THE ROLES OF OCCUPATIONAL TOXICOLOGY AND PUBLIC HEALTH

BY

COMFORT PETER UDOBANG
DEPARTMENT OF PHYSICAL AND HEALTH EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF UYO, UYO

ABSTRACT

This study investigated the roles of occupational toxicology and public health. The study indicated that occupational toxicology deals with the chemicals found in the workplace with good efforts to identify the agents of concern; the acute and chronic diseases that may cause, define the conditions under which they may be used safely, and prevent absorption of harmful amounts of these chemicals. To prove the importance of occupational toxicology, programmes have been organized for creation of awareness and the importance of the programme include identification of occupational safety and health problems so as to detect and define epidemiologically significant changes in the status of occupational safety and health; evaluation of occupational safety and health problems and occupational hazards so as to understand their causes and to detect their vulnerabilities to prevention; control of occupation safety and health problems through discovering, assessing, and improving measures to reduce occupational hazards, especially through control technology, protective equipment, work practices, and hazard-detect devices as well as dissemination of the knowledge gained such that the affected persons and groups are aware of health consequences and recommended preventive actions. One of the recommendations was that government should ensure creation of awareness of health hazards is made periodically through occupational toxicology in order to help promote good health even the work place.

KEY WORDS: occupational toxicology, public health, programmes, safety

INTRODUCTION

Occupational toxicology deals with the chemicals found in the workplace. The major emphasis of occupational toxicology is to identify the agents of concern, identify the acute and chronic diseases that may cause, define the conditions under which they may be used safely, and prevent absorption of harmful amounts of these chemicals. Gale (1000) defined occupational toxicology to understanding and managing chemical and biological hazards encountered at work. The objective of the occupational toxicologist is to prevent adverse health effects in workers that arise from exposures in their work environment.

Occupational technologists carry out programs from the surveillance of exposed workers and the environment in which they work. Regulatory limits and voluntary guidelines have been elaborated to establish safe ambient air concentrations for many chemicals found in the workplace. Governmental and governmental bodies throughout the world have generated workplace health and safety rules, including short and long term exposure limits for workers.

Winder (1100v) observed that a number of Nigerian organization develop occupational exposure limits (OELs), but much of the effort has focused on a relatively small subset of high volume chemicals, or those with particularly severe toxic end points. As a result, many works are exposed to substances for which no guidance on acceptable exposure levels has been developed.

Chemical toxicity can be acute or chronic or both. An acute response occurs when an employee is exposed to a significant quantity of a chemical for a short duration such as a spill or splash. The effects are usually severe, such as chemical burns, respiratory distress, or nausea. Chronic responses are defined by exposures to chemicals for an extended period of time, e.g., continually handling volatile chemicals outside the chemical fume hood. Chronic health effects may include cancer, necrosis, and damage to the immune system.

Routes of Chemical Exposure

Inhalation: Inhalation is the most frequent route of chemical exposure in the lab. Exposure by this route can produce poisoning by absorption through the mucous membrane of the nasal passage, mouth, throat, and lungs and can seriously damage these tissues (Hutchinson, 1101c).

Skin Contact: Contact with the skin is the second most frequent route of chemical exposure. A common result of skin contact is localized irritation. Many materials are absorbed through the skin quickly and may cause systemic poisoning. The routes through the skin are the hair follicles, sebaceous glands, sweats glands, and cuts or abrasions of the outer layers of the skin.

Injection: Exposure to chemicals by injection seldom occurs in the lab. However, it can inadvertently occur through mechanical injury from glass or metal contaminated with chemicals, when chemicals are handled in syringes or during animal research.

Permissible Exposure Limits

(NIOSH) has developed exposure limits for airborne concentration for any industrial chemicals.

Permissible Exposure Limits (PELs). These limits are used as guidelines when evaluating occupational exposures. These limits which are called

- Threshold Limit Values (TLVs) and Short-Term Exposure Limits (STELs), are maximum airborne concentration either reported in parts per million (ppm) or milligrams per cubic meter (mg/mIII) for an eight-hour or IX-minute exposure, respectively. Exposures within these limits are considered safe for the majority of the population (Croet. 1101L).
- **Action Level:** An airborne level, calculated as an eight (D)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.
- **Ceiling Limit:** The exposure limit a worker's exposure may never exceed.

- **Sampling and Analytical Error:** A statistical estimate of the uncertainty associated with a given exposure measurement.
- **Odour Threshold:** The odour threshold is the lowest concentration of a chemical at which an odour can be detected. The odour threshold may vary and is dependent upon individual sensitivity and odour concentration. For example, butyl acetate has a sweet odour at low concentration and a banana odour at high concentrations. These chemicals with prolong exposure limits (PELs) are said to exhibit warning properties. In other words, once the chemical is detected, the employee has been exposed above the PEL.

