioral HIV prevention interventions targeting high risk general population groups contain?

This thesis consists of two parts. Chapter 2, 3 and 4 focus on behavioral risk factors and determinants. **Chapter 2** addresses research question 1. Using data from a cross-sectional survey, we explore both risk and preventive factors of blood borne virus infections, including HIV infections, in particular the determinants of compliance with standard precautions, among HCWs in hospital settings. **Chapters 3 and 4** address research question 2. **Chapter 3** describes an investigation of socio-cognitive and socio-environmental determinants of risky sexual behavior and condom use among college students. **Chapter 4** describes an investigation of socio-cognitive and situational determinants of condom use among general internal migrants.

Chapters 5-8 form part II of the thesis, the step from determinants to interventions. **Chapter 5** involves research question 2 and 4, dealing with a Delphi study aimed at identifying the most important and changeable determinants of condom use, as well as identifying the most effective and feasible intervention methods to increase condom use from an expert perspective. **Chapter 6** focuses on research question 3, investigating the effectiveness of previous HIV prevention interventions through a systematic review and meta-analysis. **Chapter 7** addresses research questions 3 and 4, evaluating the reach of previous condom promotion interventions by integrating evidence from two cross-sectional surveys. **Chapter 8** describes stigmatized opinions and attitudes of HCWs towards their co-workers and patients with HIV, in order to address research question 3 in health care settings.

This thesis generally follows the order of steps of the Intervention Mapping(IM) protocol. A summary of main findings and the application of IM, together with recommendations for further research and practice, are provided in **Chapter 9**.

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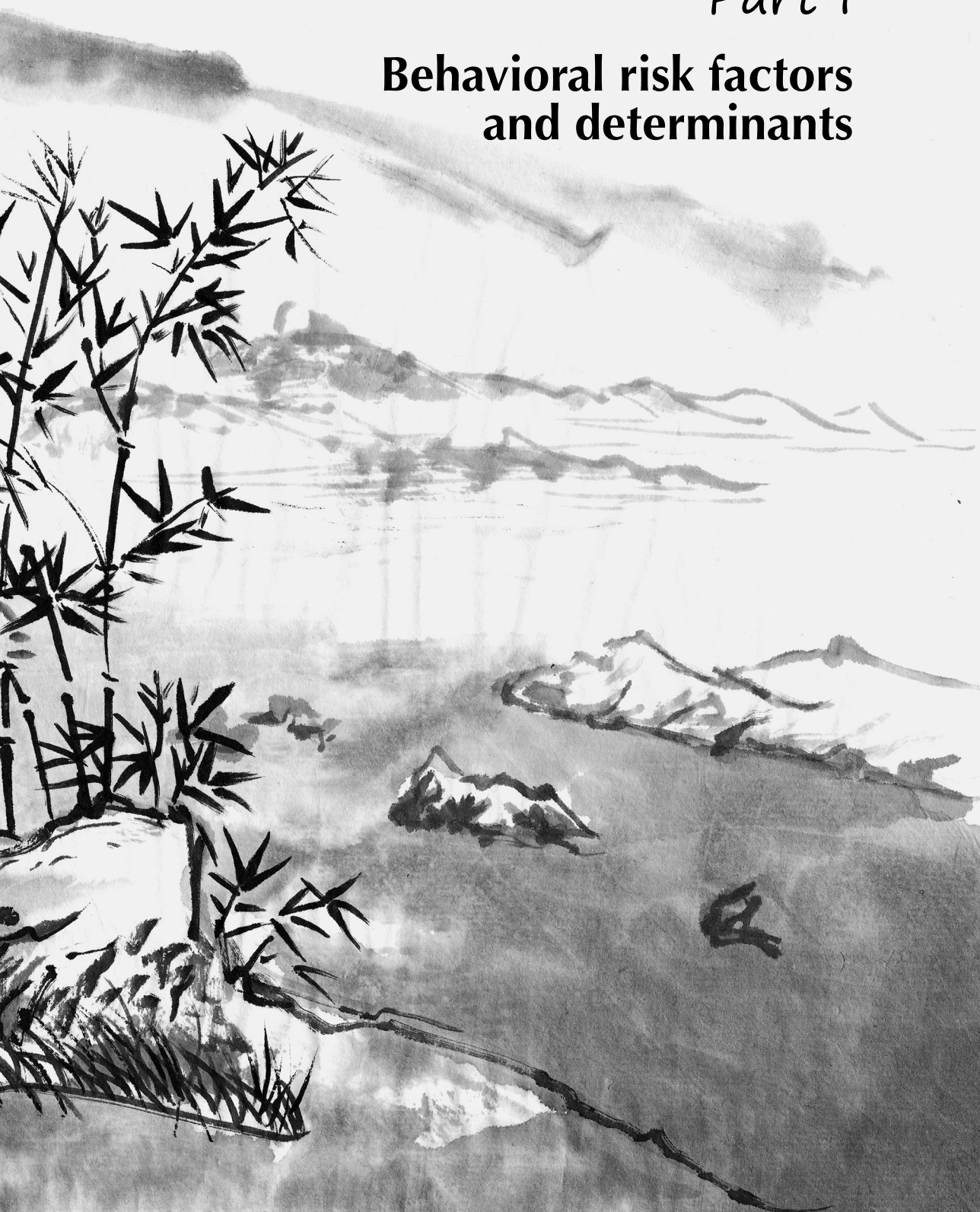






*Part 1*

**Behavioral risk factors  
and determinants**







## Chapter 2

# Occupational exposure to blood and compliance with standard precautions among healthcare workers in Beijing, China

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## **ABSTRACT**

### **Background**

Healthcare workers (HCWs) are at significant risk of blood borne viruses (BBV) infection. While the China's Standard Precautions (SP) was issued in 2004, less is known about the extent of occupational blood exposure and compliance with SP among HCWs in China.

### **Methods**

A questionnaire-based survey of 374 HCWs (96 doctors, 235 nurses and 43 technicians) was conducted in two hospitals in Beijing. A mass-action model was used to estimate the risk of BBV infection, and linear regression analyses were performed to identify correlates of compliance with SP.

### **Results**

More than 80% of all HCWs reported having at least one percutaneous injury in their working lifetime and an average of two blood exposure episodes in the preceding year. In a virtual cohort of 100 HCWs, 22 doctors, 39 nurses and 13 technicians would have contracted HBV after 10 years without vaccination. Overall the respondents were following an average of 5.3 of the 8 precautionary guidelines (95%CI: 5.1-5.5). Compliance was higher among nurses, workers having less exposure episodes and awareness of SP.

### **Conclusions**

The high level of occupational blood exposure and suboptimal compliance with SP highlights the urgent need for interventions to prevent HCWs from unnecessary BBV infection.

## INTRODUCTION

Healthcare workers (HCWs) are at a high risk of occupational exposure to blood, and thus infection with blood borne viruses (BBV), such as Hepatitis B Virus (HBV), Hepatitis C Virus (HCV) and Human Immunodeficiency Virus (HIV).<sup>1</sup> Risk of transmission of BBV has been related to occupational injuries and frequency of exposure during medical practices. According to WHO, nearly 2.5% of HIV infection and 40% of HBV and HCV infection worldwide were the results of occupational exposure among HCWs in 2002.<sup>2</sup>

An exposure that might place HCWs at risk for BBV infection is defined as a percutaneous injury (PI) (e.g., a needle stick or cut with a sharp object) or the contact of mucous membrane or non-intact skin (e.g., exposed skin that is chapped, abraded, or afflicted with dermatitis) with blood, tissue, or other body fluids that are potentially infectious.<sup>3</sup> A study among 311 American emergency medical services indicated that nearly all reported exposures and were concerned about risk of HIV and hepatitis.<sup>4</sup> In Uganda, only 18% of nurses had never had a needle stick injury in their career.<sup>5</sup> According to WHO, approximately 3 million percutaneous exposures to blood occur annually among 35 million HCWs worldwide, which were estimated to result in 16,000 HCV, 66,000 HBV, and 200 to 5000 HIV infections.<sup>2</sup> Occupational exposure to blood especially poses a serious threat to HCWs in countries with a high prevalence of BBV, such as China. By the end of 2011, China had 780,000 people living with HIV,<sup>6</sup> and the prevalence of HCV infection was 1.95% in China's community residents.<sup>7</sup> The prevalence of HBV was even higher, with 42.4% of adults having evidence of HBV exposure and 7.18% of the entire populations being chronically infected in 2006.<sup>8</sup> Despite the fierce epidemic of BBV and a great number of HCWs in China (860,000 in rural and 106,100 in urban in 2007),<sup>9</sup> it is surprisingly to realize that data concerning the extent of occupational exposure of HCWs to blood is rarely available at both national and local levels.<sup>10</sup> Moreover, to the best of our knowledge, the risk of BBV infection due to occupational blood exposure has not been quantified and reported among HCWs in China.

Internationally, following Standard Precautions (SP)[previously universal precautions (UP)] has been regarded as fundamental in the control and prevention of occupation risk to BBV infection.<sup>11</sup> The initiative of infection control precautions emerged in the US and was rapidly adopted and modified for use in other countries.<sup>12</sup> The concept was changed from UP to SP since 1996 in the US, 1996 in Canada, and recommended in other countries.<sup>13</sup> In China, the SP currently related to the official guideline on Occupational Protection from HIV Exposure for Healthcare Workers, which was issued in June 2004.<sup>14</sup> Similar to SPs in other countries, the guideline promotes basic infection control practices, including the use of personal protective equipment (PPE), the safe use and disposal of sharps, decontamination of equipment and the environment and waste management, aimed at preventing contamination by blood and specific body fluids from all patients.<sup>10</sup> However, the application of SP has not been forced by public authorities in many countries, including China, and previous studies

worldwide suggest that compliance with SP among HCWs is internationally suboptimal.<sup>2,13</sup> Despite the general belief that the severe acute respiratory syndrome (SARS) outbreak of 2003 have heightened awareness of HCWs on workplace health hazards and precautionary approaches,<sup>15</sup> many past evidences indicated the adherence to SP was still low overall, and compliance with specific aspects of SP very varies in China.<sup>16,17</sup>

Six years after issuing the China's SP by the Ministry of Health in China, we conducted a survey aiming to describe the extent of occupational blood exposure and the compliance with SP of HCWs in China. We also quantified the risk of BBV infection due to the exposure and identified correlates of protective compliance. The updated information will be of interest to develop further regulations regarding occupational blood exposure and design programs to promote the occupational safety of HCWs in China.

## **METHODS**

### **Study design and setting**

A cross-sectional survey of HCWs was conducted in two Chinese tertiary hospitals from May to June, 2010. The two tertiary hospitals are state-owned, general-referral hospitals in Beijing. According to the current classification of hospitals in China, tertiary hospitals are graded as top hospitals beside national specialized hospitals, based on their levels of medical services and management, health care quality and safety, medical technology and efficiency.<sup>18</sup>

### **Study population**

Doctors, nurses and technicians who are employed by either of the two hospitals and likely to be in contact with blood, needles and sharps were invited to participate in the survey. Internship students and people employed on a trial basis, however, were not studied. Considering possibilities of occupational exposure to blood among different clinical departments, most of the study population was invited from the following departments: internal medicine, surgery, obstetrics and gynecology, infectious diseases, and the laboratories. The term 'doctors' refers to those registered with a medical license (including dentists). 'Nurses' refers to general nurses or auxiliary nurses, 'technicians' refers to laboratory technicians, assistant technicians and multipurpose support workers. Participants were informed verbally of the aims of the survey and provided their answers completely voluntarily.

### **Measures**

The survey involved the self-administration of an anonymous written questionnaire. The HCWs were asked questions regarding the following three topics: 1) socio-demographic characteristics: age, sex, hospital site, working department, job category, and job grade (e.g., senior, junior) as determined by their employers; 2) occupational exposure to blood: experience on percutaneous injury (yes/no), exposure of mucous membrane and non-intact

skin during work lifetime (yes/no), and number of exposure episode(s) during the previous year; and 3) compliance with SP: awareness of SP (yes/no), training experience on SP (yes/no), and engagement in eight protective behaviors related to the practice of SP (yes/no, those eight behaviors were in a consensus worldwide<sup>12,19,20</sup>). Each protective behavior was assumed weighs equally to general compliance, and scored '1' if the answer was 'yes', scored '0' if the answer was 'no'. A compliance score presenting the extent of individual compliance was calculated as the sum of the scores for the eight protective behaviors of SP (ranges from 0 to 8). Higher compliance score indicates better compliance to SP.

The questionnaire was developed based on the identified possible occupation exposures to blood<sup>3</sup> and the framework of Chinese SP.<sup>14</sup> The content of the questionnaire was improved after a pilot survey and two round-table meetings in January and February, 2010. Investigators had been trained uniformly by two of the authors (X.S. & Y.W) before their field survey. People who did not wish to participate were asked to return the questionnaire unanswered.

### Data analysis and statistics

All analyses were performed using SPSS version 20.0. One-way analysis of variance with Chi-Square and Analysis of variance (ANOVA) was used to test for differences in demographic, blood exposure and compliance factors among three job categories. Univariate and multiple linear regression analyses were conducted to study possible correlates of compliance score, including demographical characteristics, blood exposure and other possible factors (awareness and training history). We performed Univariate analyses before multivariable analyses, and only variables with a Univariate *P*-value <0.2 were tested in the multivariable analysis.<sup>21</sup>

A simple mass-action model was adjusted and used to calculate the risk of occupational BBV infection (HIV, HBV, and HCV) attributable to PI among the HCWs for 1000 person years. The model was adapted from work done by the WHO on the burden of disease caused by unsafe injection practices in developing countries.<sup>12,22</sup> The equation in the model is as follow:

$$P(I) = 1 - (1 - P(s) \times P(t) \times P(e))^n,$$

where *P(I)* is the probability of an individual becoming infected each year. *P(s)* is the probability that the individual is susceptible to the organism. *P(t)* is the probability that the organism will be transmitted given the injured area is contaminated with infectious blood. *P(e)* is the probability that the individual is exposed to contaminated injection equipment, which equals the prevalence of the organism times the proportion of unsafe injections, and *n* is the number of exposures that an individual receives in one year.

## RESULTS

### Demographic information

Of the 422 questionnaires distributed, 391 (92.7%) were returned to the investigators and 374 (88.6%) had been completed. The average age of the HCWs was 36.2 years (range: 19-64 years) and the majority were female (84.0%). For all analyses we reduced job categories into three major categories: doctors (25.7%), nurses (62.8%) and technicians (11.5%). The majority (62.8%) of the respondents were nurses (Table 1). The composition of job categories varies regarding participants' sex, age and grade ( $P<0.001$ ). Although the total number of respondents was nearly the same for both hospitals (47.6% and 52.4% respectively), there was a statistically significant difference in the composition of job categories between the two hospitals ( $\chi^2=72.7$ ,  $P<0.001$ ).

**Table 1** | Socio-demographic characteristics and basic information on healthcare workers, by job category

Characteristics		Doctors		Nurses		Technicians		Total		$\chi^2$	<i>P</i>
		<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		
<b>Total</b>		96	25.7	235	62.8	43	11.5	374	100		
<b>Sex</b>	Male	43	11.5	5	1.3	12	3.2	60	16	97.2	<0.001
	Female	53	14.2	230	61.5	31	8.3	314	84		
<b>Age (years)</b>	18-30	38	10.2	94	25.1	3	0.8	135	36.1	54.7	<0.001
	31-40	36	9.6	75	20.1	6	1.6	117	31.3		
	41-50	17	4.5	55	14.7	20	5.3	92	24.6		
	51 or older	5	1.3	11	2.9	14	3.7	30	8.0		
<b>Grade</b>	Junior	38	10.2	166	44.4	4	1.1	208	55.6	88.5	<0.001
	Middle	42	11.2	68	18.2	34	9.1	144	38.5		
	Senior	16	4.3	1	0.3	5	1.3	22	5.9		
<b>Workplace</b>	Hospital-1	77	20.6	98	26.2	3	0.8	178	47.6	72.7	<0.001
	Hospital-2	19	5.1	137	36.6	40	10.7	196	52.4		

### Episodes of occupational exposure to blood

In response to questions regarding different types of occupational exposure to blood, 82.1% reported experienced PI during their working lifetime (Table 2). Almost all of the nurses (90.6%) reported that they have had a PI during their working lifetime, and the leading cause was injuries by hypodermic needles (75.7%) and syringe needles (56.6%). Of all HCWs, 21.1% reported had exposure to blood on mucous membranes, while 48.7% had experienced exposure by contact of non-intact skin, mainly through damaged skin on their hands (43.0%). The mean number of episodes of occupational blood exposure for all HSWs was 1.9 during the previous year (95%CI: 1.7-2.1). There was a statistically significant difference between the types, as well as the number, of blood exposure episodes experienced by HCWs in different job category ( $P<0.001$ ).



## Risk of blood borne virus infection attributed to percutaneous injury

The assumptions underlying the mass-action model in the Chinese context are stated in Table 3.<sup>6-8,10,22-25</sup> For cohorts of 100 doctors, 100 nurses and 100 technicians followed for 10 years (Figure 1): approximately 1 doctor, 2 nurses and 1 technician would be occupationally infected with HCV; approximately 4 doctors, 7 nurses and 2 technicians would be infected with HBV; and none would be infected with HIV (assuming the current rate of percutaneous injuries and assuming that hepatitis B vaccination is maintained). However, if none of them were vaccinated against hepatitis B, 22 doctors, 39 nurses and 13 technicians would be occupationally infected with HBV over 10 years.

**Table 2** | Occurrence of healthcare workers reporting occupational exposure to blood by job category

Occupational Exposure to Blood	Doctors (N=96)		Nurses (N=235)		Technicians (N=43)		Total (N=374)		$\chi^2$	P
	N	%	N	%	N	%	N	%		
<b>Percutaneous exposure</b>	69	71.9	213	90.6	25	58.1	307	82.1	35.3	<0.001
Surgical scalpel	21	21.9	10	4.3	3	7.0	34	9.1	25.9	<0.001
Suture needle	39	40.6	17	7.2	3	7.0	59	15.8	60.0	<0.001
Acupuncture needle	17	17.7	54	23.0	7	16.3	78	20.9	1.8	0.414
Hypodermic needle	35	36.5	178	75.7	14	32.6	227	60.7	60.2	<0.001
Syringe needle	15	15.6	133	56.6	4	9.3	152	40.6	67.2	<0.001
Others	6	6.2	26	11.1	6	14.0	38	10.2	2.5	0.287
<b>Mucous membrane exposure</b>	28	29.2	49	20.8	2	4.6	79	21.1	17.7	0.008
Eyes	26	27.1	46	19.6	2	4.7	74	19.8	9.4	0.009
Mouth	4	4.2	4	1.7	1	2.3	9	2.4	1.6	0.450
<b>Non-intact skin exposure</b>	37	38.5	135	57.4	10	23.3	182	48.7	24.7	<0.001
Hands	32	33.3	121	51.5	8	18.6	161	43.0	21.0	<0.001
Other areas of the body	10	2.7	42	11.2	3	0.8	55	14.7	5.3	0.069
<b>Exposure episodes per person during last year</b> (Mean, 95%CI)	1.6(1.4-1.8)		2.2(1.9-2.5)		1.2(1.0-1.3)		1.9(1.7-2.1)		6.6	0.001

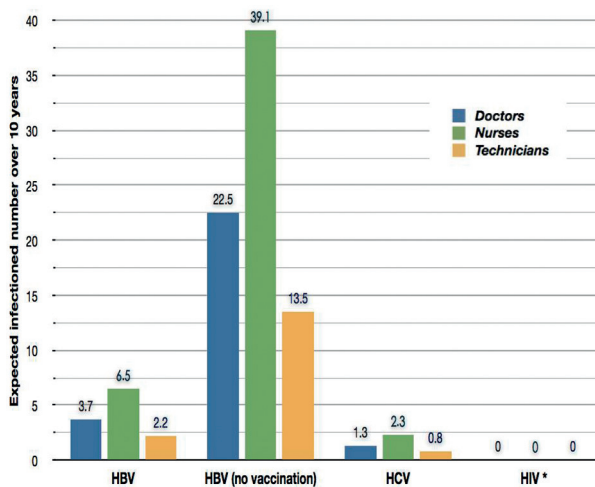
## Compliance with Standard Precautions

Less than a half of all HCWs indicated that they were aware of the China's SP or the guideline of infection control precautions (46.8%), and only 43.6% had ever been trained on related knowledge (Table 4). Of all HCWs, 80.5% protected themselves against the blood of patients, and almost all respondents reported that they washed their hands after removing disposable gloves (96.8%). However, only 24.0% of doctors and 11.6% of the technicians correctly practiced procedures regarding the disposal of sharp objects. In general, self-reported compliance with regard to the wearing of PPE<sup>26</sup> other than gloves, including masks, eye protection and aprons, was low in all job categories (less than 50%). Overall, the HCWs in this survey followed an average of 5.3 of the 8 guidelines (95%CI: 5.1-5.5).

**Table 3** | Assumptions underlying the estimation of risk of occupational blood borne virus (BBV) infection in a mass-action model

Variables	Assumptions
Probability that the individual is susceptible to HIV and HCV	– Susceptibility is the following: 1- population prevalence of the disease – Population prevalence for HIV is 0.06% <sup>6</sup> and for HCV is 1.95% <sup>7</sup>
Probability that the individual is susceptible to HBV	– Susceptibility is the following: (proportion vaccinated × [1-vaccine efficacy])+ (proportion not vaccinated × proportion with no natural immunity) – Proportion vaccinated against (at least 1 dose) HBV was (85.2% for HCWs) <sup>10</sup> – Hepatitis B vaccine efficacy is 98% <sup>23</sup> – 1.92% HCWs are HBsAg +ve and 5.23% HCWs are HbC antibody +ve, thus the proportion of HCWs with natural immunity is 7.15% (1.92%+5.23%) based on a study in Chinese HSWs <sup>8</sup> – Thus, susceptibility to HBV is 15.4%, while 92.8% if no one was vaccinated
Probability that the organism will be transmitted	– The transmission efficiency was assumed to be the same as for needle stick injuries in HCWs. – Median values are 30% for HBV, 6% for HCV and 0.3% for HIV <sup>22,24</sup>
Prevalence of HBV, HCV, and HIV	– Prevalence of HBV (HBsAg +ve) is 7.18%, <sup>25</sup> HCV is 1.95%, <sup>7</sup> and HIV is 0.06% <sup>6</sup>
Proportion of unsafe percutaneous injuries	– All percutaneous injury exposures here are assumed to be unsafe. The proportion for doctors was 71.9%, 90.6% for nurses and 58.1% for technicians
Number of exposure episodes	– The mean number of occupational blood exposure in the past year was 1.57 doctors; 2.18 nurses; 1.16 technicians

<sup>†</sup>HCWs, healthcare workers; HBV, hepatitis B virus; HCV, hepatitis C virus; HIV, human immunodeficiency virus; PI, percutaneous injury; HBsAg, hepatitis B surface Antigen; HbC antibody, hepatitis B core antibody.



\* 0.002 doctors, 0.004 nurses and 0.001 technicians were expected for HIV infection

**Figure 1** | Expected number of HBV, HCV, and HIV infections over 10 years among cohorts (n=100) of doctors, nurses and technicians.

**Table 4** | Self-reported compliance of healthcare workers with components of Universal Precautions, by job category.

Items	Doctors (N=96)		Nurses (N=235)		Technicians (N=43)		Total (N=374)		$\chi^2$	P
	N	%	N	%	N	%	N	%		
<b>General information</b>										
I have awareness of the universal precautions	50	52.1	103	43.8	22	51.2	175	46.8	2.2	0.327
I have been trained on the universal precautions	43	44.8	97	41.3	23	53.5	163	43.6	2.3	0.320
<b>Protective behavior</b>										
I protect myself against the blood and body fluids of all patients, regardless of their diagnosis	80	83.3	192	81.7	29	67.4	301	80.5	5.4	0.068
I wash my hand after removing disposable gloves	89	92.7	232	98.7	41	95.3	362	96.8	7.7	0.021
I wear double-layer glove when I have broken skin in my hand and there is possibility of exposure to blood or other body fluids	74	77.1	173	73.6	33	76.7	280	74.9	0.5	0.769
I put needles and other sharp objects into the designated sharp container	23	24.0	171	72.8	5	11.6	199	53.2	98.9	<0.001
I wear gloves whenever there is possibility of exposure to blood or blood fluids	85	88.5	211	89.8	27	62.8	323	86.4	23.0	<0.001
I wear a mask whenever there is possibility of exposure to blood or blood fluids splashing in my face	52	54.2	135	57.4	19	44.2	206	55.1	2.6	0.269
I wear eye protection (glasses) whenever there is possibility of exposure to blood or blood fluids splashing in my face	37	38.5	92	39.1	21	48.8	150	40.1	1.6	0.460
I wear a waterproof apron whenever there is possibility of exposure to blood fluids splashing on my clothes	37	38.5	93	39.6	23	53.5	153	40.9	3.2	0.201
<b>Compliance score (Mean, 95%CI)</b>										
	5.0(4.7-5.3)		5.5(5.3-5.7)		4.6(4.0-5.2)		5.3(5.1-5.5)		8.3	<0.001

Multivariate linear regression analyses of compliance scores (Table 5) demonstrated that HCWs in hospital\_2 have higher overall compliance than people in hospital\_1 (5.58, 95%CI: 5.32-5.83 compared with 4.95, 95%CI: 4.74-5.16). Of the three job categories, nurses showed the highest levels of compliance (5.53 for nurses, 95%CI: 5.32-5.73; 4.97 for doctors, 95%CI: 4.66-5.27 and 4.60 for technicians, 95%CI: 4.03-5.18). There was a

positive association between compliance score and having experienced PI during their working lifetime ( $\beta=0.51$ ,  $P=0.021$ ), awareness of UP ( $\beta=0.45$ ,  $P=0.016$ ) and training history on SP ( $\beta=0.42$ ,  $P=0.025$ ). There was a negative association between compliance score and the number of exposure episodes ( $\beta=-0.11$ ,  $P=0.007$ ). The multivariable model explained 14.0% of the variance in compliance.

