

Structural equation modeling test of the pre-intentional phase of the health action process approach (HAPA) model on condom use intention among senior high school students in Tianjin, China

Fang Xu, MD, PhD^{a,b} , Kai Bu, MA, PhD^c, Fangfang Chen, PhD^a, Shanshan Jin, PhD^d, Hanxi Zhang, MD, PhD^a, Dong Zhang, MPH^e, Caixia Sun, MPH^f, Ning Wang, PhD^a, Mengjie Han, MD^a, Lu Wang, PhD^{a,*}

Abstract

Based on the Theory of Health Action Process Approach (HAPA) Model, this study aimed to investigate factors associated with condom use intention in Chinese adolescents.

In 2017, we conducted a cross-sectional study using stratified cluster, convenience sampling method to assess condom use intention among senior high school students in Tianjin, China. One thousand eighty two senior high school students were anonymously surveyed through self-administered questionnaires. Structural equation modelling was used to assess the pre-intentional phase of HAPA model.

Among the participants, 41.5% (449/1082) were male, 54.1% (585/1082) were female, 4.4% (48/1082) were gender-deficient. The average age was 16.7 years. The final pre-intentional phase of HAPA model was acceptable (CFI=0.95; GFI=0.94; RMSEA=0.06). Action self-efficacy ($r=0.60$) had a strong direct effect on condom use intention.

The pre-intentional phase of HAPA model is valid to assess condom use intention among Chinese senior high school students. The pre-intention phase of the HAPA model could be applied to guide AIDS health educations of students, and further research is needed to evaluate the effect.

Abbreviations: χ^2/df = normed Chi-Squared, AIDS = acquired immune deficiency syndrome, CFA = confirmatory factor analysis, CFI = comparative fit index, CIs = confidence intervals, GFI = goodness-of-fit index, HAPA model = Health Action Process Approach Model, RSMEA = root mean-square error of approximation, SEM = structural equation modelling.

Keywords: acquired immunodeficiency syndromes, China, condom use intention, health action process approach, high school students

Editor: Massimo Tusconi.

The opinions expressed herein reflect the collective views of the co-authors and do not necessarily represent the official position of the National Center for AIDS/STD Control and Prevention, China CDC.

This research was supported by United Nations International Children's Fund (XMSQ20171112_001); Tianjin Higher Education Institutions Innovation Team during the Thirteenth Five-Year Plan (TD13-5049); College Student's Platform for Innovation and Entrepreneurship Training Program of Tianjin 2017 (201710063032); and Seventh Student's Platform for Science and Technology Program of Tianjin University of Traditional Chinese Medicine (CXJJ2017YD31).

The authors have no conflicts of interest to disclose.

Supplemental Digital Content is available for this article.

The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

^a National Center for AIDS/STD Control and Prevention, Chinese Center for Disease Control and Prevention, Beijing, ^b Department of Public Health, Tianjin University of Traditional Chinese Medicine, Tianjin, ^c School of Health Humanities, Peking University, ^d Beijing Institute of Ophthalmology, ^e Dongli Center for Disease Control and Prevention, Tianjin, ^f Qinghai Of Health Sciences, Qinghai, Beijing, China.

* Correspondence: Lu Wang, National Center for AIDS/STD Control and Prevention, Chinese Center for Disease Control and Prevention, 155 Changbai Road, Beijing 102206, China (e-mail: wanglu64@chinaaids.cn).

Copyright © 2020 the Author(s). Published by Wolters Kluwer Health, Inc.

This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial License 4.0 (CCBY-NC), where it is permissible to download, share, remix, transform, and buildup the work provided it is properly cited. The work cannot be used commercially without permission from the journal.

How to cite this article: Xu F, Bu K, Chen F, Jin S, Zhang H, Zhang D, Sun C, Wang N, Han M, Wang L. Structural equation modeling test of the pre-intentional phase of the health action process approach (HAPA) model on condom use intention among senior high school students in Tianjin, China. *Medicine* 2020;99:44(e22776).

Received: 3 April 2020 / Received in final form: 24 August 2020 / Accepted: 17 September 2020

<http://dx.doi.org/10.1097/MD.00000000000022776>

1. Introduction

Globally, 1.7 million people were estimated to become newly infected with HIV and 37.9 million people were living with HIV (PLHIV). Among them, 3.5 million were young people aged 15 to 24 years old in 2018 (UNAIDS, 2018).^[1] In China, according to the Chinese Center for Disease Control and Prevention (CDC), there were 861,000 reported PLHIV by the end of 2018.^[2] In the past 2 years, more than 3000 students aged 15 to 24 years old in China have been reported infected with HIV every year. In 2017, 3077 HIV/AIDS cases of students aged 15 to 24y were reported, 81.8% of whom were infected by homosexual contact behavior. In 2018, 3105 young cases (15–24 year) of students were newly diagnosed, accounting for 18.9% of all reported cases.

