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# Factors Influencing the Occurrence of Negative Health Effects Associated With Dry Cleaning Solvents

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## Abstract

This study sought to determine the health effects associated with exposure to solvents among dry cleaning workers in CBD, Nairobi. The specific objectives of the study included; to assess the health situation/exposure among the dry cleaning workers, to assess the knowledge of dry cleaning solvents among the dry cleaning workers, to assess the health effects of dry cleaning solvents among the dry cleaning workers, to establish the influence of demographic characteristics on the health effects of dry cleaning workers, to determine the influence of knowledge of dry cleaning solvents on health effects of dry cleaning worker and to establish the influence of health situation/exposure on the health effects of dry cleaning workers. The study found out that age was statistically associated with high negative health effects of the dry cleaning solvents, College level of education was statistically associated with high negative health effects of the dry cleaning solvents, University level of education was statistically associated with high negative health effects of the dry cleaning solvents, being an operator was statistically associated with high negative health effects due to the dry cleaning solvents. Loading clothes into the machine was statistically associated with high negative health effects of the dry cleaning solvents, removing clothes before the drying cycle is finished was statistically associated with high negative health effects of the dry cleaning solvents, transferring solvent-laden clothes into the dryer was statistically associated with high negative health effects of the dry cleaning solvents, changing the solvent filter was statistically associated with high negative health effects of the dry cleaning solvents, emissions

coming from the dry cleaning process was statistically associated with high negative health effects of the dry cleaning solvents, emissions coming from the dry cleaning maintenance was statistically associated with high negative health effects of the dry cleaning solvents. Provision of nose masks was statistically associated with high negative health effects of the dry cleaning solvents. Getting first information from health workers was statistically associated with high negative health effects of the dry cleaning solvents, getting first information from TV and radio was statistically associated with high negative health effects of the dry cleaning solvents, getting first information from newspapers, publications and journals was statistically associated with high negative health effects of the dry cleaning solvents. Ability to recognize headaches as an early sign and symptom of dry cleaning solvent exposure was statistically associated with high negative health effects of the dry cleaning solvents, ability to recognize nose and eye irritation as an early sign and symptom of dry cleaning solvent exposure was statistically associated with high negative health effects of the dry cleaning solvents. The study concluded that majority of the respondents had been exposed to risk of using PERC solvents; therefore, the health situation among the workers working in dry cleaners was associated with high exposure to solvents. The study also concluded that the respondents were knowledgeable on the high exposure to solvents and finally the study led to a conclusion that high exposure to solvents led to health effects. The study recommends that the government should put more resources into helping dry cleaning workers understand the concerns of health effects due to PERC exposure or into helping to implement alternatives, even though this industry has the greatest need. The study also recommends the owners of the dry cleaners to provide the employees with protective garments as they will prevent from direct exposure of PERC solvent.

**Keywords:** *health effects, dry cleaning solvents, health situation/exposure, knowledge of dry cleaning solvents, dry cleaning workers*

### 1.1 Background and Research Gap

Perchloroethylene (PERC) is widely used as the primary solvent in the dry cleaning establishments as a degreaser, and cleaner. PERC is a useful solvent in the dry cleaning industry because it is an effective cleaner and does not promote garment fading or shrinking. At least two-thirds of dry cleaners use PERC as a solvent in their dry cleaning operations [1]. Occupations in a typical dry

cleaning facility include dry cleaning operators, spotters, garment pressers, counter workers, and delivery drivers. Operators load and unload the machines and receive the highest PERC exposure, while pressers who iron (press) and finish garments after washing have lower exposures.

Animal studies have also confirm that exposure to PERC contributes to increased risk of tumors. Human exposures can produce esophageal cancer, cervical cancer, non-Hodgkin's lymphoma, and urinary bladder cancer and leukemia, likely through modulations of specific [2]. This has made the U.S. Office of Environmental Health Hazard Assessment (OEHHA) to conclude that PERC is a human carcinogen [5]. Therefore; the State of California has more recently mandated its phase-out for commercial dry-cleaning by 2023. In addition, the commercial operations in California can no longer purchase PERC washer/extractors for their operations from 2007. New Jersey, Massachusetts, New York, Texas, and the city of Toronto have similar bans under consideration.

While industry-sponsored studies show no significant neurotoxicity at long-term exposures to 800 parts per million (ppm), this is disputed by other research that does reveal evidence of harm. In one occupational exposure study, clinical examinations of neuroses revealed organic lesions of the central nervous systems of exposed workers [12]. Increase cellular peroxide levels, and increase oxidative damage to biological macromolecules [13]. Exposure can also induce hepatotoxicity (liver damage) through increased lipid per oxidation, an effect that can be accentuated by certain prescription drugs [13]. Oxidative degradation of lipids appears to be the mechanism by which exposure to PERC vapors can damage the skin [14].

