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Retrospective study of the impact Of environ mental factors on The occurrence of industrial Accidents In the United Arab Emirates Over a period of t e n years (1984 - 1993)

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RETROSPECTIVE STUDY OF THE IMPACT OF ENVIRONMENTAL FACTORS ON THE OCCURRENCE OF INDUSTRIAL ACCIDENTS IN THE UNITED ARAB EMIRATES OVER A PERIOD OF TEN YEARS (1984 - 1993)

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ABSTRACT

Industrial workers are practically exposed to multiple environmental factors causing accidents in work places. A retrospective study of the impact of environmental factors on the occurrence of industrial accidents was conducted during the period 1984-1993 in Dubai and Northern Emirates, to determine the impact of environmental factors on the incidence, causes of industrial accidents and the types of injuries among workers. Data were collected from the records of accidents registration in the industrial safety department of the Ministry of Labour and Social Affairs in Dubai Emirate. Industrial visits have been conducted to inspect and identify the existing environmental hazards (viz. cement and cement products, building and construction, chemicals, printing and engineering industries). The total number of injured workers was 159 during the period of study. Accident frequency and accident severity rates were simultaneously increased and decreased in the years of study.

The study revealed that most of the accidents (69.2%) have occured in Dubai Emirate The highest levels of incidence were recorded in the building and construction industry (33.9%) as well as in the cement and cement products industry (30.2%).

The mechanical accidental factors presented the highest risk (81.8%) followed by chemical (12.6%), electrical (3.1%) and physical (2.5%) in the different types of industries. The high prevalence of accidents among injured workers in different types of industries could be attributed to the following socio-demographic characteristics: (i) The majority of injured workers were young (mean age ranged from 30±3.2 to 40 years); (ii) they lacked both skill and experience (mean duration of employment was between 3.2±1.1 and 5.1±3.5 years); (iii) they did not enjoy good payment (highest mean salary per month was 1263.3±614.4 Dirhams); most of them came from third world countries with poor health conditions and educational or background (63.5% were Indians and 41.5% were illiterate).

Study of factors affecting industrial accidents revealed the following: Falls or slips (57.2%) and falling or flying objects (23.9%) represented the main causes of injuries. Most of accidents (93.1%) occurred due unsafe circumstances; and (84.9%) of accidents occurred as a result of unsafe act of the injured workers. Injuries of the upper limb (52.8%) and lower limb (18.7%) represented the common injury sites among injured workers especially wound (47.2%) and fracture (17%). The type of first aid offered among injured workers was not known in 55.3% of cases, and dressing (18.2%) and bandage (20.8%) were the main known first aid. Disability occurred in (21.3%) of injured workers especially in the upper and lower limbs and 24 deaths occurred in the period of study. Also 101 injured workers (63.5%) were completely recovered without residual effects.

Safety training and health education programmes to minimize accidents occurrence is therefore recommended. Meanwhile, formulation of a specific sheet for industrial accident is a must to keep reliable records and good control measures to protect workers from different hazards and should always exist in the work place in different types of industries.

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CHAPTER I

INTRODUCTION

Man and his environment are indivisible. They react upon each other in the form of give and take relationship. The industrial worker today is placed in a highly complicated environment which is getting more complicated as man is becoming more ingenious.

Environmental factors encountered as causes of accidents, worker injuries and/or health problems in the industrial environment may be classified as : Physical factors (such as heat, abnormal pressure, noise and vibration, abnormal lighting, electromagnetic and ionizing radiation); Chemical factors (such as particulates, non-particulates and liquids); Biological factors (such as insects, bacteria, viruses, fungi, etc.), Mechanical factors (such as machines and tools, etc.); Socio-economic factors and Ergonomic (such as monotony, repetitive motions, etc.) (ILO, 1990).

An accident may be defined as unexpected, unplanned occurrence which may involve injury (WHO, 1982). The possible causes and types of accidents within the undertaking are numerous and may arise from unsafe mechanical equipment, environmental condition, hazardous arrangements around the work place, and unsafe act committed (Poltev,1985). The tenth international conference of labour statisticians in 1962 adopted four international model classifications of industrial accidents. They included : (i) Classifications according to type of accidents (such as fall of persons, struck by falling objects, exposure to a contact with electric current and/or harmful substances or radiations and/or extreme temperatures, etc.); (ii) Classifications according to agency (such as machines, transport and lifters/equipments, material substances and radiation, working environment, etc.); (iii) Classifications according to the nature of injury (such as fractures, sprains, burns, acute poisoning, electrical shock, arsenals, etc.); (iv) Classifications according to the body location of the injury (such as head, neck, trunk, upper limbs, lower limbs, etc.) (ILO, 1962). The results of industrial accidents may be temporary or permanent disability and death, stoppage of work, and time loss which are due to the effect of a production-relation dangerous factor or a combination of such factors (Blake, 1993).

Many countries collect data on accidents at work, during travel or in the home. It is often obligatory to identify certain categories of accidents (e.g. boiler explosions or crane failures) that cause no injury, or accidents that cause injury of particular severity, e.g. prevent a person from doing his normal jobs for more than three days (Genot and Hublet, 1990).

The United Arab Emirates (U.A.E.) witnessed a rapid and expanding industrial growth and development in recent years. In 1991, the number of industrial enterprises have reached 739 enterprises, having more than 54,000 employees in Dubai and Northern Emirates (Ministry of Finance and Industry, 1992). Employees in working places may be exposed to different kinds of hazards (occupational and/or environmental) such as mechanical, chemical, physical, biological and electrical, and this may reflect on the increased risk of injury at work place.

AIM OF THE STUDY

1. To determine the incidence and causes of industrial accidents in the United Arab Emirates for a period of ten years from 1984 to 1993, with special emphasis on the environmental factors encountered as causes of these industrial accidents.

2 To determine the impact of environmental factors on the types of industrial injury and fate of injury (complete recovery, disability or death) encountered by workers and their distribution for the last ten years; 1984 to 1993.

CHAPTER II

REVIEW OF LITERATURE

2.1. Historical Background of Industrial Development in the United Arab Emirates.

Before the discovery of petroleum, U.A.E. knew many traditional industries, most important of which was boat building, fishing nets, ropes, smithing, pearls, gold, handcrafts, beside tanning, brick making and earthenware.

The beginning of industrial development started in 1975. In 1985, the second phase of industrial development started, in which the total income amounted to fifty billion Dirhams from natural resources; and the annual growth percent during that time was equal to 27% from general development in the country. However, in 1990 the industrial investment represented 10% of the total income of the country. Moreover, the most important material manufactured in the U.A.E. included petroleum products, fishing and its products, boats, petrochemicals, leather, gases, cement and cement products, food stuff, beverages and tobacco, spinning textiles, garments, wood and wood products, paper and paper products, printing and publishing, rubbers, plastic products, metal products, machines and equipments, and drugs. (Al Mansoory, 1990).

2.2. Location and Types of Industries in the United Arab Emirates

2.2.1. Abu Dhabi

Before 1977 most of the industries depended upon the demand of the Emirates for local consumption, but after 1977, industries have grown and more development has been taken place. Large scale factories have been built especially in the petroleum products, the most prestigious is the Abu Dhabi National Oil Company, which owns most of the companies in this field. Besides the petroleum refinery station and chemical fertilizer factory in Al Ruwais, other industries such as dairy plants, refreshment and food plants, paper industries, cement and cement product factories have been established in Abu Dhabi (Ministry of Finance and Industry, 1993 and Al Mansoory, 1990)

2.2.2. Dubai

The Emirate of Dubai is considered as the bases of industries in the U.A.E., especially due to its location and the feasibility of its huge port for import and re-export.. After the Emirates became independent in 1971, Dubai became a very important Emirate in the U.A.E. and in the Middle East, especially since very good

facilities were provided by the Government of Dubai for industrial investment, such as food, refreshments, petrochemicals, cables, pipes, clothes, cement and cement products, and dry dock for ship maintenance (Ministry of Finance and Industry, 1993 and Al Mansoory, 1990)

2.2.2.1. Jebel Ali Free Zone

This project is located in Dubai and was started in 1976 by building the biggest harbour in the Middle East. In 1985 a Free Zone was established in this area, and international companies rushed to Jebel Ali and founded their industrial activities such as clothes, food products, building materials, perfumes, cables, cleaning materials, air conditioners, spare parts, irrigation equipment, cigarettes, furniture and electricals generators. Most of these products are exported to many countries (Ministry of Finance and Industry, 1993 and Al Mansoory, 1990)

2.2.2.2. Dubai Aluminium Factory

This factory was built in Jebel Ali in 1979. The production of this factory included : Aluminium, desalination of water and sodium chloride. It's annual production amounts to 135,000 tons of Aluminium. Most of these product are exported to many countries (Ministry of Finance and Industry, 1993 and Al Mansoory, 1990).

2.2.3. Sharjah

Sharjah became the third Emirate in building industries and producing different products. More than 240 industrial enterprises are present such as petrochemicals, wood products and furnitures industries, fiberglass, plastic, and cement and cement products (Ministry of Finance and Industry, 1993 and Al Mansoory, 1990).

2.2.4. Ajman

In Ajman more than 77 industries have been presented, producing different materials such as marble, cement products, dairy, refreshment, fish grinding, poultry and home appliances (Ministry of Finance and Industry, 1993 and Al Mansoory, 1990).

2.2.5. Ras Al Khaimah

In Ras Al Khaimah more than 38 industries have been established for the production of poultry, dairy, cement and cement products, marble, bracket, pipes, nails, furnitures, fiberglass and drugs (Ministry of Finance and Industry, 1993 and Al Mansoory, 1990).

2.2.6. Al Fujairah

Al Fujairah Emirate is located in the east of the U.A.E. In the last few years, many industries sprang up, such as cement, dairy, poultry, fiber stone, ceramic, water packaging, and food (Ministry of Finance and Industry, 1993 and Al Mansoory, 1990).

2.2.7. Umm Al Quwain

In Umm Al Quwain most of the products are distributed by the research centres (like animals, food, fertilizing materials, growing small fish for research and for human consumption, cement and cement products, fertilizers and dairy) (Ministry of Finance and Industry, 1993 and Al Mansoory, 1990)

2.3. Industrial Environmental Hazards

2.3.1 Definition

The word hazard, derived from the Arabic for gaming die, implies the potential to cause harm (Seaten et al., 1994). Hazard is usually associated with the chance of injury, damage and/or loss. However, this definition has no quantifiable boundaries; i.e. how large, or small the hazard (Starr, 1986). Hazard assessment is a way of judging the degree of damage that an area may experience as a result of an earthquake, volcanic accident, object falling down and other possible act (Cothern et al., 1988). Also, hazard assessment is called "Formalized common sense". A potential hazard to human health may come to light in a number of ways - a comment of worker who notices a pungent, offensive odour; the opportune detection of chemical in the environment air, water; the presence of certain ingredients in foods that are required in the processing procedure or as preservatives, etc.; concerns raised over detectable contaminants (industrial chemical, pesticide or a natural component in food source) (Robert et al., 1987). Vanryzni and Raj (1980) mentioned that hazard assessment is defined as the estimation of level of exposure to a dangerous substance which leads to specific increase in lifetime incidence rates.

Environmental hazards can be grouped for convenience as safety and health hazards; moreover, health hazards can be further subdivided into biological, physical, chemical and biomechanical dangers (Sokas, 1993).

2.3.2 Types of Industrial Hazards

The hazards found in the work place can be divided into many types; however the most important of these types are: physical, chemical, mechanical, electrical and biological hazards.

2.3.2.1. Physical Hazards

The physical hazards encountered in the work place are as follows: noise, vibration, ionizing radiation, non-ionizing radiation, heat, etc.

2.3.2.1.1. Noise

Noise has been defined as the unwanted sound; it interferes with sound of communication. It may mask warning signals, and thereby increases at the same time the incidence of errors which may make occurrence of accidents more likely. Long

continued exposure to excessive noise can cause temporary or permanent loss of hearing, nervousness or fatigue, separately or in combination (Feldman, 1986)

2.3.2.1.2. Vibration

Vibration may affect many body parts and organs, this is depending on the vibration characteristics of human body. Meanwhile, the whole body resonance occur at 5Hz and this is mostly accounting for the resonance characteristics of the trunk and upper torso, also vibration causing back pain, swelling and increased vascular tone in the hands, as well as a tenosynovitis (Donald and Wasserman, 1993)

2.3.2.1.3 Ionizing Radiation

Radiation is energy which is transmitted, emitted or absorbed in the form of particles or waves. The effect of such radiation on living tissue is variable but the ability of this energy to ionize the target tissue distinguishes the two main sections of the electromagnetic spectrum The main effects of ionizing radiation occur on central nervous system, gastrointestinal tract, eye as cataract, skin as dermatitis, cancer and genetic damages. Occupational exposures are usually at low levels but are more prolonged. Thus, it is the neoplastic risk which is uppermost in most people's minds; e.g. the bone marrow, gonads and gastro-intestinal mucosa are at special risk (Wophoon, 1993)

2.3.2.1.4 Non-Ionizing Radiation

The two most important sources are laser and micro-waves. Microwave exposure limits vary in different countries. Laser and micro wave produce hazards on the skin, eye and different parts of the body if precautions and protection measures are not taken (WHO, 1986).

2.3.2.1.5 Heat

The body temperature is maintained within close limits by an efficient homeostatic mechanism, though diurnal variation is observed over a range of 0.5 - 1°C. Heat tends to pass from place of high temperature, to place of low temperature through three channels: conduction, convention and radiation, in this case called sensible heat. Heat affects the human body and the health. The severity of health effects of heat increases with the temperature, humidity and duration of exposure. In order of increasing seriousness, these effects are: lassitude, irritability, discomfort, lower work performance and lack of concentration, heat rash, heat cramps, heat exhaustion and heat stroke (Khogli and Karim, 1987).

2.3.2.2. Chemical Hazards

No clear cut demarcation exists between poisonous and non-poisonous substances. Many substances can harm to the body in a particular set of circumstances if present in sufficient amounts. However, substances generally regarded as poisonous are those which can harm the body, even if present relatively in small amounts or low concentrations (Wophoon, 1993).

The major routes of contact by which chemical agents gain access to the body are the lungs, the skin, the gastro-intestinal tract and parental administration. Industrial exposure to chemical agents occurs most frequently by inhalation, intradermal and oral. The effect of toxic substance on body may be either local on the skin or eye or respiratory tract and/or systemic toxicity. It is possible, therefore for toxic material to produce local effect at the point of contact as well as distant effects during its peregrinations through the body. The most common target organs are the skin, lungs, liver, nervous system, bone marrow and the kidney (Willam and Burson, 1988).

2.3.2.3. Mechanical Hazards

Mechanical hazards are the most important factor in occupational hazard which takes place in most of the industries and work place. These are due to wrong position and movement of workers and wrong design of the subjects or machines.
hazards may lead to fatigue, back pain, ketosis and many injuries and disabilities such as loss of extremities, blindness, etc.

The basic fact is that unsafe acts of workers are a factor in the majority of accidents due to mechanical hazards.
used must be of safe design and construction suited to their purpose, thoroughly guarded, properly maintained and that personnel selected to operate them should be properly qualified and adequately supervised.
equipment are over-loading, poor arrangement of materials , operating at excessive speed, lack of adequate space for operation, lack of skills and improper attitudes on the part of the operator. General methods of moving materials commonly used in industrial establishments, both large or small are handlift trucks, dragging or sliding on skids or rollers, wheel barrows, hand trucks, power trucks, overhead traveling cranes, mechanical shovels, elevators and escalators. Hand-tools are one of the major causes of mechanical hazards, and its injury are relatively numerous in all branches of industries. Since these hazards result from the use of tools that are defective or unsuited to the wanted purpose, or from unsafe methods of use, corrective measures can be carried out within the department. Too often there is failure to appreciate the importance of keeping hand-tools in good condition and avoiding the use of wrong tools for the practices and wrong habits relating to small tools within his department. Hand-tools are not ordinarily thought of as dangerous agencies likely to produce injuries.
Actually the use of hand tools in the manufacturing industries as a whole and many individual industries is a major source of injuries (Blake, 1993 and Cazamian, 1988)

2.3.2.4. Electrical Hazards

The subject of low voltage electrical hazards is extremely broad. A large number of factors closely to safety are involved in transmission and utilization of electricity such as designing, installation, protective devices, inspection, maintenance and training. Electrical hazards may be due to overloading, poor arrangement, unnecessary exposure to danger, unsafe or improper use of equipment, non-use of personal protective equipment, and/or wrong manipulation while moving the dangerous equipment. Electrical shocks due to use of electrical equipment occur without warning and are usually serious. The average individual thinks of hazards of electrical shocks in terms

of high voltage and does not always realise that it is primarily the current that kills and not the voltage (Blake, 1993 and WHO, 1986).

2.3.2.5. Biological Hazards

Biological hazards which includes bacteria, virus and fungi with the recent development of genetic engineering and resources recovery of municipal solid waste and indoor air pollutants. More attention is being paid to this area of occupational health. The use of biological agents in research laboratories and hospitals has led to the development of indicator organism, which can provide a measure of exposure to certain organism. Much more work has to be completed in this area to give physicians and industrial hygienists an understanding of the significance of exposure measurements (Sams, 1987).