According to Shanghai Social Development Report (2019) released by Shanghai Academy of Social Sciences, 1958 adolescents in Shanghai were surveyed, 8.3% of whom have ever had sexual intercourse.^[3] According to the survey of 1484 high school students in Yanqing District, Beijing, the proportion of sexual behavior among high school students was also 8.3%.^[4] Another survey was conducted among 1055 high school students in Foshan City, Guangdong Province, the statistics was 7.8%.^[5] Another survey was conducted among 721 high school students in Shanghai City, 2.3% of senior high school students had sexual behavior, and 23.5% of them had never used any contraception, the rate of never used condom was 50.0%.^[6] In 2013, another cross-sectional study conducted in 30 Provinces of China showed 39% (927/2370) of adolescents receiving abortions were undergoing repeat abortions. The primary reason for the current unintended pregnancies was non-use of contraception (68%).^[7]

Among Chinese high school students, problems with condom use during sexual intercourse, commonly included nonuse, or incorrect use or use with a low frequency, resulting in higher chance of pregnancy, abortion, sexually transmitted diseases such as HIV infection. At present, using condoms correctly is single, most efficient available and affordable method for HIV prevention; meanwhile, it is also a highly recommended strategy by World Health Organization (WHO).^[8] And consistent and correct use of condom is a key strategy for the prevention of sexually transmitted infections (STIs).^[9] A proactive approach is essential to promote public awareness of this trend and to provide effective intervention among young students.

At present, the health behavior models that have been applied in the field of AIDS health education mainly include: Knowledge, Attitudes and Practices (KAP),^[10] information-motivation-behavioral skills model (IMB),^[11] the health belief model (HBM),^[12] the theory of reasoned action (TRA),^[13] the theory of planned behavior (TPB),^[14] social cognitive theory (SCT),^[15] protection motivation theory (PMT),^[16] and integrated model.^[17] There was inconsistent phenomenon between the knowledge of AIDS and high risk behaviors, and intention-behavior gap among young students.^[10,18] Researchers have applied the HAPA to investigate HIV-related behaviors in some vulnerable populations, but not in high school students.

In a systematic review of sexually transmitted infection (STI) preventive interventions in educational settings around the world, included 16 studies settings in 5 countries, results showed interventions had a significantly positive impact on both behavioral and psychosocial outcomes.^[19] And in another systematic review of HIV prevention interventions in China, only 33.3% (15/45) studies were conducted with the health behavior models, while others did not.^[20] Guided by the theory of

healthy behavior, the research on AIDS health education among high school students in China is of great importance. This study attempted to use the pre-intentional phase of Health Action Process Approach (HAPA) Model to reveal factors associated with condom use intention.

The HAPA model was originally developed in the late 1980s by integrating social-cognitive theory, the theory of reasoned action, and the volition theories.^[21,22] The HAPA model was applied to the field of health behavior change include physical activity, dietary behaviors, fruit and vegetable intake, breakfast consumption, sugar consumption, fat consumption, dieting intention, hygienic food handling behavior, hand hygiene, sun screen use and child sun safety, breast self-examination behavior and breast cancer survivors, flu vaccine uptake, a daily flossing regimen, smoking cessation, using filtering facemask respirators, body fat, seat belt use, physical activity in living with HIV/AIDS, condom use, condom use among men who have sex with men, consistent condom use with various types of female sex partners among males who inject drugs and so on.^[23] And the HAPA model explained these health behaviors well.

The HAPA model suggests a distinction between

1. a pre-intentional motivation process that leads to a behavioral intention and
2. a post-intentional volition process that facilitates the adoption and maintenance of health behaviors.^[22]

The pre-intentional motivation process includes risk perception, outcome expectancies, action self-efficacy and behavioral intention. In the post-intentional phase, there were coping self-efficacy, action planning, coping planning, recovery self-efficacy, and behavior.

According to the pre-intentional phase of HAPA model, the individual first become motivated to change and whether he formulates an intention to refrain from risk behavior or to adopt healthy behavior depends on the perception of risk, positive outcome expectancy, and perceived self-efficacy.^[22]

In this study, the perception of risk includes AIDS Knowledge Awareness and susceptibility to HIV infection. Outcome expectancies include positive outcome expectancies and negative outcome expectancies, which are the pros and cons of using a condom. Action self-efficacy refers to condom use self-efficacy. And intention refers to condom use intention. These are demonstrated in Figure 1.

2. Methods

2.1. Ethics

The study was conducted in accordance with the Declaration of Helsinki, and the study obtained ethical approval by the ethical committee of National Center for AIDS/STD Control and Prevention of Chinese Center for Disease Control and Prevention (X170308460). Each school assigned a study liaison responsible for data collection coordination. All participants gave their oral informed consent before they participated in the study for only anonymous information was collected.