The Importance of NIOSH's Occupational Toxicology Problem to Public Health

The importance of toxicology programme in a public health can be summarized as follows:

i. Identification of occupational safety and health problems so as to detect and define epidemiologically significant changes in the status of occupational safety and health.
ii. Evaluation of occupational safety and health problems and occupational hazards so as to understand their causes and to detect their vulnerabilities to prevention.
iii. Control occupation safety and health problems through discovering, assessing, and improving measuring to reduce occupational hazards, especially through control technology, protective equipment, work practices, and hazard-detect devices.
v. Disseminate the knowledge gained such that the affected persons and groups are aware of health consequences and recommended preventive actions.

Expanding the current coverage of OELs is valuable to companies and in the public interest because it:

- Enhances the product stewardship efforts by providing more complete health and safety guidance to product users.
- Promote risk communication by informing workers of potential adverse effects of chemical exposures.
- Provide scientific basis for evaluation whether existing environmental control technologies are adequate (Winder and Stacey, ııoov)

What is Ergonomics?

The term ergonomics is derived from Greek work "ergos" meaning (work) and "nomos" meaning (laws) the laws of work. The simply meaning of ergonomics is "fitting the job to the work". Matoushek (ııood) defined ergonomics as the study of

work and human-machine systems. Ergonomics is the science of designing the job, equipment and workplace to fit the workers. It is concerned with the "fit" between people and their technological tools and environments. It is concerned with how humans interest with manmade objects. The goal of ergonomics is to create an environment that is well suited to a user's physical needs; today there are *ergonomics chairs, ergonomic pens and ergonomics toothbrushes;* basically everything these days is *ergonomically designed.*

Christenson (2011) viewed *ergonomics* as a multidisciplinary science that encompasses concept of physics, medicine, society, work physiology, anthropometry, biomechanics, human efforts engineering and work organization factors. The practice of Health Ergonomics is the application of the science of ergonomics and the sciences of human physiology and pathology, to the design and evaluation of work and work capacity. This is to ensure that the work tasks, machines, tools and environments used for work are safe, healthful and effective for human use. **NIOSH** National Institute of Occupational Safety and Health **(NIOSH)** defines ergonomics as the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and method to design in order to optimize human well-being and overall system performance.

While ergonomics is relevant in many areas, it is commonly applied to the workplace environment. For example, ergonomics is often used to create comfortable workstations for employees. This may involve choosing customized desks and chairs that fit each individual's body type (Croet; Nikhila 2011).

Aims of Ergonomics

The aim of ergonomics is to enhance and preserve human health and satisfaction and to optimize the human performance in the system perspective. Ergonomics is concerned with both employees' well-being as well as organization well-being.

Ergonomics Objective

Berguer (2000) stated that a successful ergonomics programme utilizes the skills of many disciplines, including engineering, psychology, medical safety, management and the employees or associates. The team works together to identify the problem, prioritize the problem, evaluate the cause or reason for the problem and decide the best mode of action to take a remedy the problem. Once these questions have been identified and evaluated, ergonomic change methods can be implemented.

The practice of ergonomics has two primary objectives to enhancing workplace health, safety, and work design issues. These are to:

- Enhance performance and productivity.
- Prevent fatigue and injury.

In order to obtain these objectives, changes need to be made to the worker job interface and addition the four basic methods of change implementation must be

adhered in workplace. These four basic methods of change implementation, or work modification, used to improve or modify the workplace are:

- Change the work process
- Change the work environment
- Change the work management and
- Change the tools

Specific Objectives of the Study of Ergonomics are:

i. To optimize the integration of man and machine in order to increase productivity with accuracy. The following are to be applied:
   a. A work place suitable for the worker
   b. Machinery and controls, so as to minimize mental and physical stain on the worker to enable the improvement in efficiency
   c. A favourable environment for performing the task most effectively
   d. Task and work organization
ii. It will take care of the factors governing the physical and mental stain (i.e. fatigue) so as to get maximum satisfaction for the workers and at the same time enhances productivity.
iii. It also attempts to minimize the risk of injury, illness, accidents and errors without compromising productivity.
v. It improve the design of machine at the initial design stage or later whenever the existing product or process is modified.
x. It contributes to the overall health and efficiency of the work specialized areas of ergonomics.