2.4. Occupational Accidents

2.4.1. Definition

An accident may be defined as unexpected, unplanned occurrence which may involve injury. There is a possibility of accident in every sphere of human life at home, whilst traveling, at play and at work (ILO, 1990 and WHO, 1982). The victims of an accident may not be directly involved in the activity which gives rise to it, they may be near-by workers, by-standers or those living in the vicinity (WHO, 1982).

2.4.2. Classification of Accidents

The Tenth International Conference of Labour Statisticians (ILO, 1962) adopted four international model classifications of industrial accidents. The main classifications are :

2.4.2.1. Classification According to Type of Accident

- It includes : Falls of persons, struck by falling objects, over-exertion or strenuous movements, exposure to or contact with extreme temperatures, exposure to or contact with harmful substances or radiations, exposure to or contact with electric current and other types of accidents.

2.4.2.2. Classification According to Agency

2.4.2.2.1. Machines

- It includes: prime movers, transmission machinery, working machines, wood and assimilated machines, agricultural machines, mining machinery and other machines. Metal items, boxes or working surface cause 58.8% of this type of accidents (Tsai et al , 1989)

2.4.2.2.2. Transport and Lifting Equipment

It includes: lifting machines, rail transport, other wheeled transport, air transport, water transport and other areas of transport.

2.4.2.2.3. Other Equipment

It includes: pressure vessels, furnaces, ovens, kilns, refrigerating plants, electrical installations, electrical hand tools, ladders, and scaffolding and other equipment not elsewhere classified.

2.4.2.2.4. Material Substances and Radiations

It includes: explosives, dust, gases, liquids and chemicals, flying fragments, radiations and other materials and substances.

2.4.2.2.5. Working Environment

It includes: outdoor, indoor and underground environment.

2.4.2.2.6. Other Agencies not Elsewhere Classified.

2.4.2.3. Classification According to the Nature of Injury :

It includes: fractures, dislocations, sprains, strains, concussions, internal injuries, amputations, enucleations, superficial injuries such as contusions and abrasions, wounds (cut, lacerated and contused), crushes, burns (viz: external chemical burning, friction burns due to exposure to a flame or hot object, etc.), acute poisoning, exposure to extreme temperature, effect of weather, asphyxia, effect of electric currents, effect of radiation, multiple injuries of different natures and other injuries.

Brewer et al. (1990) reported that the majority of occupational injury claims were related to superficial wounds and contusions (10.8%) and the majority of costs were attributed to sprains; while Tsai et al. (1989) reported that minor trauma or cuts or lacerations, sprains or strains, or contusions are represented by 78.4% of cases.

2.4.2.4. Classification According to the Body Location of the Injury

It includes: head, neck, trunk, upper limb, lower limb, multiple location, general injuries and unspecified location of the injury.

2.4.3. Causation of Accidents

Accidents are multicausal with many interactions between causal factors, confounding factors and therefore effect-modifying factors must be analysed carefully.

Any accident is a process of parallel and consecutive events leading to a harmful consequence. The time sequence of this process can be divided into four parts:

(i) The normal phase: the work process function as planned and it is under control.

(ii) The proceeding phase: control is lost during this phase.

(iii) The contact phase: begins affecting man

(iv) The injury phase: where injury or other harm occurs. This phase includes the lessening of intensification of harm. In an accident situation, injury is always inflicted by energy: physical or chemical. The injury comes about when the energy exceeds man's tolerance limit (Sarri, 1979).

A number of theories have been elaborated to account for accidents at work (Waldron, 1985)

1. The most influential of which has been that of accident proneness. This theory states that some people are more liable to have accidents than others because of some inverat physical or psychological characteristics.

2. Another theory stated that all the members of a population are at equal risk and the occurrence of accidents was due to pure chance.

3. Another accepted theory is that the first accident was due to chance, but that having sustained one accident, the probability of having a second increased or decreased.

Also, WHO (1982) explained accidents by the following theories:

(i) Human factor: emphasizes the prominent role of human errors in accident causation. General behavioral models view human errors as being caused by the man's limitations in the areas of perception, decision making and action, resulting in incompatibility with work requirements.

(ii) Danger factor models: explain that the accidents depend on dangers inherent in the work environment. So, accidents can be prevented by the removal of danger (risk) or by removal of man from the proximity of danger.

(iii) Casual sequence theories: indicate that an accident is the result of a chain of events, if this chain is broken, the accident can be prevented.

(iv) System theories: aim at the enlargement and combination of the above models with respect to one or a few parts of the system i.e. an accident is a disturbance or malfunction of the system.

2.4.4. Accident Proneness

The frequency with which occupational accidents occur is not the same for every worker. Some of them suffer from injuries relatively frequently (they are sometimes called "accident repeaters") and others only rarely. This has led to the coining of the

term "accident proneness". So, under conditions of equal risk, there exists a statistically significant difference in the number of accidents that occur to those persons falling in the accident prone group as compared with the rest (ILO, 1990). It should be noted that the worker who has sustained several accidents does not necessarily mean that he is accident prone, these accidents may be due to the fact that he has been assigned to a particularly dangerous machine or process in respect of which adequate safety measures have not been taken. Any other worker who be assigned to work under these conditions would also be subjected to a number of accidents (Cazamian, 1988). It has further been shown that some accident repeaters are persons who have been involved in two or more accidents without any demonstrated responsibility on their part (ILO, 1990).

The only valid individual factors which can be accepted without certitude are those which are not constitutional but acquired; these include:

(i) Age: adults have fewer accidents than the young and somewhat less frequently than the older workers. The high accident rate in the young seems to be due to their lack of experience in the job. Although after a year or two the length of service is not related to the accident rate, whereas age is indicating that other factors are also at work (Waldron, 1985).

(ii) Training and experience: which reduce the number of accidents (Waldron, 1985).

(iii) Illness: there is statistical correlation between the individual frequency of illness and that of accidents. There is no doubt that the presence of certain symptoms such as hypertension or a diseased condition such as alcoholism contribute to accidents (Cazamian, 1988). But ill health is a much less common precipitant of accident than is generally supposed. This is due to the defect in job-specific, that is to say, only jobs, where good health is essential, will show relationship between the accident rate and ill health (Waldron, 1985).

2.4.5. Accident Notification and Registration

2.4.5.1. Accident Notification

There are three categories of accidents arising out of, or in connection with, work which require notification. Those are resulting in :

(a) The death of any person, employee or public.

(b) One of the following injuries or conditions to any person.

1. Fracture of the skull, spine or pelvis.

2. Fracture of any bone: (a) in the arm or wrist; (b) in the leg or ankle.

3. Amputation: (a) hand or foot; (b) finger, thumb or toe.

4. The loss of sight of eye.

5. Burn injury.

6. Loss of consciousness due to lack of oxygen.

7. Decompression thickness.

8. Acute illness required medical treatment.

9. Any other injury which is admitted in the hospital for more than 24 hours.

(c) Any Employee, self employed person, or person being trained for employment being incapacitated from normal work for more than 3 consecutive days excluding the day of accident but including any days which would not have been working days (Bassat, 1993).

MacCallum (1978) reported that occupational accidents and cases of occupational diseases must be notified under specified conditions to the following:

i. To the management of the undertaking accidents and diseases.

ii. To the national or local authorities concerned with compensation and prevention, respectively. Notification to the management is intended to alert the medical department, the safety department or the personnel department, as the case may be, with the object if necessary of conducting a thorough accident investigation or a study of circumstances producing the disease, in order to prevent recurrence of similar accidents or cases of disease.

Notification to the competent occupational safety and health authority has also the object of deciding whether there has been any breach of statutory requirements. Also notification to the insurance company is obviously required in all cases where the victim of the undertaking is entitled to compensation for the injury or the damage sustained. Finally, notification is essential if adequate statistics are to be completed at the level of undertaking, the branch of economic activity of the country (Health and Safety Executive Publication, 1980).

2.4.5.2. Accident Registration

Registered accidents are criteria that can be used for many purposes. They are obtainable as a result of daily routine. Information on the number of cases is more reliable than information on the description of events. Also, the recorded accidents are real cases that, without any assumption, have led to harmful and unwanted consequences (Baker, 1975). For some studies, registered accidents are an inadequate measures because such reported accidents is related to injuries rather than the safety in a more general sense (Cooke and Blumen, 1979).

Registered accidents also have drawbacks as criteria. The extent of harm (usually measured as the duration of absence from work) is more or less a subjective decision made by the examining physician, the injured worker and his dependents.

Their decisions are affected by

- prevailing opinions concerning the acceptability of accidents and the length of absence.
- the hindrance caused by the injury on the job and the possibilities of temporary replacement
- the compensation schemes applied in each case (Smith and O'Day, 1982)

2.4.5.3 Misreporting and Lack of Reporting Accidents

There are drawbacks that sometimes cause the information to be completely invalid (Wilson, 1980). According to Powell et al. (1971), only 5-7% of all accidents are reported at some workplaces. Some investigators feel that registered accident measures the tendency of reporting rather than the degree of safety of the system being studied (Hale and Hale, 1972).

The following are some of the reasons for misreporting and lack of reporting: (i) feeling of guilt and sense of responsibility; (ii) medical services are not available; (iii) negative attitudes and prevailing opinions towards medical personnel; (iv) inefficiency of the reporting system (voluntary reporting is probably less efficient than compulsory reporting); (v) an accident is a rapid and mentally shocking event, the recall of which may be distorted and partial or even rationalization of what really happened; and (iv) accidents that should be reported are poorly defined and described, thus the persons concerned do not realize the need for reporting (McFarland, 1969).

2.5. Magnitude of the Problem of Industrial Accidents in the United Arab Emirates

The United Arab Emirates has shown a rapid pace of industrial growth and development which has led to many occupational and environmental health hazards. Employees in working places may be exposed to different kinds of hazards such as mechanical, chemical, physical and electrical, and this may reflect on the increase risk of injury at workplace (Ministry of Health, 1994). In 1993, the number of industrial enterprises in Dubai and Northern Emirates have reached 955 comprising of 65,000 workers, where the major number of workers have been found in the spinning, textiles, garments and leather industry (16,000, 24.6%); metal products, machine and equipment industry (15,000, 23.1%) while the least number of workers was encountered in metal industries (2,000, 3.0%), wood, wood products and furniture (3,000, 4.6%) and paper, paper products, printing and publishing (3,000, 4.6%) and mining of non-mineral raw materials industry e.g. cement and cement products (9000, 13.8%), (Table 1) and (Figure 1). (Ministry of Finance and Industry, 1994). This variation in the industrial activities may reflect on the existing hazards in working environment which may cause injuries among workers exposed to either physical, mechanical, chemical, electrical and/or biological environmental factors (Ministry of Health, 1994; Belknap, 1975).

Table (1) - Distribution of Industrial Enterprises and Workers According to Industrial Activity in Dubai and Northern Emirates in the year 1993

Industrial Activity	Industrial Enterprises No.	(%)	Workers No.	(%)
Food Stuff, Beverage & Tobacco	102	(10.7)	7000	(10.8)
Spinning Textile, Garments and Leather	128	(13.4)	16000	(24.6)
Wood, Wood Products and Furniture	73	(7.6)	3000	(4.6)
Paper, Paper Products, Printing and Publishing	52	(5.4)	3000	(4.6)
Chemicals and Chemical Products	194	(20.3)	8000	(12.3)
Mining of Non-mineral Raw Materials except Petroleum	120	(12.6)	9000	(13.8)
Basic Metal Industries	12	(1.3)	2000	(3.1)
Metal Products and Machine	214	(22.4)	15000	(23.1)
Other Conversions	60	(6.3)	2000	(3.
Total	955	(100)	65000	(100)

* Source: Ministry of Finance and Industry (1993)

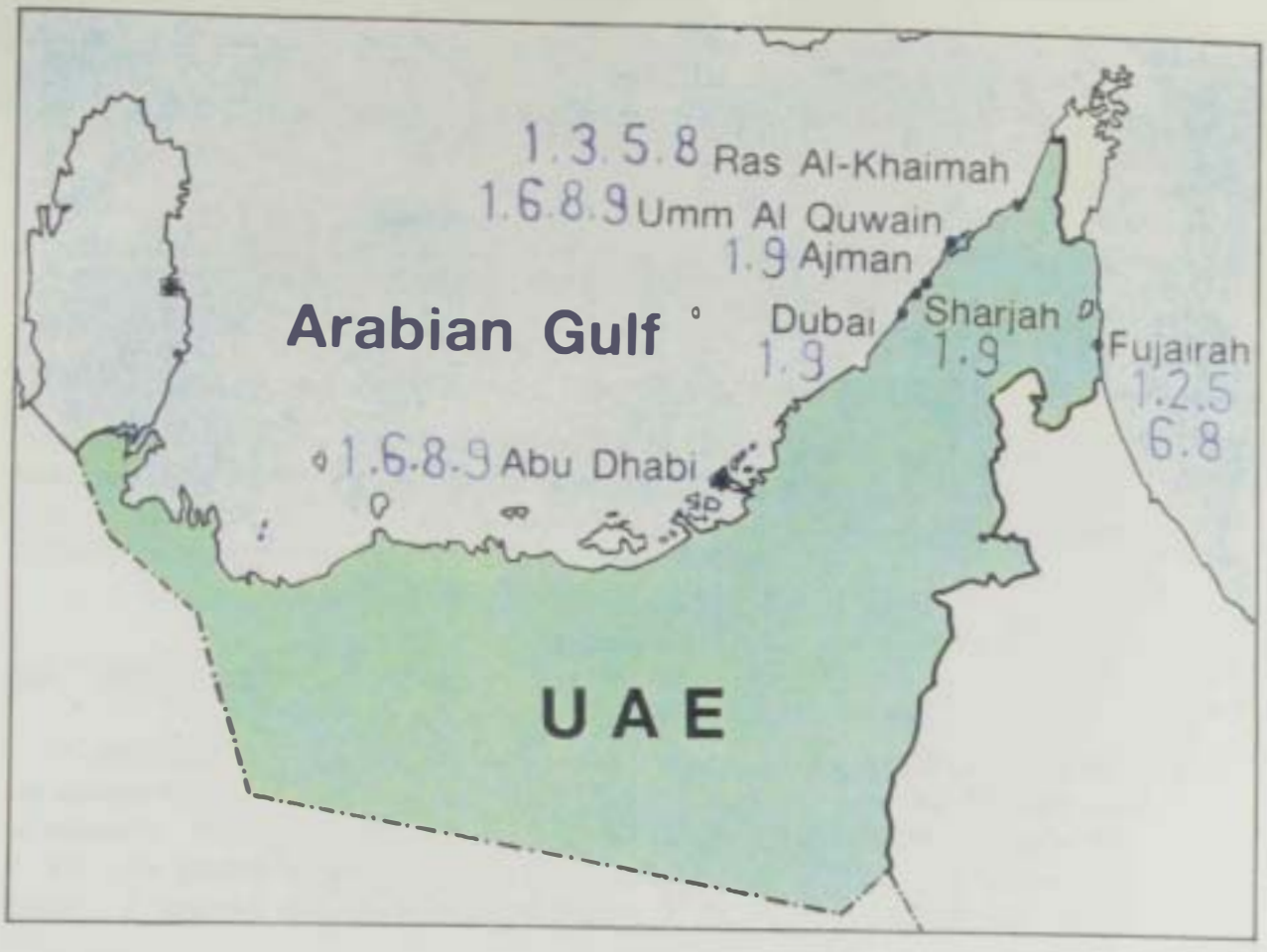

Figure (1) : Distribution Of Different types of Industries in U . A . E .

1 - Food stuff , Beverages , and Tobacco Industry .
2 - Spinning Textiles, Garments and Leather Industry .
3 - Wood and wood Products industry including Furniture .
4 - paper , paper products , Printing and publishing industry .
5 - Chemicals , Chemical Products , Petroleum , Coal , Rubber and Plastic Products Industry .
6 - Mining of non - Mineral Raw Materials Industry Except Petroleum and Coal Products .
7 - Basic Metal Industries .
8 - Metal Products , Machines and Equipments - Industry .
9 - Other Conversion Industries .

** Source : Ministry Of Finance and Industry (1994) .

CHAPTER III

MATERIAL AND METHODS

The present study was conducted retrospectively on the impact of environmental factors on the occurrence of industrial accidents among working population in the different types of industries located in Dubai and Northern Emirates during the period from first of January 1984 up to the end of December 1993.

3.1. Resources

A medline research was made to explore the impact of environmental factors on the occurrence of industrial accidents and their effects on injured workers in different types of industries. Since local references and studies on this subject were very limited in the U.A.E., the present study was mainly based on data collected from the Ministry of Finance & Industry and the Ministry of Labour & Social Affairs during the period 1984-1993.

3.2. Explorating Visits

Explorating visits were performed to representative industries (viz: cement and cement products, building and construction, chemicals, printing, engineering, etc.) in Dubai and Northern Emirates. The criteria of choosing the industry was based upon the record of incidence of industrial accidents. The aim was to be acquainted with the different industrial activities and to account for the presence of environmental hazards which could lead to the occurrence of industrial accidents. This would allow meaningful correlations for the environment in the factory and the incidence of accidents.

