Mediation and moderation effects of an educational intervention for improving intention to practise pneumoconiosis prevention among South Asian construction workers

Introduction

Pneumoconiosis are interstitial lung disease caused by the inhalation of certain dusts that damage the lungs (Cullinan & Reid, 2013). Workers in the construction industry are more likely to be exposed to these dusts, resulting in an elevated risk for pneumoconiosis among them (Ahmed & Zhu, 2007). Patients with pneumoconiosis may experience respiratory symptoms including difficulty breathing and cough, which may lead to functional decline that affects their daily lives (Cullinan & Reid, 2013). The progression of pneumoconiosis may also be associated with a range of adverse health outcomes, such as chronic obstructive pulmonary disease, lung cancer, disability and even premature death (Hung et al., 2014; Oyunbileg, Wang, Sumberzul, Chang, & Erdenchimeg, 2011; Peng et al., 2018). Given that pneumoconiosis is incurable, adopting preventive measures is important to reduce the risk for pneumoconiosis development among construction workers (Leung, Yu, & Chen, 2012).

A growing number of the ethnic minority workers has joined the construction industry to alleviate the shortage of local manpower in many countries, including Malaysia, Australia, the United Kingdom. In Hong Kong, the census report of 2016 revealed that a considerable proportion of South Asians, including 45.6% Pakistanis and 22.9% Nepalese, worked in the construction industry (Census and Statistics Department, 2017). However, most training and interventions on pneumoconiosis prevention for construction workers available in Hong Kong were primarily tailored to the Chinese population, which may not be sensitive to the South Asian workers in relation to their languages, cultures and beliefs (Occupational Safety and Health Training Centre, 2018). To promote pneumoconiosis prevention among the ethnic minority construction workers, our team has developed a culturally and linguistically appropriate educational intervention on pneumoconiosis prevention for South Asian construction workers in Hong Kong. The educational intervention was guided by the Health Belief Model (HBM) and covered information on basic facts about pneumoconiosis, preventive measures for pneumoconiosis and relevant surveillance resources. To make the intervention materials more readable and attractive, the intervention used multimedia materials including presentation slides, video clips, animations and pamphlet (Bust, Gibb, & Pink, 2008; Hare, Cameron, Real, & Maloney, 2013; Sinyai, MacArthur, & Roccotagliata, 2018). The intervention was delivered by a bilingual South Asian with a nursing background, who could serve as a cultural broker to reduce language barriers and enhance effective communication

(Chan, Javed, Lyu, Hon, & Wong, 2016). The findings indicated that the intervention achieved a good reach among South Asian construction workers in Hong Kong, and significantly changed their beliefs of pneumoconiosis and improved intention to practice preventive measures. Since the intention to perform particular behaviors is a strong predictor of the actual performance of behaviors (Schwenk & Moser, 2009; Webb & Sheeran, 2006), this intervention offers a promising approach to improve pneumoconiosis prevention among South Asian construction workers.

Apart from evaluating the overall effectiveness of the intervention, why the educational intervention was efficacious in enhancing the intention to pneumoconiosis prevention is an unanswered question. Moreover, to our knowledge, there is no published study examining the mechanisms of available interventions' efficacy in promoting pneumoconiosis prevention among construction workers. Clarifying the mechanisms underlying changes in intentions could highlight important strategies through which the intervention could increase the intention to practice preventive measures among South Asian construction workers. Our intervention on pneumoconiosis prevention was based on the HBM (Carpenter, 2010; Janz & Becker, 1984). The HBM consists of several components: (1) perceived susceptibility–perception of one's vulnerability to a negative condition; (2) perceived severity–perception of the severity of the negative condition; (3) perceived benefits–the beliefs of the effectiveness of the target behavior in reducing the risk of the negative condition; (4) perceived barriers–perception of the impediments to undertaking the target behavior; (5) cues to action–additional elements that motivate the individual to implement the target behavior; (6) self-efficacy–confidence in one's ability to perform the target behavior. According to HBM, changes in the health beliefs may modify one's health-related intention, which could in turn lead to changes in health behavior (Carpenter, 2010; Janz & Becker, 1984).

This study aimed to conduct a secondary analysis of the intervention study to test the mediating effects of the health beliefs of pneumoconiosis on the intervention's efficacy in changing intention to practice pneumoconiosis prevention among South Asian construction workers. In addition, we also examined whether the intervention was differentially efficacious in modifying health beliefs and intentions among different subgroups of construction workers. The potential moderators included gender, age, college education, marital status, monthly household income and length of employment in the construction industry. The mediation and moderation analyses were conducted using the strategies that could be applied in two-condition within-subject design (Montoya, 2019; Montoya & Hayes, 2017).