In Kenya, regulations were promulgated to control the use of PERC, the dominant dry-cleaning solvent in use today. Regulations cover workplace exposure to PERC as well as its potential release to the air. When PERC residues are discarded, they must be handled as hazardous wastes. In addition, the department of health's guideline for PERC in air recommends that the average air level in a residential community not exceed 100 micrograms of PERC per cubic meter of air, considering continuous lifetime exposure and sensitive people. Three other ways of expressing the guideline are 0.1 milligrams per cubic meter of air (0.1 mg/m3), 15 parts per billion (ppb) or 0.015 parts per million (ppm). The purpose of the regulations guideline is to help guide decisions about the nature of efforts to reduce PERC exposure. Reasonable and practical actions should be taken to reduce PERC exposure when indoor air levels are above background, even when they are below

the guideline of (100 mcg/m3). The urgency to take actions increases as indoor air levels increase, especially when air levels are above the guideline.

Currently both globally and locally, the government has put very few resources into helping dry cleaning workers understand the concerns of health effects due to PERC exposure or into helping to implement alternatives, even though this industry has the greatest need. When they need information or assistance, most dry cleaners depend on chemical and machine vendors, or on trade associations whose members are vendors and/or who have financial ties to the vendors. Due to this lack of investment into researching alternatives, the dry cleaning industry has become virtually the only industry that has not yet developed plans to phase out the use of this extremely hazardous chemical. Attempts at environmental protection have centered rather on control of PERC emissions during the dry cleaning process [16]. This industry, however, is particularly unsuited to pollution control. Majority of dry cleaners are poorly capitalized and find it difficult to afford costly pollution- control devices or to finance expensive new equipment. And even when new equipment is installed, operators often lack the training or incentive to use it properly. This study, therefore seeks to address the above mentioned gap by finding out the knowledge that the dry cleaning workers have on the health effects of the dry cleaning solvents.

### 1.2 Research Objectives

i. To assess the health situation/exposure among the dry cleaning workers.
ii. To assess the knowledge of dry cleaning solvents among the dry cleaning workers.
iii. To assess the health effects of dry cleaning solvents among the dry cleaning workers.

### 1.3 Methodology

The study employed cross sectional study design to assess the health effects associated with exposure to solvents among dry cleaning workers in CBD, Nairobi. The study population was 400 workers of the dry cleaners in the CBD of Nairobi. A list of dry cleaners was obtained with the assistance of District Statistical Officer, Nairobi. Purposive random sampling technique was applied to randomly select 160 dry cleaning workers from 20 dry cleaners in Nairobi`s CBD. Primary data was obtained using a structured questionnaire that was designed in English but will be administered by the PI or the research assistant in Kiswahili to the dry cleaner workers. The

questionnaire was pilot tested in CBD location in Nairobi, where 20 systematically selected dry cleaners that were selected were conducted prior to actual data collection to validate the questionnaire. Data analysis was conducted using SPSS version 20.0 statistical software. Exploratory data techniques were employed at the initial stage of analysis to uncover the structure of data and identify outliers or unusual entered values. Descriptive statistics such as proportions was used to summarize categorical variables while measures of central tendency such as mean, standard deviation, and range for continuous variables.

### 1.4 Findings and Discussion

The first objective of the study was to assess the health situation among the workers working in dry cleaners. Majority of the respondents 94.2% were employees, 70% had worked in the dry cleaning between 6-10 years, 30% indicated that they performed two duties in a day. Thirty four point two percent indicated that they spent below 10 minutes to perform each duty. Thirty three point three percent of the respondents indicated that they loaded and unloaded the distilling machine, 26.7% of the respondents indicated that they calculated and dealt with cash records, 16.7% of the respondents did ironing, 10% of the respondents did name tagging, 6.7% of the respondents sorted the clothes at the front desk and 6.7% of the respondents did supervision of other workers. Forty eight point three percent 48.3% of the respondents indicated that in average they washed 21-30kgs of clothes and 37.5% of the respondents indicated that in average they used 0-10Kgs of PERC. Sixty five point eight percents of the respondents indicated that they noticed the smell when loading dirty clothes into the machine, 52.2% of the respondents indicated that they did not notice the smell when removing clothes, especially thick items, before the drying cycle is finished, 51.7% of the respondents indicated that they noticed smell when they were transferring solvent-laden clothes into the dryer from the machine, 65.8% of the respondents indicated that they did not notice the smell in Cleaning lint and button traps, 68.3% of the respondents indicated that they did not notice the smell when raking out the still (distillation unit residue), 65.8% of the respondents indicated that they did not notice the smell when changing the solvent filter while another 64.2% of the respondents indicated that they did not notice the smell when handling and storage of hazardous waste. Results also indicated that 56.7% of the respondents indicated that the vapor emissions came from dry cleaning process, 55.8% of the respondents indicated that vapor emissions did not came from dry cleaning maintenance while

