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Chemical Education Transfer for Safe Practice Improvement Regarding Volatile Organic Solvents among Gasoline Station Workers, Bangkok, Thailand

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Abstract

The cross-sectional study was designed to survey on six gasoline station workers in Bangkok. Forty-one workers were participated to find out prevalence of knowledge (K), attitude (A) and practice (P) before and after 7-day appropriate intervention regarding volatile organic solvents. The results showed that before the intervention the workers had good attitude toward the harmful of using solvents, but they lacked of good knowledge on effect of volatile organic solvents as well as safe practice [using personal protective equipment (PPE) and hand washing]. After a 7-day appropriate intervention of educational training on knowledge of chemical toxicity and prevention was conducted the prevalence of workers had significantly increased in good knowledge ($p < 0.001$) and safe practice ($p < 0.001$), but significantly decreased in good attitude ($p < 0.05$). The safe practice after appropriated intervention was positively associated with good knowledge ($p < 0.01$) and good attitude ($p < 0.05$). The study showed that the workers required good knowledge on occupational hazards by engaging in good attitudinal approach toward better hazard prevention at workplace for their safe practice during work-shift. Therefore, making awareness and the regulation of using PPE should be considered to improve proper behavior toward safe practice of gasoline station workers.
Keywords: Knowledge, Attitude, Practice, Volatile organic solvents, Appropriate intervention, Gasoline station

1. Introduction

Volatile organic compounds (VOCs) solvents are pollutants which can have detrimental effects on human health. Some VOCs are mutagenic or toxic to many systems (Baker 1994; Brautbar & Williams 2002; Cal/EPA 2003). Many of them demonstrated harmful environmental effects to crop, vegetation and materials damage (Department of Environment, Community and Local Government 2007). Gasoline station workers are at risk to expose to these pollutants with no control over length and frequency of safety regulation. Roles of occupation health authorities are to assure that every worker has safe and healthy working environment by helping workers to avoid unnecessary exposure through safe practices and use of personal protective equipment (PPE) (ILO 2000; ACGIH 2001; Chiabhlaem 2011). Theoretically, safe practices depend on having appropriate attitude toward the health risks associated with exposure to solvents, which in turn depends on knowledge about danger and harmful effects of organic solvents. Most of occupational workers, who are exposed to organic solvents, have good knowledge and attitude toward the effects of organic solvents. The gasoline station worker is one of high risk group who directly exposes to toxic chemicals and should be aware of their adverse effects (Wiwanitkit 2005; Keretetse et al. 2008; Yimrungruang et al. 2008; Tunsaringkarn et al. 2011). However, KAP toward VOCs have not been assessed yet, in Thailand.

This study conducted in order to improving safe practice among gasoline station workers. The evaluation the prevalence of knowledge, attitude and practice regarding volatile organic solvents was conducted before and after appropriate intervention of providing knowledge on harmful effects and protection of volatile organic solvents by using PPE and hand washing procedure for 7 days.

2. Research Methods

2.1 Population Study

A total of 41 gasoline station workers, 23 men and 18 women from 6 gasoline stations in Pathumwan district, Bangkok, Thailand, who are 18 years or older and have been working for more than 6 months, were participated in this study. All workers were healthy and signed consent forms before the study. Permission to conduct human

subjects in this study was approved by the Ethical Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University.

2.2 Data Collection

The gasoline workers were interviewed KAP by face to face at worksite before and after 7-days appropriate intervention of knowledge of volatile organic solvents hazard and safe practice with PPE (mask) and hand washing (liquid soap). The interview for each worker took about 5 – 10 minutes.

2.3 Chemical education transfer

The researcher gave knowledge of the chemical hazard regarding VOCs, toxicity to human health, route of exposures and how to practical protections of workers by individual. In addition, we gave the small condensed manual, appropriate mask (PPE: 3M Australia Pty Limited, 9913V Type GP1 with an exhalation valve, Australian Standard), and liquid soap for hand washing (Dettol hygienic original hand soap, Reckite Benckiser, Thailand) for 7-days intervention.

2.4 Statistical calculations

All collected data were carried out with SPSS version 17.0 statistical software package. Descriptive analyzed the characteristics and pair sample t-test was computed to compare between KAP before and after appropriate intervention of gasoline station workers and logistic regression was estimated association between safe practice and parameters with 95% confidence interval (CI). A statistically significant difference was accepted at a p-value of < 0.05 similar to the other medical studies.