**Table 5** | Correlates of compliance to Universal Precautions with linear regression models.

Predictor	Compliance		Univariate		Multivariate ( $R^2=0.14$ )	
	Score	95%CI	Coefficient	95%CI	Coefficient	95%CI
<b>Social demography</b>						
Sex						
Male	4.93	4.52-5.34	-0.41	-0.86-0.04 <sup>a</sup>	0.11	-0.38-0.60
Female	5.34	5.16-5.53	-	-		
Age						
18-30	5.21	4.95-5.47	-0.29	-0.95-0.36		
31-40	5.31	5.03-5.60	-0.18	-0.85-0.48		
41-50	5.26	4.87-5.66	-0.24	-0.92-0.45		
51 or older	5.50	4.86-6.14	-	-		
Grade						
Junior	5.33	5.11-5.55	0.56	-0.17-1.29 <sup>a</sup>	0.23	-0.51-0.96
Middle	5.28	5.00-5.55	0.51	-0.24-1.25 <sup>a</sup>	0.14	-0.57-0.85
Senior	4.77	3.95-5.59	-	-		
Workplace						
Hospital-1	4.95	4.74-5.16	-0.63	-0.96- -0.30 <sup>b</sup>	-0.94	-1.29- -0.58 <sup>b</sup>
Hospital-2	5.58	5.32-5.83	-	-		
Job category						
Doctors	4.97	4.66-5.27	0.36	-0.22-0.95	1.02	0.41-1.63 <sup>b</sup>
Nurses	5.53	5.32-5.73	0.92	0.40-1.45 <sup>b</sup>	1.24	0.65-1.83 <sup>b</sup>
Technicians	4.60	4.03-5.18	-	-		
<b>Occupational blood exposure</b>						
Percutaneous exposure						
Yes	5.38	5.20-5.56	0.58	0.14-1.01 <sup>b</sup>	0.51	0.08-0.94 <sup>b</sup>
No	4.81	4.38-5.24	-	-		
Mucous membrane exposure						
Yes	5.43	5.11-5.75	0.19	-0.22-0.60		
No	5.24	5.04-5.43	-	-		
Non-intact skin exposure						
Yes	5.34	5.11-5.58	0.13	-0.2-0.47		
No	5.21	4.98-5.45	-	-		
Exposure episodes	5.28	5.11-5.45	-0.07	-0.15-0.01 <sup>b</sup>	-0.11	-0.19- -0.03 <sup>b</sup>
<b>Other possible factors</b>						
Awareness of SP						
Yes	5.56	5.31-5.81	0.53	0.20-0.86 <sup>b</sup>	0.45	0.08-0.81 <sup>b</sup>
No	5.03	4.81-5.25	-	-		
Training history on SP						
Yes	5.56	5.31-5.81	0.50	0.16-0.83 <sup>b</sup>	0.42	0.05-0.78 <sup>b</sup>
No	5.06	4.84-5.28	-	-		

<sup>a</sup>  $P<0.2$ ; <sup>b</sup>  $P<0.05$ .

## DISCUSSION

This study finds a high level of occupational exposure to blood and describes the consequent risk of BBV infection and overall suboptimal compliance with China's Standard Precautions among a group of HCWs (including nurses, doctors and technicians) in two hospitals in Beijing, China.

In this study we investigate both risk and prevention comprehensively with regard to the occupational safety of HCWs in the area of blood exposure to BBV. Besides measuring the level of occupational blood exposure and compliance with SP in detail, we identify determinants influencing blood exposure and compliance behavior to provide information for further interventions. In addition, we quantify the risk of occupational BBV infection in our respondents by using a mass-action model. The findings of our study, however, need to be interpreted with some caution. Retrospective self-reporting of occupational exposure is liable to recall bias, possibly leading to under reporting of actual exposure.<sup>27</sup> Also, many parameters in estimating the risk of BBV infection were not covered by this study, such as the HBV vaccination coverage of HCWs, but extracted from government reports<sup>6,25</sup> and other studies in China,<sup>8,10</sup> which could be different in this study sample. In terms of compliance with SP, actual adherence might be lower than reported because HCWs tend to overestimate the extent to which they comply with SP in practice,<sup>28</sup> and social desirability could also have influenced their responses.<sup>29</sup> Lastly, the respondents came from tertiary hospitals where health care quality and safety are considered to be higher than in general hospitals in Beijing. The study's sample is therefore not representative of all HCWs in China and the findings may not be generalized. On the other hand, however, the high level of risk and insufficient precautions taken in the tertiary hospitals as well as the likelihood of under reporting of exposure and over reporting of compliance reflect an urgent need for interventions to improve the occupational safety of HCWs nationally.

Among the three job categories of HCWs, nurses were identified to be at the highest risk of experiencing PI during their working lifetime and to have the highest average number of episodes during the preceding year. These findings are in line with similar studies conducted in other countries.<sup>10,30,31</sup> The percentage of nurses who reported having experienced PI during their working lifetime in our study is 90.6%, which is much higher than the percentage found in a similar study in the US (48%).<sup>32</sup> However, our findings were comparable to those of a study conducted in India (90%).<sup>31</sup> In accordance with another study in Beijing,<sup>10</sup> suture needles are the major source of PI for doctors. Nurses however experienced PI mainly from hypodermic and syringe needles. This difference makes sense considering the occupational assignments for HCWs in different job categories in China. Comparison, however, of the percentages and numbers of occupational exposures to blood reported in different studies is difficult because there is considerable variability in a range of critical factors, including the samples' demography characteristics, the method of data collecting, and the extent of involvement in risky procedures.<sup>31</sup>

Results on the estimated risks of HIV and HCV infection were similar to the quantified risks for HCWs in India.<sup>31</sup> But the risk of HBV infection estimated in this study was about 3 times higher than that in India. The difference is mainly due to the fact that HBV was more prevalent in China and the individual susceptibility probability in China was higher than it was in India during the same years.<sup>8,23-25,31</sup> In addition, the estimation is based on the prevalence of BBV infection in the general population. However, the prevalence of BBV infection among patients in hospitals is normally higher than it is among the general population. Thus the need to promote widespread adoption of safer practices to prevent BBV, including HIV, infection should not be neglected.

It is of concern that compliance with SP concerning the use of PPE (mask, eye protection, waterproof apron) is poor (less than 50%). This suboptimal level of compliance was also found in similar studies of HCWs conducted in the US<sup>33</sup> and India.<sup>12</sup> Together with the high level of occupational exposure to blood and potential consequent risk of BBV infection, the suboptimal compliance with SP highlights the urgent need for interventions to enhance the occupational safety of HCWs and prevent them from unnecessary BBV infection. By identifying a negative correlation with the compliance score, we have confirmed the assumption that promoting compliance with SP is associated with decreasing occupational blood exposure. To improve the compliance of HCWs with SP in China, the found positive correlates of compliance indicates that it is necessary to increase awareness and training coverage among HCWs. The description of various aspects of blood exposure and practices of SP in this study provides useful information for developing specific messages to meet a particular need of HCWs in a different job category. For example, the study reveals that doctors should pay closer attention to the prevention of blood exposure from suture needles. In addition, one of the hospitals appears to be more compliant with SP than the other. Previous studies suggest that this difference may be due to a more favorable physical environment at one of the hospitals.<sup>13,34,35</sup> For example, the availability of a sufficient supply of PPE is necessary for developing the safety climate within the workplace of HCWs and improving individual compliance. Finally, the final predication model only explained 14.0% of the variance in compliance. This may be because of many other psychosocial factors, such as risk perception, attitudes, self-efficacy and social norms,<sup>36</sup> which were not included in the model. Following one of the behavior change models, such as the Theory of Planned Behavior,<sup>37</sup> may offer a way to reinforce them in a structured manner.<sup>38</sup>

To prevent HCWs from experiencing occupational exposure to blood and unnecessary BBV infection in China, a range of initiatives besides promoting SP adherence should be next steps, such as improving surveillance and reporting systems for occupational health in hospitals, and establishing an effective response system within different departments, including instant action and long-term monitoring.<sup>16</sup>

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## Chapter 3

# Determinants of risky sexual behavior and condom use among college students in China

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**ABSTRACT**

The purposes of this study were to assess sexual behavior and condom use among Chinese college students, and to explore social-environmental and social-cognitive determinants associated with risky sexual behaviors within this population. A survey was conducted among 19,123 Chinese college students recruited through stratified cluster sampling. About 9% of the students reported having had sex (male=13.3%, female=5.0%, OR=2.918), 3.6% had multiple sexual partners (male=5.7%, female=1.6%, OR=3.624), and 0.9% had commercialized sex (male=1.6%, female=0.3%, OR=6.169). Only 24.8% of sexually active students had used a condom for every sexual encounter, and there was no significant difference in condom use between male students and female students. Logistic regression showed that sex (female, OR=0.769), age (older, OR=1.263), exposure to pornographic information (higher, OR=1.751), drinking (intoxication, OR=1.437), and smoking (OR=2.123-5.112) were all determinants of sexual behaviors. Path analysis showed that exposure to pornographic information, level of consumption, and sex education were important social-environmental factors of condom use. Condom use was more common among those who had greater HIV/AIDS knowledge, attitudes toward high risk behavior, self-efficacy, and intent to use a condom. Intentions were the most important and direct factor influencing condom use. The study concluded that college students are vulnerable to sexually transmitted diseases – including HIV/AIDS infection – through sexual contact. Therefore, future HIV/AIDS prevention and safer sex interventions should focus on self-protection skills and target behavior change.

## INTRODUCTION

China is experiencing one of the fastest growing HIV epidemics in the world. Compared to many other countries, the prevalence of HIV (about 0.05%) is still low in China, but the epidemic continues to expand.<sup>1</sup> Over the past few years, the main route of transmission has changed from drug injection to transmission through heterosexual intercourse. Among the 50,000 estimated new infections during 2007, 44.7% believe that they contracted the virus through heterosexual intercourse. This means sexual transmission is now the main mode for the spread of HIV.<sup>1</sup>

Young people are especially vulnerable to HIV. In China, HIV infections are concentrated in the 20-39 age group, who account for 70% of the total reported number of HIV-positive citizens. When that group is narrowed to include only those aged 20-29 years, this figure is 34.2%.<sup>1</sup> Most college students in China are 18- to 24-years-old. Premarital sex has become widely accepted among young people in China and more and more premarital sex happens due to changing attitudes toward sexual intercourse. Song's large sample survey reported that about 11.3% of college students had engaged in sexual intercourse.<sup>2</sup> Ma and colleagues showed that about 3% of college students had homosexual and/or bisexual relationships.<sup>3</sup> Tan's study even showed 6.2% of Chinese students had between three and five sexual partners.<sup>4</sup>

The major problem is that conscientiousness and self-protection skills are relatively poor among Chinese college students. Albrektsson and colleagues found that only 66.3% of male students and 55.7% of female students knew that sex with a condom significantly reduces the risk of acquiring an infection.<sup>5</sup> Of the sexually active students, 49% said that they would ask a new sexual partner about their previous partners.<sup>5</sup> Forty percent of sexually active students never used condoms.<sup>6</sup>

Intentions and self-efficacy are two important factors predicting condom-use behavior.<sup>7-12</sup> According to the Theory of Reasoned Action (TRA), the immediate cause of volitional behavior is one's intention to engage in that behavior.<sup>13</sup> Self-efficacy is proposed as an important mediator of behavior and is defined as a judgment of one's capability to accomplish a certain level of performance.<sup>14</sup> Self-efficacy is an important measurement of college students' confidence in properly using condoms and negotiating the use of condom with a potential new sex partner.<sup>15,16</sup>

The purpose of this study was to better understand the high risk behaviors related to HIV/AIDS and condom use among college students in China. The lack of research into HIV and sexual behavior among college students in China makes it difficult to develop well-informed prevention strategies for this population. Therefore, the goals of this study were:

- to assess sexual behaviors and condom use behaviors among college students in China;
- to explore the social-environmental determinants and social-cognitive determinants associated with risky sexual behaviors and condom use among Chinese college students.

## **METHODS**

### **Sample**

Nine Chinese provinces were selected, which represented the seven main geographical areas. Random sampling was conducted among colleges in the selected provinces. About three colleges were chosen from each province and cluster sampling was used to recruit students in each selected college.

### **Questionnaire**

The questionnaire for this project was designed by the work group. It included five main sections. The first section aimed to assess the respondent's personal characteristics such as age, sex, spending power, whether they smoke and drink alcohol, are exposed to pornographic information (the internet, magazines, etc.), and whether they had received sex or HIV/AIDS education. The second section was designed to assess their knowledge about HIV/AIDS using UNGASS indicators.<sup>17</sup> The higher the score achieved, the broader their knowledge. In the third section, the respondent's attitudes toward high risk sexual behaviors that can lead to the transmission of HIV/AIDS were assessed through a 5-point Likert scale, on which a higher score (ranging from 6 to 30) means stronger opposite opinion. The fourth section investigated sexual intercourse among students. In the final section of the questionnaire, the intention (with the total score ranging from 5 to 25) and self-efficacy (with the total score ranging from 5 to 25) of condom use was measured with a 5-point Likert scale, on which a higher score meant stronger intention to use condoms and higher confidence. In addition, shyness to buy condoms was assessed, on which a higher score meant more nervous and embarrassed to buy condoms.

### **Pilot study**

To evaluate the reliability and validity of the questionnaire, two tests, with a six-week interval between them, were conducted among 205 students. Results showed that the questionnaire had good reliability. Cronbach's  $\alpha$  coefficients for most sections of the questionnaire were higher than 0.7 (AIDS-related high risk behavior 0.7848, attitudes toward high risk behavior 0.7142, and intentions toward condom use 0.7690, self-efficacy of condom use 0.8412). Among 80% of the retested items, the double-test consistency was higher than 0.7, or the Spearman's correlation coefficient was higher than 0.4. The factor structure was consistent with the theoretical hypothesis and the common factors could explain 60% of the questionnaire.<sup>18</sup>

## Procedures

Before starting the study in a sampled college, approval from the campus administrative authority was obtained. All participants involved in the study were fully informed about the nature of the study, the research objectives, and the confidentiality of data by trained investigators. After this, verbal consent was obtained from the participants before they were enrolled in the study. Before putting the completed questionnaire in a hermetic box, each student answered the questionnaire individually and anonymously, so as to ensure the survey's validity.

## Data analysis

The software program EpiData 3.0 was used for data management. Statistical analyses were performed with SPSS 13.0 software. Logistic regression was used to explore the influencing factors of sexual behaviors. To investigate the association between the factors influencing condom use, path analysis was implemented to test the goodness of fit of the model using the Statistical Analysis System (SAS, Version 6.12). Covariance Analysis of Linear Structural Equations (CALIS) was performed to examine the model.

## RESULTS

A total of 19,300 college students from 30 colleges participated in the survey with 19,123 valid samples. The response rate was 99.1%. Among the valid samples, 48.7% were male and 51.3% were female. In total, 85.8% of students were of Han ethnicity, with the others a member of a Chinese minority group. Regarding the origin of the students, 38.5% were from cities and 61.5% from villages. Their average age was 20.791.5 years.

### Sexual education and HIV/AIDS knowledge

Before coming to college, 41.8% of students received sex education and 57.0% received sexually transmitted diseases (STD) and HIV/AIDS education. After college, 31.8% of students reported that they received sex education on campus, while 47.5% received STD and HIV/AIDS education on campus. As seen in Table 1, college students knew less about nontransmission route, especially about mosquito bites. As for gender difference, male students usually knew a little more than female students. The awareness percentage of male students was 10.2% higher than that of female students on "people can protect themselves from contraction HIV by using condoms."

### Sexual behavior

The average age of participants' first sexual experience was 18.9±2.1 years. Broken down by sex, males' average age was 18.8±2.2 years, and females' age was 19.2±1.9 ( $t=-4.125$ ,  $P<0.001$ ). As seen in Table 2, male students were more likely to be sexually active than female students. When sexually active students were asked about their first sexual partner, 85.3% of them said it was a person they were in love with, 9.7% said it was with a friend,

2.7% said a sex worker, and 2.4% named somebody else. Among sexually active students, 57.8% had only one sexual partner, 18.5% had two partners, 8.9% had three partners, and 14.7% had four or more partners.

**Table 1 | HIV/AIDS knowledge among college students.**

Items	Male				Female				$\chi^2$	P
	Total	N	Right	%	N	Right	%			
People can protect themselves from contracting HIV by having sex with only one faithful, uninfected partner	94.9	9118	8648	94.8	9664	9183	95.0	0.307	0.579	
People can protect themselves from contracting HIV by using condoms	84.5	9118	8184	89.8	9665	7689	79.6	372.938	<0.001	
A healthy-looking person can have HIV	79.6	9113	7338	80.5	9659	7596	78.6	10.196	<0.01	
A person can get HIV from mosquito bites	54.7	9127	5235	57.4	9661	5048	52.3	49.385	<0.01	
A person can get HIV from sharing a meal with someone who is infected	83.5	9120	7705	84.5	9666	7976	82.5	13.181	<0.001	

**Table 2 | Sexual intercourse and high risk sexual behavior among Chinese college students.**

Behavior	Male			Female			Male vs. Female			Total (%)
	N	n	%	N	n	%	$\chi^2$	P	OR (95%CI)	
Sexual intercourse	924	1211	13.3	9671	482	5.0	393.522	<0.001	2.918(2.615-3.256)	9.0
Multiple sexual partners	9238	527	5.7	9747	160	1.6	224.506	<0.001	3.624(3.029-4.335)	3.6
Homosexual intercourse	9245	86	0.9	9750	30	0.3	20.300	<0.001	3.043(2.006-4.615)	0.6
Anal sexual intercourse	9245	117	1.3	9750	38	0.4	44.973	<0.001	3.276(2.270-4.729)	0.8
Commercialized sex	9245	150	1.6	9750	26	0.3	95.028	<0.001	6.169(4.064-9.364)	0.9

### Determinants of sexual intercourse

As seen in Table 3, students who were male, older, spent more money each month, smoked, were drunk more often and exposed to pornographic material more frequently, were more likely to have had sexual intercourse.



**Table 3** | Logistic regression of influencing factors of sexual intercourse.

Variables	B	SE	Wald	df	P	OR	95CI of OR	
							Lower	Upper
Sex (1 female; 0 male)	-0.262	0.082	10.310	1	0.001	0.769	0.656	0.903
Age	0.234	0.019	158.736	1	<0.001	1.263	1.218	1.310
Exposure to pornographic information	0.560	0.028	398.092	1	<0.001	1.751	1.657	1.850
Monthly consumption	0.001	0.000	190.631	1	<0.001	1.001	1.001	1.001
Smoking (never as reference)			343.154	2	<0.001			
Sometimes	0.753	0.078	93.706	1	<0.001	2.123	1.823	2.473
Everyday	1.632	0.089	332.325	1	<0.001	5.112	4.289	6.092
Intoxication (1 yes; 0 no)	0.362	0.064	31.881	1	<0.001	1.437	1.267	1.629

Note: SE, standard error; 95%CI, 95% confidence interval;

For the regression Model,  $\chi^2=2242.891$ ,  $P<0.001$ , coefficient of determination=0.122.

### Intentions and self-efficacy of condom use

As seen in Table 4, except for “asking about past sexual experience,” there were significant differences on other items between male and female students. The rate of “discussing condom use,” “preparing condoms”, and “feeling unembarrassed to buy condoms” was higher among male students than among female students, with men’s results higher by 7.4%, 8.2%, and 12.7% points, respectively. When asked “If somebody enticed you with money to have sex, should you agree?,” two-thirds of male students said no, fewer than the 89.7% of female students. As for suggesting the use of a condom, female students had less worries and were more confident than male students, but the differences were small – between 3.0% and 7.9% points.

**Table 4** | Intention and self-efficacy of condom use among college students

Items	Total Positive (%)	Male			Female			$\chi^2$
		Yes (%)	Neutral (%)	No (%)	Yes (%)	Neutral (%)	No (%)	
Would you discuss questions about condom use with your lover?	69.9	73.7	15.9	10.4	66.3	17.2	16.5	169.4*
If having sex, would you ask about his/her sexual experience?	54.1	53.5	23.6	22.9	54.7	22.8	22.5	2.873
If having sex, would you prepare a condom in advance?	61.6	65.8	23.7	10.5	57.6	30.4	12.0	136.6*
If somebody enticed you with money to have sex, would you agree?	78.5	16.0	17.4	66.6	3.8	6.5	89.7	1506*
I would feel nervous and embarrassed to buy condoms.	20.6	45.7	27.2	27.1	60.7	24.9	14.4	572.9*

**Table 4** | Intention and self-efficacy of condom use among college students (*Continued*)

Items	Total Positive (%)	Male			Female			$\chi^2$
		Yes (%)	Neutral (%)	No (%)	Yes (%)	Neutral (%)	No (%)	
I would feel unconfident to suggest using condoms with a partner, because I would be afraid of being thought to have had a past sexual experience.	53.5	14.9	33.2	51.8	12.9	32.0	55.1	25.70*
I would feel unconfident to suggest using condoms with a partner, because I would be afraid of being thought to have a sexually transmitted disease.	63.6	11.5	26.7	61.8	9.6	25.2	65.2	27.98*
If I were to suggest using a condom to a partner, I would feel afraid of being rejected by him or her.	56.2	13.4	31.9	54.7	10.4	31.9	57.7	42.19*
If I were unsure of my partner's feelings about using condoms, I would not suggest using one.	48.9	19.9	35.2	44.9	13.6	33.7	52.8	174.6*

\*  $P < 0.001$ 

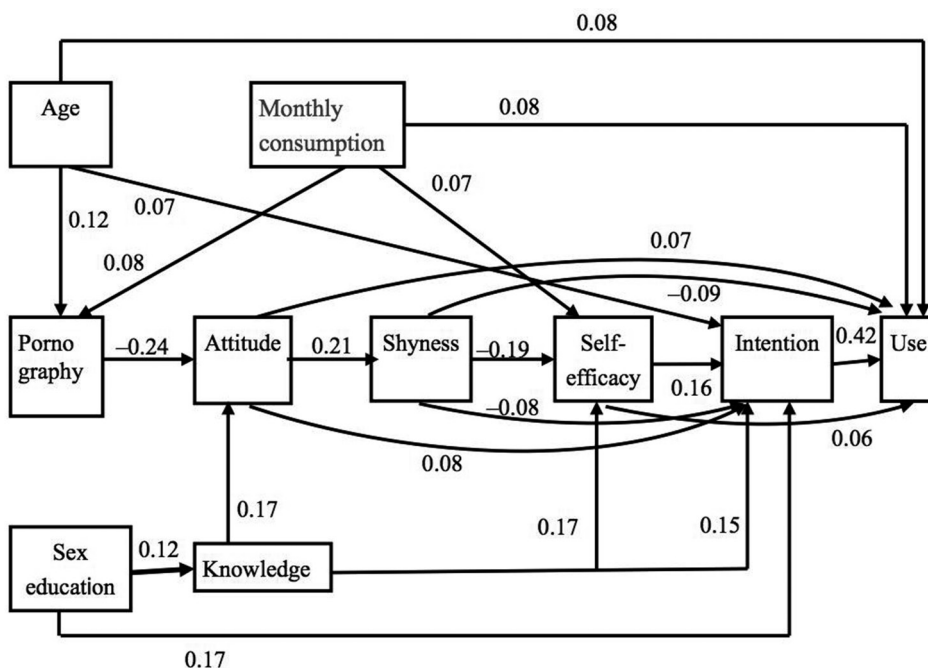
### Path analysis of determinants of condom use

During the survey, 1675 sexually active students gave information about their condom use during intercourse. Among them, 441 (24.7%) used a condom every time, 401 (23.9%) often, 561 (33.5%) sometimes, and 299 (17.9%) never. Of 1543 sexually active students who responded to the question of whether they used a condom for their last sexual intercourse, 833 (54.0%) had used a condom, and 710 (46.0%) had not. There was no significant difference between male and female students on condom use. Two hundred students gave condom use information for when they had commercialized sex, 85 (42.5%) of them used a condom every time, 28 (14.0%) often, 34 (7.0%) sometimes, and 53 (26.5%) never.