3.2.1. Industrial Environmental Survey

A walk-through survey was conducted in these representative industries. To inspect and identify the present environmental hazards, the control measures applied, the available personal protection equipment and occupational health services. (e.g. first-aid measures, pre-employment medical examination, periodic medical examination, injury records, services of industrial hygiene, etc.). Furthermore the evaluation of industrial safety included: planning, construction, ventilation, lighting, safe use of portable equipment, house keeping, fire prevention, safety of machinery and tools, safety of electric transmission and safety of material handling, air monitoring. Also, evaluation of environmental sanitation and industrial waste disposal took place.

3.3. Data collection

3.3.1. Records of Data

The data have been collected on the accidents which took place in different types of industries in Dubai and Northern Emirates during the period 1984-1993. The records of accidents of the industrial safety department of the Ministry of Labour and Social Affairs, in Dubai Emirate were used. (See Appendix 2).

3.3.2. Communications

Communications were made with the industrial safety department in the Ministry of Labour and Social Affairs. Several meetings with industrial safety inspectors were held to obtain more information about the accident occurrence, injured workers and the fate of injuries (viz., recovery, disability and death). Also, there were meetings with the physicians in the local hospitals to clarify the steps of the evaluation of cases of disabilities among injured workers; and the evaluation of disabilities was calculated according to the Federal Law No. 8 " Organizing Work Relations " for the year 1980 issued from the Ministry of Labour and Social Affairs.

3.4. Editing and Coding of Data

Data were collected in a precoded questionaire including relevant variables such as the environmental accidental factors, the injured worker and accident circumstances and then followed by coding. The sheet used to collect data in the present study was designed and divided into the three following sections (See Appendix 3).

3.4.1. Preliminary Data

Include the following :
- Name of enterprise :
- Emirate
- Total number of workers.
- Type of Industry
- Worker's age
- Duration of Employment
- Martial status
- Educational Status
- Nationality
- Salary per month.

3.4.2. Accident Data

Include the following

- Date of accident occurrence
- Time of accident occurrence
- Worker Act
- Accident circumstances
- Type of accident
- External cause of accident (Environmental factor)

3.4.3. Injury Data

Include the following.

- Site of injury
- Type of injury
- Site of first aid measures
- Type of first aid measures
- Fate of injury
- Disability
- Degree of disability
- Duration of sick leave
- Return to the previous job
- Man worked hours
- Accident frequency rate
- Accident severity rate

3.5. Accident Rates

Computation of accident frequency rate and accident severity rate during the period of study (1984-1993) was done according to the following formulae:

3.5.1. Accident Frequency Rate (A.F.R.)

It is an expression relating the number of specific accidents to the number of man-worked hours. The resolution adopted in 1962 by the tenth international conference of labour statisticians recommended that the frequency rate of industrial accident should be calculated by multiplying the number of accidents which occurred during the period covered by the statistics by 1,000,000 and then divided by the number of man-worked hours by all persons exposed to risk during the same period. It is expressed mathematically as (Brancoli, 1990) to give an indication of how often do injuries occur.

$$\text{Accident frequency rate} = \frac{\text{number of accidents}}{\text{number of man-worked hours}} \times 1{,}000{,}000$$

3.5.2 Accident Severity Rate (A.S.R.)

The objective of a severity rate is to give some indications of the loss in terms of incapacity resulting from industrial accidents. The severity rate should be calculated by dividing the number of working days lost multiplied by 1,000,000 by the number of man-worked hours for all persons covered. It answers the question how serious are the injuries. It is expressed mathematically as recommended by (IADC, 1985).

$$\text{Accident severity rate} = \frac{\text{number of working days lost}}{\text{number of man-worked hours}} \times 1{,}000{,}000$$

3.6. Statistical Analysis

For each accident a questionaire was filled and coded. Responses for variables such as the impact of environmental factors on the industrial injuries, location of accidents, factors substantiating the occurrence of accidents and first aid measures were coded. Data were fed into an IBM compatible personnel computer in the department of Planning and Statistics at the Faculty of Economics and Administration Sciences in United Arab Emirates University. The data were processed using EPI Info Version 5 programme to obtain tables and cross tabulations. Graphical analysis was performed using Minitab Version 10.

The Chi-square test is used to asses statistically significant association between two quantitative variables. P-Value for each test is reported and Fisher exact text is applied in cases were expected frequency was less than 5. The Chi-Square statistic measures the disparity between the observed frequencies obtained from the sample and the expected frequencies when no association exists between the two variables, then large Chi-square statistic suggests an association.

To overcome the lack of data on number of workers in several years, a regression line was estimated using the available data covering years 1988, 1991-1993. Fortunately the four data points gave an excellent linear fit (R^2 =99.9%) and it was assumed that the increase in the number of workers during the peirod 1984-1993 follow that same regression line (Table, 2 and Figure, 2)

Table (2) - Distribution of workers in the industrial enterprises in Dubai and Northern Emirates during the period 1984 - 1993

Year	No. of Workers
1984 x	16282
1985 x	21740
1986 x	27193
1987 x	32485
1988	38100
1989 x	43553
1990 x	49006
1991	54900
1992	60000
1993	65000

* Source: Ministry of Finance and Industry

x Expected number of workers

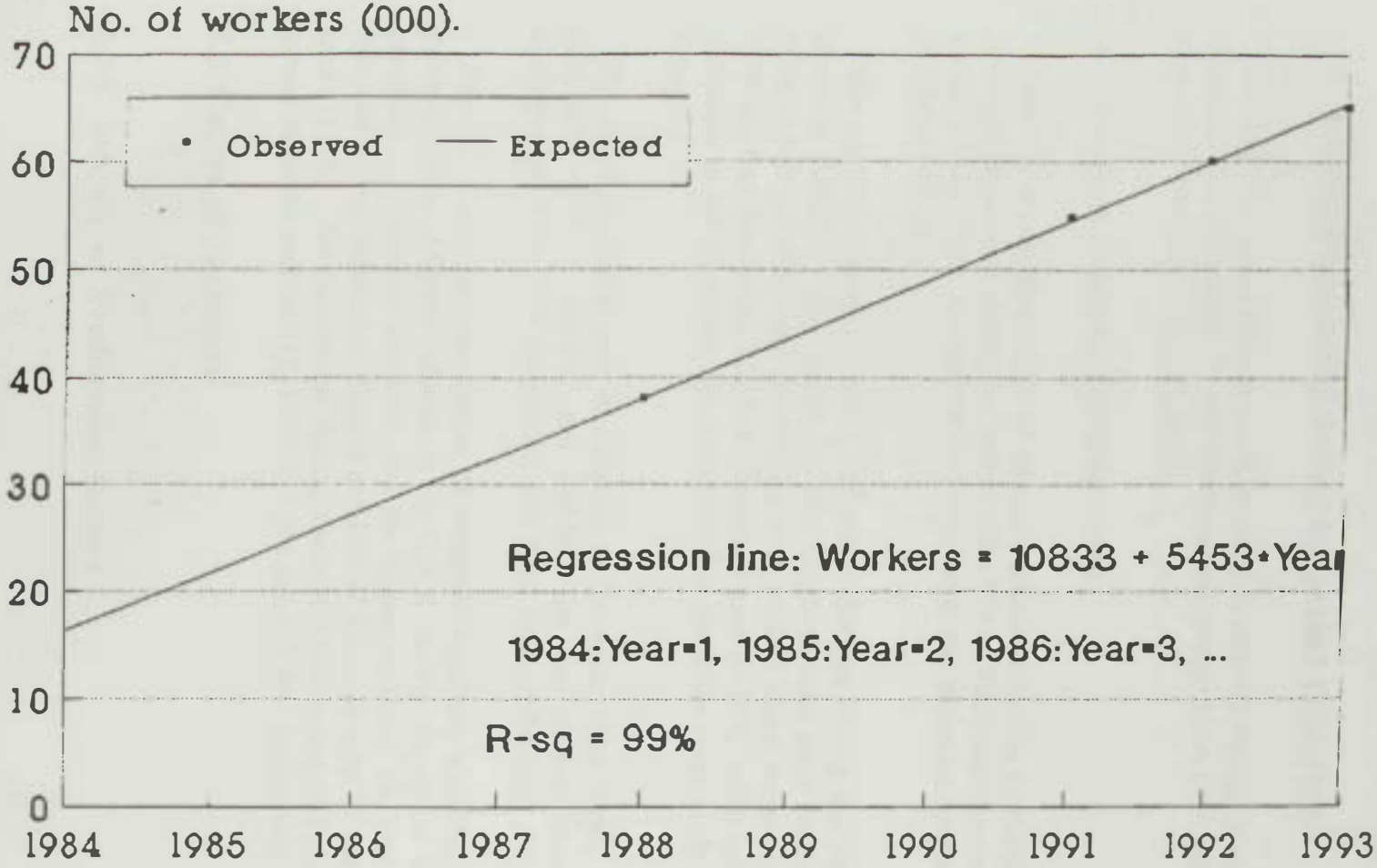

Figure (2) Number of workers during the period 1984-1993.

Chapter IV

RESULTS AND DATA PRESENTATION

4.1. Working population during the period 1984-1993

The four data points gave an excellent linear fit (R2=99.9% and it was assumed that the increase in the number of workers during the period 1984-1993 follow the same regression line (Table 2 and Figure 2).

4.2 Accident Frequency and Severity

Table (3) shows the number of injured workers according to the year of industrial accidents occurrence during the period 1984-1993. The maximum number of injured workers was in 1993 (21 injured workers); while the minimum number was in 1985 (9 injured workers).

The accident frequency rate in different industries during the period 1984-1993 shown in Table (4). The highest accident frequency rates were observed in 1984 and 1986 (0.384 and 0.306 per one million man worked hours, respectively). Contrary, 1991 showed the lowest accident frequency rate (0.114), while no or only a little difference in A.F.R. values was encountered in the other years of the study (Table 4, Figure 3)

The accident severity rate was highest in the years 1984, 1985, 1986 and 1989 (481.820, 346.596, 369.274 and 288.987 per one million man-worked hours, respectively) (Table 5) in comparison with other years of the study (Figure 3).

Table (6) shows the distribution of industrial accidents according to the type of industry among different Emirates in the U.A.E. during the period 1984-1993. The prevalence of industrial accidents was the highest in Dubai Emirate (110, 69.2%), followed by the Emirates of Sharjah and Ras Al Khaimah with 19 industrial accidents each (11.9%). The Emirates of Ajman, Umm Al Quwain and Al-Fujairah showed the lowest industrial accidents (2, 1.3%; 3, 1.9% and 6, 3.8%, respectively).

4.3 Causes of Accidents

4.3.1. Indirect or Predisposing Factors

Table (3) - Number of injured workers according to the year of industrial accidents occurrence during the period 1984 - 1993

Year	No. of Injuries
1984	15
1985	9
1986	20
1987	13
1988	12
1989	18
1990	16
1991	15
1992	20
1993	21
Total	159

Table (4) - Accident frequency rate in different types of industries during the period 1984 - 1993

Year	No. of Workers	Man-worked Hours*	No. of Injuries	Accident Frequency Rate
1984	16282	39076800	15	0.384
1985	21740	52176000	9	0.172
1986	27193	65263200	20	0.306
1987	32485	77964000	13	0.167
1988	38100	91440000	12	0.131
1989	43553	104527200	18	0.172
1990	49006	117614400	16	0.136
1991	54900	131760000	15	0.114
1992	60000	144000000	20	0.139
1993	65000	156000000	21	0.135

* Man-worked hours = number of workers x 8h x 300 days/year.

Table (5) - Accident severity rate in different types of industries during the period 1984 - 1993

Year	No. of Workers	Man-worked Hours*	Days Lost	Accident Severity Rate
1984	16282	39076800	18828	481.820
1985	21740	52176000	18084	346.596
1986	27193	65263200	24100	369.274
1987	32485	77964000	12050	154.559
1988	38100	91440000	14074	153.915
1989	43553	104527200	30207	288.987
1990	49006	11761440	375	31.884
1991	54900	131760000	6097	46.274
1992	60000	14400000	12166	84.486
1993	65000	156000000	18135	116.250

* Man-worked hours = number of workers x 8h x 300 days/year.

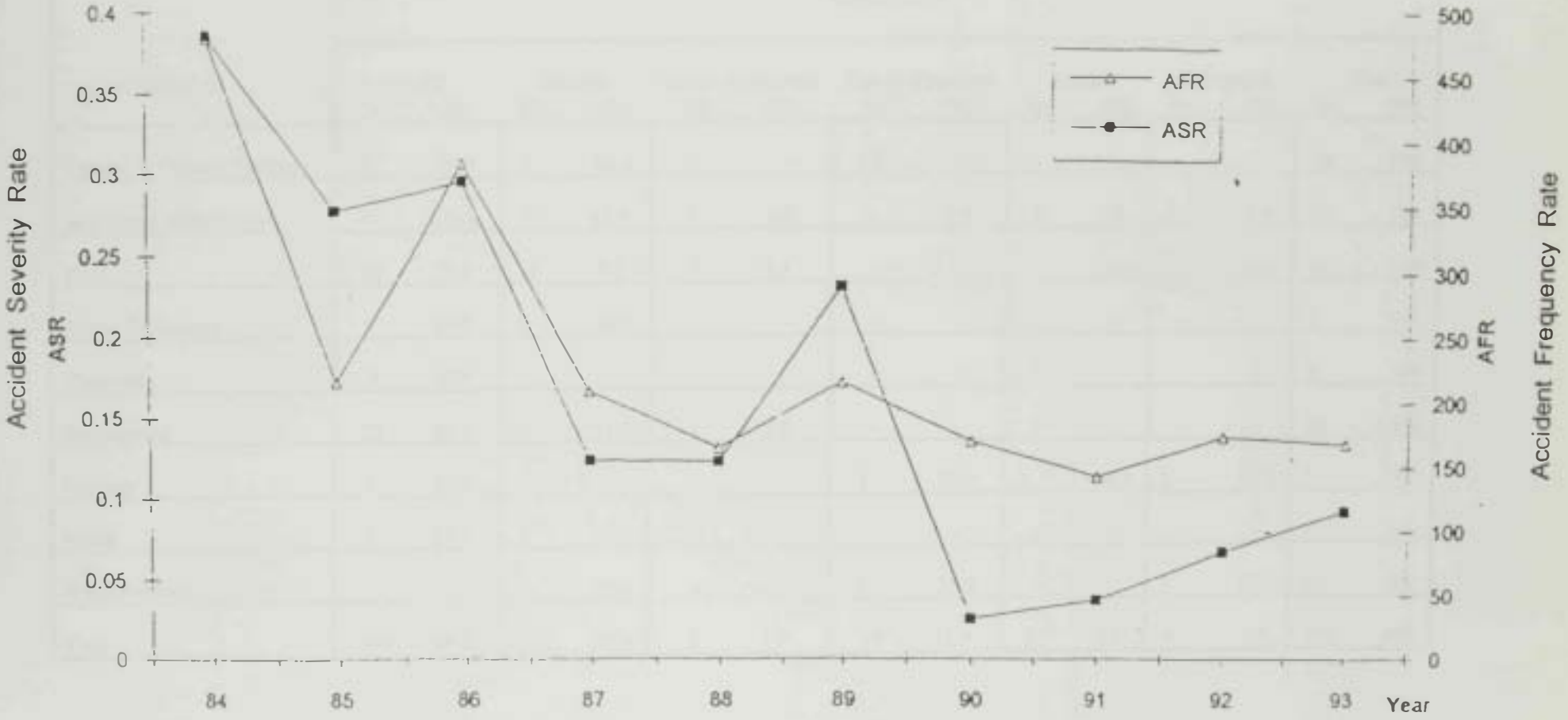

Figure (3) Relation between Accident Frequency rate and accident severity rate in different types of industries during the period 1984 - 1993 .

Table (6) - Distribution of industrial accidents according to type of industry among different emirates during the period 1984 - 1993.

Type of Industry	EMIRATE													
	Dubai		Sharjah		Umm Al Quwain		Ras Al Khaimah		Ajman		Al Fujairah		Total	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Cement & Cement Products	27	56.3	5	10.4	-	-	16	33.3	-	-	-	-	48	100
Building & Construction	43	79.6	7	13.0	1	1.9	1	1.9	1	1.9	1	1.9	54	100
Food	10	71.4	1	7.1	1	7.1	-	-	-	-	2	14.3	14	100
Plastic Processing	3	60.0	2	40.0	-	-	-	-	-	-	-	-	5	100
Chemicals	5	100	-	-	-	-	-	-	-	-	-	-	5	100
Engineering	15	83.3	2	11.1	1	5.6	-	-	-	-	-	-	18	100
Printing	1	20.0	-	-	-	-	1	20.0	1	20.0	2	40.0	5	100
Metal	6	85.7	1	14.3	-	-	-	-	-	-	-	-	7	100
Wood Products	-	-	1	33.3	-	-	1	33.3	-	-	1	33.3	3	100
Total	110	69.2	19	11.9	3	1.9	19	11.9	2	1.3	6	3.8	159	100

4.3.1.1. Personal Factors

4.3.1.1.1. Age

The mean age of injured workers in different types of industries ranged from 30.0 ± 3.16 years to 40.0 years, (Table 7). Generally, the highest mean ages were recorded among injured workers of wood products, cement and cement products and chemical industries (40, 0, 35.18±7.66 and 34.60±5.08 years, respectively), whereas the injured workers in the printing, food and plastic industries relatively showed the lowest mean ages (30.0±3.16, 32.93±12.54 and 33.0±5.20 years, respectively).

