Occupational Hazards, Legislation and the Combined Effect of Work Environment Stressors on Performance

Işıl Nurdan Işık

Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Industrial Engineering

Eastern Mediterranean University
December 2020
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

Prof. Dr. Ali Hakan Ulusoy
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Doctor of Philosophy in Industrial Engineering.

Assoc. Prof. Dr. Gökhan İzbırak
Chair, Department of Industrial Engineering

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Doctor of Philosophy in Industrial Engineering.

Asst. Prof. Dr. Emine Atasoylu
Supervisor

Examining Committee

1. Prof. Dr. Murat Caner Testik

2. Prof. Dr. Bela Vizvari

3. Assoc. Prof. Dr. Adham Makkie

4. Asst. Prof. Dr. Emine Atasoylu

5. Asst. Prof. Dr. Sahand Daneshvar

ABSTRACT

Occupational safety and health regulations are established to maintain a safe and healthy work environment and to assure the welfare of people at work. The intended goals of these written laws, rules, and regulations are not met without proper enforcement. Work environment stressors such as heat, light, dust and noise affect both employee well-being and job performance. To date, there is a gap in the literature on the combined effect of stressors on the health and performance of employees in real time, which this study intends to address.

The aims of this study include identifying the current state of occupational safety and health in North Cyprus, evaluating the effectiveness of the North Cyprus occupational safety and health law numbered 35/2008, ascertaining the degree to which employer risk assessment obligations are met, and determining the combined effect of work environment stressors on job performance.

This thesis consists of two Phases. In Phase I, the methods used are directed towards identifying current practices, the effectiveness of the occupational safety and health law, and to evaluate the risk assessments conducted by employers with questionnaires. In Phase II, measurements were made in real time of work environment stressors (heat, light, dust, noise) using appropriate devices. Work sampling method and employee self-assessments were used to evaluate work performance. The combined effect of work environment stressors on performance were identified using univariate analysis and linear regression.

The results show that the North Cyprus occupational safety and health law (35/2008) is effective as written but not useful due to lack of enforcement. An occupational safety and health management system model is suggested to overcome these challenges. This study also shows that there is a significant combined effect of measured work environment stressors on work performance.

The combined effect of work environment stressors on employee job performances in a manufacturing company is an important contribution to the literature as these measurements were made in real time compared to researcher-controlled stressors that have been reported in the literature. Moreover, the use of the work sampling method to evaluate performance is studied for the first time in a manufacturing environment. The design and results of this thesis will form the basis for future research in this field.

Keywords: OSH, Legislation, Work Environment Stressors, Combined Effect, Work Sampling, Performance.

ÖZ

Güvenli ve sağlıklı bir çalışma ortamı ve iş yerindeki insanların refahını sağlamak için iş sağlığı ve güvenliği yönetmelikleri oluşturulmuştur. Bu yazılı kanun, tüzük ve yönetmelikler, uygun uygulama yapılmadan, amaçlanan hedefleri karşılamaz. Isı, ışık, toz ve gürültü gibi çalışma ortamındaki stres faktörleri hem çalışanın refahını hem de iş performansını etkiler. Literatürde bu çalışmanın ele almayı amaçladığı bir boşluk bulunmaktadır. Bugüne kadar, stres faktörlerinin, çalışanların sağlığı ve performansı üzerindeki birleşik etkisine dair gerçek zamanlı bir çalışma bulunmamaktadır.

Bu çalışmanın amaçları, Kuzey Kıbrıs'taki mevcut iş sağlığı ve güvenliği durumunu belirlemek, 35/2008 sayılı Kuzey Kıbrıs iş sağlığı ve güvenliği kanununun etkinliğini değerlendirmek, işveren risk değerlendirme yükümlülüklerinin ne ölçüde yerine getirildiğini tespit etmek ve iş ortamındaki stres faktörlerinin (ısı, ışık, toz, gürültü) iş performansı üzerindeki birleşik etkisini belirlemeyi içermektedir.

Bu tez iki aşamadan oluşmaktadır. Aşama I' de kullanılan yöntemler, mevcut uygulamaları, iş sağlığı ve güvenliği yasasının etkinliğini belirlemeye ve işverenler tarafından yapılan risk değerlendirmelerini değerlendirmeye yöneliktir ve anketler kullanılmıştır. Aşama II' de, bir imalat şirketinde, çalışma ortam stres faktörleri için (ısı, ışık, toz, gürültü) uygun cihazlar kullanılarak, gerçek zamanlı ölçümler yapılmıştır. İş performansını değerlendirmek için iş örnekleme yöntemi ve çalışan öz değerlendirmeleri kullanılmıştır. İş ortamındaki stres faktörlerinin performans üzerindeki birleşik etkisi, tek değişkenli analiz ve doğrusal regresyon kullanılarak tanımlanmıştır.

Sonuçlar, Kuzey Kıbrıs iş sağlığı ve güvenliği kanununun (35/2008) yazıldığı gibi etkili olduğunu, ancak kanunun uygulanması için yaptırım olmadığını göstermektedir. Bu sorunları gidermek için bir iş sağlığı ve güvenliği yönetim sistemi modeli önerilmektedir. Bu çalışma aynı zamanda ölçülen çalışma ortamı stres faktörlerinin iş performansı üzerinde anlamlı bir birleşik etkisinin olduğunu göstermektedir.

Çalışma ortamı faktörlerinin bir imalat şirketinde çalışanların iş performansları üzerindeki bu birleşik etkisi literatüre önemli bir katkıdır çünkü bu ölçümler literatürde bildirilen araştırmacı-kontrollü faktörlere kıyasla gerçek zamanlı olarak yapılmıştır. Ek olarak, bu çalışma bir üretim ortamında dört çevresel stres faktörünün bir ofis ortamındaki iki veya üç stres faktörüne kıyasla birleşik etkisini ele almaktadır. Ayrıca, performansı değerlendirmek için iş örnekleme yönteminin kullanımı, bir üretim ortamında ilk kez incelenmiştir. Bu tezin tasarımı ve sonuçları, bu alanda yapılacak gelecekteki araştırmalar için temel oluşturacaktır.

Anahtar Kelimeler: İSG, Mevzuat, Çalışma Ortamı Stres Faktörleri, Birleşik Etki, İş Örnekleme, Performans.

to the man who is the world itself

Sezai Işık

ACKNOWLEDGMENTS

I would like to express my sincere gratitude and appreciation to my supervisor Asst. Prof. Dr. Emine Atasoylu for her endless support, kindness, guidance, patience, encouragement and belief in me throughout my research. Such a mentor and an amazing person one could be so lucky to have met. I'm the lucky one who had the chance to study with her. Thank you for all the joy we had through this journey!

I would like to thank the examining committee members; Prof. Dr. Murat Caner Testik, Prof. Dr. Bela Vizvari, Assoc. Prof. Dr. Adham Mackieh, Asst. Prof. Dr. Sahand Daneshvar for their contributions to my thesis.

Deepest appreciation to my beloved sister Ayşe Atasoylu for her priceless advice, inspiration, for all her contributions at every stage of my study, and for encouraging me to see different perspectives from the beginning to the end.