Because there was a significant difference between the male students and the female students, two path models were tested separately (Figures 1 and 2). Squared correlations ( $R^2$ ) of condom use behavior were 0.235 for the male model and 0.240 for the female model, respectively. That means nearly 24% of variance in condom use could be explained. The main indexes of goodness of fit implied the two final models fit the data well (the male model:  $\chi^2=29.971$ ,  $df=25$ ,  $P>0.2254$ , Goodness of Fit Index (GFI)=0.996, Root Mean Square Residual (RMR)=0.025, Bentler's Comparative Fit Index (CFI)=0.996; the female model:  $\chi^2=33.098$ ,  $df=32$ ,  $P>0.4133$ , GFI=0.988, RMR=0.030, CFI=0.998).

Figure 1 shows the determinants of condom use among sexually active male students. There are two main lines which show the direct or indirect effects of variables. One line (Line 1) is: with increasing age, male students were more exposed to pornographic information,

which promoted them to have more positive attitudes toward high risk behavior, reducing their nervous feelings towards buying condoms, while increasing their self-efficacy and intention to use condoms, and in turn, the frequency of condom use increased. The other line (Line 2) is: the more AIDS and general sexual education male students received, the more knowledge of AIDS they had, and this leads to higher opposition to high risk behavior and an increase self-efficacy, intentions toward and frequency of condom use. Meanwhile, AIDS and sex education can directly increase men’s intentions to use condoms.



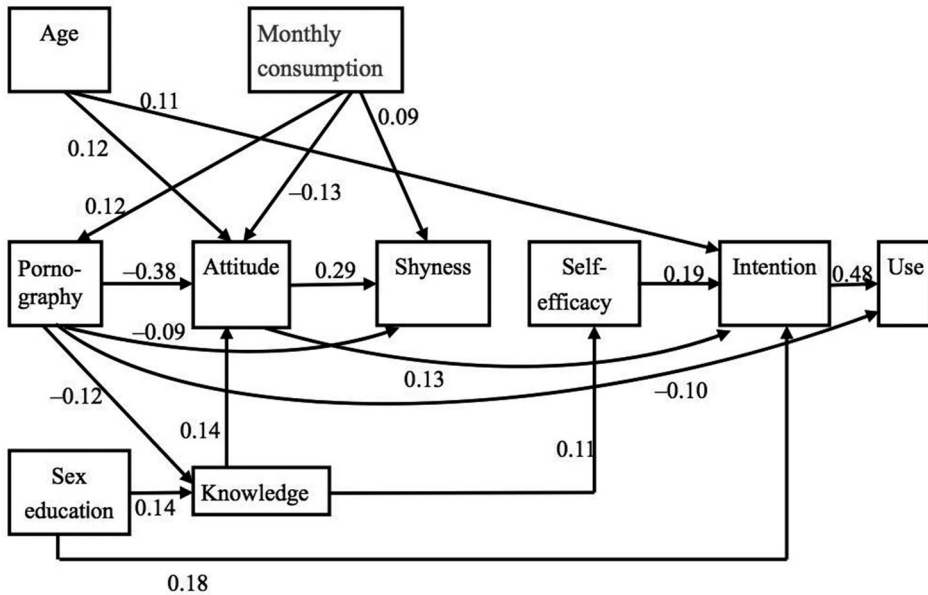
**Figure 1** | Path analysis of determinants of condom use among male college students.

Figure 2 shows the determinants of condom use among sexually active female students. The effects on Line 2 were almost identical to that of the male students, but there were significant differences on Line 1. The effects of individual monthly consumption and exposure to pornographic information among female students were stronger than those among male students.

With increased consumption, female students were exposed to more pornographic information. They had more open sexual attitudes, reported less nervous feelings towards buying condoms, and their objections to high risk behavior led to greater intentions to use condoms. However, knowledge about HIV/AIDS and frequency of condom use was less



amongst those who had greater exposure to pornography. This could indicate that some pornographic information can misguide female students to some extent. The influence of pornographic information on male students seemed to be weaker than on female students, which may be explained by the fact that almost all the male students were exposed to this kind of information.



**Figure 2** | Path analysis of determinants of condom use among female college students.

## DISCUSSION

This survey was conducted among 19,123 Chinese college students through stratified cluster sampling, so it is a large sample study with good representativeness. The results show that 9% of the students had sexual intercourse, which matches the result of Song's large sample survey (11.3%),<sup>2</sup> but is a little lower than that of Ma's study (17.6% of males and 8.6% of females)<sup>3</sup> and Huang's study (14%).<sup>6</sup> And the rates of high risk sexual behaviors were less than some small sample surveys.<sup>3,4</sup> The average age of first sexual encounter was about 19-years-old. This is very similar to results from other similar studies.<sup>3,5</sup> Although the percentage of sexually active students in China is much lower than that of other countries,<sup>19-21</sup> and even lower than that of Taiwanese students (29.5%),<sup>22</sup> sexual behaviors among young people in China have changed with the rapid development of the market economy, the wide exchange of Western and traditional cultures, and the concept of increased personal freedoms.

In this survey, we found that condom use was irregular and inconsistent. Only 24.7% of sexually active students reported using a condom every time they had sexual intercourse, a figure much lower than other studies have found, such as in Botswana (68.2%)<sup>23</sup> and Armenia (32%).<sup>20</sup> Among the 200 students who reported having commercialized sex, the rate of condom use every time was higher, at 42.5%. These findings indicate that people prefer to use a condom while having commercialized sex with a fixed partner. Other studies have shown the same results.<sup>19,24</sup> What also raises a concern is that around 20% of students did not use condoms at all, even during commercialized sex.

The results of logistic regression analysis showed that sex (male), age (older), level of consumption (higher), exposure to pornographic information (higher), drinking, and smoking were risk factors for HI high risk sexual behavior. Now, we focus on the later three factors because they are modifiable risk factors. Firstly, the relationship between heavy drinking and HIV/AIDS related high risk sexual behaviors has been identified in other studies among college students.<sup>19,20,24</sup> Excessive alcohol consumption interferes with the ability to make prudent decisions, such as engaging in safe and protected sex, and can, therefore, lead to promiscuous, irresponsible, high risk sexual behaviors. In this study, we also found a strong relationship between smoking and sexual behavior. Relatively few previous studies have looked at the association between tobacco use and sexual behavior. As for exposure to pornographic information, in this study, 57.3% of male students had watched pornographic material, and 49.3% of them had browsed pornographic websites, while only 11.4% of female students had watched pornographic material and 4.5% had browsed pornographic websites. Despite these figures, path analysis indicated that pornographic information had a more negative influence on female students. Female students exposed to more pornographic information were more inclined to engage in high risk behaviors, had less knowledge of HIV/AIDS, and used condoms less often.

Previous studies have demonstrated that young adults' risky sexual behaviors and relevant perceptions are complex and multifaceted – the result of a dynamic interaction between various social-cognitive factors, some of which include knowledge, attitudes, perceptions, and self-efficacy.<sup>9,23,25</sup> The present findings show that social-cognitive factors also influence students' choices between risky and preventative sexual behaviors. The path analysis intuitively indicated that the more sex-related and AIDS education students received, the better informed they were about HIV/ AIDS. This in turn meant they were more strongly opposed to high risk behaviors, had higher self-efficacy, more intention to use condoms, and in fact, did use a condom more frequently. Intentions were undoubtedly the most important and direct factor influencing condom use behavior. These findings suggest that, centered on these specific perceptions, attitudes and skills, future behavioral interventions among college students might be more effective.

In addition, the findings show that the decision for Chinese college students to use condoms and to discuss preventive measures with one's partner partly results from a complex web of perceptions, attitudes, and knowledge. For instance, although the majority of students reported that they would prepare a condom in advance if anticipating having sex, less than one quarter reported that they used a condom every time. This paradoxical finding has also been illustrated among college students in the USA,<sup>26</sup> the Caribbean,<sup>27</sup> and Japan.<sup>28</sup>

Female college students in this sample appeared to be active in the negotiation process, similar to descriptions of the changing sexual roles in China by Zhang and colleagues.<sup>29</sup> For instance, a gender difference was not found in reference to asking about the partner's sexual history. Furthermore, female students had more self-efficacy than male students on suggesting using a condom to a partner, because female students would not be afraid of being thought to have had past sexual experience.

### **Implications**

These results may assist health professionals working with college students in many countries, and may inform future studies of college student attitudes, self-efficacy, and practices. HIV/AIDS prevention efforts among young people should empower them with the skills needed to practice safer behaviors. This includes technical skills such as how to correctly use a condom, and social skills such as how to negotiate condom use and avoid or resolve situations that are risky. Moreover, the study indicated that some "problem behaviors" (smoking and drinking) were important influencing factors of high risk behavior, so those students who drink more often and smoke should be among the key target population, and intervention activities should pay particular attention to these students.

### **Limitations**

The privacy conditions around the study are likely to have minimized purposeful misreporting. However, the data were collected via self-report questionnaire and, therefore, students may have intentionally underreported their level of engagement in various high risk activities. Future studies should attempt to use other methods of data gathering, such as audio computer-assisted self-interviewing.

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## Chapter 4

# Exploring socio-cognitive and situational determinants of condom use among internal migrants in Shenzhen, China

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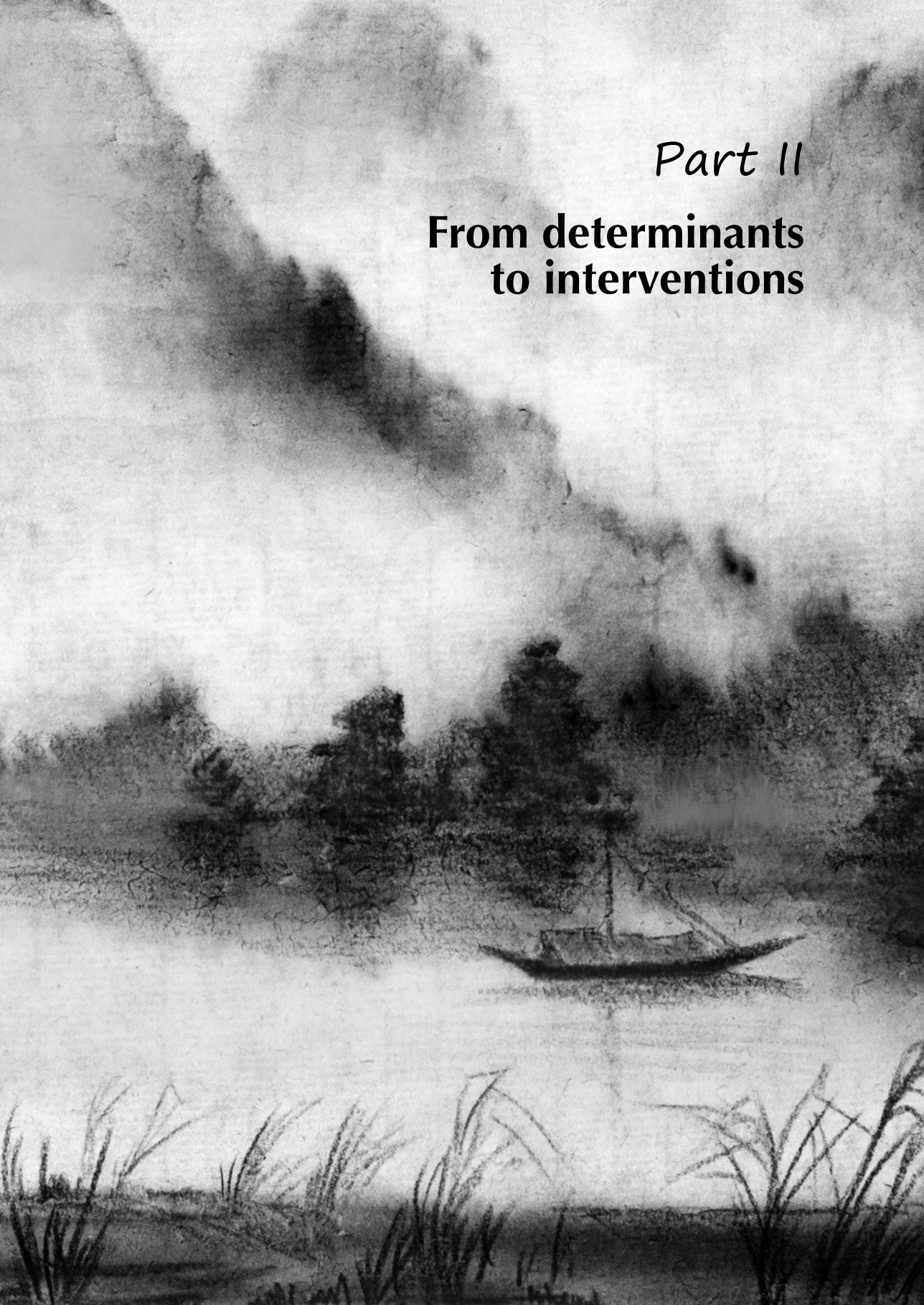
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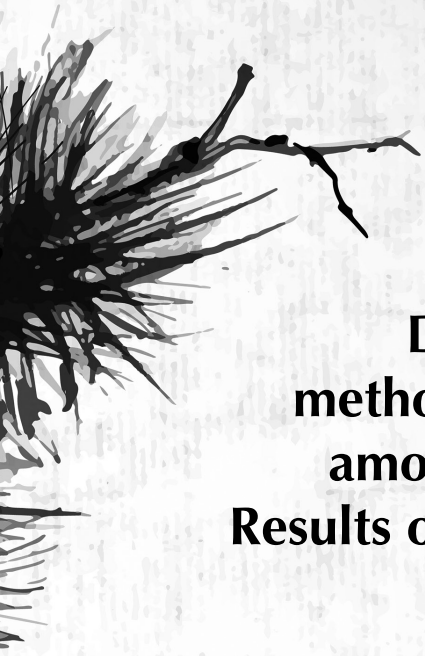


*Part II*

**From determinants  
to interventions**







## Chapter 5

# Determinants and intervention methods for increasing condom use among internal migrants in China: Results of a three-round Delphi survey

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**ABSTRACT**

This study is a step towards a behavioral intervention to prevent HIV transmission among Chinese internal migrants. To explore important and changeable determinants of condom use and inspect effective and feasible methods to increase condom use for the target population, we conducted a three-round web-based Delphi study among a panel of 62 experts between October 2012 and March 2013. The panelists were purposely selected using a stepwise procedure to represent topic-related areas of expertise. The response rate per round ranges from 21% to 81%. The panelists identified 19 possible determinants of condom use and reported 16 intervention methods they considered successful. They agreed that attitude towards condom use was the most important and changeable determinant, while applying behavioral theory, increasing sexual education and condom access, performing worksite health promotion, detecting risk factors, and working closely with relevant organizations and the government were effective and feasible methods to increase condom use among internal migrants in China. In conclusion, results of this study highlight the importance of attitude in changing condom use and underscore the need to apply behavior theory and integrate multiple educational approaches for developing behavioral HIV prevention interventions targeting internal migrants in China.



## INTRODUCTION

Chinese internal migrants, also known as the ‘floating population’, are of substantial importance to preventing HIV transmission in the country.<sup>1</sup> Since the economic reform of the late 1970s, internal mobility has increased significantly as workers, driven by large social and economic disparities, try to find better employment opportunities, higher income and a more attractive lifestyle in cities.<sup>2</sup> According to the National Bureau of Statistics, there were 145.3 million Chinese internal migrants in 2009.<sup>3</sup> One study of the national surveillance data estimated that 0.075% of them were living with an HIV infection in 2009, and projected that the prevalence of HIV among the internal migrants will reach 0.11% in 2015.<sup>4</sup> The internal migrants have an important impact on the HIV epidemic in China for the following two reasons: (1) high mobility, because they frequently shift between jobs and locations, and pay seasonal visits back home, which may further spread HIV infection to others; and (2) frequent engagement in unsafe sexual behaviors, such as commercial sex and unprotected sex.<sup>5</sup>

Condom use has been identified as one of the most efficient means available to reduce the risk of HIV transmission.<sup>6</sup> It was estimated that consistent condom users are 10 to 20 times less likely to acquire HIV compared with inconsistent or nonusers.<sup>7</sup> Despite the attention paid in recent years to the importance of condom use by the government and organizations dedicated to the fight against HIV/AIDS, condom use by internal migrants in both committed and casual relationships remains low. A cross-sectional survey of 1625 Chinese migrant construction laborers, the major component of the internal migrants, revealed that most participants had never used condoms during sex with their stable partners; 14.2% of participants indicated having had sex with a sex worker, but only 35.4% of them reported consistent condom use when having commercial sex.<sup>8</sup> In the absence of a guideline on HIV prevention at both regional and national levels, behavioral changing programs – especially programs aiming at increasing condom use – remain central to efforts aimed at decreasing the risk of sexual transmission of HIV among the internal migrants in China.

This study is an essential step in the development of a behavioral HIV prevention intervention among Chinese internal migrants following the protocol of Intervention Mapping (IM). As one of the systematic approaches to planning health promotion programs, IM maps the path from recognition of a need or problem to the identification of a solution.<sup>9</sup> Selecting important and changeable determinants of the health behavioral outcome is one of its core processes used to understand the problem and problem-causing factors. Possible determinants include personal determinants (such as cognitive factors and capabilities) and environmental conditions (such as social influences and structural influences). Previous studies have identified many possible determinants of condom use among Chinese internal migrants, such as gender, risk perception and self-efficacy.<sup>10</sup> However, little is known about the performance of those determinants in terms of their importance (i.e. strength of

association with the behavior) and changeability (i.e. how likely it is that the intervention is going to influence a change in the determinant). On the other hand, selecting effective and feasible intervention methods, another of IM's core processes, ensures the practical application of the developed program. To date, a number of studies have described behavioral and psychosocial interventions that aim to increase condom use by Chinese internal migrants,<sup>11</sup> but many of these are obscure about the methods used, and lack evidence regarding the performance of those methods in terms of effectiveness (i.e. how much it changes the behavior) and feasibility (i.e. how likely it is that the method would be practical in a forthcoming intervention).

This study aims to explore possible determinants of condom use and intervention methods that aim to increase condom use among Chinese internal migrants, as well as to assess the performance of identified determinants and intervention methods. Given the available wide range of topic-relevant colleagues who have profound knowledge and experience on design and implementation HIV prevention interventions worldwide, adopting the Delphi technique is an optimal route to achieve our goal. The Delphi technique allows us to apply an iterative process to obtain previously unknown opinions, i.e., HIV interventions among internal migrants in China, and builds consensus in a group of informed individuals. Also, this technique is one of the best-known methods for dealing with the open-ended and creative aspects of a problem because it motivates independent thought and gradual formation of group solutions.<sup>12,13</sup> By using Delphi method, we are able to collect a combination of qualitative and quantitative information, which will be of extensive interest to researchers, health educators and policy makers who wish to understand the sexual behavior of Chinese internal migrants and make practical contributions to promote HIV prevention among them.

## **METHODS**

### **Study design**

We conducted a three-round Delphi study with panelists who were provided with web-based questionnaires between October 2012 and March 2013. In the first round the panelists proposed possible determinants of condom use and past and/or ongoing intervention methods aimed at increasing condom use among Chinese internal migrants. In the following two rounds they judged the performance of each determinant and intervention method. The procedure of this study is characterized by iteration, anonymity (the panelists were not aware of each other's participation), and feedback (subsequent rounds were held using both the information introduced in the previous round and the statistical summaries of group results). We developed and hosted the web survey internally using secure university domains of LimeSurvey, an open source survey application.<sup>14</sup>

## Participants

We purposively selected the panelists using a five-step procedure recommended by Okoli and Pawlowski.<sup>12</sup> First, the five areas of possible expertise involved were identified (i.e., epidemiology; psychology; social and behavioral science; health education and promotion; health policy and management). Then each area was populated with the names of individuals, as well as their email address, research field, nationality, and work site. This information was derived from several sources, including publications on topic, previous research participation, professional email lists, and advisory panel involvement. After that, we created a list for each stakeholder area and ranked experts based upon their relevance with the studied topic. Finally, we invited 62 experts, who evenly represented the five identified areas of expertise, and were knowledgeable about HIV prevention in China. All panel members were contacted directly via an email, which included a unique URL link to the survey, and asked to nominate other experts if possible. Invitation letters and questionnaires for all rounds contained an introduction with basic information on the studied population, that is, Chinese internal migrants, who are defined in this study as Chinese citizens living in an area different from their household registration (the 'hukou' system) within China.

## Questionnaire

The first questionnaire consisted of four open questions serving as the source of creative input for idea generation. Based on their knowledge and experience, the panelists were first asked to list the following: (1) possible determinants of condom use among Chinese internal migrants in general; (2) determinants specifically influencing condom use during sex with a committed sex partner (in this study this included sex within marriage, engagement, courtship, civil union, and close long-term relationships); (3) determinants specifically influencing condom use during sex with a casual sex partner (in this study this includes short-term extramarital sex, commercial sex, one-time encounters, sex in the absence of emotional attachment or love); and (4) past and/or ongoing intervention methods aimed at increasing condom use among Chinese internal migrants. The answers in the first round were then organized and they provided the content of the following questionnaires.

In the second and third questionnaires the determinants and intervention methods identified in the first questionnaire were presented for rating in six domains: (1) the importance of the identified determinants of condom use among Chinese internal migrants in general; (2) the changeability of the identified factors regarding condom use in general; (3) the importance of the identified determinants in committed sexual relationships; (4) the importance of the identified determinants in casual sexual relationships; (5) the effectiveness of the identified intervention methods at increasing condom use among Chinese internal migrants; and (6) the feasibility of the identified intervention methods. The panelists were asked to score each determinant and intervention method on a 5-point Likert scale with the following ratings:

1=Very low; 2=Low; 3=Neutral; 4=High; 5=Very high. In the second and third questionnaires a response was compulsory for each question to ensure a complete data set.<sup>15</sup>

All questionnaires and invitation letters were provided in both Chinese and English. The panelists could read and answer the surveys in either of the two languages. Each survey was issued formally after a pilot survey was conducted among six researchers (three Chinese and three Dutch), who were asked to provide feedback and comments about the statements, process, instructions, and barriers with regard to completing the survey. On average, the first questionnaire could be completed in less than 25 minutes, the second one took about 20 minutes, and the last one took about 15 minutes.

### **Data analysis**

The qualitative answers provided in the first round were reviewed and structured into the subsequent questionnaires by two authors, who were proficient in both languages. The data in the second and third round were analyzed using SPSS version 20.0. The median and Inter Quartile Deviation (IQD) were calculated as statistical measures for all ordinal variables. The median represents the 50<sup>th</sup> percentile value of opinions, and the IQD represents the distance between the 25<sup>th</sup> and 75<sup>th</sup> value of opinions. As a rule, it was decided that panelists have reached consensus on an item if that item had an  $IQD \leq 1$ . If consensus was reached on an item in round two, it was removed from the third questionnaire. Thus, all items with an  $IQD > 1$  in the second round were reported and maintained in the third questionnaire.

## **RESULTS**

### **Study population**

In the first round survey we invited 62 panelists from China (36), the United States (15) and the Netherlands (8) and Belgium (3) to participate, of whom 13 (21%) completed the questionnaire (Table 1). Two people declined to continue participating due to lack of time, and four additional people, who were nominated by the participating panelists, were invited to participate in the second round. Of the 64 panelists invited to participate in the second round survey, 16 (25%) completed the questionnaire, and of those, 13 (81%) completed the third-round survey. Overall, 21% of our original sample participated in all three rounds of the study ( $n=13$ ). Among the five identified areas of expertise, the panelists with expertise in health education and promotion had the highest response rate (31%). Panelists who answered in Chinese had a similar response rate as panelists who answered in English (21% and 22%, respectively).

**Table 1** | Description of the panelists by Delphi round.

	Round 1	Round 2	Round 3	Overall response (%)
<b>Area of expertise</b>				
Epidemiology	1/12	3/12	3/3	3/12 (25%) *
Psychology	3/12	3/13	2/3	2/12 (17%)
Social and behavioral science	3/13	3/13	3/3	3/13 (23%)
Health education and promotion	3/13	4/14	4/4	4/13 (31%)
Health policy and management	3/12	3/12	1/3	1/12 (8%)
<b>Applied language</b>				
Chinese	10/39	10/39	8/10	8/39 (21%)
English	3/23	6/25	5/6	5/23 (22%)
<b>Nationality</b>				
Chinese	10/36	11/36	8/11	8/36 (22%) *
American	1/15	2/15	2/2	2/15 (13%)
European (Dutch; Belgian)	2/11	3/13	3/3	3/11 (27%)
<b>Overall response (%)</b>	13/62 (21%)	16/64 (25%)	13/16 (81%)	13/62 (21%)

\*  $P < 0.05$ 

### Determinants of condom use among Chinese internal migrants

The panelists identified 19 determinants of condom use in general among Chinese internal migrants (Table 2), 6 additional determinants for committed sexual relationships (25 in total), and 8 additional determinants for casual sexual relationships (27 in total). The identified determinants covered both personal factors (i.e., knowledge, attitudes, risk perception, self-efficacy and skills) and socio-environmental conditions (i.e., social norms, and environmental support). They reached consensus (IQD $\leq$ 1) for all determinants with regard to their importance and changeability for condom use in Chinese internal migrants (n=27). Almost all of the identified determinants were judged as being important (median $\geq$ 4) and changeable (median $\geq$ 4), except for the following two which were considered to be less important (median=3): embarrassment of picking up free condoms, and access to sexual health services.