4.3.1.1.2. Duration of Employment

The highest mean duration of employment was among injured workers in cement and cement products, food and building and construction industries (5.06 ± 3.50, 4.62 ± 2.99 and 4.06 ± 2.23 years, respectively). While, the lowest mean duration of employment was among injured workers in plastic, metal and engineering industries (3.20 ± 1.10, 3.71 ± 1.98 and 3.89 ± 1.94 years, respectively), (Table 7).

4.3.1.1.3. Salary Per Month

The mean salary per month was highest among injured workers in the cement and cement products, metal and building and construction industries (1263,33 ± 614.4, 1257.14 ± 463.96 and 1247.10 ± 606.22 Dirhams, respectively), while injured workers of chemicals and printing industries showed the lowest mean salary per month (1087.0 ± 739.57 and 1155.0 ± 625.38 Dirhams, respectively), (Table 7).

4.3.1.1.4 Nationality

Indian workers (101, 63.5%) were the most frequently injured workers in the different types of industries during the period 1984-1993 in comparison to the Arabian injured workers (28, 17.6%), and Pakistani injured workers (19, 11.9%), (Table 7).

4.3.1.1.5 Marital Status

Most of the majority of injured workers in the different types of industries during the period 1984 - 1993 were married (130, 81.8%); while (25, 15.7%) were single and (4, 2.5%) were divorced, (Table 7).

4.3.1.1.6. Educational Level

The injured workers in different types of industries during the period 1984-1993 were illiterate (66, 41.5%) and read and write (60, 37.7%). Only 27 (16.9%) of the injured workers had primary and preparatory school level education, while 4 (2.5%) had a secondary school level and 2 (1.3%) had a University level (Table 7).

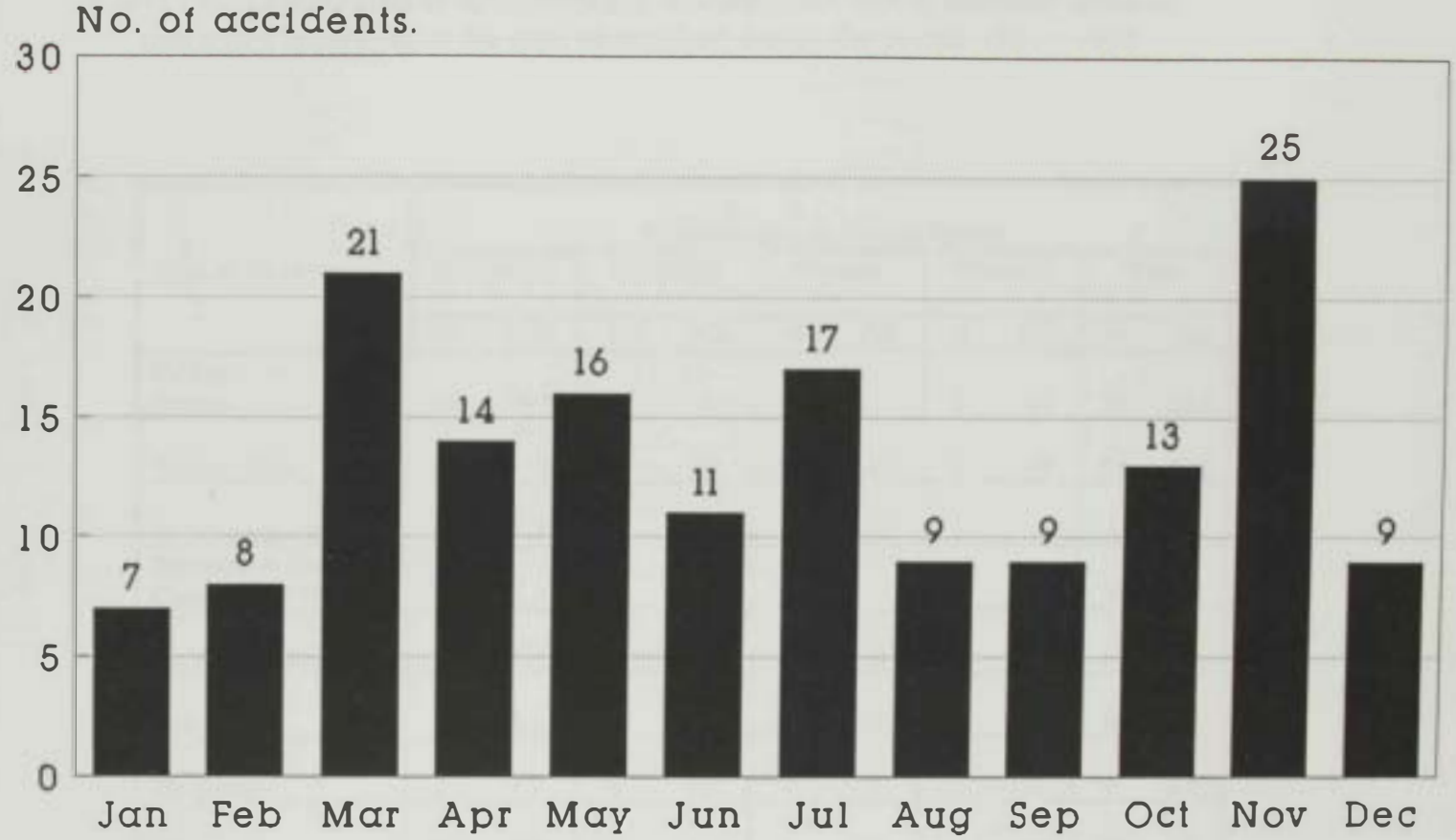

Figure (4) Distribution of accidents by month of occurence in different types of industries in the period 1984-1993.

Table (9) - Distribution of environmental accidental factors in different types of industries according to the type of accident during the period 1984 - 1993

Type of Accident	Environmental Accidental Factors									
	Mechanical		Chemical		Physical		Electrical		Total	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Falling or Flying Objects	35	26.9	1	5	-	-	2	40	38	23.9
Falls or Slips	82	63.1	6	30	1	25	2	40	91	57.2
Striking against	2	1.5	1	5	1	25	-	-	4	2.5
Exposure to Gases, Chemicals or Vapour	2	1.5	8	40	-	-	-	-	10	6.3
Pushing & Lifting	3	2.3	2	10	1	25	-	-	6	3.8
Fire	4	3.1	1	5	1	25	-	-	6	3.8
Electricity	2	1.5	1	25	-	-	1	20	4	2.5
Total	130	100	20	100	4	100	5	100	159	100

Table (10) - Distribution of accidents in different types of industries according to type of accident during the period 1984-1993

Types of Accident	Types of Industries									
	Cement & Cement Products	Building & Construction	Food	Plastic Processing	Chemicals	Engineering	Printing	Metal	Wood Products	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No (%)
Falling or Flying Objects	13 27.1	16 29.6	3 21.4	1 20.0	- -	4 22.2	- -	1 14.3	- -	38 23.9
Falls or Slips	25 52.1	31 57.4	10 71.4	2 40.0	- -	14 77.8	4 80.0	4 57.1	1 33.3	91 57.2
Striking against	2 4.2	- -	- -	2 40.0	- -	- -	- -	- -	- -	4 2.5
Exposure to Gases, Chemicals or Vapours	3 6.3	3 5.6	1 7.1	- -	1 20.0	- -	- -	1 14.3	1 33.3	10 6.3
Pushing & Lifting	2 4.2	3 5.6	- -	- -	- -	- -	1 20.0	- -	- -	6 3.8
Fire	1 2.1	- -	- -	- -	3 60.0	- -	- -	1 14.3	1 33.3	6 3.8
Electricity	2 4.2	1 1.9	- -	- -	1 20.0	- -	- -	- -	- -	4 2.5
Total	48 100	54 100	14 100	5 100	5 100	18 100	5 100	7 100	3 100	159 100

Table (11) - Distribution of environmental accidental factors in different types of industries according to accident circumstances during the period 1984-1993

Accident Circmstances	Environmental Accidental Factors									
	Mechanical		Chemicals		Physical		Electrical		Total	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Safe Circumstances	5	3.8	3	15.0	2	50.0	1	20.0	11	6.9
Unsafe Circumstances:										
Falling Equipment	52	40.0	8	40.0	1	25.0	-	-	61	38.4
Inadequate Design	44	33.8	7	35.0	-	-	1	20.0	52	32.7
Dirtiness	6	4.6	2	10.0	-	-	1	20.0	9	5.7
Poor Housekeeping	6	4.6	-	-	1	25.0	2	40.0	9	5.7
Dangerous Circumstances	10	7.8	-	-	-	-	-	-	10	6.3
Inadequate Light	7	5.4	-	-	-	-	-	-	7	4.4
Total	130	100	20	100	4	100	5	100	159	100

environmental accidental factors, the study revealed that falling equipment and inadequate design were the most frequent cause of unsafe circumstances due to either mechanical or chemical environmental factors (52, 40% and 44, 33.8%, respectively). Generally, the falling equipment and inadequate design were the most frequent causes of unsafe circumstances in the different types of industries investigated (Table 12).

Categories in Tables (11) and (12) were grouped to allow for testing association. The Chi-square test indicated a significant association (p=0.005) between environmental accidental factors (mechanical vs. non-mechanical) and accident circumstances (safe vs. unsafe). Similarly, an association between type of industry (cement and cement products, building and construction and others) and accident circumstances was significant (p=0.0273) which suggests that accident circumstances vary from one type of industry to another and vary as well as according to environmental accidental factors (see Figure 10).

4.3.2.3. Unsafe Worker's Act

Table (13) showed the distribution of environmental accidental factors in different types of industries according to act of worker during the period 1984-1993. The unwear of safety equipment (84, 52.8%) followed by wrong work method (24, 15.1%) represented the highest frequent unsafe worker's act causing accidents in comparison to other types of unsafe act, (see Figures, 6 and 11). At the meantime, 24 accidents (15.1%) took place inspite of safe worker's act. However, the wrong work method (21, 16.2%), unwear of safety equipment (80, 61.5%) and presence of unsafe area (15, 11.5%) represented the most frequent unsafe workers act in the presence of mechanical environmental. For chemical environmental factor (13, 65%) of the accidents occurred inspite of safe act of worker. Meanwhile, the commonest unsafe workers act in the studied types of industries during the period 1984-1993 was unwear of safety equipment and wrong work method (Table 14). When categories of Tables (13) and (14) were grouped, the Chi-square test indicated a significant association between act of worker and both environmental accidental factors ($p<0.0001$) and type of industry (p=0.01).

4.4 Description of Industrial Injuries

4.4.1. Site of Injury

The relation between environmental accidental factors in different types of industries and site of injury among injured workers during the 10 years (1984-1993) is shown in Table (15). The injured upper limb (84, 52.8%) and lower limb (29, 18.2%) represented the highest percent in comparison to other injury sites, such as head and neck (4, 2.5%), trunk (6, 3.8%), eyes (7, 4.4%) and multiple sites (5, 3.1%). However, death occurred in 24 injuries representing 15.1% from the total injuries. The injuries of upper limbs and lower limbs were the main sites of injuries caused by

Table (12) - Distribution of environmental accidents in different types of industries according to accident circumstances during the period 1984-1994

Accident Circumstances	Types of Industries									
	Cement & Cement Products	Building & Construction	Food	Plastic Processing	Chemicals	Engineering	Printing	Metal	Wood Products	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No (%)
Safe Circumstances	2 4.2	1 1.9	3 21.4	- -	1 20.0	3 16.7	- -	1 14.3	- -	11 6.9
Unsafe Circumstances:										
Falling Equipment	20 41.7	22 40.7	6 42.9	2 40.0	- -	5 27.8	3 60.0	2 28.6	1 33.3	61 38.4
Inadequate Design	16 33.3	20 37.0	1 7.1	2 40.0	3 60.0	5 27.8	2 40.0	1 14.3	2 66.6	52 32.7
Dirtiness	2 4.2	5 9.3	- -	1 20.0	- -	1 5.6	- -	- -	- -	9 5.7
Poor Housekeeping	1 2.1	3 5.6	2 14.3	- -	- -	2 11.1	- -	1 14.3	- -	9 5.7
Dangerous Circumstances	6 12.5	3 3.7	2 14.3	- -	- -	- -	- -	- -	- -	10 6.3
Inadequate Light	1 2.1	1 1.9	- -	- -	1 20.0	2 11.1	- -	2 28.6	- -	7 4.4
Total	48 100	54 100	14 100	5 100	4 100	18 100	5 100	7 100	3 100	159 100

Table (13) - Distribution of environmental accidental factors in different types of industries according to act of worker during the period 1984-1993

Act of Worker	Environmental Accidental Factors									
	Mechanical		Chemical		Physical		Electrical		Total	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Safe Act	10	7.7	13	65	-	-	1	20.0	24	15.1
Wrong Work Method	21	16.2	1	5.0	1	25.0	1	20.0	24	15.1
Unwear of Safety Equip.	80	61.5	1	5.0	1	25.0	2	40.0	84	52.8
Carelessness	3	2.3	2	10.0	-	-	-	-	5	3.1
Decrease of Data & Skill	-	-	2	10.0	-	-	-	-	2	1.3
Presence of Unsafe Area	15	11.5	-	-	1	25.0	1	20.0	17	10.7
Not Original Work	1	0.8	1	5.0	1	25.0	-	-	3	1.9
Total	130	100	20	100	4	100	5	100	159	100

Table (14) - Distribution of environmental accidents in different types of industries according to act of worker during the period 1984-1993

Act of Worker	Types of Industries									
	Cement & Cement Products	Building & Construction	Food	Plastic Processing	Chemicals	Engineering	Printing	Metal	Wood Products	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Safe Act	3 6.3	6 11.1	4 28.6	- -	2 40.0	3 16.7	1 20.0	3 42.9	2 66.6	24 15.1
Unsafe Act:										
Unwear of Safety Equipment	19 39.6	43 79.6	2 14.3	3 60.0	3 60.0	10 55.6	2 40.0	1 14.3	1 33.3	84 52.8
Carelessness	2 6.3	1 1.9	- -	1 20.0	- -	- -	- -	- -	- -	5 3.1
Decrease of Data & Skill	1 2.1	1 1.9	- -	- -	- -	- -	- -	- -	- -	2 1.3
Presence of Unsafe Area	- -	- -	8 57.1	- -	- -	4 22.2	2 40.0	3 42.9	- -	17 10.7
Not Original Work	1 2.1	2 3.7	- -	- -	- -	- -	- -	- -	- -	3 1.9
Total	48 100	54 100	14 100	5 100	5 100	18 100	5 100	7 100	3 100	159 100

Table (15) - Relation between environmental accidental factors in different types of industries and site of injury among injured workers during the period 1984 - 1993.

Environmental Accidental Factors	Site of Injury							
	Head & Neck No. (%)	Trunk No. (%)	Upper Limb No. (%)	Lower Limb No. (%)	Eyes No. (%)	Multiple Sites No. (%)	Death No. (%)	TOTAL No. (%)
Mechanical	3 2.3	4 3.1	72 55.4	25 19.2	7 5.4	2 1.5	17 13.1	130 100
Chemical	- -	2 10.0	7 35.0	3 15.0	- -	3 15	5 25.0	20 100
Physical	- -	- -	2 50.0	- -	- -	- -	2 50.0	4 100
Electrical	1 20.0	- -	3 60.0	1 20.0	- -	- -	- -	5 100
Total	4 2.5	6 3.8	84 52.8	29 18.2	7 4.4	5 3.1	24 15.1	159 100

environmental accidental factors, e g. mechanical (72, 55.4% and 25, 19.2%), chemical (7, 35% and 3, 15%), physical (2, 50% and 0, 0.0%), electrical (3, 60% and 1, 20%). Also mechanical factors caused death in 17 cases representing (13.1%), while chemical factors caused deaths in 5 cases representing (25%) and physical factors caused death in 2 cases representing (50%).

The upper and lower limbs injuries represented also the highest frequent sites of injuries among injured workers in different types of industries (viz: cement and cement products 19, 41.7% and 14, 29.1%; building & construction 21, 38.9% and 9, 16.7%; food 11, 78.6% and 3, 21.4%; plastic processing 3, 60% and 2, 40%; chemicals 4, 80% and 0.0%, engineering 12, 66.7% and 1, 5.6%; printing 5, 100% and 0.0%; metal 6, 85.7% and 0, 0.0%; and wood products 3, 100% and 0, 0.0%) in comparison to other body sites (Table 16).