I would like to thank all of my family members, especially my mum, sisters, friends, coworkers and teachers who helped me grow. I felt your love and support every day of my life. I'm so grateful to have all of you in my life.

And, to my daddy, I wish you could have been here with me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACGIH	The American Conference of Governmental Industrial Hygienists
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
EU	European Union
ILO	International Labor Organization
NC	North Cyprus
NIOSH	The National Institute for Occupational Safety and Health
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OSHMS	Occupational Safety and Health Management System
PPE	Personal Protective Equipment
RA	Risk Assessment
RAL	The Recommended Alert Limits
REL	The Recommended Exposure Limits
SA	Self-Assessment
SME	Small and Medium Sized Enterprises
WBGT	Wet Bulb Globe Temperature
WES	Work Environment Stressors
WHO	World Health Organization
WS	Work Sampling

Chapter 1

INTRODUCTION

1.1 Occupational Safety and Health

Occupational safety and health (OSH) is a multidisciplinary area including health, education, law, and the environment. The World Health Organization (WHO) and The International Labor Organization (ILO) first defined the aims of Occupational Health in 1950 as: “the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations by preventing departures from health, controlling risks and the adaptation of work to people and people to their jobs” (WHO/ILO, 1950).

Historically, several work-related health problems and tragedies raised concern for occupational safety and put pressure on governments to establish regulations to protect the people at work and others affected by workplaces. In 1970, after a growing number of accidents and health problems the United States Congress passed the OSH Act and gave authority to OSH Administration to establish mandatory standards (Goetsch, 2008). This was the beginning of a new era for OSH.

ILO (2008) defines OSH as:

> Occupational safety and health (OSH) is generally defined as the science of the anticipation, recognition, evaluation and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment (p.7).

It is important to note that occupational safety and health have distinct definitions. Safety relates to situations causing injury such as hazards resulting from sudden severe conditions, and health is related to disease causing conditions such as adverse outcomes from prolonged exposure to dangerous but less intensive hazards. Although these definitions have distinct meanings, the terms occupational health, occupational safety, occupational safety and health, or occupational health and safety are often used interchangeably.

While the aim of OSH is to protect workers' health and safety by providing a safe and healthy work environment, OSH also has far reaching importance through its impact on the environment, economy, and worker productivity. Companies with good OSH management practices have less environmental impact, and a healthier workforce is more productive, which in the long run, contributes to the country's economy.

When considering OSH, one could take a broad focus, as in considering an entire industrial sector, or take a narrow focus when considering a specific workplace. OSH issues can be generalizable across industrial sectors or industry and workplace specific. The construction and manufacturing industries are considered higher risk due to the nature of workplace environment factors and working conditions. In addition to the construction and manufacturing industries, OSH legislation/practices also include the following sectors: service, agriculture, forestry, and transportation. OSH encompasses any work-related 1. accidents/incidents, 2. diseases, 3. workplace risks such as environmental exposures (biological, physical or chemical), as well as 4. the determination of workplace risk, and 5. the monitoring and controlling of risks.

Workplace environments can either directly or indirectly affect employee health. A direct effect is defined as being affected by some risks in that workplace. An indirect effect may be the exposure of workers to various workplace products and waste products in the form of solids, liquids or gas, which reach the environment and result in occupational exposure of workers. Likewise, this environmental exposure may not be limited to workers if for example there is improper disposal of waste, contamination of surrounding water sources or air pollution.

When possible, it is always important to control the risk at its source. If controlling risk at the source is not feasible, technical methods are used to control the exposure, and whenever necessary, the use of personal protective equipment (PPE) is enforced to limit exposure in order to protect the health and safety of workers.

Periodic OSH training is required to protect employees. Training of employees would include sharing information on known workplace hazards, workplace specific raw materials, products and waste products, and their associated risks, as well as, the proper usage of PPE and instruction on safe work procedures.

Proper OSH practices are more likely when OSH legislation requiring regular workplace inspections is properly enforced. Risk assessment (RA), is an extremely important step in the OSH risk management process. The Canadian Center for Occupational Safety and Health (CCOHS, 2018) defines risk assessment as: “The overall process or method where you: Identify hazards and risk factors that have the potential to cause harm (hazard identification). Analyze and evaluate the risk associated with that hazard (risk analysis, and risk evaluation)”.

Risk assessments assist in determining the hazards and the precautions which need to be taken for each hazard. The responsible personnel to enforce these precautions are also identified as a result of the risk assessment.

Hazard is something with the potential to cause harm, while risk is defined as the chance that someone would be harmed from the hazard. Risk reflects both likelihood that harm will occur and its potential severity (Stranks, 2002).

Risk assessment includes 5 stages (OSHA Factsheet, 2008):

1. Identifying the hazards and those at risk
2. Evaluating and prioritizing risks
3. Deciding on preventive action
4. Taking action
5. Monitoring and reviewing.

Identification of hazards and those at risk (first step) can be achieved using certain techniques or it can be predicted from the work that company is doing, the workplace environment, and the equipment being used. Risk prioritization (step 2) is then determined by rating risk (finding the risk level) according to severity and probability of an incident (or how likely is it that the hazard will result in harm) using the following equation.

$$\text{Risk Rating} = \text{Probability (Likelihood)} \times \text{Severity} \quad (1)$$

There are some methods for identifying risk level in the literature, the most common being the Matrix Method as seen in Figure 1.1, where the degree of harm (severity) from a specific hazard and its likelihood (probability) is rated from 1 (lowest severity or unlikely) to 5 (highest severity or highly likely), and the product of these two factors

gives the risk level (risk rating). Others methods used in identifying risk level include Checklists, Hazard Operability, Hazard Analysis and Critical Control Points, Failure Modes and Effect Analysis, Fault Tree Analysis, and Event Tree Analysis (Goetsch, 2008; Asfahl, 2003).

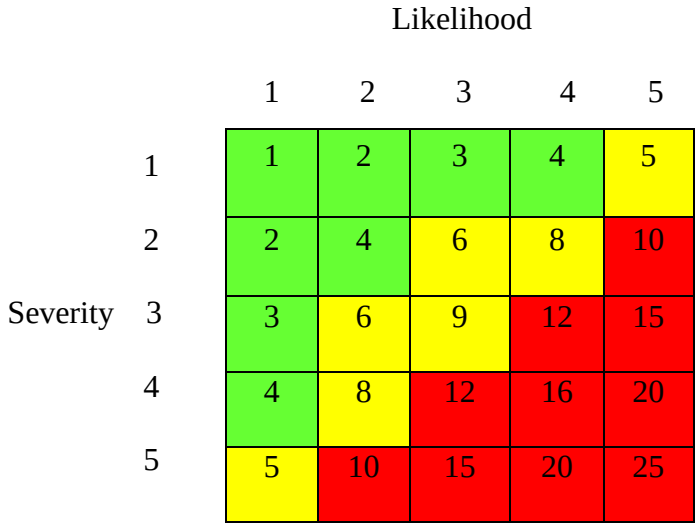


Figure 1.1: Risk Rating Matrix (Green: Low, Yellow: Medium and Red: High Risk)

When deciding on preventive action (step 3) the goal is to eliminate or control hazards. Whenever possible the hazard is eliminated. When this is not possible, an approach is taken to minimize the risk by replacing the hazardous material, equipment or procedure with one that is less hazardous, thereby controlling the hazard at the source. These represent the application of collective measures and technical preventive methods, instead of individual protective measures.