2.2. Participants and sampling

This cross-sectional study was conducted between May and October 2017 in Tianjin. The first AIDS case was reported in Tianjin in 1991.^[24] In the past 2 years, Tianjin has reported an

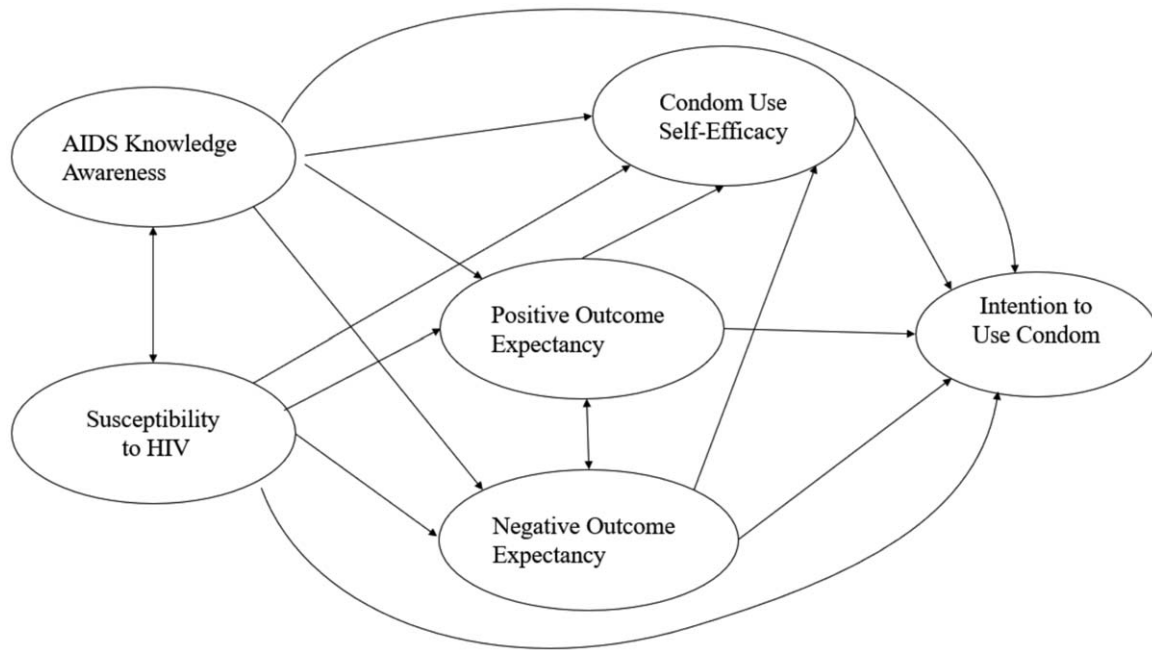


Figure 1. The initial hypothesized the pre-intentional phase of HAPA model.

average of 1 newly diagnosed student case every week. Nearly all colleges and universities in Tianjin have student cases reported infected with HIV, and even some junior high schools and secondary vocational schools have cases reported.^[25]

Stratified cluster sampling and convenient sampling were used in the current study. In 2017, there were a total of 187 middle schools in Tianjin. First, 2 middle schools and 1 vocational senior middle school were convenient sampled from Tianjin. Then, we selected all classes in the tenth grade in each school and obtained informed consent from all students before the survey. All students were informed of the voluntary nature of participation. All the participants completed an anonymous questionnaire written in Chinese in an appointed classroom. The methodology was also described in detail in another report in Chinese.^[26] A total of 1082 students aged 15 to 20 years were recruited from 2 middle schools and 1 vocational senior middle school and the response rate was 100%.

2.3. Data measurement

We developed a structured self-administered questionnaire based on the HAPA model. The original items pool was compiled by performing a literature review. The final version of the questionnaire was determined by a preliminary investigation.

The preliminary investigation recruited 38 students from 13 middle schools and 6 vocational senior middle schools using convenient sampling: 12 females and 26 males, mean age was 16.8 years old (standard deviation, SD: 0.7). We conducted reliability analysis and exploratory factor analysis (EFA) with the data. The Cronbachs α coefficients is 0.84. The results of KMO and Bartlett's test suggested this study had a sufficient sample size relative to the number of items, and the correlation matrix was not an identity matrix (KMO=0.60; $\chi^2=303.89$, $P<.001$), which indicated that data of the preliminary study were suitable for factor analysis. EFA revealed a 7-factor solution with Eigen

values >1, which explained 79.93% of the total variance. Reliability and construct validity of the self-administered questionnaire was found to be satisfying when used on a student population.

It consists of 5 aspects, including information on demographics, perception of risk (AIDS knowledge awareness and susceptibility to HIV infection), outcome expectancies (positive outcome expectancies and negative outcome expectancies), action self-efficacy and condom use intention. The AIDS knowledge awareness was evaluated by 3 items according to Questionnaire on AIDS Knowledge Awareness Rate among Young Students developed by the National Center for AIDS/STD Control and Prevention of Chinese Center for Disease Control and Prevention (2016 edition).^[27] The susceptibility to HIV infection was evaluated by 2 items according to the Perceived Risk of HIV Scale (PRHS).^[28] Positive outcome expectancies were evaluated by 2 items according to Questionnaire of AIDS Health Promotion for senior high school students (QAHP-SS)^[29] and Questionnaire compiled by Sun Xinying and others.^[30] Negative outcome expectancies were evaluated by 4 items according to Questionnaire of The Condom Use Negative Outcome Expectancies Scale.^[31] Action self-efficacy was assessed by 4 items in accordance with the Condom-Use Self-Efficacy Scale (CUSES).^[32] Condom use intention was assessed by 3 self-compiled items. Variables of AIDS knowledge awareness and positive outcome expectancies were defined by the answers of no or unclear, yes. Variables of others were assessed by a Likert-type scale of 5 points from extremely unlikely to extremely likely or extremely unconfident to extremely confident.