The mechanical environmental factors caused 72 injuries in upper limb represented (85.7%) among the injured workers in different types of industries during the period 1984-1993 (Table 17), while the injuries caused by the chemical, physical and electrical environmental factors included 7, 8.3%; 2, 2.4% and 3, 3.6%, respectively. The study revealed that finger (33, 39.3%), hand (18, 21.4%) and wrist (19, 22.6%) injuries were the most frequent injury sites caused by the environmental factors in comparison to other injury sites such as elbow (4, 4.8%), forearm (3, 3.6%), arm (4, 4.8%) and shoulder (3, 3.6%).

Table (18) shows that finger, hand and wrist were the most frequent site of injury in comparison to other sites of injuries among injured workers in different types of industries during the period 1984-1993.

Injuries to the lower limb were 29 in which 25 (86.2%) of them were caused by the mechanical environmental factors especially among injured workers in cement and cement products (14, 48.3%) and building and construction (9, 31.0%) industries (Tables 19 and 20).

4.4.2. Type of injury

Wound (75, 47.2%), fracture (27, 17%) and bleeding (14, 8.8%) were the commonest types of injuries among injured workers during the period 1984-1993 (Table 21). Meanwhile, wound and fracture were the most frequent type of injury occurred due to either the different environmental factors or the different types of industries (Tables 21 and 22).

4.5. First Aid Measures

4.5.1. Type of First Aid

Types of first-aid offered among injured workers in different types of industries during the period 1984-1993 included the following: dressing (29, 18.2%), bandage (33, 20.8%), foreign body removal (1, 0.6%), sutures (2, 1.3%), splint (3, 1.9%),

Table (16) - Relation between different types of industries and site of injury among injured workers during the period 1984 - 1993.

Types of Industries	Site of Injury													
	Head & Neck		Trunk		Upper Limb		Lower Limb		Eyes		Multiple Sites		Death		TOTAL	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Cement & Cement Product	2	4.2	4	8.3	19	41.7	14	29.1	3	6.3	2	4.2	4	8.3	48	100
Building & Construction	1	1.9	1	1.9	21	38.9	9	16.7	4	7.4	3	5.6	15	27.8	54	100
Food	-	-	-	-	11	78.6	3	21.4	-	-	-	-	-	-	14	100
Plastic Processing	-	-	-	-	3	60.0	2	40.0	-	-	-	-	-	-	5	100
Chemicals	-	-	-	-	4	80.0	-	-	-	-	-	-	1	20.0	5	100
Engineering	1	5.6	1	5.6	12	66.7	1	5.6	-	-	-	-	3	16.7	18	100
Printing	-	-	-	-	5	100.0	-	-	-	-	-	-	-	-	5	100
Metal	-	-	-	-	6	85.7	-	-	-	-	-	-	1	14.3	7	100
Wood Products	-	-	-	-	3	100.0	-	-	-	-	-	-	-	-	3	100
Total	4	2.5	6	3.8	84	52.8	29	18.2	7	4.4	5	3.1	24	15.1	159	100

Table (17) - Relation between enviromental accidental factors in different types of industries and upper limb injuries among injured workes during the period 1984-1993.

Enviromental Accidental Factors	Upper Limb Injuries							
	Finger No. (%)	Hand No. (%)	Wrist No. (%)	Elbow No. (%)	Forearm No. (%)	Arm No. (%)	Shoulder No. (%)	TOTAL No. (%)
Mechanical	30 41.5	14 19.4	18 25.0	3 4.2	2 2.8	3 4.2	2 2.8	72 100
Chemical	3 42.9	2 28.6	1 14.3	- -	- -	1 4.3	- -	7 100
Physical	- -	1 50.0	- -	- -	1 50.0	- -	- -	2 100
Electrical	- -	1 33.3	- -	1 33.3	- -	- -	1 33.3	3 100
Total	33 39.3	18 21.4	19 22.6	4 4.8	3 8.6	4 4.8	3 3.6	84 100

Table (18) - Disturbution of upper limb injuries among injured workers in different types of industries during the period 1984-1993.

Types of Industries	Upper Limb Injuries													
	Finger		Hand		Wrist		Elbow		Forearm		Arm		Shoulder		TOTAL	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Cement & Cement Products	9	47.4	3	15.8	2	10.5	2	10.5	1	5.3	-	-	2	10.5	19	100
Building & Construction	12	35.3	6	17.6	14	41.2	1	2.9	-	-	1	2.9	-	-	34	100
Food	2	33.3	2	33.3	1	16.7	-	-	-	-	1	16.7	-	-	6	100
Plastic Processing	1	33.3	1	33.3	-	-	-	-	1	33.3	-	-	-	-	3	100
Chemicals	2	50.0	1	25.0	-	-	-	-	-	-	1	25.0	-	-	4	100
Engineering	2	25.0	3	37.5	1	12.5	-	-	1	12.5	-	-	1	12.5	8	100
Printing	2	50.0	1	25.0	-	-	-	-	-	-	1	25.0	-	-	4	100
Metal	3	75.0	-	-	1	25.0	-	-	-	-	-	-	-	-	4	100
Wood Products	-	-	1	50.0	-	-	1	50.0	-	-	-	-	-	-	2	100
Total	33	39.3	18	21.4	19	22.6	4	4.8	3	3.6	4	4.8	3	3.6	84	100

Table (19)- Relation between enviromental accidental factors in different types of industries and lower limb injuries among injured workers during the period 1984-1993

Enviromental Accidental Factors	Lower limb Injuries							
	Hip Joint No. (%)	Thigh No. (%)	Knee No. (%)	Leg No. (%)	Ankle No. (%)	Foot No. (%)	Toes No. (%)	TOTAL
Mechanical	3 12.6	2 8.0	3 12.0	6 24.0	4 16.0	3 12.0	4 16.0	25 100
Chemical	- -	- -	- -	1 33.3	- -	1 33.3	1 33.3	3 100
Physical	- -	- -	- -	- -	- -	- -	- -	- -
Electrical	- -	- -	- -	- -	- -	1 100.0	- -	1 100
Total	3 10.3	2 6.9	3 10.3	7 24.1	4 13.8	5 17.2	5 17.2	29 100

Table (20) - Disturbution of lower limb injuries among injured workers in different types of industries during the period 1984-1993

Types of Industries	Lower Limb Injuries							
	Hip joint No. (%)	Thigh No. (%)	Knee No. (%)	Leg No. (%)	Ankle No. (%)	Foot No. (%)	Toes No. (%)	Total No. (%)
Cement & Cement Products	- -	1 7.1	2 14.3	4 28.6	2 14.3	3 21.4	2 14.3	14 100
Building & Construction	1 11.1	- -	1 11.1	3 33.3	1 11.1	1 11.1	2 22.2	9 100
Food	- -	1 33.3	1 33.3	1 33.3	- -	- -	- -	3 100
Plastic Processing	- -	- -	- -	1 50.0	- -	1 50.0	- -	2 100
Chemicals	- -	- -	- -	- -	- -	- -	- -	- -
Engineering	- -	- -	- -	1 100	- -	- -	- -	1 100
Printing	- -	- -	- -	- -	- -	- -	- -	- -
Metal	- -	- -	- -	- -	- -	- -	- -	- -
Wood Products	- -	- -	- -	- -	- -	- -	- -	- -
Total	1 3.4	2 6.9	4 13.8	10 34.5	3 10.3	5 17.2	4 13.8	29 100

Table (21) - Relation between enviromental accidental factors in different types of industries and type of injury among injured workers during the period 1984-1993

Enviromental Accidental Factors	Type of Injury												
	Wound N (%)	Fracture N (%)	Dislocation N (%)	Sprain N (%)	Burn N (%)	Contusion N (%)	Foreign Body N (%)	Bleeding N (%)	Poisoning N (%)	Asphyxia N (%)	Cardiac Arrest N (%)	Shock N (%)	Total N (%)
Mechanical	65 50.0	22 16.9	3 2.3	4 3.1	2 1.5	5 3.8	- -	13 10.0	- -	2 1.5	14 10.8	- -	130 100
Chemical	6 30.00	3 15.00	1 5.0	1 5.0	6 30.0	- -	1 5.0	- -	2 10.0	- -	- -	- -	20 100
Physical	2 50.0	1 25.0	1 25.0	- -	- -	- -	- -	- -	- -	- -	- -	- -	4 100
Electrical	2 40.0	1 20.0	- -	- -	- -	- -	- -	1 20.0	- -	- -	- -	1 20.0	5 100
Total	75 47.2	27 17.0	5 3.1	5 3.1	8 5.0	5 3.1	1 0.6	14 8.8	2 1.3	2 1.3	14 8.8	1 0.6	159 100

Table (22) - Relation between different types of industries and type of injury among injured workers during the period 1984-1993

Types of Industries	Type of Injury												
	Wound No (%)	Fracture No (%)	Dislocation No (%)	Sprain No (%)	Burn No (%)	Contusion No (%)	Foreign Body No (%)	Bleeding No (%)	Poisoning No (%)	Asphyxia No (%)	Cardiac Arrest No (%)	Shock No (%)	Total No (%)
Cement & Cement Products	25 52.0	11 22.9	1 2.1	1 2.1	2 4.2	1 2.1	1 2.1	2 4.2	- -	1 2.1	3 6.3	- -	48 100
Building & Construction	30 55.6	11 20.4	2 3.7	2 3.7	2 3.7	2 3.7	- -	1 1.9	- -	- -	4 7.4	- -	54 100
Food	6 42.9	- -	- -	- -	1 7.1	- -	- -	2 14.3	- -	1 7.1	4 28.6	- -	14 100
Plastic Processing	2 40.0	- -	1 20.00	- -	- -	- -	- -	1 20.0	- -	- -	1 20.0	- -	5 100
Chemicals	1 20.0	- -	- -	- -	3 60.0	- -	- -	- -	1 20.0	- -	- -	- -	5 100
Engineering	8 44.4	4 22.2	- -	1 5.6	- -	1 5.6	- -	3 16.7	- -	- -	- -	1 5.6	18 100
Printing	1 20.0	- -	- -	- -	- -	- -	- -	2 40.2	1 20.0	- -	1 20.0	- -	5 100
Metal	1 14.3	1 14.3	1 14.3	1 14.3	- -	- -	- -	2 28.6	- -	- -	1 14.3	- -	7 100
Wood Products	1 33.3	- -	- -	- -	- -	1 33.3	- -	1 33.3	- -	- -	- -	- -	3 100
Total	75 47.2	27 17.0	5 3.1	5 3.1	8 5.0	5 3.1	1 0.6	14 8.8	2 1.3	2 1.3	14 8.8	1 0.6	159 100

medication (1, 0.6%), eye wash (1, 0.6%), oxygen supply (1, 0.6%) and unknown (88, 55.3%) (Tables 23 and 24).

However, there is a trend of increase in cases received first-aid treatment (especially dressing and bandage) among injured workers as a result of mechanical environmental factors (26, 20% and 18, 13.8%) in comparison to chemical (1, 5% and 12, 60%), physical (1, 25% and 1, 25%), and electrical (1, 20% and 2, 40%). Dressing and bandage were the most frequent first aid treatment offered among injured workers in different types of industries (viz. cement and cement products 7, 14.6% and 15, 31.3%, and building & construction 11, 20.4% and 4, 7.4%, food 4, 28.6% and 4, 28.6%, plastic processing 1, 20% and 2, 40%, engineering 4, 22.2% and 5, 27.8%, printing 1, 20% and 1, 20%, metal 1, 14.3% and 2, 28.6%). However, the first aid offered among injured workers in the chemicals and wood products industries were not known.

4.6. Fate of Injury

The injury may end by complete recovery, death or disability.

4.6.1. Recovery and Death

Table 25 shows that 101 (63.5%) of the injured workers in different industries were completely recovered, 34 (21.4%) became disabled, and 24 cases (15.1%) died after accident occurrence. The mechanical environmental factors caused disability in 23 cases (17, 7%) and death in 18 cases (13, 8%); while the frequency of disability and death in the chemical, physical and electrical environmental factors was (5, 25% and 4, 20%; 4, 100% and 0, 0% and 2, 40% and 2, 40%, respectively). The Chi-square test indicated that the fate of injuries differ significantly according to environmental accidental factors (Chi-square statistic = 8.02, d.f. = 2 and p-value = 0.0182).

The frequency of complete recovery was very high among injured workers in different types of industries. However, the disability and deaths were frequent among injured workers of some types of industries such as cement & cement products (12, 25% and 4, 8.3%), building and construction (10, 18.5% and 15, 27.8%), engineering (1, 5.6% and 3, 16.7%) and metal (2, 28.6% and 1, 14.3%) (Table 26). The fate of injuries turned out to differ significantly by type of industry (cement and cement products, building and construction and others). The Chi-square statistic was 10.513, d.f. = 4 and p-value = 0.03.

4.6.2. Disability

4.6.2.1. Site of Disability

The disability was common in the upper limb injuries (15, 44.1%) and lower limb injuries (10, 29.4%), while 3 cases of injured workers suffered from eye disability (8%) and 6 cases suffered from disability of multiple sites (17.6%). The mechanical

Table (23) - Relation between enviromental accidental factors in different types of industries and type of first-aid offered among injured workers during the period 1984-1993

Enviromental Accidental Factors	Type of First-Aid									
	Dressing	Bandage	Foreign Body Removal	Sutures	Splint	Medication	Eye Wash	Oxygen Supply	Unknown	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Mechanical	26 20.0	18 13.8	1 0.8	1 0.8	2 1.6	- -	1 0.8	1 0.8	80 61.5	130 100
Chemical	1 5.0	12 60.0	- -	1 5.0	- -	1 5.0	- -	- -	5 25.0	20 100
Physical	1 25.0	1 25.0	- -	- -	1 25.0	- -	- -	- -	1 25 0	4 100
Electrical	1 20.0	2 40.0	- -	- -	- -	- -	- -	- -	2 40 0	5 100
Total	29 18.2	33 20.8	1 0.6	2 1.3	3 1.9	1 0.6	1 0.6	1 0.6	88 55.3	159 100

Table (24) - Relation between different types of industries and type of first-aid offered among injured workers during the period 1984-1993

Type of Industries	Type of First-Aid									
	Dressing	Bandage	Foreign Body Removal	Sutures	Splint	Medication	Eye Wash	Oxygen Supply	Unknown	Total
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No (%)	No (%)
Cement & Cement Products	7 14.6	15 31.3	- -	1 2.1	- -	- -	- -	- -	25 52.0	48 100
Building & Construction	11 20.4	4 7.4	1 1.9	1 1.9	1 1.9	1 1.9	1 1.9	1 1.9	33 61.1	54 100
Food	4 28.6	4 28.6	- -	- -	- -	- -	- -	- -	6 42.7	14 100
Plastic Processing	1 20.0	2 40.0	- -	- -	- -	- -	- -	- -	2 40.0	5 100
Chemicals	- -	- -	- -	- -	- -	- -	- -	- -	5 100.0	5 100
Engineering	4 22.2	5 27.8	- -	- -	1 5.6	- -	- -	- -	8 44.4	18 100
Printing	1 20.0	1 20.0	- -	- -	1 20.0	- -	- -	- -	2 40.0	5 100
Metal	1 14.3	2 28.6	- -	- -	- -	- -	- -	- -	4 57.1	7 100
Wood Products	- -	- -	- -	- -	- -	- -	- -	- -	3 100.0	3 100
Total	29 18.2	33 20.8	1 0.6	2 1.3	3 1.9	1 0.6	1 0.6	1 0.6	88 55.3	159 100

Table(25) - Fate of injury among injured workers according to environmental accidental factors during the period 1984 - 1993

Environmental Accidental Factors	Fate of Injury						Total	
	Complete Recovery		Disability		Death			
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Mechanical	89	68.5	23	17.7	18	13.8	130	100
Chemical	11	55.0	5	25.0	4	20.0	20	100
Physical	-	-	4	100.0	-	-	4	100
Electrical	1	20.0	2	40.0	2	40.2	5	100
Total	101	63.5	34	21.3	24	15.1	159	100

Table (26) - Fate of injury among injured workers in different types of industries during the period 1984 - 1993

Types of Industries	Fate of Injury						Total	
	Complete Recovery		Disability		Death			
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Cement & Cement Products	32	66.7	12	25.0	4	8.3	48	100
Building & Construction	29	53.7	10	18.5	15	27.8	54	100
Food	10	71.4	4	28.6	-	-	14	100
Plastic Processing	2	40.0	3	60.0	-	-	5	100
Chemicals	4	80.0	-	0.0	1	20.0	5	100
Engineering	14	77.8	1	5.6	3	16.7	18	100
Printing	3	60.0	2	40.0	-	-	5	100
Metal	4	57.1	2	28.6	1	14.3	7	100
Wood Products	3	100.0	-	-	-	-	3	100
Total	101	63.5	34	21.4	24	15.1	159	100

environmental factors were responsible for the 23 cases (67.6%) of disability among injured workers, especially upper limb injuries (11, 47.8%) and lower limb injuries (8, 34.8%), (Table 27). While the percentage of disability due to chemicals, physical and electrical environmental factors among injured workers were 5, 14.7%, 4, 11.8% and 2, 5.9% respectively. Injured workers in the cement and cement products and building & construction, and chemicals industries showed the highest prevalent disability (7, 20.6%, 10, 29.4% and 5, 14.9% respectively) in comparison to injured workers in other types of industries (Table 28).