Preventive and protective measures are key components of the action step (step 4) of RA. It is essential that employers and employees are part of this process. The action plan is the implementation of the specified preventive measures with an assignment of roles and responsibilities (who does what, when), and a designated completion time.

Monitoring and reviewing (step 5) of the RA ensures that the preventive and protective measures are checked periodically to determine whether they have been implemented and if so, whether they are meeting the desired endpoints to prevent or reduce risk. In the event that new problems arise, the nature and degree of the hazards must be identified and reviewed.

1.2 Legislation

Companies are mandated to provide a healthy and safe environment for their employees. In order to do this, legislation is important. In 2008, the North Cyprus government established an OSH law (35/2008) that requires companies to perform RA and this law has been enforced since March 2009 (NC Labor Office, 2008).

Before the NC OSH Law was established, there was a general statement about OSH in the NC Labor Law, (NC Labor Office, 1992) section six under articles 54 and 55. This section was referred to as "worker health and occupational safety" and consisted of two pages with five articles (54-58), including the following employer responsibilities: 1. providing a safe work environment, 2. providing equipment for this regard, and 3. reporting all accidents and incidents within two days to the government labor office. The remaining articles gave the government officers the right to stop work or shut down the workplace until precautions were taken if the hazard posed a risk to the life of an employee.

It was recognized that this general statement, emphasizing employer obligations for providing a safe work environment, was insufficient, resulting in the government establishing the 35/2008 NC OSH Law, which also harmonized with the OSH Laws of the European Union (EU). Of note, North Cyprus is not part of the EU.

The NC OSH Law is very similar to the EU Directives (89/391/EEC) (EU-OSHA, 1989). The NC OSH Law states to the employer that having OSH management system is important and providing a better work environment for employees is their responsibilities.

In order to achieve improvement in OSH with regulations, government commitment to OSH is vital (Annan et al., 2015). Studies show that clarity of regulations result in improved OSH practices. According to Andersen et al., 2019 workplace inspections, with or without penalties, are necessary to ensure effective legislation. Other studies show that inspections with penalties have the greatest impact on reducing OSH incidents (Tompa et al., 2016).

1.2.1 Regulation for Women

In 2013, The International Labor Organization (ILO) established guidelines for safety professionals and included a gender factor in their RAs (ILO, 2013). In the past two decades, the European Agency for Safety and Health at Work and WHO has also recommended gender sensitive RAs. These initiatives have raised awareness around gender differences, aiming to address any potential problems women employees may be facing while working in traditionally male dominated jobs (European Agency for Safety and Health at Work, 2013; EU-OSHA, 2014; WHO, 2006).

In addition to the NC OSH Law, in 2015 gender specific regulations were established for women who may be pregnant, postpartum or breastfeeding (article 44, 2015). This regulation defines OSH related rights for women in these circumstances, as well as, employer responsibilities such as precautions needed to be taken for their protection.

In the second section of this regulation, informing women employees about their rights and performing gender sensitive RA are described. For pregnant, postpartum and breast-feeding women, the employer has to evaluate the nature, duration and degree of exposure to any workplace hazard, and take OSH preventive measures. These measures might include a change in working hours or conditions and if this is not possible, job re-assignment (specified under article 7). In this regulation, hazards are categorized as physical, chemical and biological factors that might put at risk the health and safety of either the woman employee and/or their fetus (Article 8). According to the regulation, women who provide a medical document stating that they are pregnant or have a specific health problem that might worsen as a result of the workplace hazard cannot be forced to work in the environment where they would be exposed to said hazard. Additionally, pregnant women providing a medical document stating that nightshift work would adversely affect their health and safety, and/or that of their fetus, may request to work daytime shifts, and employers are required to honor their request.

1.3 Employer Obligation

The NC OSH law includes ten Articles under the Employer Obligation section and Article 8 describes the Employer RA Obligation. This Article states that employers are required to conduct and keep record of periodic RAs and that they are responsible for all the activities, devices, equipment, and materials in the workplace as well as the health and safety of their employees.

Article 8 continues to describe a step by step approach to properly conducting and reporting a RA and the employer responsibilities following the RA. Based on the results of the RA, the employers are required to implement preventive measures, as well as, to provide and ensure the use of PPE by employees. Additionally, in instances

where conducting a RA is not possible, such as the lack of qualified onsite OSH trained personnel, Article 8 states that outside assistance can be requested from government certified OSH professionals.

OSH professionals are trained and licensed by the NC government to meet a specific standard while conducting RAs. This training has been organized by the NC labor office since 2011 and is mostly delivered by university professors. Participants who complete the training and pass the exam are licensed as OSH professionals. In this capacity, the authorized OSH professionals are able to conduct official RAs, prepare and sign all the related documents, and provide OSH services to companies such as onsite training and guidance on how to eliminate or control hazards. In the event of an undesirable OSH incident, the employer and the involved licensed OSH professional share the same responsibility. Companies which carry out RAs without any OSH professional, bear the sole responsibility for the OSH related incident and its consequences.

In 2011, fifty OSH professionals were trained and licensed. In 2015, forty additional OSH professionals were trained to increase the number of professionals available to provide sufficient services (periodic training programs and courses) to all NC companies.

1.4 Environmental Factors and Performance

It is known that 4 basic environmental factors, heat, light, air quality and noise affect employee well-being and job performance. The risks to human health of these environmental factors are systemic (heat stress), visual (light), pulmonary (air quality) auditory/non-auditory (noise), and psychological (light, noise, heat, air quality).

1.5 Goals and Objectives

The goal of this study was to investigate the current state of OSH practices in North Cyprus, and to evaluate the effect of workplace environment stressors on performance. The study had 2 Phases. The objectives of the first Phase were to:

- measure the effectiveness of the NC OSH Law (35/2008)
- determine the extent to which employer obligations are met as written in the OSH law,
- assess to what extent RAs are carried out.

The objective of the second Phase was to:

- determine the combined effect of workplace environmental stressors on OSH and employee performance.

Chapter 2

WORK ENVIRONMENT STRESSORS

2.1 Heat

Heat is one of the most important environmental factors affecting working conditions. It affects human perception, perceived air quality, and can result in a reduction in alertness and job performance. Excessive heat exposure can lead to heat-related illnesses such as heat stroke, heat shock, heat cramps and fatigue. Additionally, work-related injuries and accidents were associated in the literature with hot working conditions causing fatigue, loss of concentration, physical discomfort and reduced alertness (Jackson & Rosenberg, 2010; Reese & Eidson, 2006).

