Cardiovascular manifestations among workers in Meat production exposed to cold environment.

Thesis
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Abstract

Meat processing sectors share the characteristic that they all handle commodities which are highly perishable and need to be processed in cold temperatures from the viewpoint of food safety. Numerous studies have reported an increased mortality from cardiovascular disease (CVD) during cold exposure. Increased CVD mortality has been related to thrombosis due to haem-concentration in cold temperature. We aimed at studying the association of occupational cold exposure in meat industry and cardiovascular problems, together with clarifying some of the biochemical changes underlying these vascular manifestations. All subjects involved in our study were evaluated by full clinical examination, resting ECG testing and the following investigations : complete blood picture, total lipid profile, plasma thrombin, plasma fibrinogen, platelete aggregability, cryoglobulin. Assessment of peripheral circulation for all examined subjects were performed by Duplex for upper Rt. arm. Our work revealed disturbed biochemical parameters among occupationally cold exposed workers, increased symptoms of peripheral vascular diseases that were not confirmed by Duplex examination. We recommend the implementation of work place environmental control measures and an appropriate work/rest regime. Periodic screening tests for early detection of cardiovascular affection in high risk workers, should be carried out regularly.

Key words : cardiovascular diseases, cold exposure, platelets aggregability

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DEDICATION

This Thesis is Dedicated To….

My family especially my father's soul , *who gave me the past, present, future……*

My ***Mother,*** *my first teacher…for her patience and care…*

My Husband,,,

My daughter Jamilla and My son Adam, *for their patience and support…*

My brother Ramy..My sisters Nancy & Enas*…for their believe in me…*

To the patients who had shared in that thesis, wishing them a good health and much improvement.

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List of Abbreviations

°C	**degrees Centigrade**
°F	**Fahrenheit**
ACGIH	**American Conference of Governmental Industrial Hygienists**
AMI	**Anterior Myocardial Infarction**
ANP	**Atrial Natriuretic Peptide**
ARC	**Arcuate nucleus**
BAT	**Brown adipose tissue**
BP	**Blood Pressure**
C	**Conduction/convection.**
C_1	**Clean**
Cal	**Calories**
CAD	**Coronary artery disease**
CBC	**Complete Blood Picture**
CHD	**Coronary heart disease**
CHPPM	**U.S Army Center for Health Promotion and Preventive Medicine**
CIVD	**Cold Induced Vasodilatation**
CL	**Chloride**
Cm	**Centimeter**
CNS	**Central nervous system**
CPR	**Cardiopulmonary resuscitation**
CPT	**Cold pressor test**
CVD	**Cardiovascular disease**
D	**Dry**
DBP	**Diastolic Blood Pressure**
DMN	**Dorsomedial nucleus**
E	**Evaporation, always negative.**
ECG	**Electrocardiogram**
ECT	**Equivalent chill temperature**
ELT	**Euglobulin clot lysis time**
FCAS	**Familial cold autoinflammatory syndrome**
Fig	**Figure**

Hb	**Haemoglobin**
HDL	**High Density Lipoprotein**
HIV	**Human immunodeficiency virus**
IHD	**Ischemic Heart Disease**
ITP	**Idiopathic thrombocytopenic purpura**
km/h	**kilometer per hour**
L	**Loose in layers**
LDL	**Low Density Lipoprotein.**
LV	**Left Ventricular**
M	**Metabolic heat production.**
m/s	**meter per second**
Mmhg	**Millimetre mercury**
Mph	**Mile per hour**
MPO	**Medial Preoptic area**
Na	**Sodium**
NaCl	**Sodium chloride**
NPY	**Neuropeptide Y**
O	**Overheating**
PAI-1	**Plasminogen Activator I-1**
PPE	**Personal Protective Equipment**
PVN	**Paraventricular nucleus**
QHCl	**Quinine HCl**
R	**Radiation.**
RTI	**Respiratory Tract Infection**
S	**Net change in heat content.**
SBP	**Systolic Blood Pressure**
Ta	**Ambient Temperature**
TG	**Triglyceride**
TLVs	**Threshold Limit Values**
TPA	**Tissue plasminogen Activator**
UCP-1	**Uncoupling protein-1**
VIP	**Ventilating, insulating and protective layering**
W/m^2	**Watts per square metre**

Introduction

It is generally agreed that as temperature decreases the risk of death increases. The size of the increased risk attributable to cold temperatures seems to depend on the average annual temperature. The Eurowinter group found smaller increases in cardiovascular mortality in colder regions (Finland) than in warmer regions (Athens, Greece)(The Eurowinter Group, 1997 & Braga et al, 2003)