4.6.2.3. Degree of Disability

Twenty-five injured workers (73.5%) presented by permanent disability of less than 15% (Table 29). In the same time, three injured workers (8.8%) were presented with permanent disability of 40% and more. Mechanical environmental factors caused 19 cases (82.6%) of less than 15% of permanent disability and 2 cases (8.7%) of 40% and more of disability among injured workers during the period 1984-1993. While, chemical, physical environmental factors caused 4 cases (80%), 2 cases (50%) of less than 15% permanent disability, respectively. The physical environmental factors caused one case of permanent disability of 40% (Table 30).

Injured workers of cement and cement products, building and construction and chemical industries presented by highest frequent permanent disability of less than 15% (4, 57.1%, 5, 50% and 4, 80%, respectively). While only injured workers of cement and cement products and building and construction industries were presented by permanent disability of 40% and more (1, 14.3% and 2, 20%, respectively), none of the injured workers of the other types of industries were encountered with this type of permanent disability (Table 31).

To test whether distribution of workers by degree of disability varies according to environmental accidental factors, workers were grouped in two categories <15% disability vs 15+%. Statistical Analysis shows that the distribution does not differ significantly according to environmental accidental factors ($p=0.095$); while it does differ by the type of industry ($p=0.008$), with more workers suffering from a higher degree of disability in the cement and cement products industry and in the building and construction industry.

Table (27) - Distribution of site of disability according to environmental accidental factors in different types of industries during the period 1984 - 1993

Environmental Accidental Factors	Site of Disability								Total	
	Upper Limb		Lower Limb		Eye		Multiple			
	No	(%)	No	(%)	No	(%)	No	(%)	No.	(%)
Mechanical	11	47.8	8	34.8	1	4.3	3	13.0	23	100
Chemical	2	40.0	1	20.0	2	4.0	-	-	5	100
Physical	1	25.0	1	25.0	-	-	2	50.0	4	100
Electrical	1	50.0	-	-	-	-	1	50.0	2	100
Total	15	44.1	10	29.4	3	8.8	6	17.6	34	100

Table (28) - Relation between different types of industries and site of disability during the period 1984 - 1993

Types of Industries	Site of Disability								Total	
	Upper Limb		Lower Limb		Eye		Multiple Sites			
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Cement & Cement Products	3	42.9	2	28.6	-	-	2	28.6	7	100
Building & Construction	4	40.0	3	30.0	1	10.0	2	20.0	10	100
Food	3	75.0	1	25.0	-	-	-	-	4	100
Plastic Processing	1	33.3	1	33.3	-	-	1	33.3	3	100
Chemicals	2	40.0	1	20.0	2	40.0	-	-	5	100
Engineering	-	-	1	100.0	-	-	-	-	1	100
Printing	1	50.0	1	50.0	-	-	-	-	2	100
Metal	1	50.0	-	-	-	-	1	50.0	2	100
Wood Products	-	-	-	-	-	-	-	-	-	-
Total	15	44.1	10	29.4	3	8.8	6	17.6	34	100

Table (29) - Degree of disability among disabled workers in different types of industries during the period 1984 - 1993

Degree of Disability %	No. of Disabled Workers	%
< 5	-	-
5-	7	20.6
10-	18	52.9
15-	1	2.9
20-	4	11.8
25-	-	-
30-	1	2.9
35-	-	-
40-	2	5.9
45-	-	-
> 50+	1	2.9
Total	34	100

Table (30) - Distribution of degree of disability according to environmental accidential factors in different types of industries during the period 1984-1993

Environmental Accidental Factors	Degree of Disability %											
	<5 No. %	5 - No. %	10 - No. %	15 - No. %	20 - No. %	25 - No. %	30 - No. %	35v- No. %	40 - No. %	45 - No. %	>50 + No %	Total No. %
Mechanical	- -	4 17.4	15 62.2	- -	2 8.7	- -	- -	- -	1 4.3	- -	1 4.3	23 100
Chemical	- -	2 40.0	2 40.0	1 20.0	- -	- -	- -	- -	- -	- -	- -	5 100
Physical	- -	1 25.0	1 2.50	- -	1 25.0	- -	- -	- -	1 25.0	- -	- -	4 100
Electrical	- -	- -	- -	- -	1 50.0	- -	1 50.0	- -	- -	- -	- -	2 100
Total	- -	7 20.6	18 52.9	1 2.9	4 11.8	- -	1 2.9	- -	2 5.9	- -	1 2.9	34 100

Table (31) - Distribution of degree of disability according to types of industries among disabled workers during the period 1984-1993

Types of Industries	Degree of Disability %											
	<5 - No. %	5 - No. %	10 - No. %	15 - No. %	20 - No. %	25 - No. %	30 - No. %	35 - No. %	40 - No. %	45 - No %	>50+ No. %	Total No. %
Cement & Cement Product	- -	1 14.3	3 42.9	- -	2 28.6	- -	- -	- -	1 14.3	- -	- -	7 100
Building & Construction	- -	2 20.0	3 30.0	- -	2 20.0	- -	1 10.0	- -	1 10.0	- -	1 10.0	10 100
Food	- -	2 50.0	2 50.0	- -	- -	- -	- -	- -	- -	- -	- -	4 100
Plastic Processing	- -	- -	3 100.0	- -	- -	- -	- -	- -	- -	- -	- -	3 100
Chemicals	- -	2 40.0	2 40.0	1 20.0	- -	- -	- -	- -	- -	- -	- -	5 100
Engineering	- -	- -	1 100.0	- -	- -	- -	- -	- -	- -	- -	- -	1 100
Printing	- -	- -	2 100.0	- -	- -	- -	- -	- -	- -	- -	- -	2 100
Metal	- -	- -	2 100.0	- -	- -	- -	- -	- -	- -	- -	- -	2 100
Wood Products	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Total	- -	7 28.6	18 52.9	1 2.9	4 11.8	- -	1 2.9	- -	2 5.9	- -	1 2.9	34

Chapter V

DISCUSSION

Workers in different types of industries are practically exposed to multiple environmental accidental factors. Every attempt must be made to identify and reduce the risk of the impact of environmental factors on the occurrence of accidents in these industries. Epidemiological studies on the impact of environmental factors on the occurrence of industrial accidents are limited.

Industrial accidents have been considered as one of the main causes of working time loss. Therefore, a decrease in the rate of accidents will have an effect on the decrease in working time loss as well as the cost of medical treatment, the compensation for injured workers and the amount of damage (Abou-Taleb, 1993). In other words, occupational injuries among workers in different types of industries cause an economic loss due to decreased productivity which is by far greater than the costs of sickness benefit and medical treatment. Hence, these injuries will represent a considerable burden on society, employees and employers as well.

5.1. Accident Frequency

The number of injured workers in different types of industries in Dubai and Northern Emirates during the period 1984-1993 was 159 (Table 3). The highest number of accidents occurred during the year 1993 (21 accidents), this can be explained by the increase in the number of working population and industrial enterprises in Dubai and Northern Emirates (65,000 workers and 955 industrial enterprises) in comparison with previous years (Ministry of Finance and Industry, 1994). In addition, the presence of new machines and technology parallel with the decrease in the skill and experience of workers may play an important role in the occurrence of highest number of accidents in this year. In the meantime, the year 1985 showed a small number of industrial accidents (9 accidents). This may be due to the fact that this year witnessed the beginning of the second phase of industrial development in the U.A.E., which was accompanied by low number of workers and enterprises, and less advanced machines and technologies. The study revealed that Dubai Emirate showed the highest number of accidents (110, 69.2%; Table 4) during the period 1984-1993 in comparison to other Emirates. This could be explained by the heavy industrial activities and investment encouraged by the Government of Dubai which reflected in higher population of workers. Moreover, the modernization of the country demanded numerous construction activities which needed cement and cement products. Building and construction industry is characterized by the presence of multiple hazardous factors (Seaten et al. 1994). This may explain the increased number of accidents occurred in these two industries in the period of study (48, 30.2% and 54, 33.9%, respectively), (Table 6).

5.2 Accident Rates

The accident rates differ from one country to another or from department to department in the same enterprise, the accident rates show considerable fluctuations between different industries (Waldron, 1985).

In the present study, the introduction of first-aid and safety programmes organized by the Ministry of Health in 1988 (Ministry of Health, 1994) and offered for all industries over the country. Such programmes include training and education which had a great effect in decreasing the accident frequency rates in the last four years of the study (0.136, 0.114, 0.139 and 0.135 per one million man-worked, respectively) (Table 4).

Accident severity rates showed four peaks in the present study during the years 1984, 1985, 1986 and 1989; when more than one fatality case occured in each year (according to the Federal law No. 8 in 1980 issued from the Ministry of Labour and Social Affairs we add 6000 days per each case fatality) (Table 5). Accident frequency and accident severity rates were similarly increased and decreased in the years of study (Figure 3). The changes in the accident frequency and severity rates in the present study may simply reflect changes on the pattern of work rather than more effective preventive measures (Seaten, et al. 1994). Meanwhile, there is a trend of linear association in both accident frequency and accident serevity rates in the last four years of study, which may indicate that inspite of the effective first aid and safety programmes organized by the Ministry of Health to increase awareness of workers about the existing hazards in industrial environment, the industry is becoming more sophisticated and demanding.

5.3. Seasonal Variation

The present study revealed that the maximum peaks of industrial accidents in different types of industries during the period 1984-1993 had occurred in the months of March and November (Figure 4). This coincided with the results of Schulzinger (1956), who reported two peaks of industrial accidents, one in November and the other in April; while David et al. (1993) mentioned that work becomes more intense in the spring and early summer and this may reflect on increased accidents in this period. The explanation of rising of accidents in March and November may be due to the following: (i) Work overload, in which the target of the industrial enterprise must be reached according to the company plan as soon as possible; (ii) Increased in the total number of working population in every plant (i.e. no vacation) because most of workers joined their works in those months.

On the other hand, the study showed that the lower rate of accident was in January and February. This may be due to the fact that these months represent the beginning of the new year in which the target of company plan started to be applied and performed.

5.4. Impact of Environmental Factors on the Precipitating Factors of Industrial Accidents

The present study revealed that the mechanical environmental factors (130, 81.8%) were predominant in comparison with other environmental accidental factors such as chemical (23, 12.6%), physical (4, 2 5%) and electrical (5, 3 2%) occurred in the different types of industries during the period 1984-1993 (Table 8). It is well known, that some industries are more hazardous than others. These differences are clearly reflected in accident statistics. It is worthy noting that the influence of environmental factors was common among the different types of industries which coincided with the accidents recorded in Great Britain during 1990-1991 (Seaten et al., 1994).

5.4.1. Type of Accident

Falls or slips and falling or flying objects represent the commonest types of accidents as a result of mechanical environmental factors in this study (63 1% and 26 9%, respectively) (Table 9). This could be attributed to the nature of work in different types of industries. Charlie (1980) found that fall and slip injuries represented (27%) of cases of injuries. While, Evans (1990) stated that only 18.9% and 5.6% of the causes of accidents due to person falling and struck by falling objects respectively. Meanwhile, exposure to gases, chemicals or Vapours (40%) and falls or slips (30%) were the highly frequent types of accidents which occurred due to chemical environmental factors. However, physical and electrical environmental factors were very limited in the causation of accidents during the period 1984-1993.

Less important causes of accidents in this study were pushing or lifting (3.8%), fire (3 8%) and electricity (2.5%). This is probably due to the strict regulations made by the Ministerial Order No. 32 for the year 1982 regarding determination of the ways and means to protect employees against work hazards issued from the Ministry of Labour & Social Affairs.

5.4.2. Accident Circumstances

The study revealed that 93.1% of accidents occurred by unsafe circumstances. At the meantime, falling of equipment and inadequate design were the most frequent causes constituting unsafe circumstance due to either mechanical or chemical (40% and 33 8%, respectively) environmental factors (Table, 11). Heinrich (1950) reported that only 10% of injuries were due to physical or mechanical conditions. Moreover, Handley (1977) pointed out unsafe circumstances represented in handling goods, whereby hand tools were not considered as one of the serious causes of accidents as machinery and transport accidents. This leads us to the importance of applying more strict procedures to protect workers against unsafe circumstances in work environment which are incriminated in causing 93.1% of accidents. This needs closer cooperation between the different departments (viz: safety, personnel, medical, etc..) in the industry to minimize the role of those unsafe circumstances in accident causation, (see Figures 13-16).

5.4.3. Worker's Act

The unsafe act of the worker represented the main factor of causing 84.9% of the industrial accidents occurred in different types of industries during the period 1984-1993 (Table 13). However, the wrong work method (16.2%), unwear of safety equipment (61.5%) and presence of unsafe area (11.5%) presented the more frequent unsafe workers act in accidents caused mainly by mechanical environmental factor While 35% of accidents occurred due to unsafe workers act in accidents caused mainly by chemical environmental factor. This can be explained by the fact that the injured workers were not adequately trained to use personal protective equipment (e.g. gloves, goggles, safety shoes and helmets). Alternatively, they feel that such safety equipment might impede their speed for production and threaten their job situation. This clarifies the importance of training the workers on performing their jobs with full safety equipment through proper application of safety programmes. Both workers and employers should get alerted to the importance of using safety and protection kits.

These results agree with most authors in different countries, as they pointed out that unsafe worker's act is responsible for causation of accidents in the range between 80 % and 88% of cases in different studies (Blake, 1993; Tye, 1977; Booth, 1975; Tredgold, 1970). Moreover, they recorded about 40% - 70% human errors which were responsible for accidents, such as improper attitude, lack of knowledge, or skill and physical unsuitability.

5.5. Impact of Environmental Factors on the Industrial Injuries Among Workers in Different Types of Industries during the Period 1984-1993.

5.5.1. Site of Injury

The present study revealed that upper limb injuries were the dominant (84, 52.8%) of the whole body injuries caused by the presence of environmental accidental factors (mechanical 72, 85.7%; chemical 7, 8.3%; physical 2, 2.4% and electrical 3, 3.6%) (Table 15). The injuries of finger, hand and wrist represented (39.3%, 21.4% and 22.6%, respectively) (Table 17). This is probably due to the fact that upper limb especially fingers and hands are usually involved in the different industrial processes (Flatt, 1972). Studies in the literature showed that the most affected site among injured workers was the upper limb (33-35%) (Hunting et al., 1994; Donovan, 1983 and Charlie, 1980); in agreement with our own results.

The lower limb involved in 18.2% of the total injuries due to the existing of environmental accidental factors especially mechanical, (Table 15). Foot (17.2%) and toes (17.2%) were the more frequent injuries in lower limb (Table 19). Charlie (1980) and IADC (1985) reported that lower limb and foot represented 32.3% and 29.9%, respectively of the total injuries. This can be explained by the negligence in use of personal protective equipment during working e.g., safety boots, unclean and slippery floor (Muller et al., 1987).

Concerning the other injury sites, in this study it was found that the frequency of head and neck injuries was 2.5% and eye injuries was 4.4% from total body injuries caused by the mechanical environmental factors (Table 15). ILO (1982) stated that those injuries could be explained by negligence in the use of personal protective equipment during work e.g. goggles and forehead hats. Therefore, intensive training programmes are indicated to teach workers how to use equipment during work; at the meantime, ergonomic picture and safety measures must be applied. However, Waldron (1985) pointed out that injuries to the eye are unfortunately common in industry. The most frequent are those caused by foreign bodies. Baker and Fisher (1977) stated that most of eye injuries can be prevented by foresight, planning and the provision of the right kind of training and equipment.

Furthermore, trunk injuries represented 3.8% of the total body injuries in this study, caused by either mechanical or chemical environmental accidental factors (Table 15). The improper methods during lifting objects and carrying load exceeding the permissible levels of the person could precipitate this injury.

5.5.2. Type of Injury

Regarding the type of injury among workers exposed to environmental accidental factors in different types of industries in Dubai and Northern Emirates during the period (1984-1993), the most frequent type was wound (47.2%), followed by fracture (17.0%) and bleeding (8.8%) (Table 22). The results can be explained by the fact that the causes of accidents in the study were falls or slips (63.1%) and falling or flying objects (26.9%) due to industrial environmental factors (viz: mainly mechanical and to a lesser extent chemical, physical and electrical factors) (Table 9), which usually lead to wound, fracture and bleeding to the body. Copeman (1992) reported that the most common injuries among injured workers was open wounds, sprains and strains, contusions and eye injuries in an urban industrial area. Also, Brewer, et al. (1990) stated that the majority of injured workers (78.4%) were classified as; cut wounds, lacerations and contusions. Moreover, Tsai et al. (1989) mentioned that the majority of occupational injuries claims were attributed to superficial injuries and contusions (27.2%), cut wounds (20.2%).

However, cardiac arrest in this study represented (8.8%) of all causes due to mechanical environmental factors (Table 21). Suruda and Smith (1992) reported that 102 deaths occurred in construction industry (50%), services (12.7%), manufacturing (12.7%) and in other industries (24.5%) during the period 1984-1986 from records obtained from National Institute for Occupational Safety and Health and Occupational Safety and Health Administration in U.S.A.