Method

Participants

A convenience sample of South Asian construction workers were recruited from community centers, ethnic minority associations and construction companies in Hong Kong. Participants were eligible if they were South Asian (Pakistani or Nepali), currently Hong Kong citizens, aged 18 and older, and worked in construction sites as construction workers.

Multimedia educational intervention

The multimedia educational intervention was developed by an advisory panel involving two health professionals, two construction site supervisors, one occupational safety nurse and one construction site nurse. The educational intervention used multimedia materials including a presentation slide, a pamphlet and several videos, which were uploaded to the webpage (http://www.cuhk.edu.hk/pneumo/en/index.html). Presentation slides for a 30-minute health talk and a pamphlet provided information in six aspects: (1) definition of pneumoconiosis; (2) types of pneumoconiosis; (3) symptoms, diagnosis, and treatment of pneumoconiosis; (4) preventive measures of pneumoconiosis; (5) steps for wearing a respirator; and (6) medical surveillance and compensation ordinance. The slide and pamphlet used short sentences, bullet points, and graphics to increase the readability of the content. A 7-minute video clip was produced to tell a story of a male construction worker, who was a breadwinner of a South Asian family in Hong Kong. The man did not use respirator at the construction site initially, but he subsequently changed his attitude when he learned the susceptibility to and severity of pneumoconiosis, and finally implemented the preventive measures to protect himself as well as his family against pneumoconiosis. Two animated video clips were developed to show the cause of pneumoconiosis. Four short videos were produced to introduce different personal protective measures against pneumoconiosis, especially the proper use of respiratory protective equipment. The written educational materials were prepared in English, Urdu and Nepali, and the video clips were prepared in English and Hindi. Four bilingual South Asians including two Nepalese and two Pakistanis were invited to provide comments and suggestions to improve the cultural appropriateness of the materials.

A trained bilingual South Asian with a nursing background delivered the interactive health talk. Presentation slides and video clips were shown during the health talk. Pamphlets were distributed to the participants for their references. Participants were asked to choose the version of materials according to their language preferences.

Measures

Intention to pneumoconiosis prevention

One item was used to assess the participants' actual practice of pneumoconiosis preventive measures in the workplace at pre-test. Another item was used to assess the participants' intention to practice of pneumoconiosis preventive measures in the workplace in the following month at post-test. Each item was rated on a five-point scale ranging from 1 (*never*) to 5 (*always*).

Health beliefs towards pneumoconiosis

Health beliefs towards pneumoconiosis were assessed at pre- and post-test. The 20-item measure included six components, including perceived susceptibility (two items), perceived severity (four items), perceived benefits (two items), perceived barriers (four items), cues to action (three actions) and self-efficacy (five items). Participants rated on a five-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The total score of the items in each factor was calculated, and a higher factor score indicated a stronger belief in that aspect. The scale had good internal consistency, with the Cronbach's α of 0.85 for perceived susceptibility, 0.85 for perceived severity, 0.84 for perceived benefits, 0.85 for perceived barriers, 0.81 for cues to action and 0.95 for self-efficacy in this study. The construct validity for the scale was examined using confirmatory factor analysis. A good fit of the model was indicated by a comparative fit index (CFI) greater than 0.95, a root mean square error of approximation (RMSEA) smaller than 0.06 and a standardised root mean square residual (SRMR) smaller than 0.08 (Hu & Bentler, 1999). A six-factor model was tested, and the indices indicated the model provided a good fit to the data (χ^2=619.51, df=150, p<0.001; CFI=0.97; RMSEA=0.056; SRMR=0.047).

Socio-demographic characteristics

Socio-demographic characteristics were measured at pre-test, which included gender, age, education, marital status, monthly household income and length of employment in the construction industry.

Procedures

We recruited participants via the help of community centres, ethnic minority association and construction companies in HK. Those who were eligible and agreed to participate were invited to attend the educational intervention. The intervention was arranged in construction

sites during lunch time or community centers in the evening. The average number of participants in each intervention was 17.3±14.1. Participants completed the self-reported measures before and after the intervention.

Statistical analyses

Descriptive statistics were presented for the study variables. Paired t-test was conducted to evaluate change in intention and health beliefs from pre- to post-intervention. Cohen's d was calculated to estimate the effect size for the paired samples, with 0.20 as small, 0.50 as medium and 0.80 as large effects (Cohen, 1988). Pearson correlation coefficients were used to describe the association between changes in health beliefs and changes in intention to practice of pneumoconiosis prevention from pre- to post-test.