64% of the respondents indicated that vapor emissions was from the clothes. Sixty percent of the respondents indicated that they were not provided with gloves, 52.5% of the respondents indicated that that they were not provided with aprons, all the respondents of the respondents indicated that they were not provided with gumboots, 96.7% of the respondents indicated that they were not provided with nose masks while 71.7% of the respondents indicated that they underwent medical checkup before employment. Eighty five point eight percent of the respondents said that they had specific operating procedures designed to reduce the amount of PERC in the air or being breathed by employees. The findings further indicate that 14.2% of the respondents said that they used windows and air freshener while 70% of the respondents used windows and electric fans to control the amount of PERC in the air.

**Table 1: Dry cleaner interview protocol**

| Statement | | Frequency | Percent |
|---|---|---|---|
| Are you an owner or an employee | | | |
| | Employee | 113 | 94.20 |
| | Owner | 7 | 5.80 |
| Length worked in dry cleaning | | | |
| | Below 5 years | 11 | 9.2 |
| | between 6-10 years | 84 | 70 |
| | 11-15 years | 25 | 20.8 |
| How many duties do you perform in a day? | | | |
| | One | 42 | 35 |
| | Two | 36 | 30 |
| | Three | 32 | 26.7 |
| | Four | 4 | 3.3 |
| | Many | 6 | 5 |
| How much time do you spend on each duty | below 10 min | 41 | 34.2 |
| | 11-20 min | 25 | 20.8 |
| | 31-40 min | 6 | 5 |
| | 41-50 min | 28 | 23.3 |
| | 51-60 min | 7 | 5.8 |
| | 60-540 min | 4 | 3.3 |

**Table 2: List the duties**

| Statement | Frequency | Percent |
|---|---|---|
| Calculation and cash records | 32 | 26.7 |
| loading the distilling machine and unloading the distilling machine | 40 | 33.3 |
| Ironing | 20 | 16.7 |
| Name tagging | 12 | 10 |
| Sorting the clothes at the front desk | 8 | 6.7 |
| Supervision of workers | 8 | 6.7 |

The second objective of the study was to establish the knowledge on dry cleaning solvents among the dry cleaning workers. Results indicated that 64.2% of the respondents said that they did not receive the information from health workers, 89.2% of the respondents said that they did not receive the information from TV and radio, 65.8% said that they did not get the information from older people from the family/community and finally 50.8% of the respondents said that they did not receive information from Newspapers, publications and journals. Eighty five point eight percent of the respondents indicated that dizziness was a sign and symptom of exposure to the dry cleaning solvents. Seventy two point five percent of the respondents said that headaches was a sign and symptom of exposure, 72.5% of the respondents said that fatigue was a sign and symptom of exposure to the dry cleaning solvents, 84.2% of the respondents indicated that nausea was not a sign and symptom of exposure to the dry cleaning solvents, 72.5% of the respondents said that nose and eye irritation was a sign and symptom of exposure to the dry cleaning solvents, 60% of the respondents indicated that skin irritation was not a sign and symptom of exposure to the dry cleaning solvents while all the respondents indicated that Lung and mucus membrane irritation was a sign and symptom of exposure to the dry cleaning solvents. Five point seven percent of the respondents said that good ventilation to avoid breathing in the fumes could prevented PERC exposure,13.9% of the respondents indicated that regular medical checkups and education on dangers of PERC exposure should be carried out, 30.3% of the respondents indicated that teaching workers about PERC effects should be emphasized, 1.6% felt that the storage facility should be properly sealed and 44.3% of the respondents felt that using alternative detergents and wearing protective gears should be emphasized. Seventy percent of the respondents indicated that the recommended time of exposure to the solvents was between 5-10 minutes while 24.2% of the respondents indicated that 11-15 minutes was the recommended time of exposure to the solvents.

The findings further indicate that 93.3% of the respondents affirmed that protection from PERC fumes is important.