The body temperature of a healthy person is 37°C which is called the 'set point' (Sherwood, 2016; Parsons, 2014; Kenney, 2015; CCOHS, 2016) and varies based on the rate of blood flow. When the body temperature increases, this alters the distribution of heat with blood flow through the skin. On the other hand, when the body temperature is low, the body tries to increase the core temperature to the set point using the heat protected in the deep tissues. Brauer (2006) described that the human body systems reach a set core temperature in response to environmental conditions, which is related to metabolic heat. A person doing physical activity creates metabolic heat inside the body. Fast dissipation of heat from the body to the environment can cause a person to feel cold, whereas, slow dissipation of heat to the environmental can lead to feeling hot. Different ways in which heat dissipates include convection, conduction,

respiration and evaporation by sweating (Kenney, 2015; Blazejczyk, 2014). When air temperature is higher than skin temperature, this difference in temperature can lead to overheating of the body and sweating starts. Sweating may result in the loss of one liter of body fluid per hour (Sawka et al., 1993). Unless replenished, this fluid and salt deficit can have health consequences including symptomatic exhaustion, kidney disease and chronic effects on the heart.

Humidity, air velocity, radiant temperature, air temperature, clothing and metabolic rate together can contribute to an increase in body temperature. The insufficient response of the body's thermoregulatory system to these factors may produce heat stress. Heat stress also known as net heat load is referred to as the heat received in excess from external and internal heat sources (Goetsch, 2008; Havenith, 2005). Heat stress is expressed by the National Institute for Occupational Safety and Health (NIOSH, 2016) as: "The net heat load to which a worker is exposed from the combined contributions of metabolic heat, environmental factors, and clothing worn which results in an increase in heat storage in the body".

NIOSH (2016) also describes heat stress as metabolic heat which is generated inside the body, plus environmental heat gained from outside, minus body's heat loss to the environment.

Heat stress index is a numerical value derived from the integration of the effects of six parameters - humidity, air velocity, radiant temperature, air temperature, clothing and metabolic rate which can be measured or calculated. Heat stress index represents the heat strain of a worker who is exposed to heat. Heat strain is the overall physiological response of the human body to heat stress. As such, heat strain on the body can be

predicted using heat stress indices. There are several types of heat stress indices which have been developed and are used to protect workers from excessive heat exposure. The most commonly used heat stress index is the Wet Bulb Globe Temperature (WBGT) that was developed in the 1950s. This heat stress index considers radiant temperature, air temperature, humidity and air movement, all of which affect rates of heat transfer from the body.

The WBGT value corresponds to the degree of exposure at different levels of work intensity. The designated WBGT limits aim to protect workers from excessive heat (>38°C). Kjellstrom et al. (2009a) suggest workers wear appropriate seasonal clothing, take breaks from work to cool the body down in order to maintain safe core body temperature below 38°C. According to WHO, workers should not be exposed to work environmental temperatures that would result in an internal body temperature of 38°C or greater (IHSA, n.d.).

Body temperatures exceeding 39°C can pose serious health risks including mental confusion, change in behavior, central nervous system failure and even death at a core temperature of 40°C (Parsons, 2009). High body temperatures can occur when the heat load is more than heat loss from the body (Spector et al., 2015; Sawka, et al., 2011).

Occupational injuries are more likely to occur with increased duration of heat. Fatigue, reduced psychomotor performance, loss of concentration and reduced alertness associated with heat exposure can all lead to injury (Varghese et al., 2018; Spector et al., 2019). Other individual factors such as sweaty palms, fogged up safety glasses, physical demanding work, lack of training and skills, impermeable PPE's etc. can also contribute to a higher risk of occupational injuries (NIOSH, 2016). Additionally,

worker demographics such as age, gender, as well as their work tasks and the industry in which they work, are useful in predicting workplace injuries caused by heat exposure.

Work capacity is defined as the percentage of a working hour that an employee can perform a task. Reduced work capacity and cognitive performance can even occur at heat exposures that do not lead to core temperatures of 38°C or greater, leading to an increase in accident risk (Kjellstrom et al., 2009a). This highlights the inverse relationship between productivity and accident risk as a result of heat exposure (Fisk, 2000; Wyon, 2004).

Kjellstrom et al. (2009b) cited that Axelsson was one of the first to establish the inverse relationship between heat exposure and productivity. Subsequently, Lundgren et al. (2013) also described the impact of thermal conditions on physical work and expected outcome or productivity.

In indoor environments, highest productivity is at work environmental temperatures of 22°C and productivity decreases at temperatures less than 21°C or over 24°C. Furthermore, in the range 25-32°C performance decreases by 2% for every degree centigrade increase in temperature above this range (Seppänen, 2006).

Flouris et al. (2018) showed that 35% of the workers who work under heat stress reported a 30% decrease in their productivity. For every degree increase above 24°C WBGT, productivity decreased by 2.6%.

Tewari & Sudarshan (2014) in their study reported a 1%-3% decrease in productivity for every 1°C increase in temperature. It has also been shown that productivity decreases at temperatures below 25°C and recovery of productivity can take more than a week (Ciuha et al., 2019). Kjellstrom et al. (2009a) emphasized that hourly work capacity is reduced when WBGT exceeds 26°C and work activities are hardly done at temperatures beyond 32°C.

Studies on climate change estimate an increase in environmental temperatures of 1.7 to 3.4 °C by the year 2080. This will impact work environments, especially workers in countries with very hot seasons and in low to middle income countries where air-conditioning is mostly unavailable (Lundgren & Kjellstrom, 2013; WHO, 2018).

Acclimatization refers to the physiological adaptation to the environment (Pogačar et al., 2018). NIOSH (2016) defines the upper limit of heat exposure, above which workers should not be working. Permissible exposure levels are determined in two categories for workers exposed to environmental and metabolic heat : 1) the Recommended Alert Limits (RAL) for workers who are not acclimated, and 2) the Recommended Exposure Limits (REL) for those who are acclimated and protects workers from heat related health effects.

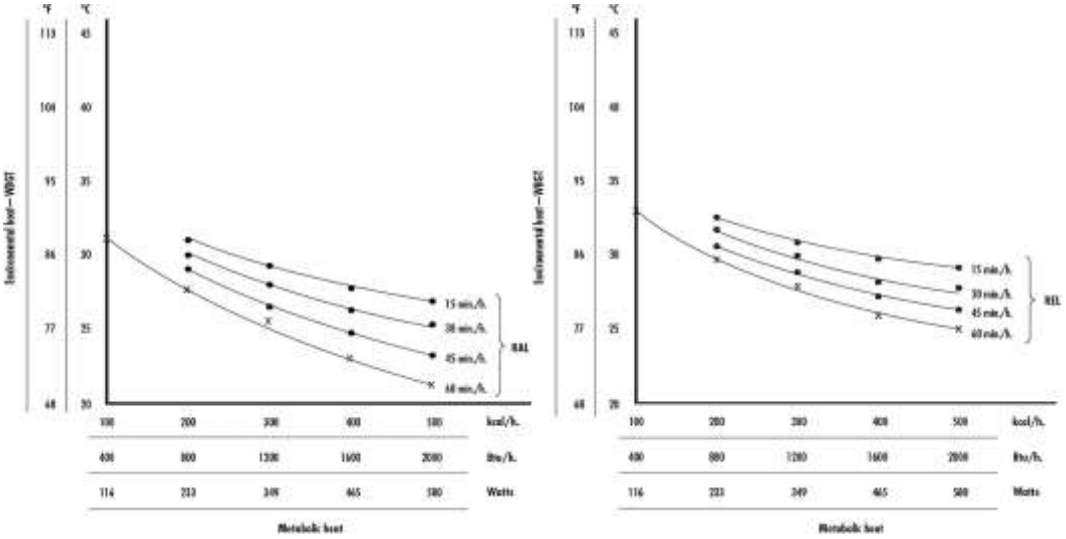


Figure 2.1: RAL-REL

The NIOSH (2016) recommends rest-breaks for the workers to dissipate the stored inner heat and protect against developing heat stress. As stated by NIOSH, they should work with planned work/rest schedules based on the RALs and RELs which are established according to metabolic heat generated by different workloads (Figure 2.1).