The following two determinants were rated to be the most important (median=5) and to have the highest level of changeability (median=4): the attitude of Chinese internal migrants towards using condoms, and the attitude of sexual partners of Chinese internal migrants towards using condoms. Moreover, the former was an especially important determinant of condom use in casual sexual relationships (mean=4.5), while the latter was especially important in committed sexual relationships (mean=5). The following three determinants were rated as having high importance (median=4) but low changeability: financial reasons (median=3), peer pressure (median=3.5) and social support (median=3.5). In addition to the identified general determinants of condom use, the taboo nature of premarital sex was identified as an important social influence on condom use in committed sexual relationships, while structural determinants (i.e., barriers to using condoms due to violence, loss of clients

and payment, sex venue, and the use of alternative means of contraception) were identified as playing important structural influences in casual sexual relationships.

**Table 2** | Socio-psychological and environmental determinants of condom use and their performances of importance and changeability among Chinese internal migrants.

Determinants	Importance		Changeability	
	Median	IQD	Median	IQD
<b>Personal cognition and capability</b>				
<i>Socio-economic status</i>				
1. Financial reasons	4	1	3	0
<i>Knowledge</i>				
2. Knowledge of HIV/STD	4	1	4	1
3. Knowledge of safe sex behavior	4	1	4	1
4. Knowledge of condom use	4	1	4	1
<i>Attitudes</i>				
5. Attitude from sex partner	5	1	4	1
6. Own attitude towards condom use	5	1	4	1
7. Beliefs on ease of use of condoms	4	1	4	1
8. Use of condom feeling during sex	4	1	4	1
9. Risk perception	4	1	4	1
10. Extent of familiarity	4	1	4	0.5
<i>Self-efficacy</i>				
11. Confidence on the use of condom	4	1	4	1
12. Embarrassed to pick up free condoms	3	1	4	1
13. Unaware that free condoms are available	4	1	4	0.75
<i>Skills</i>				
14. Open communication with partner	4	0.5	4	1
<b>Environmental condition</b>				
<i>Social norm</i>				
15. Peer pressure	4	1	3.5	1
16. Role models	4	1	4	1
17. Social support	4	1	3.5	1
<i>Environmental feasibility</i>				
18. Inconvenience to carry condoms	4	1	4	1
19. Access to sexual health services	3	1	4	1

**Note:** IQD. Inter Quartile Deviation; The panelists score in a 5-point Likert scale, 1=very low; 2=Low; 3=Neutral; 4=High; 5=Very high.

## Intervention methods aimed at increasing condom use among Chinese internal migrants

The panelists identified 16 past and/or ongoing intervention methods aimed at increasing condom use among Chinese internal migrants, covering 4 methods of intervention development, 10 intervention approaches and 2 process measures (Table 3). They reached consensus (IQD $\leq$ 1) for 14 methods (88%) on their effectiveness at increasing condom use and for 15 methods (94%) on their feasibility. All identified intervention methods were judged as being effective (median $\geq$ 4) and feasible (median $\geq$ 4).

**Table 3** | Intervention Methods aiming at increasing condom use and their performance of effectiveness and feasibility among Chinese internal migrants.

Methods	Effectiveness		Feasibility	
	Median	IQD	Median	IQD
<b>Intervention development</b>				
1. Use of behavioral theories for the development of interventions	5	1	4	1
2. Implement participatory approach	4	1	4	0.75
3. Adapt interventions to the results of monitoring	4	1	4	1
4. Effect and process evaluation during interventions	5	1	4	1.5
<b>Approaches</b>				
<b>Training and education</b>				
5. Health education of knowledge on safe sex behavior	4	1.5	5	1
6. Peer education	4	1	4	1
7. Training on skills of negotiation and decision making	4	1	4	1
8. Improve health literacy	4	0	4	0
9. Implement various forms of education	4	1	4	1
<b>Condom access</b>				
10. Distribution of free condoms	4	1	4	0.5
11. Make condoms widely available in their life environments	4	1	4	1
<b>Worksite health promotion</b>				
12. Culture-tailored health promotion in their worksites	4	1	4	1
<b>Detection risk factors</b>				
13. Detection of risk factors for HIV transmission	4	1.5	4	0
14. Apply new media in an intervention	4	0.75	4	0.75
<b>Process measures</b>				
15. Make relevant organizations commit and cooperate in every level	4	0.5	4	1
16. Support from the government	4	1	4	0

**Note:** IQD. Inter Quartile Deviation; The panelists score in a 5-point Likert scale, 1=very low; 2=Low; 3=Neutral; 4=High; 5=Very high.

The panelists agreed that using behavioral theories is the most effective (median = 5) and feasible (median = 4) method for developing successful interventions. They also agreed that evaluating interventions is important (median = 5), but had varied opinions on the

feasibility of evaluations (median = 4, IQD = 1.5). Regarding intervention approaches, half of the identified approaches were about training and education, while others involved condom access, worksite health promotion, and detection of risk factors. Furthermore, they agreed that improving health education on safe sex behavior is a very feasible approach to improving condom use (median = 5). However, they agreed less on the effectiveness of this approach (median = 4, IQD = 1.5). For process measures, they all agreed that cooperating with the government and relevant organizations was not only an effective (median = 4), but also a feasible (median = 4) method.

## DISCUSSION

The panelists in this study identified 19 possible determinants of condom use among Chinese internal migrants in general ranging from personal cognitive factors and skills to environmental conditions. They also reported 16 past/ongoing intervention methods aimed at increasing condom use among the population that they considered successful, including methods of intervention development, intervention approaches, and process measures. The panelists reached consensus on the fact that attitude towards condom use is the most important and changeable determinant. They also agreed that applying behavioral theory, conducting training and education, increasing condom access, performing worksite health promotion, detecting risk factors, and working closely with relevant organizations and the government are effective and feasible methods to increase condom use among internal migrants in China.

This is the first study that uses both the qualitative and quantitative data from a panel of international experts to understand condom use in general and provide applicable insight into increasing condom use among Chinese internal migrants in particular. This is also the first time Intervention Mapping approach has been applied in a study involving Chinese internal migrants. The results were obtained from panelists who have a variety of expertise and come from around the world, and yet they reached a strong consensus on almost all of the questions. Several limitations, however, need to be considered when interpreting the findings. This study reached a general low response rate over three rounds that may introduce certain response bias. It is, however, worth noting that the response rate is comparable to that of other studies using similar data collecting method.<sup>16,17</sup> A strength of the study is that the panelists had a great deal of valuable expertise in the area of behavioral HIV prevention interventions (including many key experts in this field). More of the panelists with expertise in health policy and management dropped out than the panelists with other expertise, which could have influenced the results. Finally, internal migrants constitute many diverse groups with varied socioeconomic status living under different environmental conditions in China. The unique data collected in this study can be broadly applied as a first step in intervention development, and can be integrated with results from specific field efforts, such as observations, field surveys, and face-to-face interviews for specific target groups.



The determinants and intervention methods identified through the Delphi technique provide practical input for the design of future interventions aimed at increasing condom use among Chinese internal migrants. First, all panelists thought that, due to their personal economic situation, Chinese internal migrants perhaps cannot afford to buy condoms and that this is an important but less changeable factor influencing their condom use. At the same time, the panelists considered that distributing free condoms to the population is a both highly effective and feasible way to improve condom use. This underscores the need for future interventions that aim to increase condom use among the population to include free condom distribution. Second, half of the identified past and/or ongoing HIV prevention intervention approaches are about training or education, which is in line with the findings of a review of relevant intervention programs.<sup>18</sup> The panelists agreed that knowledge is an important and changeable determinant of condom use, and acknowledged that health education on safe sex behavior is also feasible. However, they agreed less on whether or not increasing knowledge would increase actual condom use among the Chinese internal migrants. If it would not increase actual condom use, programs focusing only on increasing the level of knowledge regarding HIV/STDs and sexual behavior among Chinese internal migrants are insufficient to actually change risk behavior. Our study identified many other cognitive factors and personal skills associated with condom use, which were also found in other studies on condom use, such as lack of negotiation skills,<sup>19</sup> self-efficacy,<sup>20</sup> desire for trust,<sup>21</sup> and personal perception about sex partners.<sup>22</sup> In accordance with the finding of our previous review on condom promotion intervention conducted in the past decade suggests a theory-based intervention was more likely to be successful,<sup>23</sup> the panelists noted that following one of the behavioral theories (e.g., theory of planned behavior<sup>24</sup>) is crucial, regarding both effectiveness and feasibility, for developing a successful HIV prevention intervention. The core constructs of behavioral theories have a great potential to inform intervention planners about the possible determinants of condom use, and to help them reinforce multiple determinants in a structured manner.

The results of this study suggest that attitude is strongly associated with condom use and should therefore be targeted in future interventions. Previous research studies have also highlighted the importance of attitude, as one of social-cognitive factors, for both explaining and predicting condom use.<sup>25</sup> The theory of planned behavior suggests that attitude is one of factors causing behavioral intention, and is composed of both a positive or negative evaluation of a particular behavior and belief about the outcome of the behavior.<sup>26</sup> It would therefore seem that efforts (using identified intervention approaches such as training, culture-tailored worksite health promotion, and adopting new media) need to be designed to sharpen positive attitudes about condom use. The efforts should aim to show that using condoms would make life more productive and would be beneficial to the health of internal migrants in China. Finally, future interventions should pay special attention to environmental conditions. The panelists in this study identified that social influences,

including peer pressure and social support, are important for condom use in general, which is in line with the findings of other studies.<sup>27</sup> Regarding the behavior in different sexual relationships, social influences were identified as important determinants in committed sexual relationships, while structural influences were identified as important determinants in casual sexual relationships. This finding, together with the suggestion from the panelists, stresses the need for greater cooperation with relevant organizations and the government in order to increase condom use. For example, gaining commitment and support at the administrative level may be beneficial for improving the unfavorable social influences and organizational climate facing internal migrants in China.

In conclusion, the results of this Delphi study are critical input for systematically developing an HIV prevention intervention that aims at increasing condom use among internal migrants in China. For an intervention targeting this population to be successful, messages should be built upon a behavioral theory integrating cognitive factors, personal skills and environmental conditions. Moreover, the interventions should focus on shaping positive attitudes towards condom use, applying multiple intervention approaches (e.g., free condom distribution, training, worksite health promotion), and realizing commitment and support from the government and relevant organizations.

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### **Conflict of Interests**

No conflict of interests regarding producing this paper.

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## Chapter 6

# Behavioral and psychosocial interventions for HIV prevention in floating populations in China over the past decade: A systematic literature review and meta-analysis

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## ABSTRACT

### Background

Floating populations have been repeatedly characterized as “the tipping point” for the HIV epidemic in China. This study aims to systematically summarize and assess the effectiveness of HIV prevention interventions in floating populations in China over the past decade.

### Methods

We conducted a systematic search in three international databases for literature published between 2005 and 2012 with condom use as the primary outcome, and knowledge about HIV transmission and prevention and stigma towards HIV-infected individuals as secondary outcomes. The impact of interventions on changing the primary and secondary outcomes was calculated by risk difference (RD). We also performed subgroup analyses and meta-regression based on different study characteristics, using Stata 12.0, for the primary outcome.

### Results

Sixteen studies (out of 149) involved 19 different programs and a total of 10,864 participants at entry from 11 provinces in China. The pooled effect estimate of all studies indicated that people participating in HIV-related interventions were 13% more likely to use condoms (95%CI: 0.07, 0.18), however, the effects on increasing condom use exhibited significant heterogeneity across programs ( $P < 0.01$ ,  $I^2 = 0.93$ ). The meta-regression results suggest that interventions have been significantly less successful in changing condom use in more recent studies ( $\beta$ , 0.14; 95%CI: 0.01, 0.27), adjusted for sexual relationship, study design and follow-up period. Regarding the secondary outcomes, HIV-related interventions were successful at improving knowledge about HIV transmission and prevention (RD, -0.26; 95%CI: -0.36, -0.16 and RD, -0.25; 95%CI: -0.33, -0.16, respectively), and decreasing stigma (RD, 0.18; 95%CI: 0.09, 0.27).

### Conclusions

The included studies between 2005 and 2012 indicate that HIV prevention interventions among Chinese floating populations in the past decade were only marginally effective at increasing condom use, but relatively successful at increasing HIV knowledge and decreasing stigma. To avert new infections, novel sexual risk-reduction interventions taking into account the changing socio-economic and cultural situation of Chinese floating populations are urgently needed.



## INTRODUCTION

The official estimate of the number of people with HIV/AIDS in China was 780,000 at the end of 2011, and 39,183 new patients were diagnosed with HIV in 2011.<sup>1</sup> The HIV/AIDS epidemic in China displays unique epidemiological patterns, with a low overall infection rate but high prevalence among certain high risk populations, and distinctive geographic variations.<sup>2</sup> Historically, injection drug use<sup>3</sup> and commercial blood/plasma collection were the primary sources of HIV infection in China. However, infection through sexual transmission has increased rapidly in recent years. Newly diagnosed HIV cases through sexual transmission increased from 33.1% in 2006 to 76.3% in 2011.<sup>1</sup>

The emergence of large population movement patterns to find better employment opportunities, higher income, and a more attractive lifestyle in cities was driven by large economic disparities since the implementation of the “Open Door” policy in China in 1978.<sup>4,5</sup> Individuals from the so-called Chinese floating population are referred to as people who live in a different area than where their household is registered (the “*hukou*” system). The term floating was used not only reflecting a location move between the place of household registration and living, but also embodying the history of moving along the Yangtze River and the Yellow River, two so-called “mother rivers” in China.<sup>6</sup> It was estimated that there were 221 million floating population at the end of 2010, including 160 million rural-to-urban migrants.<sup>7</sup> The Chinese government and international organizations have repeatedly characterized China’s floating population as “the tipping point” for the HIV epidemic in China.<sup>8,9</sup> According to the latest review of 54 studies, approximately 50% of urban patients with HIV have a migratory background. Compared with the HIV prevalence in the Chinese general population, both the floating-out and floating-in populations have a higher risk of HIV infection.<sup>5</sup> These individuals are usually single, low educated, poorly paid, and from less progressive regions of China where sex education remains taboo.<sup>10-12</sup> Even when married, people from the floating population are still a recognized risk group because many spend long periods away from their spouse and may purchase, and in some cases sell, sex while away from home.<sup>13,14</sup> In addition, high mobility of the population has been identified as a major risk factor for facilitating HIV transmission in China, since they frequently shift between jobs and locations, and seasonal visits back home may further spread HIV infection to others.<sup>15,16</sup> A cross-sectional survey of 1625 Chinese migrant construction laborers, the largest group of the floating populations, revealed that most participants had never used condoms during sex with their stable partners; 14.2% of participants indicated having had sex with a sex worker, but only 35.4% of them reported consistent condom use when doing so.<sup>17</sup>

In the absence of an effective and affordable vaccine and due to the non-curative nature of current antiretroviral therapy, behavioral and psychosocial prevention with the goal of limiting risky sexual behaviors remain central to the efforts to decrease the sexual

transmission of HIV.<sup>18</sup> Condom use is one of the most efficient means available to reduce the risk of HIV transmission. According to the UNAIDS global report in 2012, the consistent association between behavior change and reduced incidence provides plausible support for the worldwide impact of behavioral change programming in general, although more specific evidence showing which programmatic elements have which effects is urgently needed to help guide wise investment.<sup>19</sup> Moreover, specific guidelines have not been developed for conducting interventions among floating populations in China. Some short-term education programs are launched during holiday periods when many migrants travel back to their home towns, but their impact has not been evaluated.<sup>20</sup> Thus, despite the extent of the HIV epidemic and increasing coverage of behavior change programs, rigorous evaluations of the outcome of any form of behavioral intervention for HIV prevention in floating populations in China are scarce. Finding out whether interventions are effective is critical and challenging.

Various assessments of the effectiveness of HIV/AIDS and/or sexually transmitted infection prevention activities targeted at floating populations in China have been published;<sup>21</sup> most recently, in 2008, Yu Chen et al. systematically reviewed the effects on HIV/AIDS interventions.<sup>22</sup> The review included 18 interventions published in Chinese from 1996 up to and including 2006. The studies were not controlled trials, but before-after studies assessing three outcomes of the intervention: 1) knowledge about HIV transmission, 2) knowledge about means of prevention, and 3) general attitudes toward HIV/AIDS patients. The rate difference (RD) was used as an indicator of the effect of the intervention. However, the majority of reviews applied neither a comprehensive evaluation strategy nor clear inclusion criteria, and many of the reviews are out of date. Therefore, a systematic review that incorporates explicit inclusion criteria is needed to assess systematically both behavioral and psychosocial aspects, and to update current knowledge regarding interventions for HIV/AIDS prevention in the Chinese floating populations.

The objectives of this systematic review were to 1) identify and describe HIV prevention interventions in Chinese floating populations over the past decade; 2) summarize and evaluate the effectiveness of interventions to prevent HIV/AIDS in the floating population to increase condom use; and 3) determine the effect of these interventions on knowledge about HIV transmission and prevention and stigma of HIV infection.

## **METHODS**

This review was conducted and reported according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement issued in 2010.<sup>23</sup> A review protocol was developed and followed.

## Data sources and Searches

Studies published in Chinese or English between 1 January 2005 and 1 January 2012 were primarily identified electronically by searching the following databases in July 2012: PubMed, China National Knowledge Infrastructure,<sup>24</sup> and Wangfang Data. Key words used in the database search were (“HIV” or “AIDS”) OR (“Sexual behavior” or “Condom use” or “Sexual risk behavior”) AND (“Floating population” or “Migrant worker” or “liúdòng rénkǒu” in Hanyu Pinyin) AND (“intervention” or “prevention program”) AND (“China” or “Chinese”). A manual search was performed by replacing terms with related specific words in Chinese, such as “Floating population” with “Restaurant server”, “Miner”, or “Peasant worker”.

## Study selection

The selecting process included a sequence of examining titles, abstracts and full-text. Titles of all articles retrieved from database searches were screened. The abstracts of relevant articles were audited and all studies that could be included were retrieved. We applied the population, intervention, comparison, outcome (PICO) model with respect to criteria for considering studies.<sup>25</sup> Studies were included or excluded at all stages according to the selection criteria on their participants, intervention, study design, and reported outcomes list below. If the same study data were published in both English and Chinese sources, the articles published in Chinese were treated as duplicates and excluded from the review. If the same study was found published at different times, we included the paper published first. Two authors (X.L. & Q.W.) completed this process with agreement over study eligibility.

## Participants

This review focuses on the general floating population in China. The term “floating populations in China” (Chinese: 流动人口; Hanyu Pinyin: liúdòng rénkǒu) refers to Chinese citizens who live in an area different from the place where their household is registered, in the “*hukou*” system, without any limit on the duration of living outside their registered household place. Conventional high risk groups that may overlap with the targeted population were excluded, such as men who have sex with men, female sex workers, money boys and drug users, as well as children of migrant workers who may receive school-based HIV prevention programs.

## Interventions

All forms of behavioral and psychosocial interventions designed to promote a decrease in risky sexual behaviors in Chinese floating populations were eligible for inclusion, with no restrictions on the level or mode of delivery. Only interventions conducted in Mainland China with detailed strategies for follow-up were eligible. We subdivided all intervention strategies into four types for comparison: free condom distribution, peer education, general education, or comprehensive campaigns. The first three intervention types are relatively

straightforward, applying a single strategy, whereas a comprehensive campaign was defined as an integrated intervention with at least two single strategies.

### **Study Design**

The following study designs were eligible for inclusion: randomized controlled trials (RCT) and controlled before-and-after (CBA) or before-and-after (BA) studies. To reduce the effects of bias due to selective drop-out, we only included studies reporting no significant differences in the socio-demographic characteristics of participants before and after the intervention(s), including age, gender, educational level and marital status. We excluded review papers, non-peer-reviewed local/governmental reports, and conference abstracts and presentations.

### **Outcome measures**

Four outcomes were identified as the primary or secondary indicators to assess the effectiveness of HIV prevention interventions. Only articles reporting the primary outcome were eligible, secondary outcomes may or may not have been reported in the included studies.

The primary outcome measure was self-reported condom use. Use was defined as a) having used a condom during their last (sometimes referred to as latest) sexual encounter; or b) using a condom usually or every time for sex. When a paper reported both, we chose the first definition as our indicator. Condom use could be reported with regular sex partners and/or casual sex partners. When both were mentioned, we chose the behavior that occurred with the regular sex partner. The original primary outcome was measured as a binary variable on a nominal scale (e.g., Did you use a condom during your last sexual encounter? “Yes” or “No”).

The secondary outcomes were knowledge about HIV transmission and prevention, and stigma towards HIV-infected individuals. Specifically, we examined the level of accurate knowledge that HIV can be contracted by unsafe sex and condom use can decrease the risk of HIV transmission, and the amount of stigma towards HIV-infected individuals, which we broadly defined as an unfavorable attitude or belief directed towards individuals who are living with HIV.<sup>26</sup> The original secondary outcomes were also measured as binary variables (e.g., Can HIV be contracted by unsafe sex? “Yes” or “No”).

### **Data collection and analysis**

Data from each eligible study, including study period, study site, study design, language, sample size, rate of loss to follow-up, participants' demographic characteristics, intervention strategy, and intervention outcome, were extracted using a pre-designed data extraction form. All data were entered twice before initiating analysis; the accuracy of all data extracted by the main reviewer was checked, including data in tables.

With respect to the quality of the evidence, the Cochrane Collaboration's tool in Review Manager (RevMan, version 5.0) was used to assess bias risk. Selection bias, performance bias, detection bias, attrition bias, and reporting bias were assessed by two reviewers who judged the risk of these biases for each study as 'low', 'high', 'unsure', or 'unknown'. Consensus was necessary to form a final judgment. We also performed the Begg and Mazumdar rank correlation test to measure potential presence of publication bias in each outcome of studies with Stata software (version 12.0).

Subgroup analyses and multiple-moderator meta-regression were conducted to evaluate the impact of the following factors on the primary outcome: 1) intercourse relationship: behavior within an unstable sexual relationship (commercial sex, casual sex, extramarital sex partner) or within a stable relationship (spouse, long-term partner); one study might present both indicators; 2) study design: RCTs and CBA studies had control groups, whereas BA studies did not have a control group; 3) follow-up period (from starting the intervention to the end of intervention) of less than or more than 6 months; 4) year of publication: before 2010 or during or after 2010; 5) intervention strategy: free condom distribution, peer education, general health education, or comprehensive campaign.

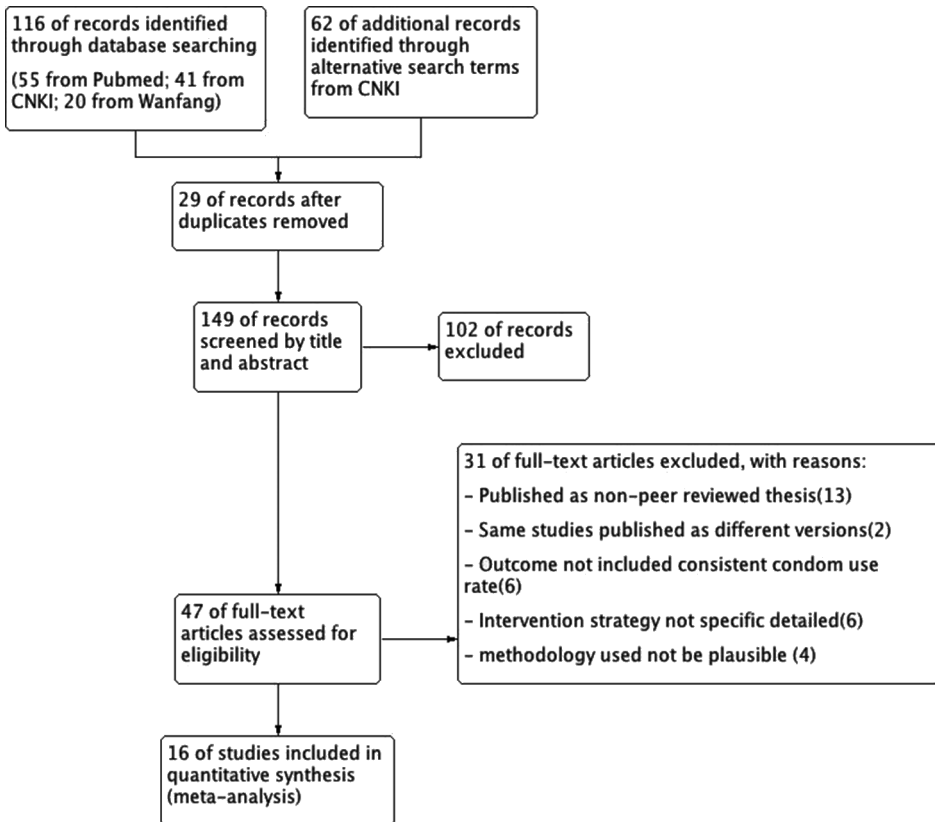
The absolute impact of interventions on the observed risk of primary and secondary outcomes was measured using risk difference (Risk Difference,  $RD = d_0/n_0 - d_1/n_1$ ). RD was applied as comparison between effects before and after interventions to designs that lacked a control group, and applied as comparison between intervention and control groups (corrected by baseline effects) to designs with a control group. For studies that provided more than one intervention interval, risk for each interval was assessed separately. Tests of  $\chi^2$  and  $I^2$  were used to measure heterogeneity, Z tests were conducted to measure the effect within groups, and  $\chi^2$  tests were applied to measure the effect across groups. We managed data and synthesized the effect sizes using RevMan 5.0. We conducted subgroup analyses and multiple-moderator meta-regression using Stata 12.0 (weights were the inverse of variance of each RD). Mantel-Haenszel random effects meta-analyses were applied because the intervention effects were assumed to vary across studies.