Several machanisms were suggested to describe the relationship between cold exposure and CHD. Some authors assessed the relation of the myocardial infarction (MI) and sudden death with the cold exposure.(Gerber et al,2006). Many authors demonstrated simultaneous elevation of blood pressure and plasma noradrenaline concentration in response to cold exposure, others found that cold-evoked sympathetic activation not only elevated blood pressure but also increased platelet count and volume and whole blood viscosity (which increased by 21%). These authors also noted a rise in cholesterol and suggested that the increase in sympathetic nervous activity related to cold may serve to enhance platelet function, offering a possible explanation for the risk to essential hypertensives of thrombosis in cold weather.(Katz et al, 2000, Arntz et al,2001 & Goodwin et al,2001)

In this thesis, we begin by summarizing the relevant literature on the associations between cold temperatures and health. It explains the effect of cold, physiological mechanisms of the body to the cold exposure and the pathological effect of cold exposure with particular reference to diseases of the cardiovascular system and the affection of the hemodynamic parameters that can lead to these diseases. It continues to describe how the cold exposure affects the workers (particularly the meat production workers) during their duration of employment under very low temperature, if they are not complying to the international standards of safe working area and personal protective equipment.

Indoors industries workers (meat processing industry, cold stores in industry and in the transport chain from industry to the shops) are in great risk of cold exposure. Due to the negative impact of cold on human health and performance, as well as on work productivity, quality and safety, a comprehensive strategy of risk assessment and management practices and methods is needed for work in cold environments. (ISO 15743:2008)

Aim of the work

Our work is designed to study the prevalence of cardiovascular manifestations encountered among the exposed workers, to investigate some of the hemodynamic variables that affect the biochemical parameters especially the coagulation profile as well as the lipid profile, and to determine the haemostatic risk factors affecting CVS due to cold exposure.

The Ultimate goal of our study is to reduce cardiovascular cold impact among cold exposed workers.

Chapter I

Cold Exposure

Working in cold conditions is a hazard with many thousands of workers exposed to cold in environments such as outdoor work in winter months, freezer plants, meat packinghouses and cold storage facilities.

I-A. Cold environment challenges of the worker

Air temperature, air movement (wind speed), and humidity (wetness) are the environmental challenges for the workers. In order to work safely, these challenges have to be counterbalanced by proper insulation (layered protective clothing), by physical activity and by controlled exposure to cold (work/rest schedule).

I-A-1. Air Temperature

Air temperature is measured by an ordinary thermometer in degrees Celsius (°C) or degrees Fahrenheit (°F).

I-A-2. Wind Speed

Different types of commercially-available anemometers are used to measure wind speed or air movement. These are calibrated in meters per second (m/s), kilometers per hour (km/h) or miles per hour (mph). Air movement is usually measured in m/s while wind speed is usually measured in km/h or mph. The following is a suggested guide for estimating wind speed if accurate information is not available:
8 km/h (5 mph): light flag moves,
16 km/h (10 mph): light flag fully extended,
24 km/h (15 mph): raises newspaper sheet,
32 km/h (20 mph): causes blowing and drifting snow.

I-A-3. Humidity (wetness)

Water conducts heat away from the body 25 x faster then dry air. Humidity (water vapor content of air) plays a significant role in heat loss, especially by evaporation. In high humidity climates, the air already contains many water molecules, which decreases the air's capacity to accept more water. This is due to the concentration gradient, which is decreased in cases of high humidity. The high humidity limits sweat evaporation, and hence, heat loss. On the other hand, low humidity promotes heat loss through evaporation, especially during exercise. Nonetheless, low humidity environments are not without their problems to the athlete. If water from the skin evaporates faster than sweat production, severe dryness of the skin may occur (King, 2004).

I-B. Cold environment controls of the exposed workers:

I-B-1. Proper insulation (PPE)

I-B-2. Physical Activity

The production of body heat by physical activity (metabolic rate) is difficult to measure. However, tables are available in literatures showing metabolic rates for a variety of activities. Metabolic heat production is measured in kilo calories (kcal) per hour. One kilocalorie is the amount of heat needed to raise the temperature of one kilogram of water by 1°C.

I-B-3. Work/rest schedule

The "work warm-up schedule" is developed (table1) by the Saskatchewan Department of Labor. This work schedule has been adopted by the American Conference of Governmental Industrial Hygienists (ACGIH) as Threshold Limit Values (TLVs) for cold stress.