The RALs and RELs are defined according to a "standard man" (70 kg body weight and 1.8 m^2 body surface) in order to normalize the data. Gender based standards do not exist. Traditionally regulations have not made gender distinctions in tolerance and adaptation to heat. The literature on gender differences in heat tolerance has been controversial. One study by Venugopal et al. (2016) emphasized that high heat (WBGT 30°C) exposure is a health risk for women workers while Lundgren et al. (2013) describe women as having a higher core temperature, more efficient at disposing of heat and better able to tolerate humidity than men.

2.2 Light

Lighting in the workplace is an important environmental factor affecting OSH. Light dose is light exposure received by the eyes either directly from the source or indirectly

reflecting off another surface (Bellia et al., 2011). Adequate workplace lighting is required to reduce accident and incident risk. Poor lighting has been associated with a decrease in work speed, performance and productivity, as well as, an increase in the number of work breaks, absenteeism, errors, accidents and injuries (Hoffmann et al., 2008; Juslén & Tenner, 2005). Natural lighting is recommended whenever possible.

Poor or inadequate lighting can cause discomfort in the visual system commonly referred to as eye strain as well as lead to visual deterioration and directly affect worker performance. Symptoms of eye strain include irritation, itchiness, double or blurred vision and can often vary based on the task performed or the duration in poor lighting (Health and Safety Executive, 1997). Additionally, poor lighting can lead to general fatigue, mental fatigue, a slower response time when carrying out tasks, a negative impact on behaviors or attitudes, and a decrease in job satisfaction. Anxiety, migraine headaches, nausea, pain in the back, neck and shoulders, and poor concentration are other negative effects of inadequate lighting in the workplace (Hawes et al., 2012; Lee & Brand, 2005; Sundstrom et al., 1994). Employees needing to adjust their posture to avoid glare or see the task from a different angle often sustain awkward postures while working (Health and Safety Executive, 1997) leading to neck and back pain. Workers can also be exposed to excessive contrast and flicker as a result of inadequate lighting.

Workplace design should consider adequate lighting based on the work environment, and type of work being performed in order to optimize worker health, reducing eye pain, headache and general fatigue (CCOHS, 2020). Research shows that nonglare and thermally comfortable work environments increase worker productivity (Abdou, 1997; Hemphälä & Eklund, 2012). Additionally, when there is sufficient lighting workers feel happy, more active (Smolders & de Kort, 2014) and there is less daytime

sleepiness resulting in an increase in performance (van Bommel & van den Beld, 2004). Employees working in offices with an open floor plan that have adequate lighting have a reduction in eye symptoms, fatigue, cognitive problems and an increase in performance (Baron et al., 1992; Boudreau et al., 2013; Haapakangas et al., 2012).

Illuminance is a parameter that measures in lux units the light on a unit area of a work surface and determines the adequacy of the light level to see an object (Occupational Safety and Health Branch Labour Department, 2008). Daylight factor is used to determine illuminance from natural sources (Al Horr et al., 2016). According to Consensus Statement (Lowden et al., 2019), workers who are working near windows have more daytime alertness due to exposure to natural daylight. Higher job satisfaction, work performance and improved visual comfort and health have also been associated with working near windows or in environments with natural lighting (Katabaro & Yan, 2019; Al Horr et al., 2016; Jamrozik et al., 2018).

Circadian rhythm is the internal body clock that realizes the day and the night. Night shift workers experience circadian rhythm disturbance where the body gets confused because when workers are ready to sleep, they have to work, when they are alert, they have to sleep. Circadian rhythm disturbance results in body malfunction which in turn causes daytime sleepiness, nighttime insomnia, an increased accident rate, as well as reduced cognitive performance which results in a decrease in work performance (Juslén & Tenner, 2005). Circadian adaptation corrects for this and is possible with artificial lighting. Research on lighting and its effect on circadian adaptation shows it is possible to improve worker well-being using proper lighting (Lowden et al., 2019; Burgess et al., 2002; Boudreau et al., 2013). Women and men are approximately equally likely to be shift workers (19% and 21%, respectively) (Burgess et al., 2002).

Pauley (2004) has shown that night shift workers have higher incidence of cancer including breast cancer in women.

Lighting should be adequate for different work activities. Daylight Factor recommendations have been established for different types of activities. For instance, simple activities such as reading, or filling requires 1.5%-2.5% Daylight Factor, while machine work requires 8% Daylight Factor (Stein et al., 2010). There are also recommended illumination levels. On average, the recommended illumination levels for offices range between 300 and 750 lux, for general building areas (outdoor car parks and information desks) 10-500 lux, and for manufacturing and processing areas 200-1000 lux. For special activities such as working with fine pieces, local lighting is required (Preto & Gomes, 2019; Occupational Safety and Health Branch Labour Department, 2017; Health and Safety Executive, 1997).

2.3 Dust

Studies show that air quality affects worker health, comfort, productivity and performance. Poor air quality has been associated with reduction in worker performance (De Giuli et al., 2012; Nevalainen et al., 2003), and a study by Wyon (2004) showed that poor air quality could reduce office worker performance by 6-9%. Conversely, studies by Reijula (2008) and Wyon (2004) demonstrated that good quality air improved worker well-being, performance and productivity.

It has been recognized that there are short and long-term consequences to poor air quality including the development of chronic symptoms or diseases. For example, although it might not be apparent in the short-term, mental health can be impacted and mental illness can be a long-term consequence of poor air quality (Singh, 1996;

Wargocki et al., 2002). Additional long-term health problems can include cardiovascular disease, hypersensitivity and allergies, as well as asthma-related issues (Houtman et al., 2007; Jaakkola et al., 2013). Symptoms which arise as a result of poor air quality include dry and irritated eyes, nose, throat and skin, as well as, headaches, fatigue, shortness of breath, sinus congestion, coughing, sneezing, dizziness and nausea.

One of the main reasons for sub-optimal air quality is poor air circulation and lack of ventilation systems. Ventilation systems are necessary to reduce air pollutants (Nevalainen et al., 2003). Studies show that the most common indoor air problems are dry and stuffy air, dust, dirt, draft, unpleasant odor, chemicals, molds, fungi, bacteria, gases, vapors, and moisture (Reijula, 2008; Wolkoff & Nielsen, 2017; Kwong et al., 2018).