## RESULTS

A total of 149 potentially relevant studies were identified in a search of databases (Figure 1). We excluded 102 records at the title or abstract level as they fell outside the scope of this systematic review or did not meet the inclusion criteria, and read the full text of the remaining 47 potentially relevant records. Finally, we included 16 studies published in 13 different journals in our evaluation (Appendix S1).<sup>27-42</sup>

## Description of studies

Except one study that was published in English, all included papers were published in Chinese. Four studies, including one RCT and three CBA studies, had a control group. Fifteen studies were BA studies (Table S1). The included studies involved a total of 10,864 participants from 11 different provinces and central municipalities in China. The mean age of participants varied between 18 and 40 years, and the overall educational background was usually lower than secondary school. The majority of workers were male in all samples except three studies carried out in female-only populations.<sup>30,35,39</sup>



**Figure 1** | PRISMA flow diagram of the systematic literature reviewing process.

To simplify the comparison of the intervention effects, we recorded every intervention campaign separately. A total of 19 intervention campaigns was recorded in 16 studies, including three studies with two different intervention campaigns.<sup>29,30,42</sup> All campaigns were conducted in the decade preceding 2012, although exact starting dates were not given in

most studies. Nine of them were published before 2010 and 10 were published in or after 2010. The follow-up period of all campaigns ranged from one month to one year, with a median of six months. Most campaigns supplied general health education as an intervention strategy alone or comprehensively, with formats including general lectures, training of doctors, and the distribution of printed educational materials, including leaflets and posters. One study had free condom distribution as a single strategy,<sup>29</sup> and two campaigns conducted peer education as a single strategy.<sup>30,32</sup> Of the nine comprehensive campaigns, one applied a behavioral theory, namely the protection motivation theory (PMT).<sup>35</sup> Knowledge, risk perception, self-efficacy, and skills were the main factors included in developing the theory-based intervention, with formats including group discussions, brainstorming, role-playing, homework assignments, games, and lectures. Although four studies indicated having a controlled design, no specific information on the control condition was given.

Regarding outcome measures, five campaigns assessed condom use within casual sex relationships, whereas the remaining 14 campaigns assessed condom use within regular sexual relationships (three assessed them both). Twelve studies reported the level of accurate knowledge about HIV transmission and/or HIV prevention in addition to behavior, and six studies included the level of stigma towards HIV patients.

### Effects of HIV prevention interventions on the primary outcome

We applied Mantel-Haenszel random effects meta-analysis to estimate the intervention effect of the studies (Figure 2). The mean rate of condom use prior to intervention for all studies was  $0.23 \pm 0.11$ ; 10 of 19 campaigns reported no effect on condom use after intervention ( $N=2337$ , 39.3%), whereas the pooled effect estimate of all studies suggested that people who participated in a HIV prevention-related intervention were 13% more likely to use condoms (95%CI: 0.07, 0.18). The result of the heterogeneity test showed that the included campaigns varied significantly in their effects on condom use ( $P < 0.01$ ,  $I^2 = 0.93$ ).

Subgroup analyses were conducted to explore the possible source of the heterogeneity for the primary outcome (Table 1). The impact of interventions on condom use was not significantly different between regular and casual sexual relationships ( $\chi^2 = 0.19$ ,  $P > 0.05$ ). This also applied to controlled and non-controlled studies ( $\chi^2 = 3.07$ ,  $P > 0.05$ ), and to shorter and longer follow-up periods ( $\chi^2 = 0.47$ ,  $P > 0.05$ ). Papers published during or after 2010 reported no significant effect on increasing condom use among the floating population in China (RD, -0.05; 95%CI: -0.1, 0). This is contrary to papers published before 2010, where statistically significant effects were reported (RD, -0.20; 95%CI: -0.29, -0.11;  $\chi^2 = 8.52$ ,  $P < 0.01$ ). Regardless of whether studies were published before or after 2010, the mean rate of condom use at baseline did not differ significantly between studies ( $0.27 \pm 0.07$  and  $0.28 \pm 0.15$ , respectively;  $t = 0.072$ ,  $P > 0.05$ ). Regarding different intervention strategies, although RD results indicated that all four strategies had a positive effect on condom use, their

effect demonstrated no significant difference ( $\chi^2=4.64, P>0.05$ ); comprehensive campaigns (that were mostly carried out during or after 2010) were relatively less effective (RD, -0.08 compared with RD, -0.18, -0.22 and -0.15). Even controlling for sexual relationships, study design and follow-up period in a weighted multiple-moderator model, publication year remained significantly related to the effect of the interventions on changing condom use ( $\beta, 0.14; 95\%CI: 0.01, 0.27$ ). The four factors together explained 21.7% of the variance of the effect.

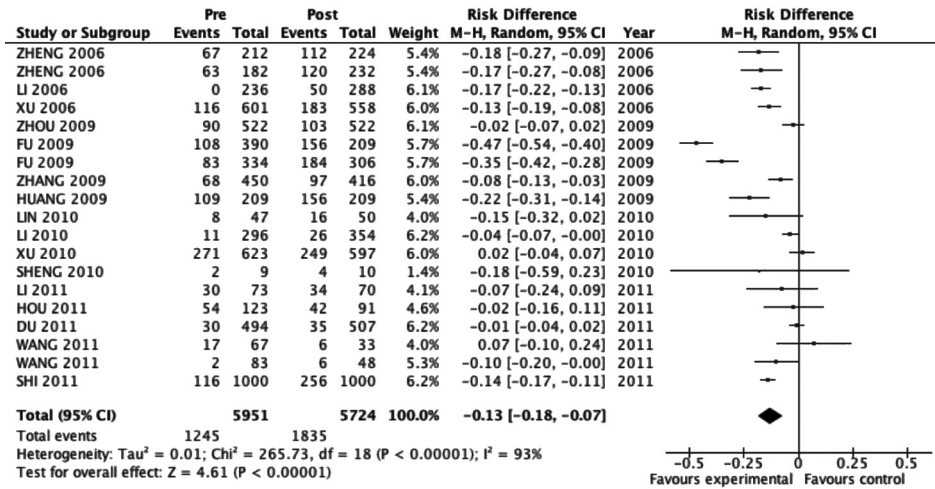


Figure 2 | Forest plot of primary effect evaluation for Chinese floating populations: condom use rate.

### Effects of HIV prevention interventions on secondary outcomes

Secondary outcomes were reported less frequently (Figure 3). Nonetheless, HIV prevention interventions greatly improved relevant knowledge among the participants, i.e. knowing that HIV can be contracted by unsafe sex and that condom use can decrease the risk of HIV transmission (RD, -0.26; 95%CI: -0.36, -0.16, and RD, -0.25; 95%CI: -0.33, -0.16, respectively), and the effect was significant in all included studies. The estimated pooled effect suggested that people participating in HIV prevention interventions were 18% less likely to exhibit HIV-related stigma (95%CI: 0.09, 0.27).



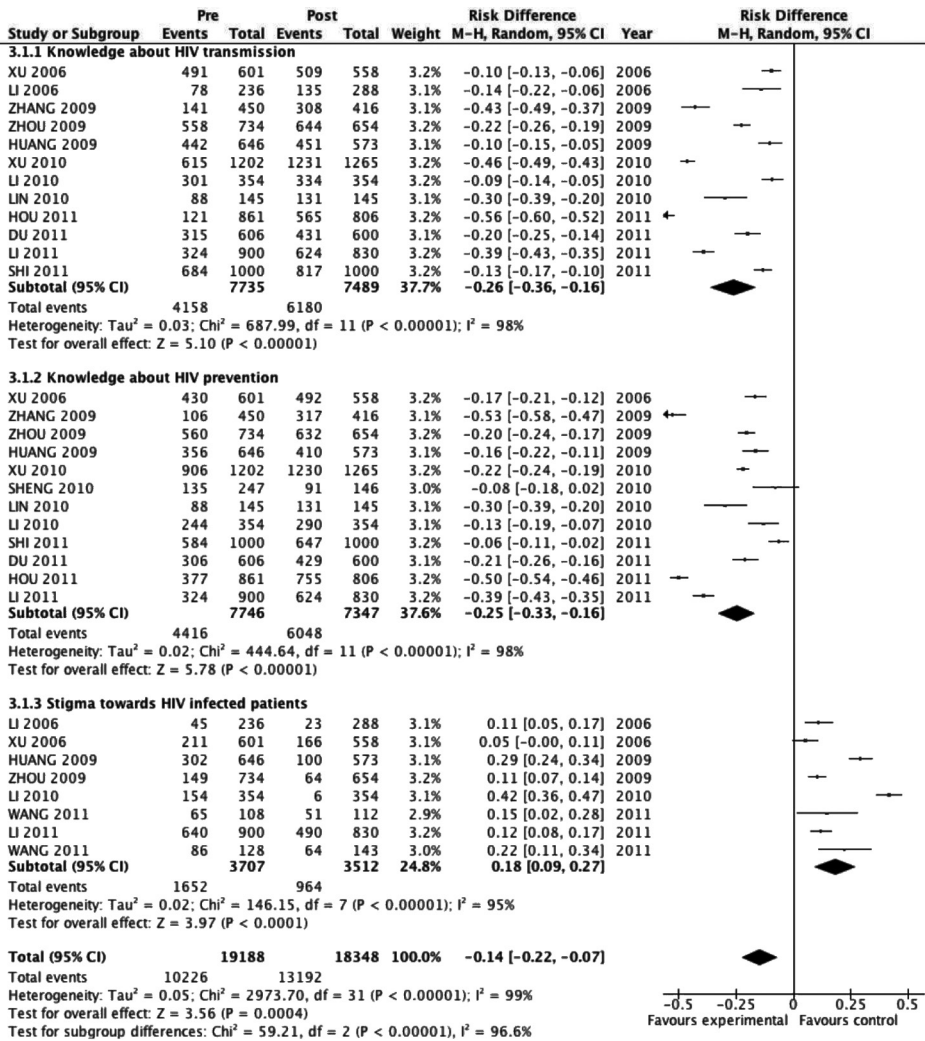
Table 1 | Subgroup analysis on condom use evaluation for Chinese Floating Population.

Subgroup	No. of campaign	RD <sup>c</sup>	Heterogeneity	Effect test	Test of RD <sup>c</sup>
<b>Relationship</b>					
Stable	14	-0.12 (-0.19, -0.06)	$I^2=0.95$	$Z=3.58^{**a}$	$\chi^2=0.19$
Unstable	5	-0.15 (-0.21, -0.08)	$I^2=0.64$	$Z=4.37^{**a}$	
<b>Study Design</b>					
RCT & CBA <sup>b</sup>	4	-0.06 (-0.11, -0.02)	$I^2=0.38$	$Z=4.61^{**a}$	$\chi^2=3.07$
BA <sup>b</sup>	15	-0.14 (-0.20, -0.07)	$I^2=0.94$	$Z=4.08^{**a}$	
<b>Published Year</b>					
Before 2010	9	-0.20 (-0.29, -0.11)	$I^2=0.94$	$Z=4.53^{**a}$	$\chi^2=8.52^{**a}$
In or after 2010	10	-0.05 (-0.10, 0.00)	$I^2=0.81$	$Z=1.98$	
<b>Follow-up</b>					
< 6 months	6	-0.17 (-0.32, -0.02)	$I^2=0.97$	$Z=2.22^a$	$\chi^2=0.47$
≥ 6 months	13	-0.11 (-0.16, -0.07)	$I^2=0.84$	$Z=4.65^{**a}$	
<b>Intervention</b>					
Free condoms	1	-0.18 (-0.27, -0.09)	Not applicable	$Z=3.98^{**a}$	$\chi^2=4.64$
Peer education	2	-0.22 (-0.49, 0.05)	$I^2=0.97$	$Z=1.58$	
General education	7	-0.15 (-0.26, -0.04)	$I^2=0.95$	$Z=2.57^{**a}$	
Comprehensive campaign	9	-0.08 (-0.14, -0.02)	$I^2=0.86$	$Z=2.55^{**a}$	

Note: a. \*denotes  $P<0.05$ ; \*\*denotes  $P<0.01$ .

b. BA: Before-and-after Design; CBA: Controlled Before-and-after; RCT: Randomized Controlled Trial.

c. RD: Risk Difference. Negative RDs imply greater condom use increase for the intervention group than for the comparison group.



**Figure 3** | Forest plot of secondary effect evaluation for Chinese floating populations: knowledge and stigma.

### Risk of Bias

Information on random sequence generation was insufficient in all studies. We identified 75% of the studies as having a high selection bias, whereas 48% of the studies had high attrition bias caused by incomplete outcome data. The risks for performance, detection, and reporting biases varied considerably per study. We also considered other sources of bias, including intervention exposure and delayed exposure, which were lowest in the theory-based study. Results of statistical tests on potential publication bias indicate that the

funnel plots were symmetric for all outcomes ( $P=0.133$  in assessing condom use;  $P=0.485$  in assessing knowledge on HIV prevention;  $P=0.520$  in assessing knowledge on HIV transmission and  $P=0.274$  in assessing stigma).

## DISCUSSION

This is the first systematic review to summarize and assess the effectiveness of behavioral and psychosocial HIV prevention interventions among floating populations in China through meta-analysis. The main finding from the included studies between 2005 and 2012 was that HIV prevention interventions among Chinese floating populations in the past decade were only marginally effective at increasing condom use, but relatively successful at increasing HIV knowledge and decreasing stigma.

### **Effectiveness of HIV prevention interventions among floating populations in China**

This review agrees with some of the findings in the systematic review by Yu Chen et al.<sup>22</sup> in 2008, which clarified how HIV prevention interventions increase HIV-related knowledge. However, our review distinguishes the effect on condom use from that of another previous review by Hong et al.<sup>2</sup> in 2009. The information published from 2001 to 2008 indicates that HIV-related knowledge significantly increased, as well as condom use, and risky behaviors decreased. The differences with our findings may be explained by the changing of time, variations in definitions of indicators, and in socioeconomic characteristics of participants. The previous review included participants from high risk populations, such as female sex workers and injection drug users, as well as general population groups, such as students and villagers, in contrast to the specific floating populations studied in this review. In addition, most of the included studies were uncontrolled trials, which are usually considered as effectiveness evidence rather than efficacy evidence. This might also explain the overall modest effect sizes in this study, as effectiveness trials are likely to detect smaller effect sizes than efficacy trials.<sup>43</sup>

Subgroup analyses and multiple-moderator analyses for changing condom use indicated that publication year is a possible source of heterogeneity, and the effect on changing condom use was no longer significant in papers published after 2009. However, for the interpretation of this finding we should take into account the correlation between publication year and type of intervention strategy. Single strategies, mostly applied before 2010, were more effective at improving condom use than comprehensive campaigns that were mostly applied in and after 2010. This contradicts the literature on intervention development suggesting that comprehensive interventions should be more effective.<sup>44</sup> The anomaly can be explained by the combination of relatively out of date single strategies now combined in a comprehensive campaign. In other words, more comprehensive campaigns have been conducted in recent years, although they might have generally combined single strategies developed earlier. The current Chinese floating populations have experienced extensive social and economic

changes over the last decade. Compared to the older generation of the floating population, the new generation is younger and primarily single when they move to a new city, indicating that they are probably more sexually active and less restricted by their family.<sup>45</sup> In addition, the social norms and rules that previously guided the behavior of people in their villages have been largely abandoned or play a smaller role in a new and more open society.<sup>46</sup> Thus, new intervention strategies should take this changing socio-economic and cultural situation of Chinese floating populations into consideration in order to be effective, as suggested by the literature on intervention development.<sup>44</sup> On the other hand, although the controlled studies (RCT and CBA) didn't show significant differences on intervention outcomes compared to BA studies without the control groups (which may be caused by the limited number of included controlled studies), they generated no significant heterogeneity in this review, indicating that a rigorous study design is important for conducting successful HIV prevention programs among the floating populations in China.

### **Implications for future behavioral and psychosocial interventions**

A recent WHO systematic review of behavioral interventions targeting adolescents and young adults in developing countries identified 22 school-based studies<sup>47</sup> and 22 community-based behavioral studies<sup>48,49</sup> that employed experimental or quasi-experimental designs, but none of the studies were conducted in China. The China Ministry of Health recently acknowledged that targeted intervention work for high risk populations remains stuck at the stage of pilot programs with low coverage.<sup>2</sup> Our systematic review of 16 recent studies indicates the importance of developing HIV/AIDS prevention interventions that take into account the changed socio-economic and cultural situation of the new generation of floating populations. As prior studies have documented, and the results from this review suggest, a change in knowledge alone is not sufficient to reduce high risk behavior<sup>50</sup> and stigma.<sup>51</sup> Thus, given the relatively high HIV knowledge scores after the conventional promotion strategy in Chinese floating populations (i.e., >50% correct), attention appears to be needed to decrease behavioral risk when developing HIV-related prevention interventions. Most past health education and health promotion campaigns in this review had recognized that their target population has limited health literacy on HIV/AIDS, but they seldom included instruction sessions on how to deal with new obstacles and develop healthy behaviors in the new socio-economic and cultural environment. In order to be effective at promoting behavior that prevents HIV transmission, health education and health promotion campaigns, therefore, should not only provide sufficient information about related healthy behaviors in easily understandable formats and language, but also include sessions on how to deal with various barriers, access to health services, and how to decrease risk in new urban settings.<sup>46</sup> Intervention strategies should also take full advantage of the social network of target populations and create a friendly atmosphere and environment during the implementation of these interventions in order to make them more sustainable. Previous studies have indicated that applying behavioral models at individual

level (e.g., the Protection Motivation Theory<sup>35</sup>), and at ecological level (e.g., the Network-Individual-Resource Model<sup>52</sup>), will considerably improve our understanding of the various socio-cognitive and environmental factors of condom use in a structured manner. Further, any successful intervention program must be conducted in close cooperation with cross-cultural and diverse organizations, including CDCs, community health centers, NGOs, and academic institutions.

Increasing attention is given to the important role of the floating population in the HIV epidemic in China, and there are a number of governmental and non-governmental organizations dedicated to the fight against HIV/AIDS among these population groups. To date, besides national and local CDCs, there are two national governmental organizations and seventy-three domestic NGOs working on HIV/AIDS and STD prevention and control in China.<sup>53</sup> In recent years, these organizations have conducted several HIV prevention interventions targeting the floating population across the country, such as the “3 approaches and 3 gifts”<sup>54</sup> “361 model education”,<sup>55</sup> and “Caring for migrant workers in construction sites”<sup>56</sup> programs. Strategies in almost all of these interventions consisted of general health education and free condom distribution, as also found in our review. Although we were able to gather some descriptive information on these intervention strategies from the websites or in reports of the governmental and non-governmental organizations, we could not identify any clear data on measurement of their effects. Therefore this information could not be included in our study. In two instances there was some reference to improvement of indicators, but without defining the exact outcome effect.<sup>55,57</sup> Another review also pointed out that there is a lack of reported effect evaluation regarding the achievement of NGOs in preventing HIV transmission in China.<sup>58</sup> To design a successful HIV prevention intervention for the floating population, it is necessary to emphasize the importance of process and effect evaluation.

### **Strengths and weaknesses of this review**

This study was an update and comprehensive literature review. It not only described the efforts to prevent HIV transmission in Chinese floating population over the past decade, but also applied comprehensive indicators to evaluate their effectiveness. The chosen indicators (condom use, knowledge and stigma) are crucial components of the Knowledge-Attitude-Practice model<sup>59</sup> that was broadly used in developing and evaluating prior health promotion interventions in China. They are also essential factors in the battle against HIV transmission in floating populations, given the marked epidemiological shift in HIV infection from IDU to sexual transmission over the past decade in China. Another strength is that we conducted a meta-analysis to synthesize independent studies and explore differences across studies. The quantified estimate of effectiveness allows policy makers and designers of health education programs to formulate concrete and realistic goals for future behavioral and psychosocial HIV prevention interventions.

However, care must be taken when applying the pooled estimate to general floating populations in China, as the formal definition of this population remains under debate. The floating population of China includes a variety of occupations and the studies in this review are mainly based on one specific occupation, such as construction workers.<sup>33</sup> This systematic review also has some limitations. First, the review is affected directly by the quality of the studies, which not only contained a high selection bias due to the convenient sample approach often applied, but also attrition bias due to participants moving in or out of the area during intervention(s). Second, although socio-demographic characteristics were controlled before and after the intervention(s) in this study, it does not necessarily guarantee controlling for many non-tangible yet profound social and psychological characteristics that may determine the self-selection. Third, the source of heterogeneity on the primary outcome was only explored by subgroup analyses on aspects of study design and interventions. The influences of other factors, especially socio-economic characteristics of participants (such as age, income and educational level), on heterogeneity cannot be elucidated through the data provided in our study. Fourth, we did not explore in depth the factors influencing the secondary outcomes because it was not the main scope of this study. More evidence is needed regarding the contribution of individual intervention elements on their effectiveness at increasing knowledge and decreasing stigma. Finally, we chose to generalize the specific feelings and stigma associated with HIV-infected individuals.<sup>26</sup> However, recent conceptual frameworks have highlighted that important differences exist in the way this stigma may influence the attitudes, behaviors, and experiences of individuals living with HIV compared to individuals without HIV, as well as differences in the relationship with HIV-infected individuals (e.g., family members, colleagues, etc.).<sup>60,61</sup>

### **Future research**

We included only one study in this review with a theory-based comprehensive intervention. However, we found potentially high effectiveness for many related programs based on theories about changing health behaviors, such as social cognitive theory. With a better understanding of health behavior theories, the next step should be to apply rigorous study designs with theoretical frameworks to develop effective strategies that meet the needs of the changing socio-economic and cultural situation of the floating population in China.

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### **Data availability**

All data underlying our findings are provided as results in this manuscript and supporting information accompanying with this manuscript. The primary data on studied literature are available to all interested researchers on request.

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Table S1 | Extracted data for description of included studies (n=16).

