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Original Article

Cold Exposure and Health Effects Among Frozen Food Processing Workers in Eastern Thailand

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ABSTRACT

Frozen food processing workers work under a cold environment which can cause several adverse health effects.This study explored factors affecting workers' health in the frozen food industry in Thailand. Participants comprised 497 workers exposed to a cold working environment and 255 office workers who served as the controls.

Data were collected by a survey on the work environment, and the interview of workers for abnormal symptoms. The exposed group had the following characteristics: 52.7% male, overall average age of 27 (SD 6.6) years old, attained elementary education (Grade 4 and Grade 6) (54.1%), married (48.9%), smokers (21.3%), alcohol consumption (31.0%), duration of work was between 1 and 5 years (65.2%), working 6 days a week (82.7%), 1–5 hours of overtime per week (33.8%), office workers (33.9%); work category: sizing (6.9%), peeling (28.3%) dissecting (22.2%), and in the warehouse (8.6%). The temperature in the work environment ranged from 17.2°C to 19.2°C in most sections, −18.0°C in the warehouse, and 25°C in the office areas. Warehouse workers had more abnormal symptoms than controls including repeated pain in the musculoskeletal system (OR 11.9; 95% CI 6.12–23.45), disturbance throughout the body (OR 4.60; 95% CI 2.00–10.56), respiratory symptoms (OR 9.73; 95% CI 3.53–26.80), episodic finger symptoms (OR 13.51; 95% CI 5.17–35.33).

The study results suggest that workers' health should be monitored especially with regard to back and muscle pain, respiratory symptoms, episodic finger symptoms, and cardiovascular symptoms. Health promotion campaigns such as antismoking and reduction of alcohol consumption should be established because smoking and alcohol consumption are contributing factors to the pathogenesis of Raynaud's phenomenon and peripheral vascular disorders such as hypertension and heart disease.

1. Introduction

As one of the world's main food production hubs, Thailand is famous for its frozen food industry. The seafood industry inevitably needs labor to work in many different sections like shrimp beheading, peeling, sizing, dissecting, and so on.

Frozen food processing workers have been exposed to potential health hazards including physical, biological, chemical, and psychosocial work environments [1,2]. Low temperatures are necessary in the production of industrial frozen food, which keep the maintains the quality of fresh food for longer. However, it can be dangerous causing the body core temperature to drop. Accompanied with wind speed and humidity levels, low temperature can affect workers' health [1,3–7].

Although there has been no report on work-related cold stress in Thailand [8], there are several studies that examine the effects of a low temperature working environment and its impact on heath in other locations [3–9]; therefore we should pay attention to these impacts because there are a large number of warehouse workers whose jobs are located in low temperature work environments [9].

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After exposure to low temperature, symptoms may not appear immediately. This delay period might distract health care personnel from considering low temperature as the cause of adverse health effects [3,4,9].

Low temperature working environments can cause various diseases [3–7,9] if there is no proper policy in place to control the adverse health effects from cold exposure. Cold exposure may affect various organs such as the respiratory system, musculoskeletal system (usually at temperature below 10 degrees [2]), and cause skin disorders such as rash and hives (urticaria) [11], and cold-associated trauma such as Raynaud's phenomenon [12], frostbite, trench foot, chilblains, and hypothermia.

It is evident that cold work environments can cause adverse health effects [1,4–7,9,10,13]; however, in Thailand, studies on cold exposure and health effects are limited. This study aims to explore the health effects of working in cold environments, to determine factors causing abnormal symptoms in frozen food industrial workers, and to provide basic information to monitor health risks resulting from cold exposure.

2. Materials and methods

This is a cross-sectional study in which data were collected from April to September 2013.

2.1. Study population and participants

The study population comprised workers exposed to cold work environments who worked in two frozen food factories in Rayong Province, Thailand. The study participants were calculated using the formula for simple logistic regression analysis [14], where n was the sample size required, P was the rate of the event based on Lekcharoen et al [15] who found that the proportion of workers who were exposed to cold frequently for more than 3 hours a day was 61.4% ($p = 0.614$) and $P_1 - P_2$ is the difference of the event between physical hazard exposed and nonexposed groups in which the minimum difference was 0.15.