Table 1: Work warm-up Schedule.

THRESHOLD LIMIT VALUES WORK/WARM-UP SCHEDULE FOR FOUR-HOUR SHIFT*

Air Temperature Sunny Sky		No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
°C (approx)	°F (approx)	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks	Max. Work Period	No. of Breaks
-26° to -28°	-15° to -19°	(Norm breaks) 1		(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4
-29° to -31°	-20° to -24°	(Norm breaks) 1		75 min.	2	55 min.	3	40 min.	4	30 min.	5
-32° to -34°	-25° to -29°	75 min.	2	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease	
-35° to -37°	-30° to -34°	55 min.	3	40 min.	4	30 min.	5	Non-emergency work should cease			
-38° to -39°	-35° to -39°	40 min.	4	30 min.	5	Non-emergency work should cease					
-40° to -42°	-40° to -44°	30 min.	5	Non-emergency work should cease							
-43° to below	-45° & below	Non-emergency work should cease									

(Table 1: The Canadian Center for Occupational Health and Safety-physical agents-a,2008.)

At any temperature, you feel colder as the wind speed increases. The combined effect of cold air and wind speed is expressed as "**equivalent chill temperature**" (ECT) or simply "**wind chill**" temperature in degrees Celsius or Fahrenheit. It is essentially the air temperature that would feel the same on exposed human flesh as the given combination of air temperature and wind speed. It can be used as a general guideline for deciding clothing requirements and the possible health effects of cold. In Canada the term "**wind chill factor**" is used. This is a measurement of a heat loss rate caused by exposure to wind and it is expressed as the rate of

energy loss per unit area of exposed skin per second (e.g., joules/ [second-metre^2] or watts/metre^2, W/m^2).
(The Canadian Center for Occupational Health and Safety-physical agent-a, 2008)

I-C. Workers at risk of suffering due to the cold exposure include:

- Outdoor workers including:-
    - Road builders, house builders and other construction workers.
    - Hydro and telecommunications linemen.
    - Police officers, fire fighters, emergency response workers, military personnel.
    - Transport workers, bus and truck drivers.
    - Fishers, hunters, trappers and divers
- Workers in refrigerated warehouses,
- Meat packaging and meat storage workers.
- Outdoor recreation workers (and enthusiasts).

((The Canadian Center for Occupational Health and Safety-physical agent-b, 2008)

I-D. Other risk factors for cold exposure injury .

There are many factors that increase the risk of injury from exposure to cold temperatures.

- Extremes of age.
- A history of cold injury. Damage to the skin may happen more quickly in areas that had a cold injury in the past.
- Familial: cold autoinflammatory syndrome (FCAS), a genetic condition also known as cold urticaria or cold-induced hives.
- Conditions that may change your mental awareness, such as:
    - Mental illness
    - Alcohol use or withdrawal and Drug abuse or withdrawal
    - Alzheimer's disease or dementia
- Conditions that affect body temperature regulation, such as:
    - Hypopituitarism
    - Hypothyroidism
    - Hypoadrenalism
    - Hypoglycemia
    - Wernicke's encephalopathy
    - Stroke
    - History of a head injury
    - Poor nutrition or low body fat
    - Skin diseases or injury, such as burns
    - Parkinson's disease
    - Adrenal gland disorders
- A history of surgery to an area that had a cold injury
- Living in poverty or being homeless
- Immobility. If you are not able to move normally, your body does not make heat as well and you may feel colder.

Medications

- Anticoagulants such as warfarin, heparin, and aspirin.

- Chemotherapy or radiation therapy.
- Corticosteroids, such as prednisone.
- Medications to prevent organ transplant rejection.
- Other medications, such as heart, high blood pressure, antidepressant, or tranquilizer medications

Diseases

- Arteritis
- Atherosclerosis
- Burns
- Cancer
- Diabetes
- Hemophilia
- Human immunodeficiency virus (HIV) infection
- Idiopathic thrombocytopenic purpura (ITP)
- Kidney disease
- Lupus
- Malnutrition or an eating disorder such as anorexia nervosa or bulimia
- Multiple sclerosis
- Peripheral neuropathies
- Peripheral arterial disease
- Raynaud's phenomenon
- Rheumatoid arthritis
- Skin diseases

Being exposed to cold temperatures in the workplace, such as working in cold-storage units, meat industry, having certain health risks (Nissl ,2005).