Source	Study Characteristics	Sample Size	Demography	Intervention Program	Outcome
<b>Li, 2006</b> <sup>27</sup>	<b>Site:</b> Nanning, Guangxi <b>Design:</b> Before-and-after <b>Language:</b> Chinese	<b>Before:</b> 236 <b>After:</b> 288	<b>Age (mean):</b> 29.9 <b>% male:</b> 84.75 <b>% &gt;high school:</b> 2.97 <b>% married:</b> 62.71	<b>Category:</b> General health education <b>Follow-up period:</b> 6 months <b>Strategies:</b> Poster publicity; brochures distribution; lectures; video on kill of condom use; health advisory.	- Condom use with unstable sexual partner - Knowledge - Stigma
<b>Xu, 2006</b> <sup>28</sup>	<b>Site:</b> Yongkang, Zhejiang <b>Design:</b> Before-and-after <b>Language:</b> Chinese	<b>Before:</b> 601 <b>After:</b> 558	<b>Age (mode):</b> 20-39 <b>% male:</b> 53.7 <b>% &gt;high school:</b> 8.8 <b>% married:</b> 41.1	<b>Category:</b> General health education <b>Follow-up period:</b> 8 months <b>Strategies:</b> Poster publicity; brochures distribution; audio and video propaganda; multiple educational materials dissemination; knowledge quiz.	- Condom use - Knowledge - Stigma
<b>Zheng, 2006</b> <sup>29</sup>	<b>Site:</b> Xian, Shaanxi <b>Design:</b> Before-and-after <b>Language:</b> Chinese	<b>Before:</b> 212 <b>After:</b> 224	<b>Age (mean):</b> 28.8 <b>% male:</b> 90 <b>% &gt;high school:</b> N/A <b>% married:</b> N/A	<b>Category:</b> Free condom distribution <b>Follow-up period:</b> 10 months <b>Strategies:</b> poster information about condoms freely available.	- Condom use
<b>Fu, 2009</b> <sup>30</sup>	<b>Site:</b> Guangzhou, Guangdong <b>Design:</b> Before-and-after <b>Language:</b> Chinese	<b>Before:</b> 182 <b>After:</b> 232	<b>Age (mean):</b> 28.8 <b>% male:</b> 87 <b>% &gt;high school:</b> N/A <b>% married:</b> N/A	<b>Category:</b> General health education <b>Follow-up period:</b> 10 months <b>Strategies:</b> distribute related educational brochures, and VCDs; lectures on HIV preventive knowledge; advisory or consult by Q-A twice a week.	- Condom use
<b>Fu, 2009</b> <sup>30</sup>	<b>Site:</b> Guangzhou, Guangdong <b>Design:</b> Before-and-after <b>Language:</b> Chinese	<b>Before:</b> 413 <b>After:</b> 381	<b>Age (SD):</b> 26.13±4.98 <b>% male:</b> 0 <b>% &gt;high school:</b> N/A <b>% married:</b> N/A	<b>Category:</b> General health education <b>Follow-up period:</b> 3 months <b>Strategies:</b> Poster publicity; photography shows to promote related knowledge; lectures; pamphlets distribution.	- Condom use
	<b>Before:</b> 356 <b>After:</b> 327	<b>Age (SD):</b> 26.78±4.50 <b>% male:</b> 0 <b>% &gt;high school:</b> N/A <b>% married:</b> N/A	<b>Category:</b> Peer education <b>Follow-up period:</b> 3 months <b>Strategies:</b> choose and trained 40 "core" persons as health educator to conduct peer education in their work fields; "core" persons educated others by group discussion and individual communication.	- Condom use	
<b>Huang, 2009</b> <sup>31</sup>	<b>Site:</b> Hefei, Anhui <b>Design:</b> Before-and-after <b>Language:</b> Chinese	<b>Before:</b> 646 <b>After:</b> 573	<b>Age (mode):</b> 30-40 <b>% male:</b> 96.59 <b>% &gt;high school:</b> 19.2 <b>% married:</b> 86.84	<b>Category:</b> Comprehensive campaign <b>Follow-up period:</b> 1 month <b>Strategies:</b> educational booklets dissemination; poster and bulletin broadcast; related videos and movies watching; peer education; free lecture; free condoms distribution; free advisory and counseling services.	- Condom use with sex workers - Knowledge - Stigma

**Table S1** | Extracted data for description of included studies ( $n=16$ ) (Continued).

Source	Study Characteristics	Sample Size	Demography	Intervention Program	Outcome
<b>Zhang, 2009</b> <sup>32</sup>	<b>Site:</b> Shenzhen <b>Design:</b> Controlled before-and-after <b>Language:</b> Chinese	<b>Intervention:</b> B: 450 <b>Control:</b> B: 490; A: 445	<b>Age (mean):</b> 32.73 <b>% &gt;high school:</b> 12.7 <b>% married:</b> N/A	<b>Category:</b> Peer education <b>Follow-up period:</b> 6 months <b>Strategies:</b> Trained 50 volunteers as peer educators, who educate others about HIV-related knowledge and skills.	- Condom use with non-marital sex partner - Knowledge
<b>Zhou, 2009</b> <sup>33</sup>	<b>Site:</b> Hefei, Anhui <b>Design:</b> Before-and-after <b>Language:</b> Chinese	<b>Before:</b> 943 <b>After:</b> 671	<b>Age (mean):</b> 33 <b>% male:</b> 93.8 <b>% &gt;high school:</b> 17.1 <b>% married:</b> 73.4	<b>Category:</b> Comprehensive campaign <b>Follow-up period:</b> 5 months <b>Strategies:</b> free condoms distribution; peer education; mini-media publicity; free consult.	- Condom use with stable sexual partner; Knowledge - Stigma
<b>Li, 2010</b> <sup>34</sup>	<b>Site:</b> Lantian, Shaanxi <b>Design:</b> Controlled before-and-after <b>Language:</b> Chinese	<b>Intervention:</b> B: 354; A: 354 <b>Control:</b> B: 383; A: 383	<b>Age (mode):</b> 18-50 <b>% male:</b> N/A <b>% &gt;high school:</b> N/A <b>% married:</b> N/A	<b>Category:</b> General health education <b>Follow-up period:</b> 4 months <b>Strategies:</b> personal advocacy; pamphlet and booklets distribution; poster; related movies watching; community training of doctor.	- Condom use - Knowledge - Stigma
<b>Lin, 2010</b> <sup>35</sup>	<b>Site:</b> Beijing <b>Design:</b> Randomize Controlled Trial (RCT) <b>Language:</b> English	<b>Intervention:</b> B: 196; A: 145 <b>Control:</b> B: 104; A: 81	<b>Age (SD):</b> 22.99±9.7 <b>% male:</b> 0 <b>% &gt;high school:</b> 22.0 <b>% married:</b> 20.0	<b>Category:</b> Comprehensive campaign <b>Theory:</b> Protection motivation theory (PMT) <b>Follow-up period:</b> 4 months <b>Strategies:</b> Emphasis on knowledge, negative consequence of high risk behaviors; decision making, goal setting, communication skill, condom negotiation skill, condom use skill, self-efficacy improvement, consensual relationships and empowerment. Format included games, group discussions, videos, role plays, brainstorming and homework assignments.	- Condom use - Knowledge
<b>Sheng, 2010</b> <sup>36</sup>	<b>Site:</b> Haining, Zhejiang <b>Design:</b> Controlled before-and-after <b>Language:</b> Chinese	<b>Intervention:</b> B: 247; A: 146 <b>Control:</b> B: 233; A: 184	<b>Age (mean):</b> 39.96 <b>% male:</b> N/A <b>% &gt;high school:</b> 1.2 <b>% married:</b> 93.5	<b>Category:</b> Comprehensive campaign <b>Follow-up period:</b> 11 months <b>Strategies:</b> conducted for construction workers. Educational materials distribution; focus group discussion; poster and bulletin broadcast; condom distribution and skills counseling; peer education.	Condom use with sex workers Knowledge Stigma

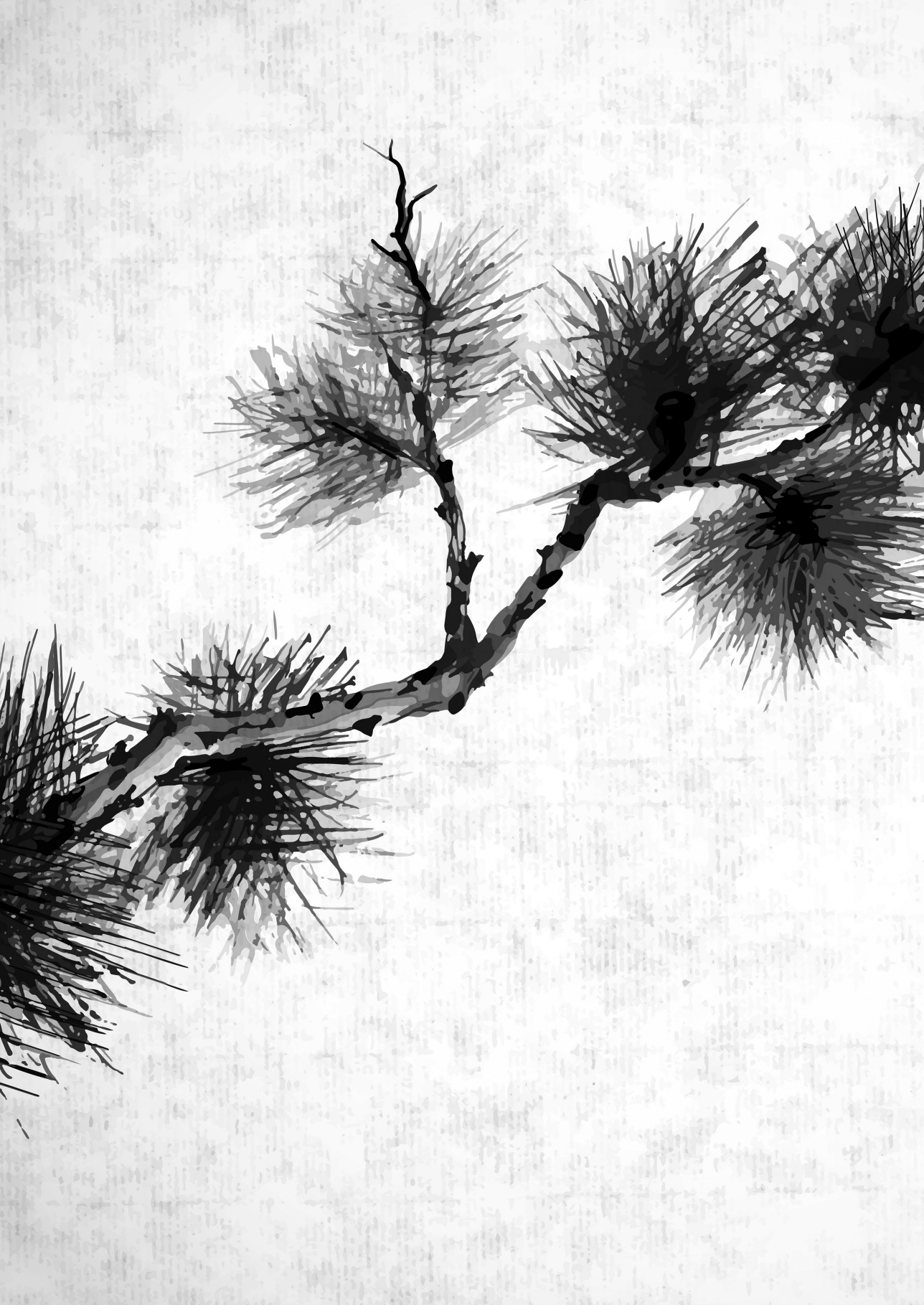
Table S1 | Extracted data for description of included studies ( $n=16$ ) (Continued).

Source	Study Characteristics	Sample Size	Demography	Intervention Program	Outcome
<b>Xu, 2010</b> <sup>37</sup>	Site: bars in Beijing Design: Before-and-after Language: Chinese	Before: 1202 After: 1265	Age(mode): 18-35 % male: 63.1 %≥high school:55.2 % married: 20.9	Category: Comprehensive campaign Follow-up period: 4 months Strategies: free condoms distribution; peer education; personal advocacy; lecture and knowledge training; booklets distribution; knowledge quiz with prize.	Condom use Knowledge
<b>Du, 2011</b> <sup>38</sup>	Site: Chongqing Design: Before-and-after Language: Chinese	Before: 600 After: 600	Age(mode):30-40 % male:85.31 %>high school: 1.82 % married: 84.32	Category: Comprehensive campaign Follow-up period: 12 months Strategies: Educational martial distribution; focus group discussion; peer education; free condoms distribution; prized knowledge quiz.	Condom use with spouse Knowledge
<b>Hou, 2011</b> <sup>39</sup>	Site: Qingdao, Shandong Design: Before-and-after Language: Chinese	Before: 861 After: 806	Age(SD): 22.0±2.8 % male: 0 %>high school: 5.9 % married: 0	Category: Comprehensive campaign Follow-up period: 6 months Strategies: Reproductive-related education brochures dissemination; Posters; lectures; free condoms distribution; peer education; free counseling hot-line.	Condom use Knowledge
<b>Li, 2011</b> <sup>40</sup>	Site: Anshang, Liaoning Design: Before-and-after Language: Chinese	Before: 900 After: 830	Age(SD):34.63±8.67 % male: 96.6 %>high school: 0.1 % married: 24.1	Category: General health education Follow-up period: 12 months Strategies: general community education (poster, educational material distribution in hint)	Condom use with sex workers Knowledge Stigma
<b>Shi,2011</b> <sup>41</sup>	Site: Shenyang, Liaoning Design: Before-and-after Language: Chinese	Before: 1000 After: 1000	Age(SD):34.6±9.3 % male: 82.6 % >high school: 1.0 % married: 65.4	Category: Comprehensive campaign Follow-up period: 6 months Strategies: Educational materials distribution; poster and bulletin broadcast; lectures; health counseling; free condom distribution.	Condom use Knowledge
<b>Wang,2011</b> <sup>42</sup>	Site: Shenyang, Liaoning Design: Before-and-after Language: Chinese	Before: 112 After: 112	Age(mode): 30-40 % male: 96.4 %≥high school: 5.4 % married: 82.1	Category: General health education Follow-up period: 6 months Strategies: brochures distribution; posters; video play.	Condom use with spouse Stigma
		Before: 143 After: 143	Age(mode): 40-50 % male: 95.1 %>high school: 5.6 % married: 87.4	Category: Comprehensive campaign Follow-up period: 6 months Strategies: brochures distribution; posters; video play; focus group discussion; peer education.	Condom use Stigma

Appendix S1. Examples in study selection form

No.	Database	language	Paper	Screening studies-Step 1 (Abstract Stage)						Full text-Step 2 (Full-text Stage)						Include		
				Inclusion Criteria			Exclusion Criteria			Inclusion Criteria			Exclusion Criteria					
				SD	PTCP	ITVN	Outcome	Publication	Duplicate	Score	Include	SD	PTCP	ITVN	Outcome		Duplicate	Publication
1	Pubmed	EN	Yang,2005	0	1	0	1	1				2						
2	Pubmed	EN	Hesketh,2006	0	1	0	1	1				2						
3	Pubmed	EN	strand,2006	0	1	0	1	1				2						
4	Pubmed	EN	thorborg,2006	0	1	0	1	1		1		1						
5	Pubmed	EN	Hesketh,2007	0	0	0	1	1				1						
6	Pubmed	EN	Li,2007	0	1	0	1	1				2						
7	Pubmed	EN	Li,2007	0	1	0	1	1				2						
8	Pubmed	EN	Li,2007	0	1	0	0	1				4						
9	Pubmed	EN	Olan,2007	1	1	1	1	1				4	1	1	1	0	0	3
10	Pubmed	EN	Xu,2007	0	0	0	1	1				1						
11	Pubmed	EN	Hesketh,2008	0	1	0	1	1				2						
12	Pubmed	EN	IO,2008	0	1	0	1	1				2						
13	Pubmed	EN	IO,2008	0	1	0	1	1				2						
14	Pubmed	EN	Mai,2008	0	1	0	1	1				2						
15	Pubmed	EN	Wong,2008	0	1	0	1	1				2						
16	Pubmed	EN	Wong,2008	0	1	0	1	1				2						
17	Pubmed	EN	Hong,2009	0	1	0	1	1				2						
18	Pubmed	EN	Hong,2009	1	1	1	1	1		1		3						
19	Pubmed	EN	Li,2009	0	1	0	1	1				2						
20	Pubmed	EN	Mou,2009	0	1	0	1	1				2						
21	Pubmed	EN	Wong,2009	0	0	0	1	1				1						
22	Pubmed	EN	Chan,2009	0	0	0	1	1		1		0						
23	Pubmed	EN	Chen,2010	0	1	0	1	1				2						
24	Pubmed	EN	Li,2010	0	1	0	1	1				2						
25	Pubmed	EN	Li,2010	1	0	1	1	1				3						
26	Pubmed	EN	Lin,2010	1	1	1	1	1				4	1	1	1	1	0	4
27	Pubmed	EN	Liu,2010	0	0	0	1	1				1						1
28	Pubmed	EN	Liu,2010	0	0	0	1	1				1						0
29	Pubmed	EN	Mou,2010	0	1	0	1	1				2						0
30	Pubmed	EN	Peng,2010	0	1	0	1	1				2						0
31	Pubmed	EN	Qiu,2010	0	0	0	1	1				1						0
32	Pubmed	EN	Rou,2010	1	0	1	1	1		1		2						0
33	Pubmed	EN	Wong,2010	0	0	0	1	1				1						0
34	Pubmed	EN	Zhang,2010	0	0	0	1	1				1						0
35	Pubmed	EN	Chen,2011	0	1	0	1	1				2						0
36	Pubmed	EN	Chen,2011	0	0	0	1	1		1		0						0
37	Pubmed	EN	He,2011	1	1	1	1	1				4	1	1	0	1	0	3
38	Pubmed	EN	He,2011	1	0	1	1	1				3						0
39	Pubmed	EN	Lp,2011	0	1	0	1	1				2						0
40	Pubmed	EN	Mok,2011	0	1	0	1	1		1		1						0
41	Pubmed	EN	Qiu,2011	0	1	0	1	1				2						0
42	Pubmed	EN	Rotheram,2011	1	1	1	1	1				4	1	1	1	1	0	4









## Chapter 7

# Are condom-promotion interventions reaching internal migrants in China?: Integrated evidence from two cross-sectional surveys

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Submitted







## Chapter 8

# Opinions and attitudes of health care workers towards HIV-infected co-workers and patients in two tertiary hospitals in Beijing, China

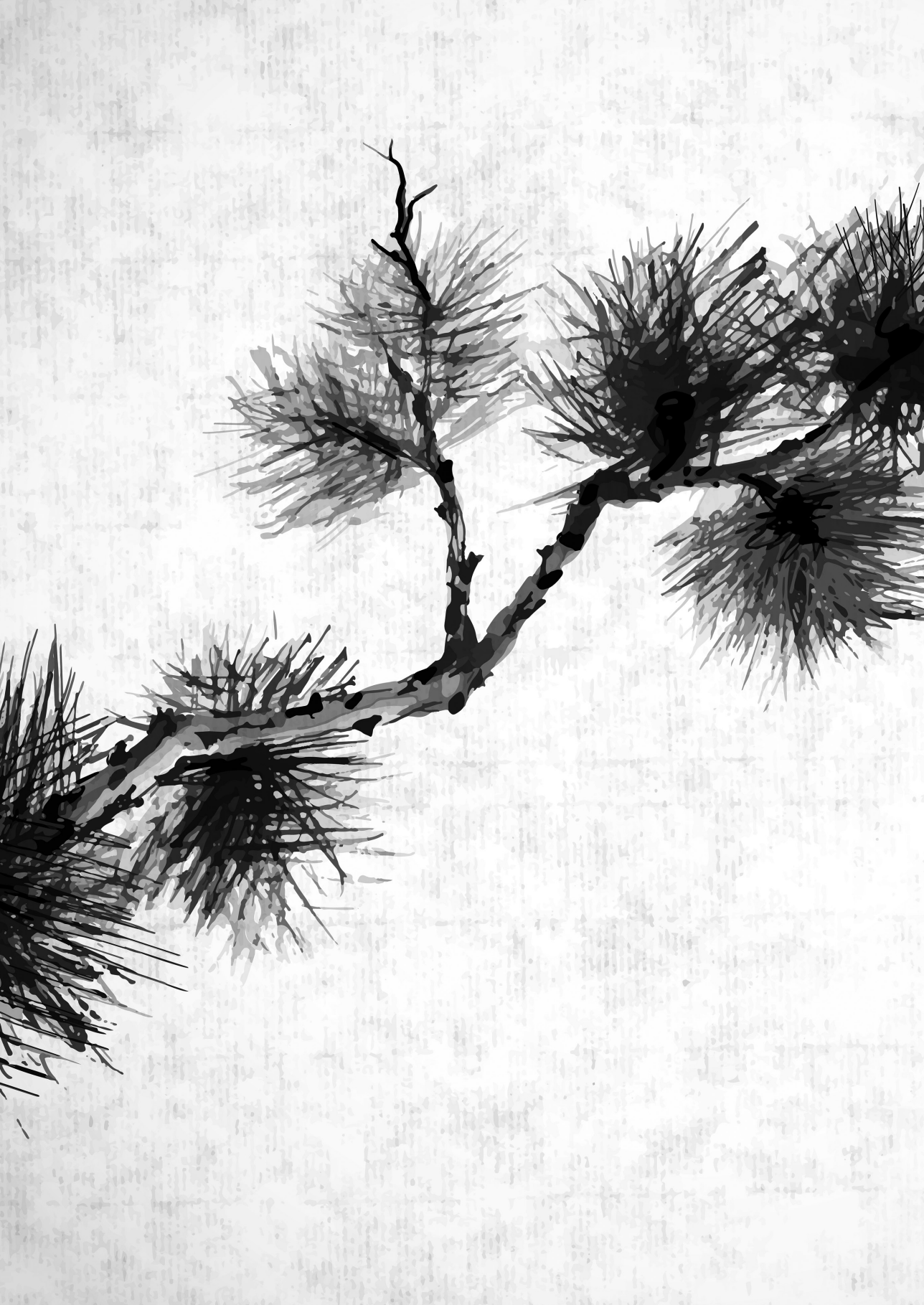
Xiaona Liu,<sup>2</sup> Xinying Sun,<sup>1</sup> Lenneke van Genugten,<sup>2</sup> Yuhui Shi,<sup>1</sup>  
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Submitted

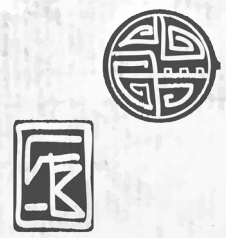






# Chapter 9

## General discussion



This thesis describes a number of studies on the identification of risk factors and determinants of HIV-related behaviors among several high risk yet neglected general population groups in China, and explores the elements bridging these determinants into effective and practical HIV prevention interventions. The purpose of this thesis is to contribute to the development of effective preventive measures against HIV infections in the neglected high risk populations (i.e., health care workers, college students and internal migrants) in China.

## 9.1 | MAIN FINDINGS

### *Research question 1:*

What are risk factors of HIV infections in health care settings?

### *Answer:*

Occupational exposure to blood (including percutaneous injury, exposure of mucous membrane and non-intact skin), and high frequency of exposure place health care workers (HCWs) at risk for transmission of blood borne viruses (BBV), including HIV.

More than 80% of HCWs had at least one percutaneous injury in their working lifetime and an average of two blood exposure episodes in the preceding year (Chapter 2). Among three common HCW job categories (nurses, doctors and technicians), we identified nurses to be at the highest risk of percutaneous injuries and to have the highest average number of exposure episodes. Suture needles are the major source of injuries for doctors, while hypodermic and syringe needles are the major injury sources for nurses. In addition, we confirmed our assumption that promoting compliance of HCWs with Standard Precautions (SP) guidelines is associated with decreased occupational blood exposure.

To improve the compliance with the protective guideline among HCWs, and ultimately prevent transmission of BBV infections in health care settings, the results of our study suggest that it is necessary to increase awareness of SP and training coverage among HCWs in China. Also, a favorable physical environment, for example the availability of sufficient supplies of personal protective equipment (e.g. glove, mask, eye protection, apron), will help developing a safe climate within the workplace of HCWs and stimulate individual compliance with the guideline.

### *Research question 2:*

What are important determinants of sexual risk behaviors leading to HIV infections in high risk general population groups?

*Answer:*

For college students in China, knowledge about HIV/AIDS, attitudes toward high risk behavior, self-efficacy, and intention to use a condom were statistically significantly important cognitive determinants of their use of condoms, and the exposure to pornographic material, level of consumption, and sex education were statistically significantly important social-environmental determinants of their use of condoms. For internal migrants in China, condom use was positively associated with perceived benefits and condom use discussion among male migrants, while it was associated with self-efficacy and educational level among female migrants.

We found statistically significant differences with regards to sex negotiation and decision making between male students and female students (Chapter 3). For example, female students were identified to have more self-efficacy than male students in suggesting using a condom. For general internal migrants we also found that female and male migrants differ in their determinants of condom use (Chapter 4). Apart from positive associations with condom use, we found that perceived barriers to condom use, such as financial obstacles and personal embarrassment regarding condom purchase, were negatively associated with condom use. This was the case for both males and females. Also, personal characteristics, namely living with children and duration of residence in the place of enumeration (period of in-migration), were positively associated with the condom use of male migrants.

The behavioral model used – Health Belief Model (HBM) - was able to explain the condom use behavior of females better than that of males. Table 1 lists the behavioral determinants identified by using the HBM for male and female migrants separately. In addition, a generic perspective on determinants of condom use among Chinese internal migrants was collected from a panel of experts in a Delphi study (Chapter 5). The panelists identified 19 determinants of condom use in general, 6 additional determinants for committed sexual relationships, and 8 additional determinants for casual sexual relationships. These determinants covered both individual factors (e.g. knowledge, attitudes, risk perception, self-efficacy and skills) and socio-environmental conditions (e.g. social norms, and environmental support). The panelists also reached a consensus on the importance and changeability of each determinant. Table 1 summarizes the determinants of condom use among Chinese internal migrants with additional determinants identified by the panelists. These determinants should be taken into consideration when developing new interventions to promote condom use among internal migrants in China.