Singh (1996) also identified the following factors affecting indoor air quality: 1. design and construction, 2. environmental, 3. perceptual and psychological, 4. cultural and organizational. The combined effects of these factors can affect health.

Indoor air parameters can be divided into three categories; physical, chemical and biological. Physical parameters include room temperature, relative humidity and air movement. Chemical parameters include carbon dioxide, carbon monoxide, ozone, formaldehyde, and total volatile compounds. Biological parameters include airborne bacteria and fungal counts (Van Tran et al., 2020).

Ventilation falls under construction and design as well as physical parameters affecting air quality. In a study by Pitarma et al. (2016), natural ventilation was advantageous

over mechanical ventilation reducing energy cost, but mechanical ventilation provided controllable fresh air and removed contaminants faster than natural ventilation. It is notable that in buildings where mechanical grinding, welding and fabrication is performed, the total particulate levels are higher in the air if the space is naturally ventilated (Kwong et al., 2018). Mukhopadhyay et al. (2014) cited that worker exposure to indoor pollutants, may be 2 to 5 times, and occasionally up to 100 times higher than exposure to outdoor pollutants (US EPA, 2013).

Among the physical indoor parameters affecting air quality, research on humidity reveals that low humidity has some adverse effects such as dryness of the eyes, nose and throat, while high humidity, above 80%, causes fatigue and stuffiness. Additionally, humidity can cause growth of mold and dust mites, which can affect the airways and cause or exacerbate existing asthma (Edimansyah et al., 2009).

2.4 Noise

Noise can be simply defined as unwanted sound and one of the most important occupational hazards known to have auditory and non-auditory effects on health (Stansfeld & Matheson, 2003; Al-Arja & Awadallah, 2020; Tessier-Sherman et al., 2017; Basner et al., 2014).

Auditory effects of noise such as temporary or permanent hearing loss are well studied in the literature (Lie et al., 2016; Levin et al., 2016; Bedi, 2006; Lao et al., 2013; Eleftheriou, 2002; Martinez, 2012). Recent studies have increasingly focused on the non-auditory effects of noise. Findings include the adverse effects of noise exposure including cardiovascular disorders, hypertension (Dzhambov et al., 2014; Tomei et al., 2010; Dzhambov & Dimitrova, 2016; Nserat et al., 2017), sleep disturbance (Hume,

2010; Münzel et al., 2014), stress level, (Abbasi et al., 2019), annoyance (Ali, 2011; Beutel et al., 2016), mental illness, cognitive performance (Basner et al., 2014; Liebl & Jahncke, 2017), and poor pregnancy outcomes (Dzhambov et al., 2014; Ristovska et al., 2014). Additionally, emotional changes such as anger, helplessness, disappointment, depression, anxiety, agitation, distraction, dissatisfaction, withdrawal, as well as, exhaustion and stomach discomfort (WHO, 2011), have all been associated with noise exposure. Research has also revealed a relationship between noise exposure and a decline in job performance (Abulude et al, 2018) and an increase in work related injuries (Basner et al., 2015; Lusk et al., 2004; Münzel et al., 2014; Yoon et al., 2015; Tzivian et al., 2015; Ristovska et al., 2014; Pyko et al., 2015).

Occupational noise exposure has been found to increase the likelihood of injuries in a manufacturing plant where potentially dangerous machines are used (Dzhambov & Dimitrova, 2017). Workers, exposed to background noise, fail to perceive auditory warning cues and have difficulty concentrating, which can lead to mental fatigue and human error (Morata et al., 2005; Brammer & Laroche, 2012; Picard et al., 2008).

Noise-induced hearing loss can be caused by sound pressure levels higher than L_A 75-85 dB eg, in industrial settings, which can either be a one-time impulse sound exposure, or prolonged exposure to a continuous sound. In some industries noise levels can exceed 85 dBA (OSHA, 2006). According to Atmaca et al. (2005), industries in Turkey, had noise levels greater than 80 dBA.

Hearing loss due to occupational noise exposure is higher in developing countries (Lie et al., 2016), where worker hearing loss can range between 7% and 21% (Nelson et al., 2005; Dobie, 2008). In addition to an increase in work related accidents and injuries

hearing loss has severe social impact since it leads to the inability to understand speech (Basner et al., 2014).

Long-term occupational noise exposure and cardiovascular disorders have been studied in industrial settings with a higher incidence of cardiovascular disease and mortality were noted among noise-exposed workers (Basner et al., 2014). Some studies have also shown a relationship between noise exposure and hypertension (Attarchi et al., 2012) while results of other studies did not support these findings (Tessier-Sherman et al., 2017).

Many countries enforce general health and safety legislation. To protect workers from excessive noise exposure, OSH legislation includes workplace noise level assessments, setting maximum noise exposure limits, PPE usage to reduce noise exposure, as well as audiometric testing to monitor for hearing loss. The U.S. Occupational Safety and Health Administration (OSHA) defines the permissible noise exposure limit at L_{Aeq8h} 90 dB, and if the exposure level exceeds L_{Aeq8h} 85 dB, employers are required to provide a hearing conservation program to their at risk employees (OSHA, n.d.).

Noise exposure levels are higher in some specific work sectors including industry, shipbuilding, construction, military and farmers, putting these workers at higher risk for hearing loss than those working in other sectors (Lie et al., 2016).

In a study conducted by Anjorin et al. (2015) on noise in industries such as refining, mining, oil and gas, construction and manufacturing, found that workers were exposed to noise levels greater than 85 decibels (A-weighted)(dB[A]).

Haapakangas et al. (2008) found that employees working in offices with an open space plan are more affected by noise than those working in traditional office spaces. Productive daily work hours were reduced by half, in office settings with an open space plan, as employees tried to overcome the noise factors by taking extra breaks and working overtime in order to maintain their productivity and well-being.

Occupational noise concerns of SMEs are greater due to lack of resources and insufficient hazard management (Laird et al., 2011; Reinhold et al., 2015). SMEs and small workshops are rarely the focus of studies on occupational noise (Jabbari et al., 2016) yet it is known that job performance of employees in the SMEs are also impacted by noise exposure. One study showed a significant relationship between noise and work performance in SME employees working in the manufacturing industry who are aware that noise exposure can lead to hearing loss (Mapuranga et al., 2020).

Normal hearing is defined according to an international standard (ISO, 2013). There is natural a decline in hearing with age in the frequency range of 3-8 kHz, and hearing loss is associated with men more than women. By age 60, age-related hearing loss is approximately 30-40 dB for men and 20 dB for women in the range of 3-6 kHz (Lie et al., 2016).

Noise exposure during pregnancy has an effect on the health of infants and is associated with a low birth weight (Ristovska et al., 2014).

2.5 Combined Effect of Work Environment Stressors

Work environmental stressors may include physical, chemical, biological, social and work organizational factors. Stansfeld & Matheson, 2003 suggested studying the combined effects of multiple stressors rather than simply summing up the effect of

individual stressor. In a study by Abbasi et al. (2020), the combined effects of noise and air temperature condition was larger than each individual effect.