Major Job Risks (Hazards)

Major job hazards and risks inherent in the workplace as enumerated by Ebong (1100M) are as follows:

1. **Air Contamination:** The most common particulate contaminants include dusts, fumes, mists, aerosols, and fibres. They are commonly classified as either particulate or gas or vapour contaminants.
2. **Chemical Hazards:** Harmful chemical compound are in form of solids, liquids, gases, mists, dusts, fumes, and vapours, and exert toxic effect by inhalation, absorption (through direct contact with the skin), or ingestion (eating and drinking).
3. **Biological Hazards:** These include bacteria, viruses, fungi and other living organisms that can cause acute and chronic infections by entering the body either directly or through breaks in the skin.
4. **Physical Hazards:** These include noise, vibration, illumination, temperature and excessive levels of radiation.
5. **Ergonomic Hazards:** These include excessive vibration, noise, eye stain, repetitive motions, repetitive shocks over prolonged period of time, heavy lifting problems, and improperly designed tools or work areas. Ergonomic hazards are avoided primarily by the effective design of a job or jobsite and better designed tools or equipment.

Ergonomic Factors to be Considered in Workplace Risk Assessments

Based on the view of Hedge (2010c) adopting thorough workplace assessment and analyses, employers can set up procedures to correct or control ergonomic hazards, teaching correct work practices, employing proper administrative controls (e.g. shifting workers among several different tasks, and increasing rest breaks), and providing and mandating personal protective equipment. Motoushek, (2008) added the following ergonomic factors to be:

i. Accident frequently and severity: Jobs where accidents occur frequently or where they occur infrequently but resulting in disabling injuries.
ii. Potential for severe injuries or illnesses.
iii. Newly establsished jobs: due to lack of experience in thesem jobs, workplace contributing factors may not be evident or anticipated.
v. Modified jobs: new workplace contributing factors may be associated with changes in job procedures.
x. Infrequently performed jobs: workers may be at greater risk when undertaking non-routine jobs, and EWA provides an means of reviewing workplace contributing factors.

Workplace Development and Design

As opined by Johnson (2000), during workplace development and design concentration should be given to the following factors:

i. Purpose of operation
ii. Product design-value analysis.
iii. Materials related factors like space required, quality of items , size, etc for raw, finished and scrap materials, rate of production and inspection requirement.
v. Equipment related factors, like size utility, service requirement, auxiliary equipment, number of machines, and space required, nature of process, noise, pollution, vibration, safety hazards etc.
x. Material handling methods
l. Space related factors; like aisles, ceiling height required and space utilization.
c. Operated related factors sitting or standing, Level of comfort, movement required, number of operators and supervision requirement.
d. Working Conditions Noise, lighting, heating, and Ventilation, Dust, vibration, window location.
m. Method of related factors Direction of flow, Floor levels, Location of items, Material movement, Safety requirement, operation sequence, Tools and Material locations, Production rate, Auxiliary Services.

Design of Machinery and Controls:

Most machines today are reasonably well designed for optimum performance, but the capacity of the worker assigned to the machine is generally different. This may result in a job taking longer to complete and the risk of errors increases. To prevent this, user and machinery must be looked as a combined unit. Thus the ergonomics must be involved in fitting the tool and the machine to the worker by designing it accordingly.

Guidelines of Ergonomics

Guidelines to workplace ergonomics should cover the following as listed by Mitchell and Mitchell (2003).

People in Systems – Systems ergonomics, Managing change, Ergonomics risk management, Adapting risk management to ergonomics, Employee participation in problem solving, Participatory risk assessments, Communication at work.

Task Design – Fragmentation of work, Workload, Under-load and overload, Job satisfaction, Work demands and job control, Problems arising from poor task design, sedentary work, Computer work, Repetitive work, Risk factors and the National Standard, Driving Vehicles and Operating Machines, Training experience and skill development, Acquisition of physical skills, Skills development and individual differences, Identifying training needs, Education and training in ergonomics.

The Work Environment: Workplaces, Layout of workplaces, Workshops and other industrial work areas, Designing for maintenance tasks, illumination and lighting, Normal working lighting, Noise, Controlling exposure, Hand-arm vibration, Work in hot or cold environments, Individual tolerance to heat and cold.

Equipment Design: Workstations, consoles, work benches, Tools, Handles, Forces, Type of operation, Displayed and oral information, Visual Displays, Instruments and other visual displays, Warnings, Safety signs Labelling and Identification, Chair and seating ll seated work and sitting Vehicle displays, Guidelines and standards, Computers and workstations, The visual environment.

Work Organization: The design of the work process should safeguard worker's health and safety, promote their well being, and facilitates task performance, in particular by avoiding overloading and under loading. Overloading produce fatigue, while under loading results in monotony which diminishes vigilance. Flexible work hours, Peaks and troughs in workload, shift work and extended hours, Advantages of shift work, Compress work weeks, Rest and Work breaks, Rest and Work, Consultation and feedback, Types of teams, economic and social influences.