**Table 1** | Behavioral determinants of condom use among Chinese internal migrants, by sex (Chapter 4 and 5).

Male	Female
	Self-efficacy
<b>Perceived benefits</b>	<b>Perceived social norm</b>
– Knowledge	– Knowledge
<b>Perceived barriers</b>	<b>Perceived barriers</b>
– Financial reasons *	– Financial reasons *
– Embarrassment about buying in stores	– Embarrassment about buying in stores
– Embarrassed to pick up free condoms *	– Embarrassed to pick up free condoms *
– Inconvenience to carry condoms (skill)	– Inconvenience to carry condoms (skill)
<b>Open communication between partners (skill)</b>	<b>Open communication between partners (skill)</b>
– Attitudes towards condom use	– Attitudes towards condom use
<b>Attitudes from sex partner</b>	<b>Attitudes from sex partner</b>
– Risk perception	– Risk perception
<b>Peer support *</b>	<b>Peer support *</b>
– Social support *	– Social support *

\* The experts in our Delphi study reached a consensus (IQD $\leq$ 1) that these determinants are of less importance (Medians $\leq$ 4) or less changeable (Median $\leq$ 4).

### *Research question 3:*

What can be learnt from evaluations of previous HIV prevention interventions?

### *Answer:*

Previous HIV prevention interventions among Chinese internal migrants were only marginally effective at increasing condom use, but relatively successful at increasing HIV knowledge and decreasing stigma.

In our systematic review and meta-analysis of the effectiveness of previous HIV prevention interventions at increasing condom use (Chapter 6), we found that single component interventions, mostly applied before 2010, were more effective than comprehensive campaigns that were mostly applied in and after 2010. This contradicts the literature on intervention development suggesting that comprehensive interventions should be more effective.<sup>1</sup> Our explanation of this apparent contradiction is that possibly out of date single strategies were later combined into comprehensive campaigns. In other words, although more comprehensive campaigns were conducted in recent years, these may have combined single (inefficient) strategies developed earlier. This finding thus suggests that new intervention strategies should take the changing socio-economic and cultural situation of Chinese internal migrants into account in order to be effective.

Furthermore, we highlighted the need to increase the reach of condom promotion interventions among Chinese internal migrants (Chapter 7). The reach of condom promotion interventions among internal migrants was low, as there was a distinct discrepancy



between what was offered and what was reported to have been received regarding condom promotion techniques among the migrants. Study of six often-used techniques aiming at increasing condom use indicated that new interventions should consider using techniques that are likely to reach internal migrants (e.g. distribution of educational materials in print and free condoms) and extending the migrants' preferred health education approaches (e.g. by adopting preferred channels and adjusting reinforcements).

In another study (Chapter 8), we showed that HCWs, including doctors, nurses and technicians, held rigid opinions on managing HIV-infected co-workers and stigmatizing attitudes towards HIV-infected patients. We described their opinions and attitudes as a reflection of the effect of previous HIV prevention interventions in health care settings. Almost all HCWs responded that they perceived a high risk of HIV transmission. Correlate analysis indicated that the high risk perception maybe the result of the insufficient HIV-related knowledge combined with the high rate of percutaneous injury in HCWs. In order to effectively prevent discriminative practices against people with HIV in health care settings, and to encourage HCWs be successful health advocates in preventing HIV, we thus suggest efforts on increasing HIV-related knowledge and improving compliance to SP among HCWs in China.

*Research question 4:*

Which elements should effective and practical behavioral HIV prevention interventions targeting high risk general population groups contain?

*Answer:*

Behavioral HIV prevention interventions should at least: 1) increase condom availability and access (targeting socioeconomic determinants); 2) provide training and education (targeting HIV knowledge, risk perception, self-efficacy and skills); 3) apply behavioral theory (targeting multiple determinants in a structured manner); 4) perform worksite health promotion; and 5) work closely with relevant governmental and non-governmental organizations (targeting social and structural determinants).

In total, we described 16 intervention elements that a panel of experts considered successful in interventions aimed at increasing condom use from both effective and practical perspectives, including four methods of intervention development, ten intervention approaches, and two process measures (Chapter 5). In addition, distribution of educational materials in print and free condoms were recommended as elements in behavioral HIV prevention interventions, which are the techniques most likely to reach the general internal migrants and that are also preferred by the migrants. We also identified health service centers as the most preferred venue by the migrants for distributing materials (Chapter 7). For techniques that are relatively preferred but reach fewer migrants, i.e. individual health counselling and lecture and/or

training, future interventions containing these techniques should strive to increase their reach to the migrants (e.g. incentives, follow-up, favorable locations). Furthermore, assuming access to the internet continues to improve in China, future media health promotion may be delivered through television and the internet, which were identified by the migrants as their most preferred channels to receive condom-promotion information. Implementing behavioral HIV prevention interventions among college students in China is challenging.<sup>2</sup> College students generally fall under the definition of internal migrants in China,<sup>3</sup> and the suggested effective and practical elements of interventions among internal migrants may also be worth considering when developing HIV prevention interventions among college students.

## 9.2 | METHODOLOGICAL ISSUES

The studies presented in this thesis applied a variety of methodologies, varying from quantitative cross-sectional studies to integrated studies of qualitative and quantitative exploratory nature. These studies have several limitations and the results and conclusions should be interpreted in light of these limitation. In this section, considerations regarding study design, measure, sampling, and the theoretical framework are discussed.

### Cross-sectional studies

Five cross-sectional studies were included in this thesis, with a number of limitations (Chapter 2-4, 7 and 8). Firstly, due to the cross-sectional design, these studies do not imply causality. However, the five studies provide an up-to-date ‘snapshot’ of the characteristics and many associates that may be important for HIV prevention among our target population groups. They are therefore useful in generating hypotheses for future research and providing evidence for developing relevant interventions.<sup>4</sup> Secondly, the five studies applied self-administrated questionnaires. The outcome measure of the questionnaires was self-reported behavior and not observed (or actual) behavior. The data used relied on self-reported information, and thus may suffer from recall bias (e.g. the frequency of condom use in the preceding year was forgotten) and social desirability bias (e.g. favorable social norms “Most people at my age are using condoms these days” were overrated; own positive behavior “I wear gloves whenever there is possibility of exposure to blood” was overrated; and negative attitude “I feel disgusted by HIV-infected patients” was underestimated). Thirdly, the questionnaires used were self-designed and not validated before application. Thus, it is not certain that the separate constructs were measured as intended in each questionnaire. However, all these constructs did have a high internal consistency (e.g. construct ‘perceived barriers’ with Cronbach’s  $\alpha=0.769$  in Chapter 4, and construct ‘attitudes towards HIV-infected patients’ with Cronbach’s  $\alpha=0.686$  in Chapter 8). Although, we could not collect and analyze information about the non-responders, the response rate of each cross-sectional study was high, ranging from 88.6% to 95.0%, and no apparent evidence suggests differences between respondents and non-respondents.

Regarding possible selection bias, the participants in the five cross-sectional studies, except the one among college students, were not randomized samples. The large sample of college students was strictly recruited through stratified cluster sampling, with relatively good representativeness (Chapter 3). However, in the studies among HCWs in tertiary hospitals in Beijing, the participants were doctors, nurses and technicians who were likely to be in contact with blood, needles, and sharps (Chapter 2 and 8). In these hospitals the health care quality and safety are considered to be higher than in general Chinese hospitals.<sup>5</sup> It is thus possible that the level of occupational risk exposure and HIV-related stigma in health care settings was underestimated, which underscores our call for interventions to prevent HCWs from BBV transmission, including HIV infections, nationally.<sup>6</sup>

Finally, in the studies among internal migrants in Shenzhen, the participants were recruited from community health care centers that they visited for an occupational health screening project (Chapter 4 and 7). Given the sheer size and heterogenic nature of internal migrants in China,<sup>7</sup> our sample cannot be considered representative of all Chinese internal migrants. On the other hand, integrating the worksite-based screening approach did overcome the rather difficult challenge of reaching the target population, and gave a very high response. Moreover, completing the screening project was compulsory for people working at six of the major worksites (e.g. hotel, retail market, and construction site), of Chinese internal migrants as identified by the Chinese government.<sup>8</sup> A comparison of our sample with the national dynamic monitoring population in 2011 did not show significant differences in socio-demographical characteristics.<sup>8</sup> Therefore, we consider the sample adequate for an exploration to support the main core of this thesis on developing a behavioral HIV prevention intervention targeting internal migrants in China.

### **Systematic Review and meta-analysis**

Our systematic literature review and meta-analysis is one of the first to systemically review and quantitatively evaluate recent studies on behavioral HIV prevention interventions among Chinese internal migrants (Chapter 5). It has however some limitations, particularly due to the quality of the studies involved. They not only contained high selection bias because the convenience sample approach was often applied, but also attrition bias because of participants moving in or out of the area during the intervention(s). The influences of many more factors, especially the socioeconomic characteristics of participants (such as age, income and educational level), on heterogeneity cannot be elucidated through the data provided in our study. More consistent descriptions and greater consistency in presentation of outcome measures in scientific papers is essential to improve the quality of data that can be analyzed in systematic reviews, as well as increase the usability of the results in practice.<sup>9</sup>

## Delphi Study

In our three-round Delphi study, the data are dependent on the participants included in the study. We generally had a low response rate over three rounds (21%), possibly introducing response bias (Chapter 6). The highest drop-out was among health policy and management experts. Therefore, the viewpoints of managers might be somewhat under-represented in the final outcomes. In addition, as in other Delphi studies, the procedure of panel selection may have introduced some bias.<sup>10</sup> Experts with a positive attitude towards condom promotion interventions may have been over-represented, since they were primarily recruited from a contact list of people participating in previous similar interventions. Estimations of the expected effectiveness and feasibility of measures could have been different if the panel had been selected through genuine random sampling of the available pools of reference groups. On the other hand, the Delphi technique allows us to apply an iterative process to obtain previously unknown opinions, i.e. HIV interventions among internal migrants in China, and include the viewpoints of different stakeholders or experts, no matter what their geographical location, since the study was conducted remotely. Also, the technique guarantees anonymity and results are not skewed by otherwise dominant opinion leaders. We are thus able to deal with the open-ended and creative aspects of the problem because it motivates independent thought and gradual formation of group solutions.

## The theoretical framework

The Health Belief Model (HBM) used in Chinese internal migrants, together with extended constructs self-efficacy and social norm (Chapter 4), are not the end point to explore the mechanisms of unprotected sex. As we were able to only explain 31% of the variance on condom use in female migrants and 17% of the variance in male migrants, there is still room for improvement to explain better the variance in behavior. Firstly, the constructs investigated focused mainly on the element of individual cognition due to practical limits in the length of the questionnaire (see listed determinants in Table 1). However, studies have shown that the concept of protected sex consists of more dimensions.<sup>11,12</sup> Ideally, the influence of other dimensions of condom use should be investigated further. For example, evidence suggests that institutional and departmental commitment is also important in promoting safe sex.<sup>13,14</sup> Secondly, other theoretical frameworks could also have been considered, such as the Theory of Planned Behavior (TPB)<sup>15</sup> or Social Cognitive Theory.<sup>16</sup> A widely accepted notion is that attitudes towards using a condom - a construct from TPB - plays a crucial role in protected sex,<sup>17,18</sup> as also suggested in our Delphi study (Chapter 5). Moreover, for internal migrants previous studies suggest that situation factors like drinking alcohol and smoking could influence their frequency of condom use,<sup>19,20</sup> and socioeconomic factors like household-involved welfare may also affect their decision on condom use.<sup>21,22</sup> New studies thus should include investigations into these constructs, as they might prove valuable additions in promoting condom use.

### 9.3 | RECOMMENDATIONS

The studies presented in my thesis are among the first to contribute to the development of successful HIV prevention interventions targeting China's neglected high risk general population groups. Based on our studies, I formulate a number of important recommendations for further research and use in practice.

#### *Recommendations for further research*

1. Current efforts and resources for HIV prevention in China focus predominantly on conventional well-known high risk groups (e.g. MSM and FSW).<sup>23</sup>

*I recommend more study on the challenges and barriers faced by the high risk general population groups described in my thesis, who are the majority of the population and very likely to develop or already have risk behaviors that may lead to HIV transmission.*

2. Among the neglected general high risk population groups in my thesis, HCWs are particularly vulnerable to blood borne viral infections, including HIV, due to a high level of occupational exposure to blood, a danger not adequately averted due to suboptimal compliance with standard precautions.

*I recommend comprehensive studies among health care workers in China, looking into both personal, environmental and structural factors of compliance with standard precautions, considering personal factors such as awareness of standard precautions, environmental factors such as supplies of personal protective equipment, and structural factors such as surveillance and reporting systems of occupational health.*

3. College students and internal migrants in China are vulnerable to sexually transmitted diseases, including HIV infection, through unprotected sexual contact. The findings in my thesis suggest that condom use should be considered as an interaction involving both intrapersonal and interpersonal determinants.

*I recommend that future studies developing behavioral HIV prevention interventions should follow or adapt behavioral theories or models to target the various socio-cognitive and environmental determinants of condom use in a structured manner.*

4. The socio-cognitive determinants investigated in my thesis play an important role in condom use, but attention should also be paid to other determinants due to recent socio-economic and cultural changes in society <sup>24</sup> For example, new evidence has indicated that labor migrants are increasingly exposed to more environmental hazards (e.g. deprived living conditions) than urban residents,<sup>25</sup> and that situational factors like drinking alcohol could influence the frequency of condom use among labor migrants.<sup>26</sup>

*I recommend that further research is necessary to assess the changed socioeconomic and cultural environment of the new generation of the high risk general population groups, especially for the internal migrants, when developing behavioral HIV prevention interventions in China.*

5. My thesis generated both quantitative and qualitative input for the development of successful HIV prevention interventions targeting internal migrants in China, the first steps of the intervention mapping framework.<sup>1</sup> The next step in this process would be designing, implementing and testing interventions based on the findings in practice. In Annex 1 we present an example applying our findings to the next IM steps for developing an intervention, especially explaining how identified determinants could be incorporated into a successful HIV prevention intervention in Chinese internal migrants. However, when translating the intervention map into practical strategies, it also important to consider to whom and how the intervention is going to be delivered.<sup>27</sup>

*I recommend more study investigating the application of Intervention Mapping in HIV prevention among different high risk population groups in China, and identifying areas where crucial information is still lacking, in particular with regard to barriers, facilitators, and means of effective communication (e.g. internet, social media).*

#### *Recommendations for practice*

1. In health care settings, the HCWs in relatively good-quality hospitals reported rather rigid opinions on managing HIV-infected co-workers and stigmatizing attitudes towards HIV-infected patients that may lead to discriminative medical practices. Health care workers play an important role in health advocacy, therefore stimulating positive attitudes is important in improving the quality of health care delivered to HIV infected patients.

*I urgently recommend strong campaigns among health care workers in a wide range of health care settings in China to reduce their stigma towards people living with HIV.*

2. The findings of the studies among Chinese internal migrants in my thesis suggest that previous HIV prevention interventions targeting the migrants were only marginally effective at increasing condom use, and only reached a limited proportion of the target population.

*I recommend more HIV prevention interventions containing effective and practical strategies in order to be successful.*

3. To date, a number of governmental and non-governmental organizations addressing HIV/AIDS in China have conducted many HIV prevention interventions targeting high risk

populations, including internal migrants. However, many of the previous interventions solely contain elements improving knowledge of the target population.<sup>28</sup> One of the core findings in my thesis is that a change in knowledge alone is not sufficient to improve self-protective behavior, e.g. wearing gloves or using condoms. The findings in my thesis concerning important and changeable determinants and intervention strategies can be readily applied in developing new interventions.

*I recommend that multiple socio-cognitive and determinants of risk behaviors, besides knowledge, need to be taken into account when designing and implementing HIV prevention interventions.*

*I recommend that novel HIV prevention interventions should provide Chinese college students with sufficient skills, including the skills to use a condom correctly, and social skills such as how to negotiate condom use and identify and avoid risky environments.*

*I recommend that novel HIV prevention interventions among internal migrants in China should not only provide sufficient information in easily understandable formats and language, but also include sessions on how to deal with various barriers to condom use, access to health services, and how to decrease risk in new urban settings.*

*I recommend that future interventions should increase the perception of male migrants on the benefits of condom use, and should empower female migrants with higher education and self-efficacy.*

4. In view of the current scientific literature and available reports, especially on activities of non-governmental organizations, it is clear that there is lack of evidence for robust study design and evaluation methodology in China.<sup>29</sup>

*I recommend that more emphasis is given to the importance of process and effect evaluation when designing successful HIV prevention interventions for neglected high risk general population groups.*

*I strongly recommend to work closely with both governmental and non-governmental organizations when performing behavioral HIV prevention interventions, as their commitment would contribute substantially in keeping interventions accessible and sustainable.*

## **ANNEX 1 | AN EXAMPLE OF APPLYING THE FINDINGS OF THIS THESIS IN THE DEVELOPMENT OF A HIV PREVENTION INTERVENTION, FOLLOWING INTERVENTION MAPPING FRAMEWORK**

The studies regarding internal migrants described in **chapter four to seven** are activities performed following the first three steps of Intervention Mapping (IM) framework to develop an evidence-based and theory-based intervention. In the following example we collate our findings and apply these in the IM development steps, especially explaining how identified determinants can be translated into a successful HIV prevention intervention targeting internal migrants in China.

### **Step 1: Needs assessment**

The first step of IM was carried out in three parts: a cross-sectional quantitative study (**chapter four**), and additional Delphi study (**chapter five**) and literature review (**chapter six**). First, analysis of the health problem: a short epidemiological analysis on STI and HIV was done by reviewing literature from Chinese and English literature databases, and reports from governmental and non-governmental organizations. Then, analysis of behavior: in view of the available literature on the effects of previous behavioral HIV prevention interventions conducted among Chinese internal migrants, it was decided to limit the behavior outcome as condom use. Subsequently, analysis of behavioral determinants: a cross-sectional study and additional qualitative study using Delphi technique were conducted to identify possible determinants influencing condom use at the personal level, and collect additional insights on the behavior problem. Some social and cultural determinants of condom use at environmental levels were discussed in experts meetings, but were excluded in the further steps, because the experts from local public health services considered these factors either not important or not changeable. Several environmental elements considered both important and changeable (e.g. availability and accessibility of condoms) were considered in the following steps.

### **Step 2: Identify performance objectives, determinants and finally change objectives**

This step produces a set of matrices of selected ecological levels that combines performance objectives (POs) for each level with selected personal determinants to produce change objectives (COs). It was carried out by the Delphi study (**chapter five**) and expert meetings. Based on the needs assessment, the overall behavioral outcome among male migrants was defined as ‘Consistently and correctly using a condom in sexual intercourse with steady or causal partners in order to prevent HIV and STI’; the behavioral outcome among female migrants was defined as ‘motivate sexual partner to consistently and correctly use condoms during sexual intercourse’. Next, the results of the Delphi study were applied to prioritize determinants and decide on the most important and changeable determinants that an ideal intervention would want to target. As a result, three determinants, namely perceived benefits,



perceived barriers and skills were chosen, and six POs were defined targeting male migrants in expert meetings. These POs address preparatory behaviors for condom use, namely plan to use condoms, purchase or obtain condoms, have condoms readily available, and discuss use of condoms with sex partner, and then using them, namely correctly use condoms and maintain use of condoms at next encounters. Subsequently, a matrix of change objectives (Table 2), including objectives for changing benefits perception (Be), barriers perception (Ba) and skills (Sk) has been developed.

**Table 2** | Performance objectives (POs) and change objectives (COs) for the behavioral outcome among male internal migrants: consistently and correctly using a condom during sexual intercourse

<b>Performance objectives</b>	<b>Perceived Benefits</b>	<b>Perceived Barriers</b>	<b>Skills</b>
<b>PO1.1:</b> Plan to use condoms	<b>Be1.1:</b> Describe importance of planning condom use	<b>Ba1.1:</b> Aware of the possibility of getting STI when having sex with no condom	
<b>PO1.2:</b> Purchase or obtain condoms	<b>Be1.2:</b> Identify places where condoms can be easily purchased or obtained	<b>Ba1.2:</b> Express confidence to be able to purchase or obtain condoms  <b>Ba1.3:</b> Feel comfortable to purchase or obtain condoms	
<b>PO1.3:</b> Have condoms readily available	<b>Be1.3:</b> Describe the importance of keeping condoms readily available	<b>Ba1.4:</b> Express confidence about carrying condoms	<b>Sk1.1:</b> Identify various ways to carry condoms or places where keep condoms to easily reach
<b>PO1.4:</b> Discuss use of condoms with sex partner	<b>Be1.4:</b> Feel being responsible and respectful to the partner to discuss use of condoms	<b>Ba1.5:</b> Express confidence in discussing use of condoms	<b>Sk1.2:</b> List the discussion steps involved in condom use
<b>PO1.5:</b> Correctly use condoms	<b>Be1.5:</b> Describe favorable outcome of use condoms correctly		<b>Sk1.3:</b> Describe condom use procedure
<b>PO1.6:</b> Maintain use of condoms at next encounters	<b>Be1.6:</b> Explain the advantages of using condoms consistently	<b>Ba1.6:</b> Express confidence in being able to use condoms at next encounters	

On the other hand, five determinants, namely knowledge, skills, self-efficacy, perceived social norm and perceived barriers were chosen, and five POs were defined targeting female migrants. These POs address preparatory behaviors for condom use, namely plan to use condoms, purchase or obtain condoms, have condoms readily available, and discuss use of condoms with sex partner, and finally motivate sex partner use condoms correctly and consistently. Subsequently, a matrix of change objectives (Table 3), including objectives for changing knowledge (K), skills (Sk), self-efficacy (Se), social norm perception (Sn) and barriers perception (Ba).

### **Step 3: Theory-based methods and practical strategies**

First an inventory of evidence on previous methods and strategies were made by a systematic review, a Delphi study, and quantitative studies described in **chapter five to seven**. Then we held a brainstorm session with prevention officers and experts working in the field of local HIV prevention in Shenzhen on successes that they experience in their daily activities. We especially encouraged the prevention officers to think of intervention techniques they think are important to apply to the migrants. Based on the brainstorm session and the evidence inventory, especially evidence on the effectiveness and feasibility of methods and strategies, we identified methods that are possibly applicable to the identified COs in the previous step. Applicable methods including training with feedback, tailoring and the provision of condoms, peer education, group discussions and individual counselling focusing on barriers to change, and video portrayal of acceptable normative condom behavior. For example, tailoring was identified as the applicable method to achieve the objective that male migrants are able to describe importance of planning condom use (determinant perceived benefits Be1.1). Application is distributing pamphlet with information about sexual health and diagram hints.

Based on the review of the literature models or theories on behavioral change we used the following theories: Health Belief Model,<sup>30</sup> Social Cognitive Theory<sup>16</sup> and Implementation Intentions Theory.<sup>31</sup> Health Belief Model was used to target perceived benefits and barriers for condom use. Social cognitive theory was used to target self-efficacy, behavioral skills for condom use and preparative behavior like carrying condoms and negotiating condom use.<sup>32,33</sup> Methods for intervention were also derived from theory on implementation intentions for preparative behavior like carrying condoms, plan to buy and store condoms.<sup>34</sup> Moreover, the methods provided information on risks and STI, persuasive arguments to use condoms<sup>35</sup> and anticipate a negative consequence after unsafe sex to change knowledge and outcome expectancies.<sup>36,37</sup>

**Table 3** | Performance objectives (POs) and change objectives (COs) for the behavioral outcome among female internal migrants: motivate sexual partner to consistently and correctly use condoms during sexual intercourse

Performance objectives	Knowledge	Skills	Self-efficacy	Perceived social norm	Perceived Barriers
<b>PO2.1:</b> Plan to use condoms	<b>K2.1:</b> Describe effects of using condoms			<b>Sn2.1:</b> Recognize use of condoms among the peers	<b>Ba2.1:</b> Aware of the possibility of getting STI when sex with no condom
<b>PO2.2:</b> Purchase or obtain condoms	<b>K2.2:</b> Describe places where condoms can be purchased or obtained <b>K2.3:</b> Describe condom brands	<b>Sk2.1:</b> Identify various ways to carry condoms or places where keep condoms to easily reach <b>Sk2.2:</b> List the discussion steps involved in condom use <b>Sk2.3:</b> Describe Condom use procedure <b>Sk2.4:</b> Describe possible solutions when sex partner wants sex without condom	<b>Se2.1:</b> Express confidence to be able to purchase or obtain condoms <b>Se2.2:</b> Express confidence about carrying condoms <b>Se2.3:</b> Express confidence in discussing use of condoms <b>Se2.4:</b> Express confidence about motivating condom use in the long term	<b>Sn2.2:</b> Recognize social acceptance of purchasing or obtaining free condoms <b>Sn2.3:</b> Recognize respect from the partner of discussing condom use <b>Sn2.4:</b> Recognize social acceptance of protective sex	<b>Ba2.2:</b> Feel comfortable to purchase or obtain condoms
<b>PO2.3:</b> Have condoms readily available					
<b>PO2.4:</b> Discuss use of condoms with sex partner					
<b>PO2.5:</b> Sex partner use condoms correctly and consistently					

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## Summary

The Human Immunodeficiency Virus (HIV) infection is a major threat to public health. An increasing concern in China is that HIV has bridged from conventional high risk groups (e.g. intravenous drug users, sex workers, and men having sex with men) to general population groups such as college students, health care workers and internal migrants (also known as floating population in China) with increased risk. There is lack of evidence on factors influencing HIV risk behaviors and effective preventive measures among these high risk general population groups in China. For developing successful HIV prevention interventions targeting these population groups, and ultimately preventing HIV infections in the general population, it is essential to identify determinants influencing (sexual) risk behaviors, and investigate how effective and practical interventions can best be developed targeting these determinants.