Hygge & Knez (2001), studied the combined effect of noise, heat and light on cognitive performance and found that in noisy environments, workers have more attention, but reduced accuracy. The combined effect of noise and heat was found to impact long term recall, while noise and light affected free recall of emotionally toned words. The study was done in an office setting where temperature, noise and illuminance were controlled by researchers. Results showed women performed better in problem solving tasks and remembered more words than men.

In an experimental environment, Chao et al. (2013), studied the combined effect of noise, vibration and low temperature (5°-25°C) on physiologic parameters. They concluded that noise was the major factor in hearing loss, while vibration and temperature did not have an impact on hearing. The combined effect of hand/arm vibration and low temperature was found to potentially induce white finger syndrome.

Temporary threshold shift (TTS), also known as auditory fatigue, is defined as temporary hearing loss following noise exposure. Chen et al. (2007) studied the combined effect of noise, heat and workload exposure and concluded that recovery from TTS was longer when short-term noise exposure occurred in the setting of heavy workload and hot environments.

For a task performance studied by Muzammil et al. (2011), illumination level, noise level and the age of a worker was shown to have significant effect on task performance.

Higher noise levels with poor lighting had a negative effect on assembly performing tasks of works of varying age groups.

Dianat et al. (2016) studied noise, lighting and heat in three manufacturing sites to collect both quantitative and qualitative data to better understand the work environmental conditions and worker perception. The study concluded that worker perception of work environmental factors and the measurements taken were consistent and these factors affected work performance.

According to a study by Abbasi et al. (2020), the combined effect of noise and air temperature were found to be more significant on human memory than each alone. Neurophysiologic response to stimuli was noted to be aggravated by an increase in temperature while working at high noise levels, while response accuracy was not affected. Reaction time of cold exposed subjects was noted to be much slower in noisy environments.

Shi et al. (2013) studied the combined effect of temperature, relative humidity and work intensity on human strain and found that heat significantly impacted human strain at intense workloads.

A study by Realyvásquez et al. (2016) showed that temperature, humidity, air quality, noise and lighting had a significant combined effect on both employee performance and psychological characteristics.

There are studies with one stressor effect on self-assessed performance. For instance, controllable thermal environment with self-assessed performance in an office

environment found that thermal satisfaction improves workplace productivity (Tanabe et al., 2015; Geng et al., 2017) concluded that in a controlled office environment thermal comfort had an effect on productivity.

Kang et al. (2017) studied the impact of indoor environmental factors on worker activity such as layout, air quality, thermal comfort, lighting and acoustics. They concluded that all these factors individually affected worker activity, but acoustics had the greatest impact on worker productivity. Among other common office noises, conversation noise had the most significant negative impact.

Chapter 3

METHODOLOGY

3.1 Phase I Methodology

Structured interviews and questionnaires were used to understand employee awareness of OSH, the effectiveness of the OSH law, and the fulfillment of RA obligation by employers in NC. Questionnaires were administered in three different stages. First, employers were interviewed to see whether they were conducting RAs, and if so, they were asked to complete a questionnaire. OSH professionals and labor office inspectors were also surveyed to get their opinion on OSH law and its effectiveness. Another questionnaire addressed gender specific regulations and OSH issues affecting women in the workforce.

3.1.1 Employer Interview Questionnaire

The employers were interviewed using a questionnaire designed to determine: 1) their knowledge of OSH law, 2) whether they had received any OSH training, 3) if they provided OSH training to their employees, 4) whether they were conducting RAs, 5) knowledge of any workplace hazards, 6) precautions being taken, 7) whether they received any services from authorized OSH Professionals, 8) whether a government inspector had conducted a preventive inspection, 9) if employers were keeping records of the accidents, 10) if employers had knowledge of the requirement to report accidents to the government labor office within two working days of the accident, and, 11) any other recommendations or opinions employers had to share about workplace OSH or RA problems, and what additional topics they might like to learn (Appendix A).

3.1.2 Risk Assessment Questionnaire

The questionnaire was distributed to companies which carried out RAs. It includes three sets of questions. First set was designed to get information about the company. The other sets were designed to understand effectiveness of the OSH law and the effectiveness of the RA which they performed, respectively.

Questions using a 5-point Likert scale (strongly agree, agree, no idea, disagree and strongly disagree) were designed to identify how OSH law improved the workplace, how OSH law improved precautions taken by the company, and the effectiveness of the OSH law in terms of its applicability.

Another 5-point Likert scale question set (always, often, sometimes, rarely and never) assessed the effectiveness of the RA in determining hazards and taking precautions, how RA results are used in OSH measures, and how RAs are used in the employer-employee collaboration processes. Yes/No type questions were structured to identify how employers use the information they gather through RA in planning risk evaluation, how they are organizing the information to perform harm and risk evaluation, and which topics they are taking into account for harm and risk evaluation. Additionally, employers are asked at the end of the questionnaire to share narrative comments or suggestions regarding other OSH issues and any comments or suggestions regarding the questionnaire (Appendix B).

3.1.3 OSH Professionals Questionnaire

In the second stage of Phase I, a questionnaire was distributed to OSH professionals to gather their opinion and experience about OSH law and its effectiveness, and to learn how they were conducting official RAs for companies. The questionnaire utilized a 5-point Likert scale, Yes/No type questions and open-ended questions.

A section of the questionnaire was designed to gather personal information from the OSH professional including workplace, education level, which year and where they received their OSH professional license, the number of companies to which they provided professional services and the number of RAs they performed after obtaining licensure, the sectors to which they provided their professional services, and any difficulties they faced while conducting RAs.

The 5-point Likert scale (strongly agree, agree, no idea, disagree, and strongly disagree) were prepared to determine the effectiveness of the NC OSH law and to understand how it contributes to improving the work environment.

Additional 5-point Likert scale (strongly agree, agree, no idea, disagree, and strongly disagree) were prepared to ask professionals to evaluate how legislation and enforcement can be improved and to rank order each item numerically from 1 to 10 based on importance towards improving enforcement of OSH law and regulations (1= most important, 10= least important). An open-ended question was included to get additional recommendations from the OSH professionals on enforcement of OSH legislation, law and regulations. A Yes/No type question was structured to understand their considerations about determining harm while conducting RAs.

5-point Likert scale (strongly agree, agree, no idea, disagree, and strongly disagree) were structured to understand which precautions companies take after conducting RAs and how companies were using the results of risk determination and risk evaluation.

An open-ended question was included at the end of the questionnaire, asking OSH professionals to share any recommendations or suggestions about the questionnaire or any other OSH issue (Appendix C).

3.1.4 OSH Inspectors Questionnaire

In the third stage of Phase I, a questionnaire was distributed to the labor office OSH inspectors. There were 13 inspectors in NC, 2 in Girne, 2 in Gazimağusa, 1 in Güzelyurt and 8 in Lefkoşa. Personal information was gathered including place of employment, education level, which year and where they started doing inspections, whether and where they received training to become an inspector, the number of workplace inspections they completed after becoming an inspector, how often (monthly/yearly) they were doing inspections, how many of these inspections were preventive inspections, the sectors to which they gave their professional service, and any difficulties they faced while doing inspections.