3. Analysis results

3.1 Characteristics of workers

The average age of gasoline station workers was 32.5 years, of whom 56.1% were men and 43.9% were women. The mean BMI (Body Mass Index) was 23.6 Kg/m3. However, 4.9% of workers in the group of BMI < 18.5 were found to be malnutrition, while the other 4.9% of worker in the group of BMI > 30 were found to be obesity. The average number of years working at the gasoline station was 2.7 years. Slightly one half of workers (53.7%) were alcohol drinking whilst most of them (82.9%) were non-smokers (Table 1).

3.2 Assessing of KAP

Assessing the KAP of the respondents by face to face interview regarding VOCs before giving appropriate intervention revealed that most of workers had some knowledge on effects of VOCs to human health (80.5%) and can protect themselves from exposure to VOCs (80.5%) but they had low prevalence of over all good knowledge at 34.1%. Most of the workers had good attitudes of harmful protection of solvents (95.1%) but lack of safe practice (14.6%) especially only using any PPEs during work shift (22.0%) as shown in Table 2.

After giving appropriate interventions for 7 days, the KAP were significantly increased in knowledge of volatile organic solvents (from 34.1% to 85.4%, $p < 0.001$, pair sample t-test), safe practice (from 14.6% to 85.4%, $p < 0.001$, pair sample t-test) of using PPE (85.4%) and hand washing (92.7%) but decreased in good attitude (from 95.1% to 75.6%, $p < 0.05$, pair sample t-test) of all items. In addition, 19.5% of the workers using PPE and hand washing normally were PPE for 4.8 hours a day and 65.9% wore 1-3 times a week for 2.2 hours a day (Table 3).

3.3 The association of having safe practice with various factors

The result of safe practice showed the positive association with having good knowledge ($p < 0.01$, logistic regression analysis) and having good attitude ($p < 0.05$, logistic regression analysis) with odd ratio at 0.03 and 9.67 respectively (Table 4).

4. Discussion

Volatile Organic Compounds (VOCs) are solvents usually found in petrochemicals, paint wastes, dry cleaning chemicals, furniture stripper, carburetor cleaners, etc. The VOCs have some carcinogenic compounds liked benzene, ethyl benzene (IARC, 1989). The potential risk to human health to VOCs is related to the dosage and exposure pathways (ingestion, respiration and dermal absorption). Therefore, knowledge, attitude and practice toward VOCs are important for any occupational workers.

Our results from interviewing 41 gasoline station workers in Pathumwan district, Bangkok revealed that there are nearly equal number of men and women with average age of 32.5 years old and almost half of them were alcohol drinking. They were low number of workers (7/41 or 17.1%) who smoking cigarette (< 5 cigarettes per day). This

low percentage might be based on the gasoline station regulation which prohibit smoking in the gasoline station area. Since, more than 4000 compounds including several toxic VOCs (e.g., benzene, styrene, 1,3-butadiene) have been identified in environmental tobacco smoke (ETS). The VOCs concentrations emitted by tobacco smoking were linearly associated with the number of cigarettes consumed (Xie et al. 2003)

Results on whether or not the workers having good knowledge and safe practice of VOCs were low at 34.1% and 14.6%, respectively, however, they had good attitude towards prevention of these solvents. Lack of good knowledge and low in safe practice might be caused by the under educated of workers who normally have only attended the secondary schools (Tunsaringkarn et al. 2004). About 78.0% of workers have never received information on chemicals from any sources either from their employers or the officer from the Ministry of Labor. Moreover, the low number of safe practice might be caused by the cost of PPE which the workers could not be afforded and the discomfort the worker experienced while wearing the PPE. As it clearly exhibited that there is only 7.5% of workers used any PPE (mask, grove etc.) during their work-shift.

Ideally, having good knowledge with good attitude should be improving safe practice of workers. The prevalence results of knowledge and practice after appropriate intervention for 7-days were significantly increased from 34.1% to 85.4% (pair sample t-test; $p<0.001$) with using PPE 85.4% and hand washing 92.7% but the prevalence of good attitude was significantly decreased from 95.1% to 75.6% (pair sample t-test; $p < 0.05$). It might be due to the use of PPE in which 22.9% of workers felt discomfort and uneasy while wearing PPE during working and 4.9% complained that they could not communicate to customer. However, most of them preferred to protect themselves by hand washing. Our results revealed that hand washing should be more practical for this worker group which it can also decreased risk from skin absorption but can't prevent VOCs via inhalation which is the main route of exposures.

The result of having safe practice was positively associated with good knowledge and good attitude (logistic regression, $p<0.01$ and $p<0.05$) while other factors of age, sex, work period, smoking and alcohol drinking were not associated to safe practice. So, knowledge transfer by the educational training on chemical toxicity and prevention are very important activities for monitoring of changing behaviour in worker safe practices.