Substituting the values in the formula thus defined the error (α) of 5% (=1.96) and the statistical power ($1 - \beta$) of 90% (=1.28). The calculated sample size was 442.7 $\cong$ 443. Because this study explored many variables, therefore, the sample size [14] when n_p was the adjusted sample size, and n_1 was the calculated sample size was made using the formula for simple logistic regression analysis. R^2 was the coefficient of multiple logistic regression, and for this study was set at 50% ($R^2 = 0.50$). The calculated sample size using the formula was 886 individuals.

All participants were permitted to decline or withdraw at any time from the study without penalty. Those who agreed to participate signed an informed consent form. The Institutional Review Board of Burapha University provided ethical approval for the study protocol.

2.2. Tools and data collection

2.2.1. Interview

Participants were recruited to the study based on voluntary basis and informed consent was obtained. The interview schedule consisted of five parts: Part 1—Sociodemographic characteristics such as sex, age, education, marital status, smoking history, and drinking history. Part 2—Current working history, number of working hours per day, number of working days per week, time to relax outside of work per day. Part 3—Health effects; cold exposure symptoms such as *repeated pain in the musculoskeletal system* (back pain and muscular pain), *symptoms throughout the body* (discomfort, shivering, itching after cold exposure, entire body cold), *respiratory symptoms* (asthma, respiratory wheezing, cough, excessive sputum, runny nose), *episodic finger symptoms* (darkening of fingers, reddening of fingers, finger pain, toe pain), *face and skin symptoms* (urticarial, face pain), *peripheral circulation symptoms* (blurry vision, headache, confusion), *cardiovascular system* (pallor of fingers, chest pain, arrhythmia). The symptoms were rated by a score of two levels (0–1); where 0 = no symptoms and 1 = has symptom. The interview schedule was verified by two occupational medicine physicians, and an occupational health specialist, then underwent a trial before use.

2.2.2. Working environment data

Secondary data of workplace temperature monitoring were used in this study. A real-time digital thermometer was used to monitor workplace temperature.

2.3. Data analysis

A statistical analysis package (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) was used for data analysis. Sociodemographic characteristics, work history, and health effects were described in terms of percentages, means and standard deviations. Factors affecting health were analyzed using logistic regression—backward elimination (p-remove = 0.10) to determine the relationships between age, sex, smoking, drinking, duration of work (years) and seven types of abnormal symptoms: (1) repeated pain in the musculoskeletal system, (2) symptoms throughout the body, (3) respiratory symptoms, (4) episodic finger symptoms, (5) face and skin symptoms, (6) peripheral circulation symptoms, (7) cardiovascular system symptoms.

3. Results

3.1. Demographic characteristics

Although 886 was calculated as the sample size for this study, there were 752 (85%) participants which consisted of 497 individuals exposed to cold and 255 controls who worked in offices. Among the exposed group, 52.7% were male, 62.0% were 21–30 years old, 54.1% attained elementary education, 48.9% were married, 21.3% were smokers with a mean smoking duration of 8.45 (SD 6.63) years, 31.4% was drinkers (Table 1).

3.2. Current work history

Duration of work among the study group ranged from 0.08 to 22 years, with an average of 2.23 (2.70) years, working 8 hours a day or more. The majority (82.7%) worked 6 days per week. The average amount of overtime was 3.48 hours per week (Table 2).

The temperature in the work environment of the study subjects ranged from 17.2°C to 19.2°C in most sections, and −18.0°C in the warehouse. Workers in sizing, peeling, dissecting, and warehouse sections were exposed to cold hazards from the work environment, process water, and processing products. The temperature in the office areas was 25°C.

3.3. Health effects resulting from cold exposure

The participants reported that they had abnormal symptoms, which included musculoskeletal system symptoms, discomfort, respiratory symptoms, episodic finger symptoms, face and skin symptoms, peripheral circulation symptoms, and cardiovascular symptoms (Table 3).