2.4. Statistical analysis

SPSS software (version 19.0; IBM Corp, Armonk, NY, USA) was used for data process and analysis. The measurement data were described by median and quartile interval. The enumeration data

were described using frequencies and percentages. Intergroup differences were compared by χ^2 test. Reliability analysis was conducted. Cronbachs α coefficient >0.6 is qualified. IBM SPSS AMOS 17.0 (IBM Corp, Armonk, NY, USA) was used for structure equation modeling (SEM). SEM is a multi-statistics method used to calculate the fit of the data to the theoretical models. And SEM is generally composed of 2 steps:

1. confirmatory factor analysis (CFA), which tests the fitting degree between the hypothetical construct and sample data, thus determining the structural validity;
2. path analysis, which aims to verify the rationality of structure model and illustrate the causal link among the major latent variables.

Through SEM, we could estimate coefficients of variables as well as direct, indirect, and total effects among latent variables in the regression model. Goodness-of-fit indices were used to evaluate the model fitness, including Chi-Squared goodness-of-fit test (χ^2/df), the goodness-of-fit index (GFI), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). In general, the criteria to assess the model were: $\chi^2/df < 5$, $GFI > 0.9$, $CFI > 0.9$, and $RMSEA < 0.05$. Statistical significance was set at $P < .05$.

3. Results

3.1. Demographic characteristics

The details of the demographic information are demonstrated in Table 1. Among 1082 participants, there are more female than male (54.1% vs 41.5%), and 48 (4.4%) were lack of gender information. The largest proportion (90.2%) of the students were aged below 18 years, mean age was 16.7 years old (standard deviation, SD: 0.7). The sample consisted of slightly more middle school students than vocational senior middle school students (51.6% vs 48.4%).

3.2. AIDS knowledge awareness and positive outcome expectancies

The total percentages of correct answers to the 3 AIDS knowledge awareness questions were: 45.0% for Question 1: AIDS is a serious incurable infectious disease; 30.4% for Question 2: HIV upsurge in China's students and the main mode of transmission: male homosexual sex, followed by heterosexual sex; 50.4% for Question 3: unidentifiable by symptoms and appearance. And among 76 students with sex experience, the percentages of correct answers to the 3 questions were 50%, 46.1% and 42.1%. And among 1006 students without sex experience, the percentages of correct answers to the 3 questions were 44.6%, 29.2%, and 51.0%. The percentages of correct answer to Question 2 showed significant differences ($\chi^2 = 9.456$, $P = .002$) between 2 groups. But the percentages of correct answers to Question 1 and Question 2 had no significant differences ($\chi^2 = 0.823$, $P = .364$; $\chi^2 = 2.233$, $P = .135$).

The overall percentages of correct answers to the 2 questions of positive outcome expectancies were: using condom correctly could protect you from HIV infection was 34%, using condom correctly could contracept was 50.7%. And among 76 students with sex experience, the percentages of correct answers to the 2 questions of positive outcome expectancies were 50% and 75%,

Table 1

Demographic characteristics of senior high school students in Tianjin, China (n = 1082).

Variable	N(%)
Sex	
Male	449 (41.5)
Female	585 (54.1)
Unclear	48 (4.4)
Age	
<18	976 (90.2)
≥18	106 (9.8)
Place of residence	
Cities and towns	815 (75.3)
Rural area	267 (24.7)
Types of Schools	
middle school	558 (51.6)
Vocational senior middle school	524 (48.4)
Sexual Behavior	
yes	76 (7.0)
no	1006 (93.0)

while among 1006 students without sex experience, the percentages of correct answers to the same questions were 32.8% and 48.9%. The percentages of correct answer had significant differences between 2 groups ($\chi^2 = 9.311$, $P = .002$; $\chi^2 = 19.249$, $P < .001$).

3.3. Reliability analysis

The Cronbachs α coefficients of the self-administered questionnaire were all greater than or equal to 0.6 which indicated the stability of the questionnaire. The Cronbachs α coefficients are presented in Table 2.

3.4. Confirmatory factor analysis

Results of confirmatory factor analysis are presented in Figure 2. The goodness-of-fit statistics indicated that the structural equation model was acceptable and was appropriate for the data. The standardized regression weights (factor loading) and median scores for all items are listed in Table 3. Frequencies and percentages of All Items are showed in Supplement Table 1, <http://links.lww.com/MD/F115>. The factor loadings were above 0.40 (0.42–0.90) and statistically significant ($P < .001$).

Table 2

The Cronbachs α coefficients of the self-administered questionnaire (n = 1082).