**Table 3: Sources of Information**

| | | Frequency | Percent |
|---|---|---|---|
| Health workers | No | 77 | 64.2 |
| | Yes | 43 | 35.8 |
| Newspapers, publications and journals | No | 61 | 50.8 |
| | Yes | 59 | 49.2 |
| TV and radio | No | 107 | 89.2 |
| | Yes | 13 | 10.8 |
| Older persons in the family/community | No | 79 | 65.8 |
| | Yes | 41 | 34.2 |

**Table 4: Measures to prevent PERC exposure**

| | Frequency | Percent |
|---|---|---|
| Good ventilation to avoid breathing in the fumes | 7 | 5.70 |
| Medical checkups and education on dangers | 17 | 13.90 |
| Teaching workers about the PERC effects | 37 | 30.30 |
| The storage facility should be properly sealed | 2 | 1.60 |
| Using alternative detergents and wearing protective gears | 54 | 44.30 |

The third objective sought to assess the health effects of dry cleaning solvents. Ninety one point seven percent of the respondents indicated that they have had dizziness as a sign and symptom of health effect of the dry cleaning solvents, 74.2% indicated that they had headache as a sign and symptom of health effect of the dry cleaning solvents, 63.3% indicated that they had fatigue as a sign and symptom of health effect of the dry cleaning solvents, 65% indicated that they had not experienced nausea as a sign and symptom of health effect of the dry cleaning solvents, 65% indicated that they had not experienced nose and eye irritation as a sign and symptom of health effect of the dry cleaning solvents, 51.7% indicated that they had not experienced nausea as a sign and symptom of health effect of the dry cleaning solvents while all had Lung and mucus membrane irritation as a sign and symptom of health effect of the dry cleaning solvents. These findings agree with California Dry Cleaning Industry Technical Assessment Report (2005) that found out that symptoms associated with respiratory exposure include dizziness, headache; drowsiness and eye, nose, and throat irritation.

**Table 5: Health effects of PERC**

| | | Frequency | Percent |
|---|---|---|---|
| Dizziness | No | 10 | 8.3 |
| | Yes | 110 | 91.7 |
| Skin irritation | No | 62 | 51.7 |
| | Yes | 58 | 48.3 |
| Headaches | No | 31 | 25.8 |
| | Yes | 89 | 74.2 |
| Lung and mucus membrane irritation | No | 120 | 100 |
| | Yes | 0 | 0 |
| Fatigue | No | 44 | 36.7 |
| | Yes | 76 | 63.3 |
| Nausea | No | 72 | 65 |
| | Yes | 48 | 35 |
| Nose and eye irritation | No | 63 | 52.5 |
| | Yes | 57 | 47.5 |

### 1.5 Conclusion and Recommendations

The study concluded that majority of the respondents had been exposed to risk of using PERC solvents; therefore, the health situation among the workers working in dry cleaners was associated with high exposure to solvents. The study also concluded that the respondents were knowledgeable on the high exposure to solvents and finally the study led to a conclusion that high exposure to solvents led to health effects.

The study recommends that the government should put more resources into helping dry cleaning workers understand the concerns of health effects due to PERC exposure or into helping to implement alternatives, even though this industry has the greatest need. The study recommends that the government should give regulations which promulgated to control the use of PERC, the dominant dry-cleaning solvent in use today. The Regulations should cover workplace exposure to PERC as well as its potential release to the air. The study recommends that more training should be offered to the employees of dry cleaners on health effects of the dry cleaning solvents, the amount of PERC to be used and the recommended time of exposure to the solvents. The study also recommends the owners of the dry cleaners to provide the employees with protective garments as they will prevent from direct exposure of PERC solvent.

**1.6 References**

**1. American Conference of Government Industrial Hygienists.** (1999) *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* Cincinnati: American Conference of Governmental Industrial Hygienists.

**2. International Agency for Research on Cancer.** (1995) "IARC monographs on the evaluation of carcinogenic risks to humans," Tetrachloroethylene, vol. 63, pp. 159–221.

**12. Sinczuk-Walczak H. (**2008) Status of the nervous system and bioelectric activity of the brain in dry cleaning plant workers exposed to tetrachloroethylene. *Med Pr*; 39(2):91-9.

**13. Costa C, Pasquale RD, Silvari M, Catania S.** (2006) In vitro evaluation of oxidative damage from organic solvent vapors on human skin. *ToxicolI Vitro*; 20(3):324-31.

**14. Zhu QX, Shen T, Ding R, Liang ZZ, Zhang XJ.** (2006) Cytotoxicity of trichloroethylene and perchloroethylene on normal human epidermal keratinocytes and protective role of vitamin E. *Toxicology;* 209(1):55-67.

**16. Tichenor, B.** (1992) U.S. EPA Research on Dry cleaning Residual Reduction. Proceedings from the International Roundtable on Pollution Prevention and Control in the Dry cleaning Industry. Washington, DC: U.S. EPA Office of Pollution Prevention and Toxics, EPA/774/R-92/002