5.6. First Aid Measures to Injured Workers in Different Types of Industries During the Period 1984-1993

The study revealed that (44 7%) of injured workers received known first aid offered in work places either to minor or major injuries before being back to work or referred to hospitals, specially dressing (18.2%) and bandage (20.8%) (Tables 23 and 24), while the first aid of the remaining cases (55.3%) was not known during the period 1984-1993. Offering first aid did increase the number of injured workers got complete recovery (63.5%; Table 25). This emphasises the importance of the existence of the first aid centres in work places provided by medical staff, medical equipment and medication, which would minimize the disability, sick-leaves and even facilitate the follow-up treatment. The main type of first aid was dressing and bandage (Table 23) as the most frequent type of injuries were wound (47.2%), fracture (17.0%) and bleeding (8.8%) (Tables 22 and 23).

Other types of first aid offered were splint (1 9%), sutures (1.3%), foreign-body removal (0 6%), medication (0.6%), eye wash (0.6%) and oxygen supply (0.6%) (Tables 23 and 24).

Gallaspy (1994) mentioned that environmental hazards existing in work places may produce a wide range of injuries. Adequate knowledge of first aid treatment offered in work places as well as transfer to the most appropriate medical centre, can make the difference in obtaining the best possible outcome.

5.7. Fate of Injury

5.7.1. Recovery and Death

The present study showed that 63.5% of the injured workers were completely recovered without residual affects (Tables 25 and 26). This indicates that the reported injuries were fluctuated from mild, moderate and/or severe type. It also reveals the importance of first aid measures applied in work places to minimize the duration of sick leaves, and rehabilitation as well as the adherence to safety procedures.

Twenty-four deaths (15.1%) occurred in the different types of industries due to existence of environmental accidental factors during the period of the study. This can be attributed to shortage and insufficient protection ways and means applied in work place, such as insufficient first aid measures and the absence of a well trained first aid personnel which help to minimize the risk of serious injuries. However, the Ministry of Labour and Social Affairs issued several Ministerial Orders (e.g. Ministerial Order No 32 for the year 1982 regarding determination of the ways and means to protect employees against work hazards; and Ministerial Order No. 37/2 for the year 1982 concerning the levels of medical care the employer is obliged to provide for his workers.) to overcome this problem of industrial accidents which still contribute a major health problems for the working population.

5.7.2. Disability

5.7.2.1. Site of Disability

The present study revealed that 21.3% of injured workers became disabled (Tables 25 and 26) specially upper limb 44.1% and lower limb 29.4% (Tables 27 and 28). These results agree with those of Featherston (1964), who reported that upper and lower limbs were the most frequent sites of disability (35% and 28%, respectively). Cornford (1970) stated that about one half of disability occurred in upper limb and one third in lower limb from total sites of disability.

Concerning eye disability, only 8.8% was encountered among disabled workers (Tables 27 and 28). This low percentage can be explained by the fact that injuries to eyes by mechanical and chemical environmental accidental factors are dangerous and serious effects are frequently the end results; therefore more precautions are usually taken.

5.7.2.2. Degree of Disability

The disabled cases with less than 15% disability represented 73.5% among them 20.6% showed 5% disability; while, 8.8% of disabled cases were reported as having disability of 40% and more (Tables 29, 30 and 31). All these disabled cases received their compensation payment according to Federal Law No. 8 "Organizing Work Relations" for the year 1980 issued from the Ministry of Labour and Social Affairs.

5.8. Socio-demographic Characteristics of Injured Workers

Man and his environment are inseparable. His behaviour is a result of past and present interaction with his surrounding environment. It is for this reason that the study of socio-demographic characteristic in an accident cannot divorce itself from those interaction and must have some influence on them (Surry, 1968).

5.8.1. Age

The present study revealed that the lowest mean age was 30± 3.16 years among workers of printing industry and the highest mean age was 40 years among workers of wood products industry (Table 7). This is similar to results obtained in previous studies and discussed by many authors from different countries. Health (1991) mentioned that the younger employees have higher incidence rates of injury. Moreover, Elliott (1985) and Walter (1985) mentioned that old workers tend to have fewer accidents than younger workers as a result of their experience.

5.8.2. Duration of Employment

The lowest mean duration of employment was 3.2 ± 1.10 years among workers of plastic processing industry and the highest mean duration of employment was 5.06 ± 3.50 years among workers of cement and cement products industry (Table 7). This short length of time on job and type of work performed may increase incidence rates of injury (Health, 1991). Also, those workers are the most active group in every industrial enterprise, as they carry all responsibility to work. Their self-confidence might be reflected on their carelessness in dangerous jobs. On the other hand, Muller et al. (1987) suggested that although injury rates decline with the length of service, the age of workers, declining job danger. It is the job factor which is the most important factor in determining the risk of injury. The details of job risk needs more studies

5.8.3. Salary Per Month

The lowest mean salary per month was 1087.00± 239.57 Dirhams among workers of chemicals industry and the highest mean salary per month was 1263.33 ± 614.4 Dirhams among workers of cement and cement products (Table 7). The increased salary per month may be considered a big motivation for the workers to be more cautious during work performance with more productivity and decrease in the incidence rates of injury.

5.8.4. Nationality

Indian workers (63.5%) represented the higher nationality among injured workers; while, Arabian injured workers were (17.6%) and Pakistani injured workers (11.9%) (Table 7). Those foreign workers came from the third world countries with poor health condition, change in rhythm of life and change in the tradition and habituation which may have reflected on the increase in the incidence rates of industrial injury among them.

5.8.5. Marital Status

Most of the injured workers were married (81.8%) in comparison to 15.7% of them were single (Table 7). However, Robertson and Keer (1983) mentioned that single workers showed higher accidents in comparison to married workers and this could be attributed to the lack of family responsibility and they were most likely younger and might be less cautious. This is the opposite to our results. On the other hand, Muller et al. (1987) in his study of industrial accidents did not observe any relation between marital status and occurrence of injuries.

5.8.6. Educational Level

Results obtained in this study showed that illiteracy (41.5%) was common among injured workers followed by read and write (37.7%) (Table 7). Jones and Griffith (1992) stated that the incidence of occupational injury is reduced by improved education of the worker. It must be noted that education helps the individual to learn more and adopt considerable skills needed for safety.

5.9. Impact of the Type of Industry on the Occurrence of Industrial Accidents During the Period 1984-1993.

5.9.1. Cement and Cement Products Industry

The present study revealed that industrial accidents were common among cement and cement products industry (48, 30.2%; Table 6) The mechanical environmental accidental factors (87.5%) were the most frequent type in comparison to chemical (10.4%) and physical (2.1%) factors existed in this industry (Table 8). Meanwhile, it is worth noting that the injured workers showed a highly frequency injuries in upper and lower limbs (41.7% and 29.1%, respectively, Table 16) and especially in the finger, hand, leg, ankle and toes (47.4%, 15.8%, 24.0%, 16.0% and 16.0%, respectively; Tables 18 and 19). Moreover, wounds (52.0%) and fractures (22.9%) were the most frequent injuries occurred among injured workers (Table 20). These injuries were caused mainly by falls or slips and falling or flying objects (52.1% and 27.1%, respectively, Table 10); and also due to the presence of unsafe circumstances such as falling equipment (41.7%) and inadequate design (33.3%) (Table 12); in addition to the unsafe worker's act (e.g. unwear of safety equipment (39.6%) and wrong work method (43.8%), (Table 14). Most of injured workers were completely recovered without residual effects (66.7%), while 25% of them had permanent disability especially in upper and lower limbs. However, the degree of disability was less than 20% (Tables 26, 28 and 31). These data agree in general with those reported by Prodan (1990), who showed that most of the accidents in cement industries were due to falls of earth and rock, or have occurred during transportation. The main type of injuries were bruises, cuts and abrasions which occured during handling work.

5.9.2. Building and Construction Industry

Building and construction represented the highest risk type of industry in the present study, (54, 33.9%, Table 6). Similar to cement and cement products industry, the most frequent type of environmental accidental factors was the mechanical (87.0%) followed by chemical (13.0%) (Table 8). It is worth noting that 15 (27.8%) of injured workers in the industry died after accident occurrence, while 21 (38.9%) and 9 (16.7%) suffered upper and lower limbs injuries respectively; mainly in fingers, wrist, leg and toes (Tables 16,18 and 20). Wound and fracture (55.6% and 20.4%, respectively) (Table 22) were frequently encountered among injured workers. The main cause of these injuries were falls or slips (57.4%) and falling or flying objects (29.6%) (Table 10); the presence of unsafe circumstances such as falling equipment (40.7%) and inadequate design (37.0%), (Table 12); and the unwear of safety equipment (79.6%) (Table 14). Most of the injured workers completely recovered 53.7%, while 18.5% had some disability especially in upper and lower limbs and the degree of disability has fluctuated from 5% to > 50% (Tables 26, 28 and 31). Literature reports, in agreement with our results, showed that occurrence of accidents in building and construction industry was practically attributed due to mechanical, electrical hazards and/or lifting equipment as well as lack of training and experience of labourers in which the unskilled labourers (Kisner and Fostbroke, 1994; Bachofen, 1990)

5.9.3. Food Industry

Fourteen (8.8%) accidents were recorded in the food industry during the period 1984-1993 (Table 6). The mechanical and chemical accidental factors (87.7% and 14.3%, respectively; Table 8) were also the main factors encountered in this type of industry. Upper and lower limbs injuries (78.6% and 21.4%, respectively, Table 16) were the predominant site of injury among injured workers. Wounds (42.9%) have frequently occurred among injured workers (Table 22). The main causes of injuries were falls or slips (71.4%) and falling or flying objects (21.4%). Also falling equipment (42.9%) and the presence of unsafe area (57.1%) were involved in causing industrial accidents (Tables 10, 12 and 14). Most of the of injured workers in the food industry were completely recovered 71.4%, while 28.6% became disabled, especially in upper and lower limbs with a degree of disability below 10% (Tables 26, 28 and 31). Malagie (1990) reported that machines and handling equipment are the commonest causes of mechanical accident occurrence in the food industry, in agreement with our own findings.

5.9.4. Engineering Industry

Eighteen (11.3%) accidents were recorded during the period of study in engineering industry. The main environmental factors responsible for these accidents were as follows: mechanical (72.2%), electrical (22.2%) and chemical (5.6%), (Table 8). Similar to the food industry, the most frequent sites of injury among injured workers were the upper limbs (66.7%; Table 16), while wounds (44.4%) and fractures (22.2%; Table 22) represented the commonest type of injuries. Falls or slips (77.8%) and falling or flying objects (22.2%); falling equipment (27.8%); unwear of safety equipment (55.6%) and presence of unsafe area (28.6%) were the main causes of accidents in this type of industry (Tables 10, 12 and 14). Most of the injured workers (14, 77.8%) were completely recovered, while 3 cases (16.7%), died and 1 case (5.6%) was disabled in the lower limb with 10% degree of disability (Tables 26, 28 and 31). The findings presented in this work are supported by those reported by other investigators (Seaten et al 1994), who showed that multiple environmental factors could lead to various types of injuries in mechanical engineering industry.

5.9.5. Other Types of Industries

Generally, lower rates of injuries were recorded in other types of industries such as printing, plastic processing, chemicals, metal and wood products (3.1%, 3.1%, 3.1%, 4.4% and 1.9%, respectively; Table 6). The most frequent types of environmental accidental factors involved in these industries were mechanical followed by chemical, physical and electrical (Table 8). Like engineering industry, the upper limbs were the most common site of injury in these industries (Table 16 and 18), while wounds, bleedings and fractures were the frequent types of injuries (Table 22). Fall or slips; falling equipment; inadequate design; and unwear of safety equipment were also the commonest causes of accidents (Tables 10, 12 and 14). Only four deaths have occurred in these industries, while 40 - 100% of injured workers completely recovered

and 0% - 60% became disabled (Table 26). The rate of disability was common in upper limb followed by lower limb, and the degree of disability did not exceed 20% (Tables 28 and 31). The prevalence of industrial accidents in these types of industries could be attributed to mechanical hazards which happened during normal operations, cleaning, setting and maintenance of machines; falls of people or materials, contact with moving or stationary objects; hand tools; electricity; fire and/or explosion (Seaten, et al, 1994 and DeBoer, 1990); in agreement with our own results.

5.10. Limitations of the Study

The recorded number of industrial accidents during the period of study (1984-1993) were limited due to the following:

1. Misreporting of industrial accidents.
2. Shortage in notification on industrial accidents from the employers to the industrial safety department in the Ministry of Labour and Social Affairs.
3. Under-reporting of industrial accidents at both the national and the enterprise level.
4. The basic data from the accident reports produced at work place are often poor, particularly with regard to the description of the accident sequence and contributing environmental factors.
5. Some types of industries were not included in the study (viz. Dubai Aluminium Factory, most of industries in Jebel Ali Free Zone, etc.)
6. Some industries are not supervised by the authorities of the Ministry of Labour and Social Affairs, but they are supervised by the authorities of the Municipalities in the different Emirates.

Chapter VI

CONCLUSION AND RECOMMENDATIONS

A. CONCLUSIONS :

1. The United Arab Emirates has witnessed a rapid pace of industrial growth and development during the period of study (1984-1993), which has led to various occupational and environmental health hazards.

2. Workers in different types of industries are practically exposed to multiple environmental accidental factors (e.g. mechanical, chemical, physical and electrical)

3. The mechanical factors were the major causes of accidents among all types of industries investigated, followed by chemical factors.

4. Building and construction were the most hazardous industries, followed by cement and cement products with respect to the number of accidents and severity of injuries (e.g. death, disability, etc.).

5. Falls and/or slips were the most frequent types of accidents recorded among injured workers in all industries, followed by falling or flying objects.

6. Falling equipment and inadequate design represented the main accident circumstances caused injuries among industrial workers, while unwear of safety equipment was the main worker's act affected accidents.

7. Upper limbs were the most frequent site of injury as well as disability among injured workers in most industries, while wounds and fractures were the commonest type of injury.

8. Most injured workers in the different types of industries were illiterate, unskilled, less motivated, and have had not acquired the necessary training and/or experience.

9. Shortage of first aid measures and the absence of first-aid personnel in work place almost had negative effect on the fate of injury (e.g. death, disability) among injured workers, especially in building and construction, and cement industries.

B. RECOMMENDATIONS

1 A safety training programmes of workers particularly for the new comers can reduce the incidence of accidents in different type of industries The workers should apply all safety rules and instructions and refrain from any act that may hinder the execution of these instructions.

2 Health education programmes can play an important role in controlling and preventing industrial accidents. It should include all personnel at all levels. Workers must be educated and informed about the importance of wearing safety equipments. The health education programmes are considered to be a principal factor in minimizing work injuries. The execution of these programmes can be carried out through the cooperation between the personnel authorities in Ministry of Labour and Social Affairs, Ministry of Health and Municipalities.

3 There is a need to improve data collection activities in the area of occupational health. Priority should be given to design specific form for industrial accident including data concerning the personal history of the injured worker, accident occurrence, first aid treatment, nature and type of injury, fate of injury, sick leaves, etc. (see Appendix, 4). This sheet must be generalized in all types of industries to help the follow-up and statistical review measurement should be made mandatory in accident reporting through this form.

4. Good control measures should be applied to protect workers from different hazards existing in the working environment in different types of industries.

5 The employers of different types of industries must provide the work place with all first aid measures and train some employees on first aid treatment.

6. Communications must be done between the authorities of Ministry of Health (i.e.emergency units in the hospitals, either Government of Local), Ministry of Labour and Social Affairs (i.e. industrial safety department) to overcome the problems of shortage in notification of industrial accidents, (i.e. actual situation and/or accidents) in different types of industries in the U.A.E.

7 Further studies are needed specially on the impact of the different environmental factors on accident occurrence in terms of full investigation of the environment of the more frequent accidental workplaces and those having least accident frequency.

8. According to studies on accidents arising in different types of industries, it has been observed during the period 1984-1993 that the mechanical hazards are the highest specially from falls or slips from the building and construction sites. Therefore, it is recommended to avoid such mishaps of hand-tools through safety measures to be taken as safety training of the individual workers, health education and, at the meantime health check of the fitness should be conducted for workers.