The previous study of KAP regarding organic solvents among printing workers in Hong Kong (Yu et al. 2005) found that the prevalence of good knowledge, appropriate attitude and safe practice were low. They also reported that good knowledge was positively associated with awareness of relevant legislation, past drinking behavior but negatively associated with current smoking. Safe practice did not depend on knowledge and attitude but associated with information by supervisors.

Most KAP of various workers in previous studies showed their lack of good knowledge and safe practice of using PPE which safe practice does not necessarily depend on good knowledge and appropriate attitude as the previous studies (McDougall et al. 1993; Petter et al. 2000; Haladiya et al. 2005; Palimalam et al. 2007; Truong et al. 2009). However, the results from our study revealed that good knowledge was positively associated with safe practice, thus safe practice of these workers could be improving by chemical education transfer on chemical toxicity and their personal protection practice (PPE and hand washing) along with good attitude.

5. Conclusions

Safe practice of gasoline station workers could be improving by providing chemical education with good attitude. Direct safety instruction, encouraging the use of PPE and supervisions at the worksite should be more effective in ensuring safe practices. Moreover, the motivation and strict regulations (e.g. using PPE during work shift, better-designed of PPE to be suitable for the environment of gasoline station) are very importance guidelines in changing worker's behavior for continuing their routine safe practices. The government, occupation health authorities, other relevant statutory bodies and employers should play the active roles in providing worker with knowledge dealing with necessary precaution and chemical toxicity information.

Further study on laboratory measurement of urinary biomarkers (trans, trans-muconic acid (t, t-MA), formaldehyde and acetaldehyde) before and after 7 days appropriate intervention could confirm the associations between safe practice and having good knowledge and attitude.

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Table 1. Personal characteristics of workers

Personal characteristics	**Number**	**Mean ± SD or Percentage**
Age (years)	41	32.5 ± 11.3
Work Period (years)	41	2.7 ± 1.7
BMI (Kg/m^2)	41	23.6 ± 3.8
≤ 18.5	2	4.9%
>18.5 – 25.0	27	65.9%
>25.0 – 30.0	10	24.4%
> 30.0	2	4.9%
Gasoline Station Worker	41	
Men	23	56.1%
Women	18	43.9%
Current Cigarette Smoking	7	17.1%
Current Alcohol Drinking	19	46.3%

Table 2. KAP of workers surveyed

KAP variables	**Affirmative answers**	
	before app. intervention[a]	**after app. intervention[a]**
Knowledge of volatile organic solvents		
• Gasoline have volatile organic solvents	73.2	92.7
• Volatile organic solvents affect human health	80.5	92.7
• Volatile organic solvents can cause of cancer	61.0	85.4
• We can protect ourselves from volatile organic solvents	80.5	85.4
Attitudes		
• Workers should have protective guideline of volatile organic solvents for safe practice	95.1	92.7
• Workers should wear PPE during work-shift	100.0	75.6
• Workers should wash their hands during work-shift	100.0	92.7
Practice		
• Workers use any PPE during work-shift	22.0	85.4
• Workers wash hand during work-shift	82.9	92.7
[a]app. intervention: appropriate intervention		

Table 3. Comparison of good KAP of workers before and after appropriate intervention

Factor	Prevalence (%) before app. intervention[a]	Prevalence (%) after app. intervention[a]	*p-value*
Having good knowledge	14/41 (34.1)	35/41 (85.4)	*<0.001*
Having good attitude	39/41 (95.1)	31.41 (75.6)	*<0.05*
Having safe practice	6/41 (14.6)	35/41 (85.4)	*<0.001*
Safe practice everyday for 4.8 hr/D	-	8/41 (19.5)	-
Safe practice 1-3 times/week for 2.2 hr/D	-	27/41 (65.9)	-
No practice	-	3/41 (7.3)	-
No answer	-	3/41 (7.3)	-

[a]app. intervention: appropriate intervention

Table 4. The association of having safe practice with characteristics, good K and A factors.

Factor	Prevalence (mean or percentage)	Odd Ratio	95% CI	*p-value*
Age (years)	32.5	1.006	0.930 – 1.088	*0.881*
Sex (men/women)	(23/18)	0.118	0.012 – 1.126	*0.063*
BMI (Kg)	23.6	1.177	0.889 – 1.557	*0.255*
Work Period (years)	2.7	1.082	0.636 – 1.843	*0.770*
Alcohol Drinking	46.3	1.889	0.305 – 11.684	*0.494*
Having good knowledge	85.4	0.030	0.003 – 0.278	*<0.01*
Having good attitude	75.6	9.667	1.429 – 65.377	*<0.05*

For smoking, the logistic regression analysis did not include because of greatly inflated standard error
CI: Confidence Interval