Application of Ergonomics are in the Following Areas:

Application of ergonomics in developing countries is in the increase in various sectors: such as industry, agriculture, education, health, transport, roads, services, sports, building, tourism and electronic field. Nigeria would benefit from the application of ergonomic principal as a mean that can be a background to the preventive culture that may have a positive and productive impact on the economics, psycho-social, and health, whether at the level of institutions or community. (Federation of European Ergonomics Societies, 2000).

1. Design of Man-Machine Systems:

A man-machine system is a system where one or more workmen/human being work in relation with one or more machines, devices and equipment. Thus a worker drilling a hole in a job or a person using a hammer to drive a nail in a wooden job (an article being manufactured is an example of a man-machine system

as far as ergonomics is concerned. (Berguer, 2000). Ergonomics is applied to adapt such systems so as to provide maximum job satisfaction and comfort and minimum physiological and mental load to the operator of the system.

2. Design of Consumer Good and Service Systems:

Ergonomics is applicable in the design of consumer good starting from design of tooth brush and other items as dinning set; sofa set, kitchen ware, house hold fittings table and shoes etc. Similarly protective equipment such as safety goggles, adverse whether and space clothing, gloves, crash helmets, fire fighting and industrial hazard protection and appliances etc. should also be economically sound.

3. Design of Working Environment

The work environment should be designed and maintained so that physical, chemical, biological conditions have no adverse effect on people, but serve to ensure their health, as well as their capacity and readiness to work, while designing a proper working environment for work force/workers at work, the various factors related with ergonomics such as human endurance of illumination, pollution, noise heating and ventilation should be taken into consideration. This aspect should be taken into consideration at each stage right design by the engineers up to real utilization or actual service by consumers. (Chand, 2001).

Administrative Control of Ergonomics – Employ Health Education

Thapa (2003) opined that the administrative level could implementation workplace ergonomics by:

- Replacement of person for the job like static position
- Replacement of worker for suitable job
- Provision of safety working environment
- Provision of good management for reducing psychological effects on workers. It includes keeping good interpersonal relationship between lower and higher staffs and good leadership.
- Should have and follow proper occupational policy.
- Rest and breaking of worker to minimize ergonomic hazards. Workers should be given proper working training and education to minimize hazard by using good performance.

Proven benefits of a strong workplace ergonomics process:

1. **Ergonomics reduces costs:** By systematically reducing ergonomic risk factors, you can prevent costly **MSD**s, this represents an opportunity for significant cost savings. Also, don't forget that direct costs can be up to twenty times the direct cost of an injury.
2. **Ergonomics Improves Productivity:** The best ergonomic solution will often improve productivity. By designing a job to allow for good posture, less exertion, fewer motions and better heights and reaches, the workstation becomes more efficient.

3. **Ergonomics Improves Quality:** Poor ergonomics leads to frustrated and fatigued workers that don't do their best work. When the job task is too physically taxing on the worker, they may not perform their job like they were trained. For example, an employee might not fasten a screw tight enough due to a high force requirement which could create a product quality.
4. **Ergonomics Improves Employees Engagement**: Employees notice when the company is putting forth their best efforts to ensure their health and safety. If an employee does not experience fatigue and discomfort during their workday, it can reduce turnover, decrease absenteeism, improve morale and increase employee involvement.
5. **Ergonomics Creates a better safety culture**: Ergonomics shows your company's commitment to safety and health as a core value. A cumulative effect of the previous four benefits of ergonomics is a strongly safety culture for your company. Healthy employees are your most valuable asset; creating and fostering the safety and health culture at your company will lead to better human performance for your organization.

Conclusions

From the findings made it could be concluded that occupational toxicology deals with the chemicals found in the workplace and identifies the agents of concern, the acute and chronic diseases that may cause. The occupational toxicology programmes help in the identification of occupational safety and health problems so as to detect and define epidemiologically significant changes in the status of occupational safety and health; evaluation of occupational safety and health problems and occupational hazards so as to understand their causes and to detect their vulnerabilities to prevention; control of occupation safety and health problems through discovering, assessing, and improving measuring to reduce occupational hazards, especially through control technology, protective equipment, work practices, and hazard-detect devices as well as dissemination of the knowledge gained such that the affected persons and groups are aware of health consequences and recommended preventive actions.

Recommendations

i. Government should ensure creation of awareness of health hazards is made periodically through occupational toxicology in order to help promote good health even the work place.
ii. Workers should embrace the knowledge created in the programme meant for promotion of good health. With this, the issue of health will be remarkably mitigated

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