To evaluate the mediating mechanisms, we then investigated whether changes in intention were mediated by changes in health beliefs from pre- to post-test. The mediation analyse were examined using path-analytic approach in two-condition within-participant designs, which could estimate the mediating effects in pre-post-test design with repeated measures (Montoya & Hayes, 2017). Changes in perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action and self-efficacy were entered as multiple mediators. The confidence intervals for the mediating effects were estimated by bootstrap method from 5,000 samples. A significant mediating effect was indicated by a 95% confidence interval that did not contain 0 (Montoya & Hayes, 2017). The mediation analyse were conducted using MEMORE macro in SPSS (Montoya & Hayes, 2017). Covariates can be excluded from mediation analyses when the covariates were not affected by measurement instance (Montoya, 2019), thus the socio-demographic factors were not included in the mediation analyses.

Moderation analyses in two-condition within-subject design were used to examine whether the intervention effect for health beliefs and intention were moderated by socio-demographic factors (Montoya, 2019). Additive moderation analyses were used to examine the multiple potential moderators including gender, age, college education, marital status, monthly household income and length of employment in the construction industry. Moderation analyses were conducted using Mplus 7.1.

Only one participant did not complete the post-test, we excluded this participant in data analyses. Of the remaining 1001 participants, 3.4% participants had missing responses on age and 8.4% participants had missing responses on length of employment in the construction industry. No missing data was observed in other variables. In the moderation analyses, missing data was handled by a full information maximum likelihood (FIML) method.

Results

Sample characteristics

During the period between October 2017 and March 2019, we approached 1,083 South Asian construction workers who met the eligibility criteria, and 1,002 of them (92.5%) agreed to participate in the study. A total of 1,001 workers participated in the intervention and completed the pre- and post-test survey, which were included in the data analyses in this study. Sample characteristics are shown in Table 1. Participants included 828 men (82.7%) and 173 women (17.3%), who were on average 38.67 years of age (SD=10.83). The majority of them (80.8%) were married. They worked in the construction industry for an average of 99.78 months (SD=79.82).

Health beliefs and intention to practice of pneumoconiosis prevention from pre- to post-test

The descriptive statistics for health beliefs and intention to practice of pneumoconiosis prevention at pre- and post-test are shown in Table 2. Paired-t-test indicated significant increases in perceived susceptibility, perceived severity, perceived benefits, cues to action and self-efficacy after the intervention with small to large effect sizes (Cohen's d: 0.206-0.605), and a significant decrease in perceived barriers with a small effect size (Cohen's d=0.116). The participants reported an improvement in intention to practice of pneumoconiosis prevention after the intervention with a moderate effect size (Cohen's d=0.517). The changes in health beliefs was positively associated with changes in intention to practice, with a moderate association for changes in self-efficacy and small association for changes in perceived severity and perceived benefits (Table 3).

Mediation analysis

The results of mediation analysis of health beliefs as mediators for the intervention's effects on intention to practice of pneumoconiosis prevention are shown in Table 4. There were significant indirect effects for perceived severity (b=-0.104, SE=0.031, 95% CI: -0.165, -0.043) and self-efficacy (b=-0.171, SE=0.026, 95% CI: -0.223, -0.122). Thus, the intervention could significantly increase perceived severity of pneumoconiosis and participants' self-efficacy in implementing the preventive measures, which in turn accounts for the increase in intention to practice of pneumoconiosis prevention after the intervention.

Moderation analyses

The results of moderation analyses are shown in Table 5. Changes in perceived severity was found to vary by gender (β = 0.730, p = 0.041) and length of employment in the construction industry (β = 0.004, p = 0.048). Compared with female workers, male workers tended to report a larger increase in perceived severity of pneumoconiosis from pre- to post-test. Compared with those who worked for a longer period, participants who worked in the construction industry for a shorter period were more likely to show greater increases in perceived severity of pneumoconiosis from pre- to post-test.

Changes in perceived barriers was found to vary by age (β = -0.057, p = 0.004) and monthly household income (β = -0.767, p = 0.003). Compared with the older participants, younger participants were more likely to show a greater decrease in perceived barriers from pre- to post-test. Compared with the participants who had a monthly household income lower than the local median, participants who had a monthly household income above the local median were more likely to show a greater increase in perceived barriers from pre- to post-test.

Changes in self efficacy was found to vary by age (β = -0.036, p = 0.050) and gender (β = 0.868, p = 0.046). Compared with the younger participants, older participants were more likely to show a greater increase in self-efficacy from pre- to post-test. Compared with female workers, male workers tended to report a larger increase in self-efficacy from pre- to post-test.

Changes in intention to practice was found to vary by marital status (β = 0.232, p = 0.025). Compared with participants who were single or divorced, married participants tended to report a lower increase in intention to practice from pre- to post-test.

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