Aspects	Cronbachs α coefficient
Risk perception	
AIDS knowledge awareness	0.64
Susceptibility to HIV	0.60
Outcome expectancies	
Positive outcome expectancies	0.79
Negative outcome expectancies	0.88
Action self-efficacy	0.88
Condom use intention	0.75
Total	0.85

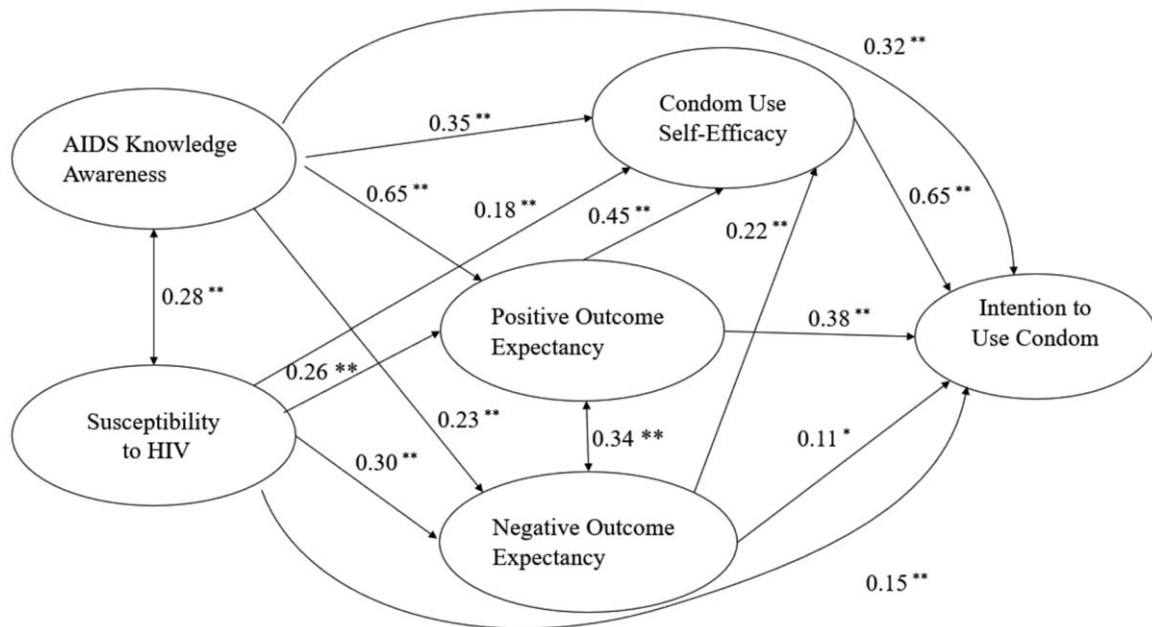


Figure 2. Confirmatory factor analysis on the pre-intentional phase of HAPA model.

3.5. Path model

To generate a parsimonious model, the statistically insignificant paths were removed and the final model is depicted in Figure 3. The fit indices suggested that the model met the conservative criteria, explaining 43.0% of the variance of condom use

intention. Table 4 displays the direct, indirect, and total effect of variables on condom use intention. The perception of risk including AIDS Knowledge Awareness and susceptibility to HIV infection, had indirect effects on condom use intention; that is, through the positive outcome expectancies ($r=0.63$) and negative

Table 3
Factor loadings and median scores of all items in questionnaire used in senior high school students in Tianjin, China.

Item	Factor loading	M	Q
Risk perception1: AIDS knowledge awareness			
AIDS is a serious incurable infectious disease	0.43	1	1
HIV upsurge in China's students and the main mode of transmission: male homosexual sex, followed by heterosexual sex	0.51	1	1
Unidentifiable by symptoms and appearance	0.42	2	1
Risk perception2: susceptibility to HIV			
My classmates and friends may be infected with HIV	0.87	3	1
My classmates and friends may be a HIV carrier	0.82	3	1
Positive outcome expectancies			
Using condom correctly could protect you from HIV infection	0.77	1	1
Using condom correctly could contracept	0.76	2	1
Negative outcome expectancies			
Condom use makes you feel uncomfortable	0.85	3	1
Condom use lessens your sexual pleasure	0.90	3	1
Condom use ruins your mood or atmosphere of sex	0.82	3	0
Condom use makes your sex partners think that you do not trust he/her	0.65	3	0
Action self-efficacy			
I feel confident I could suggest using condoms without he or she would think I've had sexual experience	0.66	3	1
I feel confident I could suggest using condoms without he or she would think I've a sexually transmitted disease	0.78	3	1
I feel confident I could suggest using condoms with my partner without fear of he or she would think I thought they had a sexually transmitted disease	0.89	3	1
I feel confident I could suggest using condoms with my partner without fear of rejection	0.89	3	1
Condom use intention			
I could using condom correctly if I have an intercourse	0.76	3	2
Whether I prepare condoms before intercourse	0.86	3	2
Whether I ask about my partner's sexual experience before intercourse	0.55	3	1