CHAPTER VII

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Appendix (1)

Figure (5): Unsafe storage

Figure (6): Unsafe Act (improper Lifting)

Figure (7): Chemical hazards

Figure (8): Physical hazards

Figure (9): Hazards in building and construction industry

Figure (10): Unsafe working circumstances

Figure (11): Unsafe worker act

Figure (12): Mechanical hazards in industry

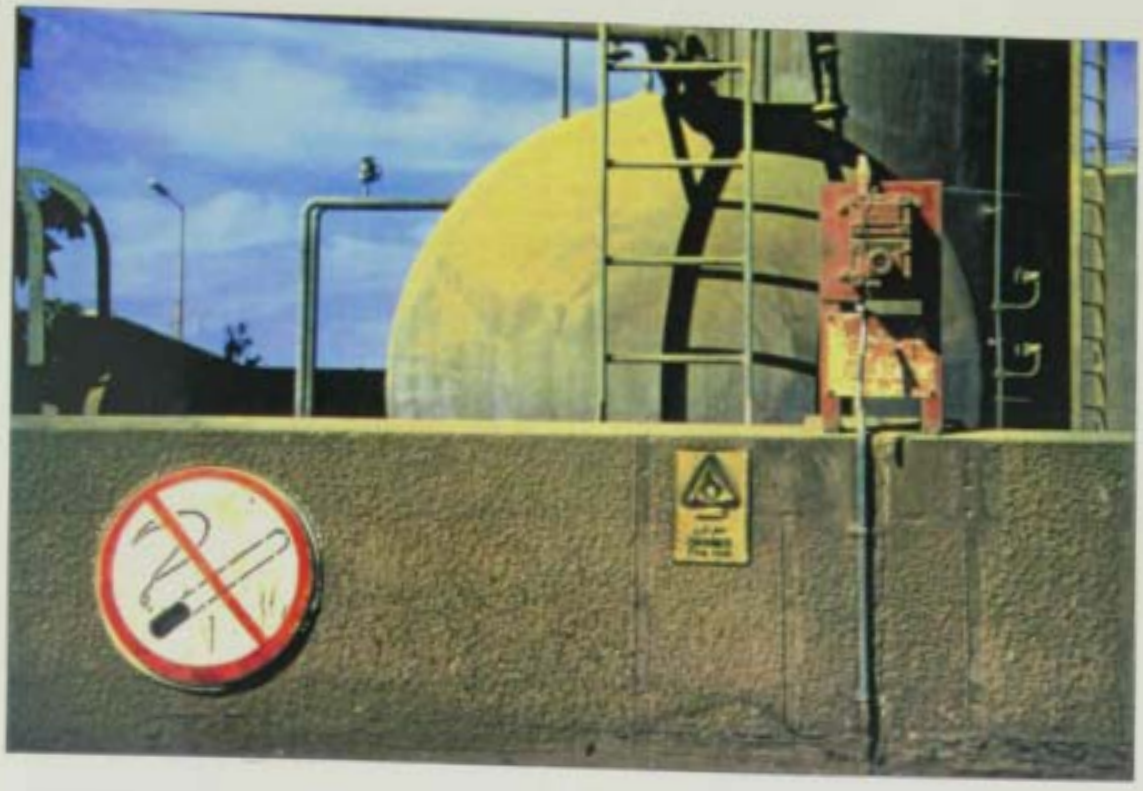

Figure (13): Safety signs

Figure (14): Air monitoring system

Figure (15): Satey signs

Figure (16): Safety notices

دولة الامارات العربية المتحدة Appendix (2)
وزارة العمل والشئون الاجتماعية

نموذج رقم (٢)
اجراءات الأمن الصناعي
نموذج تحقيق اصابة العمل

(أ) بيانات عن المنشأة :

اسم المنشأة ورقم بطاقتها : .....

عنوان المنشأة : .....

النشاط الاقتصادي : .....

اسم المدير المسئول : .....

عدد العاملين : رجال ..... نساء ..... أحداث .....

(ب) بيانات عن المصابين :

م	الاسم	الجنسية	العمر	المهنة	المرتب الشهري	ملاحظات
..	.....	.....	.....	.....	.....	.....
..	.....	.....	.....	.....	.....	.....
..	.....	.....	.....	.....	.....	.....
..	.....	.....	.....	.....	.....	.....
..	.....	.....	.....	.....	.....	.....
..	.....	.....	.....	.....	.....	.....
..	.....	.....	.....	.....	.....	.....
..	.....	.....	.....	.....	.....	.....

(ج) بيانات عن الاصابة :

تاريخ وقوع الاصابة : .....

تاريخ اخطار الاصابة : .....

السبب الذي نتجت عنه الاصابة : .....

وقت وقوع الحادث : .....

نوع الاصابة : .....

موقع الاصابة من الجسم : .....

تاريخ الوفاة (في حالات الوفاة) : .....

م/رضا ٠٠٠/

(د) تحليل الحادث :

هل حدث تلف لاجزاء المنشأة أو المواد المستعملة من جراء الحادث اذكر التفاصيل ؟

.....

.....

هل وقع الحادث نتيجة اخطاء تعزى للمنشأة اذكر التفاصيل ؟

.....

.....

هل وقع الحادث نتيجة تصرف تعزى من العامل أو أحد العاملين اذكر التفاصيل ؟

.....

.....

ما هو الجزء الذى تسبب فى الحادث ؟

.....

.....

ما هى وسائل الوقاية المتوفرة لمنع وقوع مثل هذا الحادث ؟

.....

.....

هل هناك مخالفة قانونية اذكر التفاصيل ؟

.....

.....

.....

ما هى التوصيات التى يراها المفتش ؟

.....

.....

.....

.....

م / رضا ٠٠٠ /

Appendix (3)

PRELIMINARY DATA

1. Serial No : Name of Enterprise

2 Emirate Dubai (1) Sharjah (2) Ajman (3)
U A Q (4) R A K (5) Fujairah (6)

3 Total No. of Workers

4 Type of Industry Cement & Cement Products (1)
Building & Constructions (2) Food (3)
Plastic processing (4) Chemicals (5) Engineering (6)
Printing (7) Metal (8) Wood Products (9); Others....

5 Age : ..... Years

Job Specification Administrative (1) Technical (2)

6 Duration of Employment ..... Years

7 Marital Status : Single (1) Married (2)
Widowed(3) Divorced(4)

8 Educational Status : Illiterate (1) Read & Write (2)
Prim. Education (3) Prep. Education (4)
Sec. Education (5) University Education (6)

9 Nationality : Arabian (1) Indian (2) Pakistani (3)
Srilankan (4) Thailandian (5) Filipino (6); Other .....

10 Salary per month : Dhs .....

Shifts : absent (1) present : morning (2) afternoon (3) evening (4)

ACCIDENT DATA :

11. Date of Accident : Day _____ Month _____ Year _____

12. Time of Accident : Morning _____ Afternoon _____ Evening _____

Location of Accident : In plant (1) Department : _____
Outdoor (2) Explain : _____

13. Unsafe workers' act : Absent (1)
Present :Wrong work method (2); Unwear of safety equipment (3) ;
Carelessness (4); Decrease of data and skill (5); Disobedience of restriction (6); Presence of unsafe area (7); Not original work (8); Struggle (9); Other....

14 Unsafe Environmental Condition : Absent (1)

Present : Falling Equipment (2) Inadqeate design (3), Dirtiness (4), Poor housekeeping (5), Dangerous circumstances (6); Inadequate Lighting (7), Poor Shielding (8), Work overload (9), Other.....

15 Type of Accident : Falling or Flying Objects (1), Falls or slips (2), Striking against (3), Exposure to gases, chemicals or vapours (4), pushing and lifting (5), fire (6), Electricity (7), Explosives (8), Radiation (9), More than one type (10); unknown cause (11); Other.....

16 External cause of accident : Mechanical (1), Chemical (2), Physical (3) Electrical (4), Other.....

INJURY DATA

Site of injury : 17. Head : No (0) Yes (1), 18 Neck : No (0) Yes (1);
19 Chest : No (0) Yes (1), 20 Abdomen : No (0) Yes (1),
21 Back : No (0) Yes (1); 22 Eyes : No (0) Yes (1),
23 Fingers : No (0) Yes (1); 24 Hand : No (0) Yes (1);
25 Wrist Joint : No (0) Yes (1); 26 Elbow Joint : No (0) Yes (1);
27 Forearm : No (0) Yes (1), 28. Arm : No (0) Yes (1),
29. Shoulder Joint : No (0) Yes (1), 30 Hip Joint : No (0) Yes (1),
31 Thigh : No (0) Yes (1); 32 Knee Joint : No (0) Yes (1)
33. Leg : No (0) Yes (1), 34. Ankle Joint : No (0) Yes (1);
35. Foot : No (0) Yes (1), 36. Toes : No (0) Yes (1);
Other.....

Type of Injury : 37. Wound (Cut / lacerated / Contused / Other) : No (0) Yes (1),
38. Fracture : No (0) Yes (1), 39. Dislocation : No (0) Yes (1);
40. Sprain : No (0) Yes (1), 41 Burn : No (0) Yes (1),
42. Contusion : No (0) Yes (1); 43 Foreign Body : No (0) Yes (1);
44. Poisoning : No (0) Yes (1),
45. External Bleeding : No (0) Yes (1);
46. Internal Bleeding : No (0) Yes (1),
47 Shock : No (0) Yes (1), 48 Asphyxiation : No (0) Yes (1),
49. Cardiac arrest : No (0) Yes (1);
Other.....

50. Site of First Aid : In-Plant (1). Outdoor . Government Hospital (2)
Private Hospital (3)

Type of First Aid : 51. Dressing : No (0) Yes (1); 52. Bandage : No (0) Yes (1);
53. Foreign Body removal : No (0) Yes (1);
54. Sutures : No (0) Yes (1); 55. Splint : No (0) Yes (1);
56. Medications : No (0) Yes (1); 57. Eye Wash : No (0) Yes (1);
58. Oxygen Supply : No (0) Yes (1); 59. Unknown : No (0) Yes (1);
Other....

60 Fate of Injury : Complete Recovery (1), Disability (2), Death (3)

Disability Sites

61 Fingers : No (0) Yes (1);
62 Hand : No (0) Yes (1);
63 Wrist Joint : No (0) Yes (1),
64 Elbow Joint : No (0) Yes (1);
65 Forearm : No (0) Yes (1),
66 Arm : No (0) Yes (1),
67 Shoulder Joint : No (0) Yes (1),
68 Hip Joint : No (0) Yes (1),
69 Thigh : No (0) Yes (1),
70 Knee Joint : No (0) Yes (1)
71 Leg : No (0) Yes (1),
72 Ankle Joint : No (0) Yes (1);
73 Foot : No (0) Yes (1),
74. Toes : No (0) Yes (1);

Other .....

75 Degree of disability

76 Duration of days lost (sick leave) : ..... Days

77 Return to the previous job : No (1) Yes (2)

78 New Job : No (1) Yes : Administrative (2)
Technical (3)

79 Man-worked hours

80 Accident Frequency Rate

81 Accident Severity Rate

Appendix 4

Sheet

Company Data

1. Name of Company
2. Address:
3. Economical activity:
4. Total Number of workers:

Personnel Data

1. Name of injured worker:
2. Age:
3. Sex:
4. Occupation:
5. Nationality:
6. Address:
7. Duration of employment:
8. Salary per month
9. Marital Status:
10. Educational level:
11. Work shift:
12. Past occupation:

Accident Data

1. Date of accident:
2. Time of accident:
3. Location of accident:
4. Unsafe worker's act:
5. Unsafe environmental conditions:
6. Type of accident:
6. Environmental cause of accident:
7. Amount of damage in case of (fire, explosion):

Injury Data

1. Site of injury:
2. Type of injury:
3. Site of first aid:

4. Type of first aid:
5. Fate of injury:
6. Disability site:
7. Degree of disability:
8. Duration of sick leave:
9. Compensation:
10. Total estimated cost of the accident:

Other Data

1. Witness to accident:
2. Superintendent's recommendation:
3. Safety officer recommendation:

Remarks

٢ ـ كانت تتقصهم المهاره والخبره (متوسط خبرتهم في العمل كانت بين ٢ر٣ ± ١ر١ الى ١ر٥ ± ٥ ر٣ سنه) .

٣ ـ لم يكونوا يتمتعون بدخول جيده (أعلى دخل شهري كان ٣ر١٢٦٣ ± ٤ر٦١٤ درهم) .

٤ ـ معظمهم وافدون من بلدان العالم الثالث ، حيث كانت ظروفهم الصحيه والتعليمية متدنيه (٥ ر٦٣٪ من الهنود ، ٥ ر٤١٪ كانوا لمبين) .

وقد أظهرت دراسة العوامل المسببه للحوادث الصناعيه الأتي : ـ

١ ـ الوقوع أو التزحلق (٢ر٥٧٪) وسقوط أو تطاير الأجسام (٩ر٢٣٪) مثلت الأسباب الرئيسية للأصابات .

٢ ـ ١ر٩٣٪ من الحوادث حدثت بسبب ظروف عمل غير آمنة .

٣ ـ ٩ر٨٤٪ من الحوادث حدثت بسبب تصرف غير آمن للعمال المصابين .

كما أظهرت الدراسة أن اصابات الأطراف كانت الأكثر شيوعا بين العمال حيث مثلت اصابات الأطراف العليا (٨ ر٥٢٪) والأطراف السفلى (٧ ر١٨٪) .. وكانت الجروح (٢ر٤٧٪) والكسور(١٧٪) أكثر الأصابات شيوعا .

وكان نوع الأسعاف الأول المقدم للعمال المصابين غير معروف فى (٣ر٥٥٪) من الحالات .. أما الحالات التي تم اسعافها فكانت الضماد (٢ر١٨٪) والرباط (٨ ر٢٠٪) أكثر الأسعافات الأوليه استعمالا .

وقد بلغت حالات العجز (٣ر٢١٪) بين العمال المصابين خاصة فى الأطراف العليا والسفلى .. وقد توفى ٢٤ عاملا متأثرين بأصابتهم خلال فترة الدراسه ، و تم شفاء ١٠١ مصابا (٥ ر٦٣٪) تماما دون تخلف أي عاهة .

وقد أوصت الدراسة بأهمية برامج السلامة المهنية والتثقيف الصحي فى الأقلال من وقوع الحوادث . وكذلك تصميم استمارة مستوفية لجميع البيانات الخاصة بالحادثة واصابة العمل وذلك للرجوع اليها لأي بيانات تطلب ، ووقاية العمال من مختلف المخاطر التى تتواجد فى بيئة العمل فى مختلف انواع الصناعة من خلال وسائل التحكم والسيطرة الجيدة على هذه المخاطر .

الملخص العربي

يتعرض العاملون في الصناعة الى عوامل بيئية متعددة تسبب الحوادث في أماكن العمل ... وقد أجريت هذه الدراسة الاسترجاعية ، عن أثر العوامل البيئية على وقوع الحوادث الصناعية خلال فترة عشرة سنوات [١٩٨٤ ـ ١٩٩٣] في دبي والامارات الشمالية ، بهدف أن تبين أثر العوامل البيئية على حدوث وأسباب الحوادث الصناعية وأنواع الأصابات بين العمال .

وقد تم جمع البيانات من سجلات الحوادث من قسم الأمن الصناعي بوزارة العمل والشئون الاجتماعية فيأمارة دبي ... وقد أجريت زيارات ميدانية لبعض المنشآت الصناعية للتعرف على المخاطر البيئية المتواجدة .. مثل مصانع الأسمنت والتشييد والبناء والطباعة والمواد الكيمائية والهندسية .. وقد بلغ عدد العاملون المصابين في فترة الدراسة (١٥٩) عاملا .... و كان معدل تكرار الحادثة .. ومعدل شدة الحادثة يزدادان وينقصان معا في سنوات الدراسه .

وقد أظهرت الدراسه أن معظم الحوادث (٢ر٩٦٪) قد وقعت في أمارة دبي ، وأن أعلى معدلات للحوادث ككل جرت فى صناعة التشييد والبناء (٩ر٣٣٪) وصناعة الأسمنت (٢ر٣٠٪) .

كما أظهرت الدراسه أن أعلى نسبة للحوادث وقعت بسبب العوامل البيئية الميكانيكية (٨ر٨١٪) يليها العوامل الكيمائية (٦ر١٢٪) ثم الكهربائيه (١ر٣٪) والفيزيائيه (٥ ر٢٪) في مختلف الصناعات .. وقد وجد أن انتشار الحوادث كان عاليا بين العمال المصابين في مختلف أنواع الصناعات ، وأن ذلك يؤول الى الصفات الأجتماعيه والديمغرافيه لهؤلاء العمال ، والتي شملت : ـ

١ ـ غالبية هؤلاء العمال كانوا لحد ما صغار السن (متوسط أعمارهم تراوحت بين ٣ر٣٠٪ ± ٢ر٣ الى ٤٠ سنه) .

المشرفـــون

الأستاذ الدكتور/ شـــريف قنـــديـــل
الاستاذ بكليـــة العلـــوم
جامعـــة الامارات العربية المتحدة

الدكتور/ أحمد نبيل محمد أبو طالـــب
رئيس قسم الصحة المهنيـة
وزارة الصحـة
الامارات العربية المتحـــــدة

الدكتـــور/ ماجـــد عثمـــان
المـدرس بكليـــــة
العلـوم الأدارية والأقتصادية
جامعـة الامارات العربية المتحـــدة


بسم الله الرحمن الرحيم

دراسة استرجاعية عن
أثر العوامل البيئية على وقوع الحوادث الصناعية
في دولة الإمارات العربية المتحدة
خلال فترة عشر سنوات
(١٩٨٤-١٩٩٣)

رسالة مقدمة ايفاء جزئياً
لدرجة الماجستير
في علوم البيئة

أحمد السيد إبراهيم الهاشمي
بكالوريوس طب وجراحة الفم والأسنان

كلية العلوم
جامعة الإمارات العربية المتحدة
١٩٩٥