The overall aim of this thesis is to contribute to the development of effective preventive measures against HIV infections in different neglected general high risk population groups in China. The specific research questions addressed are:

1. What are risk factors of HIV infections in health care settings?
2. What are important determinants of sexual risk behaviors leading to HIV infections in high risk general population groups?
3. What can be learnt from evaluations of previous HIV prevention interventions?
4. Which elements should effective and practical behavioral HIV prevention interventions targeting high risk general population groups contain?

This thesis consists of two parts. In part I, three studies were conducted to investigate factors and determinants of risk behaviors leading to HIV infections among three different population groups. **Chapter 2** describes a cross-sectional study among health care workers (HCWs), including doctors, nurses and technicians, in two tertiary hospitals in Beijing. We found that almost all HCWs had at least one percutaneous injury in their working lifetime and an average of two blood exposure episodes in the preceding year. We also revealed a suboptimal compliance with standard precaution (SP) among the participants, which is associated with the identified high level of occupational blood exposure. Job category, blood exposure episodes and awareness of the guideline are important factors influencing compliance with the preventive guideline. Also, by using a mass-action model, we estimated the risk of blood borne viruses infections (BBV), including HIV infections, due to the identified level of exposure to blood.

**Chapter 3** describes a cross-sectional study among college students across nine provinces of Mainland China. The results show that only 24.8% of sexually active students had used a condom for every sexual encounter. College students who were male, older, spent more

money each month, had smoking behavior, drunk more often, and exposed to pornographic material more frequently, were more likely to have had sexual intercourse. Moreover, by using path analysis in male and female students separately, we found that exposure to pornographic information, level of consumption, and sex education are important social-environmental determinants of condom use. We also identified that HIV/AIDS knowledge, attitudes toward sexual risk behavior, self-efficacy, and intent to use a condom are important cognitive determinants of condom use.

**Chapter 4** reports the results of a cross-sectional study among general internal migrants in Shenzhen. The results demonstrate that the condom use of the population was low. Different determinants were associated with the condom use of male migrants versus female migrants; only perceived barriers to condom use was negatively associated with condom use in both groups. Condom use was positively associated with the following socio-cognitive and situational determinants: perceived benefits and condom use discussion among male migrants, and self-efficacy among female migrants. Furthermore, personal characteristics, namely living with children and migration duration, were also associated with the condom use of male migrants, while educational level was associated with condom use of female migrants.

Chapters 5, 6, 7 and 8 form part II, the step from determinants to interventions. **Chapter 5** describes a three-round Delphi study in which a panel of epidemiology, psychology, social and behavioral science, health education and promotion, health policy and management experts identified 19 possible determinants of condom use, and 16 intervention methods they considered successful targeting internal migration populations. The panel reached a consensus that attitude towards condom use was the most important and changeable determinant, while applying behavioral theory, increasing sexual education and condom access, performing worksite health promotion, detecting risk factors, and working closely with relevant organizations and the government were the most effective and feasible methods to increase condom use among internal migrants in China.

In **Chapter 6**, a systematic literature review and meta-analysis, we extensively reviewed studies on behavioral and psychosocial interventions for HIV prevention targeting general internal migrants in China over the past decade. The results show that the previous interventions were successful at improving knowledge about HIV transmission and prevention, and decreasing stigma in general. People participating in HIV-related interventions were 13% more likely to use condoms. However, the effects on increasing condom use exhibited significant heterogeneity across programs. By conducting meta-regression analysis, we found that interventions have been significantly less successful in changing condom use in more recent studies, adjusted for sexual relationship, study design and follow-up period.



We further investigated the reach of previous condom promotion interventions among internal migrants in **Chapter 7**. By integrating data of two cross-sectional studies among healthcare providers (staff of local CDCs) and internal migrants in Shenzhen, we show that condom promotion interventions that had been offered by the healthcare providers to internal migrants reached a limited proportion of the targeted population. Although there appears to be a good match between what is offered and what is preferred by the internal migrants regarding condom promotion techniques.

In **Chapter 8**, as a way of inspecting the influences of previous HIV prevention interventions in health care settings, we report the results of a cross-sectional survey on opinions and attitudes of HCWs towards their co-workers and patients with HIV. The results show that HCWs perceived a high risk of HIV transmission in both co-worker and HCW-patient relationships. Most of the HCWs feel disgusted more by patients infected HIV through sexual contact than those infected through blood transfusion or mother-to-child transmission, and believed that HCWs have the right to refuse to care for infected patients, and that those patients should be treated only in designated hospitals. The results also show that almost all HCWs intended to avoid performing invasive clinical procedures or nursing services for HIV-infected patients. Among all job categories, nurses had significantly most stigmatizing attitudes towards HIV-infected patients.

Finally, **Chapter 9** contains my answers to the research questions, an overall discussion, and key implications for research and practice, followed by a number of recommendations for future research and practice. As this thesis generally follows the order of steps of the Intervention Mapping (IM) protocol, I also provide an example of applying IM with the results described in the thesis to the development of a behavioral HIV prevention intervention among Chinese general internal migrants as an annex.

*Recommendations for further research:*

1. More study on the challenges and barriers faced by the high risk general population groups described in our thesis, who are the majority of the population and very likely to develop or already have risk behaviors that may lead to HIV transmission.
2. Comprehensive studies among health care workers in China, looking into both personal, environmental and structural factors of compliance with standard precautions, considering personal factors such as awareness of standard precautions, environmental factors such as supplies of personal protective equipment, and structural factors such as surveillance and reporting systems of occupational health.
3. Future studies developing behavioral HIV prevention interventions should follow or adapt behavioral theories or models to target the various socio-cognitive and environmental determinants of condom use in a structured manner.

4. Further research is necessary to assess the changed socioeconomic and cultural environment of the new generation of the high risk general population groups, especially for the internal migrants, when developing behavioral HIV prevention interventions in China.
5. More study investigating the application of Intervention Mapping in HIV prevention among different high risk population groups in China, and identifying areas where crucial information is still lacking, in particular with regard to barriers, facilitators, and means of effective communication (e.g. internet, social media).

*Recommendations for practice*

1. Strong campaigns among health care workers in a wide range of health care settings in China to reduce their stigma towards people living with HIV.
2. More HIV prevention interventions containing effective and practical strategies in order to be successful.
3. Multiple socio-cognitive and determinants of risk behaviors, besides knowledge, need to be taken into account when designing and implementing HIV prevention interventions.
4. Novel HIV prevention interventions among internal migrants in China should not only provide sufficient information in easily understandable formats and language, but also include sessions on how to deal with various barriers to condom use, access to health services, and how to decrease risk in new urban settings.
5. Future interventions should increase the perception of male migrants on the benefits of condom use, and should empower female migrants with higher education and self-efficacy.
6. More emphasis is given to the importance of process and effect evaluation when designing successful HIV prevention interventions for neglected high risk general population groups.
7. Work closely with both governmental and non-governmental organizations when performing behavioral HIV prevention interventions, as their commitment would contribute substantially in keeping interventions accessible and sustainable.

## Samenvatting

Het Humaan Immunodeficiëntievirus (HIV) virus vormt een grote bedreiging voor de volksgezondheid. Een steeds groter worden de zorg is dat HIV een brug heeft geslagen van conventionele hoge risico groepen (bijv. IV drugsgebruikers, prostituees, en MSM). Zoals naar algemene bevolkingsgroepen onder andere studenten, zorgverleners en interne migranten (die in China ook bekend staan als de *floating population*) die een verhoogde risico op besmetting hebben. Er is onvoldoende kennis over deze factoren van de HIV risico gedrag en effectieve preventieve maatregelen binnen de hoge risico groep. Om succesvolle doelgericht op deze groepen HIV preventieve interventies te ontwikkelen en om uiteindelijk HIV besmetting in de algemene bevolking te voorkomen. Is het noodzakelijk om factoren te identificeren die risicovolle seksuele gedragingen beïnvloeden en te onderzoeken hoe effectiever en praktischer interventies is, zijn op basis van deze factoren te ontwikkelen.

Het hoofddoel van dit proefschrift is om bijdragen aan de ontwikkeling van een effectieve preventieve maatregelen. Om HIV besmetting tegen te gaan onder verschillende vergeten hoge risico populaties in China.

De specifieke onderzoeksvragen die worden behandeld zijn:

1. Wat zijn de risicofactoren van HIV besmetting in de gezondheidszorg?
2. Wat zijn belangrijke determinanten van risicovolle seksuele gedragingen die kunnen leiden tot HIV besmettingen in de hoog risico algemene bevolkingsgroepen?
3. Wat kan geleerd worden van evaluaties van eerdere HIV preventieve interventies?
4. Welke elementen zouden effectieve en haalbare zijn op HIV preventieve interventies binnen de hoge risico groep?

Dit proefschrift bevat twee delen. In deel 1 zijn er 3 studies uitgevoerd om factoren en determinanten van risicovolle gedragingen die kunnen leiden tot HIV besmettingen bij drie verschillende populaties.

**Hoofdstuk 2** beschrijven van een cross-sectionele studie bij zorgverleners in twee tertiaire ziekenhuizen in Beijing oa artsen, verpleegkundigen en andere zorgverleners. Wij vonden dat vrijwel alle zorgverleners minstens een prikincident hebben meegemaakt tijdens hun loopbaan met een gemiddelde van twee incidenten. Waarin ze werden blootgesteld aan bloed in het afgelopen jaar. Ook lieten we zien dat er onder de respondenten een suboptimale naleving van de algemene voorzorgsmaatregelen-richtlijnen. Welke samenhangende hoog aantal incidenten van blootstelling aan bloed tijdens het werk. Beroepstype : blootstelling aan bloed en bewustzijn van de richtlijnen zijn belangrijke factoren die naleving van de preventieve richtlijnen beïnvloeden. Door het toepassen van een model hebben we het

risico van overdraagbare bloed aandoeningen geschat op basis van de gevonden niveau van blootstelling.

**Hoofdstuk 3** beschrijven van een cross-sectionele studie onder universitaire studenten in 9 Chinese provincies. De resultaten laten zien dat slechts 24,8% van de seksueel actieve studenten altijd een condoom gebruikten. Met name mannelijke studenten / oudere / meer geld te besteden hebben per maand, roken / meer alcohol nuttigden en vaker worden blootgesteld aan pornografisch materialen hadden een hoge kans om seks te hebben. Het uitvoeren van aparte pad-analyses onder mannelijk en vrouwelijke studenten toont aan dat blootstelling aan pornografisch materialen, consumptie niveau en seksuele educatie belangrijke sociale- en omgevingsdeterminanten van condoom gebruik zijn. Wij hebben ook aangetoond dat HIV/AIDS kennis, attitudes over seksuele risico gedrag, eigen-effectiviteit en intentie om een condoom te gebruiken bij belangrijke cognitieve determinanten van condoomgebruik zijn.

**Hoofdstuk 4** beschrijven van de resultaten van een cross-sectionele studie onder algemene interne migranten in Shenzhen. De resultaten laten zien dat het niveau van condoomgebruik van de populatie laag is. Verschillende determinanten hingen samen met het condoomgebruik van mannelijke en vrouwelijke migranten; alleen ervaren barrières in condoomgebruik had in beide groepen dezelfde (negatieve) associatie. Condoom gebruik was positief geassocieerd met de volgende social-cognitieve determinanten: ervaren voordelen en het bespreken van condoomgebruik bij makkelijke migranten; en eigen-effectiviteit bij vrouwelijke migranten. Verder waren enkele persoonlijk kenmerken, zoals met kinderen in een huis wonen en de migratie-duur ook geassocieerd met condoomgebruik bij mannelijke migranten , terwijl opleidingsniveau samenhang met het condoomgebruik van vrouwelijke migranten.

Hoofdstukken 5, 6, 7 en 8 vormen deel II, de stap van determinanten naar interventies.

**Hoofdstuk 5** beschrijven van een 3-ronde Delphi onderzoek waarin een panel met experts uit verschillende disciplines 19 mogelijke determinanten van condoom gebruik heeft geïdentificeerd, en 16 interventies die zij succesvol achtten voor gebruik bij interne migranten. De panel bereikte consensus dat attitude over condoom gebruik de belangrijkste en meest veranderbare determinant is, terwijl het toepassen van gedragstheorieën, het bevorderen van seksuele educatie en toegang tot condooms, het uitvoeren van werkplaats gezondheidsbevordering, het detecteren van risico factoren en nauw samenwerken met relevante organisaties en de overheid als meest effectieve en haalbare methoden om condoomgebruik bij interne Chinese migranten te bevorderen werden geacht.

In **hoofdstuk 6**, een systematische literatuur review en meta-analyse, hebben we studies naar gedrags- en psychosociale HIV preventieve interventies gericht op interne migranten in China over het afgelopen decennium. De resultaten lieten zien dat eerdere interventies

succesvol zijn geweest in het vergroten van kennis over HIV transmissie en voorkoming ervan, en verkleinen van stigma over het algemeen. Deelnemers aan HIV-gerelateerde interventies gebruikten condooms 13% vaker dan niet-deelnemers. Echter, de omvang van de effecten op het bevorderen van condoomgebruik liepen bij de verschillende studies flink uiteen. Door het uitvoeren van een meta-analyse zagen we dat interventies significant minder succesvol zijn geweest in recente studies, ten opzichte van oudere studies, als we corrigeren voor type relatie, studie design en follow-up periode.

Verder hebben we het bereik van eerdere interventies ter bevordering van condoomgebruik onderzocht in **hoofdstuk 7**. Door het integreren van data afkomstig uit twee cross-sectionele studies onder zorg professionals (werkzaam bij lokale GGD-en) en interne migranten in Shenzhen, lieten wij zien dat de aangeboden interventies ter bevordering van condoomgebruik bij migranten een beperkte deel van de doelgroep heeft bereikt. Er lijkt een redelijk overeenstemming te zijn tussen de interventies die zijn aangeboden, en de type interventies die migranten zouden willen ontvangen.

In **Hoofdstuk 8** hebben we, om zodoende de invloeden van eerdere HIV interventies in de gezondheidszorg setting, de resultaten gepresenteerd van een cross-sectionele studie naar de opinies en percepties van zorgverleners ten aanzien van hun collega's en patiënten die besmet zijn met HIV. De resultaten laten zien dat zorgverleners een hoge risico ervaren voor HIV transmissie in bij zowel relaties met HIV besmette collega's als patiënten. De meeste zorgverleners ervaren een hogere mate van weerzin voor patiënten die HIV opliepen door seksuele contacten, dan voor patiënten die besmet raakten via moeder-op-kind of bloedtransfusie besmettingen. Verder waren zij van mening dat zorgverleners de zorg voor besmette patiënten mochten weigeren, en dat deze patiënten alleen in aangewezen ziekenhuizen behandeld zouden moeten worden. De resultaten lieten verder zien dat bijna alle zorgverleners de intentie hadden om invasieve handelingen bij HIV besmette patiënten te vermijden. Van de verschillende beroepsgroepen, hadden verpleegkundigen de meest stigmatiserende attitudes tegenover met HIV besmette patiënten.

**Hoofdstuk 9** bevat als afsluiter mijn antwoorden op de onderzoeksvragen, een algemene discussie en een aantal aanbevelingen voor onderzoek en praktijk. Aangezien dit proefschrift in grote lijnen de Intervention Mapping (IM) stappen volgt, geeft ik ook een als voorbeeld van een toepassen van IM met de resultaten gepresenteerd in dit proefschrift, voor het ontwikkelen van een gedragsinterventie gericht op interne Chinese migranten als appendix.

*Aanbevelingen voor onderzoek:*

1. Meer studies naar de uitdagingen en barrières die de hoog risico algemene bevolkingsgroepen beschreven in dit proefschrift tegenkomen. Deze bevolkingsgroepen vormen een merendeel van de populatie in China en hebben een groot risico op het

- reeds hebben of ontwikkelen van risicovol seksuele gedragingen die tot HIV transmissie kunnen leiden.
2. Uitgebreide studies onder zorgverleners in China, waarbij zowel persoonlijke, omgevings- en organisatorische factoren die naleving van de algemene voorzorgsmaatregelen beïnvloeden, zowel bijv. persoonlijke factoren zoals bekendheid met de algemene voorzorgsmaatregelen, omgevingsfactoren zoals de beschikbaarheid van de benodigde zelf beschermende materialen, en organisatorische factoren zoals surveillance en meldsystemen.
  3. Toekomstige studies die HIV preventie interventies ontwikkelen zouden gedrags-wetenschappelijke theorieën moeten toepassen om gericht de verschillende socio-cognitieve- en omgevingsdeterminanten van condoom gebruik op een structureerde wijze mee te nemen.
  4. Meer onderzoek naar de veranderende socio-economische en culturele omgeving van de nieuwe generatie van deze hoofd risico algemene bevolkingsgroep is nodig, met name voor de interne migranten, bij het ontwikkelen van interventies.
  5. Meer onderzoek naar het toepassen van Intervention Mapping (IM) bij verschillende Chinese hoog risico populaties, en het identificeren van kennis-lacunes, in het bijzonder t.o.v. barrières, facilitatoren en effectieve communicatie middelen (bijv. internet, sociale media).

*Aanbevelingen voor de praktijk:*

1. Sterke campagnes onder zorgverleners in een breder range van Chinese zorginstellingen om stigma naar mensen met HIV te verkleinen.
2. Meer HIV interventies die effectieve en praktisch uitvoeren strategieën bevatten om zodoende succesvol te zijn.
3. Andere socio-cognitive en omgevings determinanten van risicogedrag behalve kennis, moeten worden meegenomen bij het ontwerpen en implementeren van HIV preventie interventies.
4. Nieuwe HIV preventie interventies onder Chinese interne migranten moeten niet alleen voldoende informatieve in makkelijk verstaanbare formats bieden, maar ook sessie bevatten hoe om te gaan met de barrières van condoom gebruik, toegang tot zorginstellingen en hoe risico in nieuwe stedelijke settings verkleind kan worden.
5. Toekomstige interventies zouden de perceptie van mannelijke migranten over de voordelen van condoomgebruik moeten stimuleren, en zouden vrouwelijke migranten moeten machtigen door middel van hogere opleiding en eigen-effectiviteit.
6. Meer nadruk moet worden gelegd op het belang van proces en effect evaluatie bij het ontwerpen van HIV preventie interventies voor de vergeten hoog risico populaties.
7. Er moet nauw worden samengewerkt met overheids- en niet-overheidsorganisaties als men HIV preventie gedrags-interventies uitvoert, aangezien hun betrokkenheid essentieel is voor het toegankelijk houden van interventies in de lange termijn.

## Acknowledgements

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Gothenburg, May 2015



## Curriculum Vitae



Dr. Xiaona Liu was born in Hunan, China, on the 24<sup>th</sup> of August, 1983. After completing clinical internships and obtaining a bachelor degree in preventive medicine at Shanxi Medical University in 2008, she moved to Beijing and started studying health education and social medicine at Peking University. During her studies she was involved in several research projects in the fields of behavioral change and health literacy.

In 2009 she completed a youth health promotion project in India, and in 2010 she completed the Honors Internship Program in China's Ministry of Health. In 2011 she obtained her MSc in public health with a thesis on the development of a tool evaluating health literacy on respiratory infectious diseases. Subsequently, she was awarded a Sino-Dutch national scholarship to conduct a PhD at the department of Public Health at Erasmus MC, University Medical Center Rotterdam, the Netherlands. There she also obtained a research MSc in public health in 2013 with a thesis on a systematic literature review and meta-analysis of behavioral and psychosocial interventions for HIV prevention. During her PhD study, she worked in close collaboration with research institutions and CDCs in Beijing and Shenzhen to conduct the research resulting in this thesis.



## Publications

**Liu X**, Erasmus V, Sun X, Cai R, Shi Y, Richardus JH. Preventing HIV transmission in Chinese internal migrants: a behavioral approach. *Scientific World Journal*. 2014;2014:319629.

**Liu X**, Erasmus V, Tan J, van Genugten L, Sun X, Richardus JH. Exploring socio-cognitive and situational determinants of condom use among internal migrants in Shenzhen, China. (submitted)

**Liu X**, Erasmus V, van Genugten L, Sun X, Tan J, Richardus JH. Are condom-promotion interventions reaching internal migrants in China?: Integrated evidence from two cross-sectional surveys. (submitted)

**Liu X**, Erasmus V, Wu Q, Richardus JH. Behavioral and psychosocial interventions for HIV prevention in floating populations in China over the past decade: a systematic literature review and meta-analysis. *PLoS One*. 2014;9(6):e101006.

**Liu X**, Sun X, van Genugten L, Shi Y, Wang Y, Niu W, Richardus JH. Occupational exposure to blood and compliance with standard precautions among health care workers in Beijing, China. *Am J Infect Control*. 2014;42(3):37-38.

**Liu X**, Sun X, van Genugten L, Shi Y, Wang Y, Niu W, Richardus JH. Opinions and attitudes of health care workers towards HIV-infected co-workers and patients in two tertiary hospitals in Beijing, China. (submitted)

Sun X, **Liu X**, Shi Y, Wang Y, Wang P, Chang C. Determinants of risky sexual behavior and condom use among college students in China. *Aids Care-Psychological and Socio-Medical Aspects of Aids/Hiv*. 2013;25(6):775-783.

**Liu X**, Chang C, Sun X. Global overview of health literacy and its prospective development in China. *Chinese Journal of Health Education*. 2012;28(2):150-153.

Sun X, **Liu X**, Chang C, Du W, Tian Z, Zhang P. Establishment and evaluation of assessment system of health literacy regarding respiratory infectious diseases. *Chinese Journal of Disease Control and Prevention*. 2012;16(8):707-711.

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**Liu X**, Sun X. The status and its analysis of health literacy, physical and mental health for Chinese civil servant. *Chinese Journal of Health Management*. 2010;4(4):236-238.

# PhD Portfolio

## Summary of PhD training and teaching activities

<b>Name PhD student:</b> Xiaona Liu	<b>PhD period:</b> 2011-2015	
<b>Erasmus MC Department:</b> Public Health	<b>Promotor:</b> Prof.dr. J.H. Richardus	
	<b>Supervisor:</b> Dr. V. Erasmus	
<b>PhD training</b>	<b>Year</b>	<b>ECTS</b>
Master in Public Health, Netherlands Institutes for Health Sciences (Nihes), 2011-2013		
<b>Core curriculum</b>		
– Study design	2011	4.3
– Biostatistical Methods I: Basic Principles	2011	5.7
– Biostatistical Methods II: Classical Regression Models	2012	4.3
– Public Health Research Methods	2012	5.7
– International Comparison of Health Care Systems	2012	1.4
– Site Visit to Municipal Health Service Rotterdam	2013	0.3
– Integration Module	2013	0.3
<b>Advanced short courses</b>		
– Epidemiology of Infectious Diseases	2011	1.4
– Psychiatric Epidemiology	2012	1.1
– Chronic Disease	2013	1.1
– Planning and Evaluation of Screening	2013	1.4
– Health Services: Research and Practice	2012	0.9
– From Problem to Solution in Public Health	2013	1.1
<b>Erasmus summer programme</b>		
– Principles of Research in Medicine	2012	0.7
– Methods of Public Health Research	2012	0.7
– Topics in Meta-analysis	2013	0.7
– Introduction to Global Public Health	2012	0.7
– Methods of Health Services Research	2012	0.7
– Primary and Secondary Prevention Research	2012	0.7
– Social Epidemiology	2012	0.7
– The Practice of Epidemiology Analysis	2013	0.7
<b>Other specific courses</b>		
– Intervention Mapping Summer Programme	2012	1.5
– Writing in the Sciences	2013	1
<b>Conferences and presentations</b>		
– Poster presentation: 19th International AIDS Conference, Washington D.C., USA	2012	1
– Poster presentation: International Viral Hepatitis Congress, Frankfurt, Germany	2013	1
– Poster presentation: International Symposium HIV & Emerging Infectious Diseases, Marseille, France	2014	1
<b>Teaching activities</b>		
– Lectures Health Intervention Development in Shenzhen CDC	2013-2014	1.5
– Training Hand Hygiene Intervention Preschools Shenzhen	2015	1.5
– Supervision of MSc student Free University Amsterdam	2015	2
– Reviewer AIDS and Behavior, PLoS One, British Journal of Medicine and Medical Research, OMICS Publishing Group	2012-2015	2