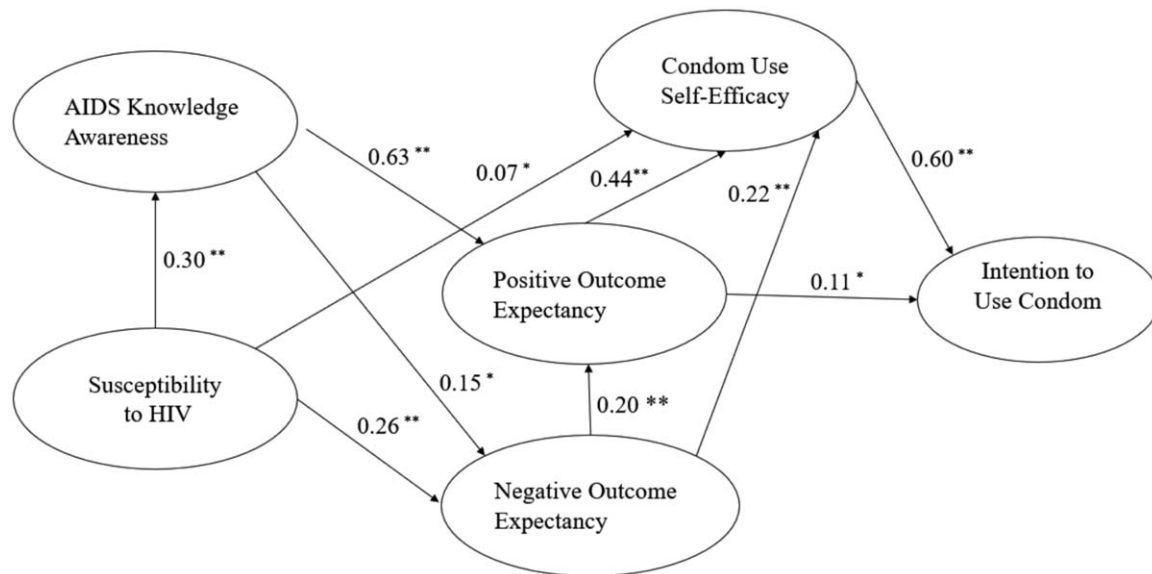


Figure 3. The final model.

outcome expectancies ($r=0.15$), respectively. Positive outcome expectancies had direct effect ($r=0.11$) on condom use intention, meanwhile had indirect effects on condom use intention through condom use self-efficacy ($r=0.44$). However, negative outcome expectancies only had indirect effects on condom use intention through condom use self-efficacy ($r=0.22$). Furthermore, the direct effect of action self-efficacy ($r=0.60$) had a strong direct effect on condom use intention.

4. Discussion

The present study aimed to apply the pre-intentional phase of HAPA model to reveal factors associated with condom use intention. To our knowledge, this is the first study applying HAPA model in the field of AIDS prevention among adolescents and the first survey on AIDS knowledge among senior high school students in Tianjin. In general, the pre-intentional phase of HAPA model fit the data well. In previous studies,^[18,33,34] condom use self-efficacy has been the focus of attention. While focusing on action self-efficacy, this study revealed the relationship between condom use self-efficacy and condom use intention. In recent years, research on condom use intention of young people has caused more concern.^[35,36]

Findings of this study demonstrated the direct effect of action self-efficacy on condom use intention was relatively strong and positive. Similar results were demonstrated in previous studies among adolescent students.^[35] However, another study indicated no association of condom use self-efficacy and condom use intention.^[36] The contradiction was possibly caused by the different study populations and different theories of health behavior.

Notably, the total effect of positive outcome expectancies were positive to condom use intention which is consistent with previous study.^[37] Students with sex experience had a higher awareness of condom benefits (positive outcome expectancies) than those without. It suggests that these students pay more attention to sexual health knowledge. And in the previous study which including 22% participants were sexually experienced point out that programs for sexually inactive youth should focus on the preventive role of condoms and improve knowledge about the efficacy of condom use.^[36]

Negative outcome expectancies only had indirect effects on condom use intention through condom use self-efficacy, but the effect was extremely weak. Previous study^[31] suggested interventions should focus on reduction of negative outcome expectancies of condom use because negative outcome expectancies were obstacle to condom use.

Risk perceptions, both AIDS knowledge awareness and susceptibility to HIV, have indirect effects on condom use intention. Similar results were demonstrated in previous study,^[31] risk perception was less important in determining ones intention to take action. But in our study, AIDS knowledge awareness and susceptibility are different paths to affect to condom use intention. One possible explanation could be that peoples perception of risk is multidimensional, and different dimensions play different roles. The present study demonstrated that the AIDS knowledge awareness was associated with condom use intention through positive outcome expectancies and negative outcome expectancies. And the direct effect of AIDS knowledge awareness to positive outcome expectancies was relatively strong

Variable	Direct effects	Indirect effects	Total effects
Risk perception1: AIDS Knowledge Awareness	0	0.25	0.25
Risk perception2: susceptibility to HIV	0	0.14	0.14
Positive outcome expectancies	0.11	0.26	0.37
Negative outcome expectancies	0	0.08	0.08
Action self-efficacy	0.60	0	0.60

and positive. Students with sex experience were more aware of the AIDS epidemic than those without. But the total percentages of correct answers to the 3 AIDS knowledge awareness questions are low. It suggests that adolescent students need more effective HIV prevention programs.

In addition, the present study demonstrated that the susceptibility to HIV was associated with condom use intention through condom use self-efficacy and negative outcome expectancies. Previous studies have revealed the relationship between susceptibility to HIV and condom use self-efficacy among young student,^[33] but the total effect of the susceptibility to HIV on condom use self-efficacy was extremely weak. Other studies have also suggested perceived susceptibility could not predict condom use self-efficacy among youth students.^[38] This contradicting conclusion may be caused by the different study subjects and theoretical model of these studies. When we carry out AIDS Health Education, the susceptibility to HIV should be strengthened.

There were some limitations in the current study. First, The HAPA model includes pre-intentional motivation process and a post-intentional volition process, but only the pre-intentional phase of HAPA model was performed in this study. Further longitudinal studies are required to test the post-intentional volition process of HAPA model. Second, the data were self-reported, thus may or may not be accurate and not fully represent the actual behaviors. Future research should focus on the behaviors of condom use among this population. Finally, this study was a stratified cluster sampling and convenient sampling, only surveyed 1 grade students, which may involve selection biases, and may have limited the generalization from the research findings to adolescent students.

5. Conclusions

The pre-intentional phase of HAPA model is valid to assess condom use intention among Chinese senior high school students. Furthermore, the survey also exposed the insufficient knowledge of the condom use among Chinese high school students. With the HAPA model, we can enhance AIDS health education of high school students by offering them specific action planning and copying planning, such as how to use condom correctly. Considering that condom use self-efficacy played a key role in promoting condom use intention, this research provides useful advice for the prevention of STIs, unintended pregnancy, and abortion. Future research should focus on raising AIDS knowledge awareness, susceptibility to HIV, positive outcome expectancies of condom use, action self-efficacy, and reducing negative outcome expectancies of condom use among senior high school students.

Acknowledgments

We would like to thank Tianjin Centers for Disease Control, Dongli Education Bureau and Dongli Center for Disease Control and Prevention for enhanced support in the implementation of this research. Thanks to the teachers organization work and students cooperation in the 3 surveyed schools.

Author contributions

Conceptualization: Fang Xu, Kai Bu, Lu Wang.

Data curation: Fang Xu.

Formal analysis: Fang Xu.

Funding acquisition: Kai Bu, Lu Wang.

Investigation: Fang Xu, Shanshan Jin, Dong Zhang, Caixia Sun.

Methodology: Fang Xu, Ning Wang, Mengjie Han, Lu Wang.

Project administration: Fang Xu, Kai Bu, Dong Zhang.

Writing – original draft: Fang Xu.

Writing – review & editing: Fang Xu, Kai Bu, Fangfang Chen, Shanshan Jin, Hanxi Zhang, Dong Zhang, Caixia Sun, Ning Wang, Mengjie Han, Lu Wang.

References

- [1] The Joint United Nations Programme on HIV/AIDS (UNAIDS). Global HIV & AIDS statistics. Available at: https://www.unaids.org/sites/default/files/media_asset/UNAIDS_FactSheet_en.pdf [Accessed July 1, 2019]
- [2] Jin Ling Evening News. 30% of people living with HIV do not self-awareness, the fourth generation of HIV testing reagents come!. Available at: http://www.dzwww.com/xinwen/shehuixinwen/201905/t20190530_18775400.htm [Accessed May 30, 2019]
- [3] Sina. The post-00 s generation is more open-minded about sex, according to a report on sexual health of teenagers in Shanghai. Available at: http://k.sina.com.cn/article_3242720492_c147fcc01900i2h5.html [Accessed April 18, 2019]
- [4] Shen YK, Wu PL, Liu ZH. Analysis on sexual behavior and AIDS health education among high school students in Yanqing District, Beijing. *Chin J Sch Health* 2017;38:1821–4.
- [5] Huang XB. Investigation and research on the status quo of students attitudes towards love, sex and sexual behavior in senior high schools in Foshan. *Chin J Human Sexual* 2018;27:157–60.
- [6] He L, Du L, Xu T, et al. Investigation of KAP on sexual and reproductive health of middle school students. *Chin J Fam Plan* 2018;26:17–20.
- [7] Liu J, Wu S, Xu J, et al. Is repeat abortion a public health problem among Chinese adolescents? A cross-sectional survey in 30 Provinces. *Int J Environ Res Public Health* 2019;16:794.
- [8] Dick B, Ferguson J, Ross D. Preventing HIV/AIDS in young people. A systematic review of the evidence from developing countries. Introduction and rationale. *World Health Organ Tech Rep Ser* 2006;938:1–3. 317–41.
- [9] Anstee S, Shepherd J, Graham C, et al. The evidence for behavioural interventions addressing condom use fit and feel issues to improve condom use: a systematic review. *Sex Health* 2019;16.
- [10] Guo ZY, MA MX, Xie RD, et al. Function pathway of AIDS knowledge, attitudes and behaviors among college students in high prevalence areas based on Structural Equation Modeling. *Chin J Health Educ* 2018;34:24–8.
- [11] Liu Z, Wei P, Huang M, et al. Determinants of consistent condom use among college students in China: application of the information-motivation-behavior skills (IMB) model. *PloS One* 2014;9:e108976.
- [12] Abraham C, Sheeran P, Spears R, et al. Health beliefs and the promotion of HIV-preventive intentions amongst teenagers: a Scottish perspective. *Health Psychol* 1992;11:363–70.
- [13] Morrison D, Gillmore M, Baker S. Determinants of condom use among high-risk heterosexual adults: a test of the theory of reasoned action1. *J Appl Soc Psychol* 2006;25:651–76.
- [14] Ramirez-Correa P, Ramirez-Santana M. Predicting condom use among undergraduate students based on the theory of planned behaviour, Coquimbo, Chile. *Int J Environ Res Public Health* 2018;15:1689.
- [15] Levy E, Kaufman M, Yori G, et al. Interventions targeting social cognitive determinants of condom use in the general Sub-Saharan population: a systematic review. *Cogent Psychol* 2019;6:1637167.
- [16] Gong J, Stanton B, Lunn S, et al. Effects through 24 months of an HIV/AIDS prevention intervention program based on protection motivation theory among preadolescents in the Bahamas. *Pediatrics* 2009;123:e917–28.
- [17] Protogerou C, Johnson B, Hagger M. An Integrated model of condom use in sub-saharan african youth: a meta-analysis. *Health Psychol* 2018;37:586–602.
- [18] Tang YH, Li YX, Wang XP. Analyzing the status of HIV/AIDS infection of college students and its counter measures. *Chin Health Serv Man* 2017;34:474–6.
- [19] Mon KSN, Bird Y, Schwandt M, et al. STI health disparities: a systematic review and meta-analysis of the effectiveness of preventive interventions in educational settings. *Int J Environ Res Public Health* 2018;15:2819.

- [20] Xiao Z, Noar S, Zeng L. Systematic review of HIV prevention interventions in China: a health communication perspective. *Int J Public Health* 2014;59:123–42.
- [21] Schwarzer R. *Self-Efficacy in the Adoption and Maintenance of Health Behaviors: Theoretical Approaches and a New Model. Self-Efficacy: Thought Control of Action*. Washington DC: Hemisphere Publishing Corporation; 1992.
- [22] Schwarzer R, Luszczynska A. How to overcome health-compromising behaviors: the health action process approach. *Euro Psychologist* 2008;13:141–51.
- [23] Zhang CQ, Zhang R, Schwarzer R, et al. A meta-analysis of the health action process approach. *Health Psychol* 2019;38:623–37.
- [24] Zhou N, Dong XY, Bo JY, et al. Prediction of AIDS epidemic trend in Tianjin by Grey Model. *Chin J Prev Med* 2009;43:742–3.
- [25] Tianjin Centers for Disease Control and Prevention. Tianjin Jizhou Center for Disease Control and Prevention promoted the Installation and Use of Condom Self-service Distributor in Universities. Available at: http://ncaids.chinacdc.cn/zxxz/dfjl_10360/201808/t20180828_190068.htm [Accessed August 7, 2018]
- [26] Xu F, Bu K, Zhang D, et al. A cross-sectional study on AIDS-related knowledge and demands for health education among first-grade students of senior high schools in Tianjin. *Chin J Epidemiol* 2019;40:1618–23.
- [27] Jin SS, Bu K, Xu F, et al. Survey of the AIDS awareness among college freshmen by using two versions of AIDS basic knowledge questionnaire. *Chin J AIDS STD* 2017;23:520–3.
- [28] Napper L, Fisher D, Reynolds G. Development of the perceived risk of HIV scale. *Aids Behav* 2011;16:1075–83.
- [29] Cai Y. Evaluation of school-based HIV/AIDS peer-led prevention program and ROCCIPI policy research among senior high school students from coastal cities in China. Fudan University 2011.
- [30] Sun X, Liu X, Shi Y, et al. Determinants of risky sexual behavior and condom use among college students in China. *Aids Care* 2013;25:775–83.
- [31] Tsui HY, Lau JT, Wang Z, et al. Applying the pre-intentional phase of the Health Action Process Approach (HAPA) Model to investigate factors associated with intention on consistent condom use with various types of female sex partners among males who inject drugs in China. *Aids Care* 2016;28:1079–88.
- [32] Brafford L, Beck K. Development and validation of a condom self-efficacy scale for college students. *J Am Coll Health* 1991;39:219–25.
- [33] Jin S, Bu K, Chen F, et al. Correlates of condom-use self-efficacy on the EPPM-based Integrated Model among Chinese College Students. *Biomed Environ Sci* 2017;30:97–105.
- [34] Ballester-Arnal R, Ruiz-Palomino E, Gil-Llario MD. Structural equation modeling test of an integrated model of Spanish Youth's Condom use. *Aids Behav* 2017;21:1407–16.
- [35] Yu B, Chen X, Stanton B, et al. Quantum changes in self-efficacy and condom-use intention among youth: a chained cusp catastrophe model. *J Adolesc* 2018;68:187–97.
- [36] Chambers RS, Rosenstock S, Lee A, et al. Exploring the role of sex and sexual experience in predicting American Indian adolescent condom use intention using protection motivation theory. *Front Public Health* 2018;6:318.
- [37] Xu Y, Chen X, Yu B, et al. The effects of self-efficacy in bifurcating the relationship of perceived benefit and cost with condom use among adolescents: a cusp catastrophe modeling analysis. *J Adolesc* 2017;61:31–9.
- [38] Setegn T, Takele A, Bedada N, et al. Correlates of risk perception to HIV infection, abstinence and condom use among Madawalabu University Students, Southeast Ethiopia: using Health Belief Model (HBM). *Global J Med Res Dis* 2013;13:24–32.