The remaining sections of the OSH inspectors questionnaire are just about the same as the OSH professional questionnaire.

Questions using the 5-point Likert scale (strongly agree, agree, no idea, disagree, and strongly disagree) were prepared to understand the effectiveness of the NC OSH law and how it contributed to improving the work environment.

Additional 5-point Likert type questions (strongly agree, agree, no idea, disagree, and strongly disagree) were prepared to ask inspectors to evaluate how legislation and enforcement can be improved and to rank order each item numerically from 1 to 10 (1= most important, 10= least important) based on importance towards improving enforcement of OSH law and regulations. An open-ended question was included to get

any additional recommendations from the OSH inspectors on enforcement of OSH legislation, law and regulations. A Yes/No type question was structured to understand their considerations about determining harm during RAs.

Questions using the 5-point Likert scale (strongly agree, agree, no idea, disagree, and strongly disagree) were structured to understand which precautions companies take after conducting RAs, and how companies are using the results of the risk determinations and risk evaluations.

An open-ended question was included at the end of the questionnaire, asking OSH Inspectors to share any recommendations or suggestions about the questionnaire or any other OSH issue (Appendix D).

3.1.5 Gender Specific OSH Legislation Questionnaire

Hospital workers (excluding physicians) were surveyed to explore any gender differences in OSH, and more specifically whether male and female hospital workers in North Cyprus are equally protected in the work setting. A meeting was held with a doctor from the management team to understand OSH policies and issues in the hospital. The 50-bed hospital with a total of 60 non-physician employees (47 female and 13 male) includes inpatient, outpatient, emergency, surgical, obstetric, primary and specialty services.

The questionnaire was distributed to 41 of the 45 employees actively working during this study period. There was a 90% response rate (31 female and 6 male).The questionnaire was designed to gather demographic information such as age, gender, weight (BMI), highest level of education, current and past job titles, duration of employment, average hours at work per day, nature of work such as average duration

standing or sitting per day, number of days of overtime or night shift worked, average number of hours of sleep, and the number of missed work days in the past year due to health problems, work related injury or illness, or family issues such as the sole provider of child care and other responsibilities at home.

The questionnaire included a 5-point Likert scale and Yes/No type questions, as well as a space for narrative comments. The 5-point Likert scale questions addressed safety issues, environmental conditions at work, impact of hazards, availability of suitable PPE, work requiring an uncomfortable posture and inquiry into any pain in the neck, back, shoulders or arms, exposure to violence, any experience of burnout, any other work or home responsibilities , any stress due to home responsibilities, and work-life balance. A section of the questionnaire (Yes/No responses) was designed for women employees to identify any difficulties they may experience at work due to dysmenorrhea, pregnancy and lactation (needing to breastfeed). Another section of the questionnaire (Yes/No responses) assessed: OSH training of employees, the variability of work shifts (day or night), the adequacy of the daily work breaks (duration and number), and whether employees went home with work clothes. There was also a question to determine the average number of cigarette breaks an employee took per day. Open ended questions were included to determine employee perspective and understanding of potential occupational hazards, preventive measures, whether they felt protected from potential harm, and to gather their concerns and suggestions (Appendix E).

Statistical analysis of questionnaire responses was conducted to find any significant gender difference in responses. Analysis was also conducted to determine any significant correlation among the gender groups.

3.2 Phase II Methodology

In Phase II, work environment stressors including heat, light, dust and noise were measured using devices in a wood-working company. The floor plan of the wood working company can be seen in Appendix F. Measurements were made in all four seasons (Winter, Spring, Summer and Fall) in parallel with a self-assessment questionnaire which assessed worker understanding and perceptions of selected stressors in the work environment. Work sampling method and self-assessment results were used in order to evaluate work performance. For each season, five days were selected and for consistency, the observation time for workers were the same using the work sampling method. In other words, the randomly selected times of the day when the workers were observed during the five days in Winter, were the same times of the day as the five days in all the other seasons.

Work sampling method was first introduced to the British textile industry by L.H.C. Tippett in 1940 under the name of 'ratio delay.' It collects necessary information in less time and at lower cost compared to other methods because it is an observational method. It has three main uses; activity and delay sampling, performance sampling and work measurement (Barnes, 1980). Work sampling method is basically based on the probability that an event is likely to occur. Therefore, when the samples are large enough, random observations reflect the real situation with a certain error. In this thesis, work sampling method is used to determine performance. Observations are made of employee working and non-working time during their daily work shift. During the study period, each workers was doing the same job.

For the work sampling method, the following study procedure was defined. Study steps include:

- Definition of the problem.
- Study approval by the employer, defining workers to be included in the study, and making them understand the purpose of the study.
- Determining the accuracy of the final result, the confidence level and the error.
- Preliminary work sampling study.
- Designing the study i.e., deciding on;
    - number of observations which were going to be made,
    - number of workers to be observed,
    - number of days needed for observations and
    - designing an observation form to be used.
- Analyzing and summarizing the data at the end of each day.
- Checking the error at the end of each day to decide on when to stop the observations.
- Preparing the report (Barnes, 1980; Van Blommenstein et al., 2011).

The stated problem is clearly explained to the employer and workers. The employer granted permission to the observer to make measurements, observations and conduct a questionnaire. The observer made sure that workers understood the procedure. The preliminary work sampling is held with 95% confidence interval with 5% error. The number of observations, days and workers were therefore determined for the study, and an observation form was designed. A ‘table of random sampling times’ from (Barnes, 1980, pp.428) was used to determine the randomly selected observation

times. Therefore, for each day, random observation times were defined. Table 3.1 shows the observation form example.

Table 3.1: Observation Form

# of worker / time	Time 1		Time 2			Time n	
	Working	Idle	Working	Idle	. . .	Working	Idle
W1							
W2							
.. .. ..	.. .. ..		.. .. ..				.. .. ..
W15							

At the end of each day, error was calculated using the following formula.

$$Sp = 2\sqrt{\frac{p(1-p)}{N}} \quad (2)$$

where S= desired relative accuracy

p= percentage expressed as decimal

N= number of random observations (sample size).

Calculations are continued until the error (relative accuracy) reached less than 0.05 at a confidence level of 95%. When error was less than 0.05, observations were stopped as this signified that an adequate number of observations required to determine performance had been reached. The number of observations was equal to 1725 per season while total working time observations were 1299, 1107, 1332 and 1342 for Winter, Summer, Spring and Fall, respectively.

Additionally, a questionnaire was distributed to all fifteen workers at the beginning of the measurements for each season, to understand whether their opinions and mental or physical conditions had changed. This questionnaire consisted of worker demographics, working conditions, and work-life balance, (5-point Likert scale), overall health questions (5-point Likert scale), as well as knowledge of OSH and their perceptions of workplace stressors (Yes/No type questions) (Appendix G). At the end of each day, workers answered self-assessment questions including questions about the work environment and their own performance (Appendix H).

The Sound Level Meter (SE-400) device was positioned at 1.0 m above ground and at least 1.0 m away from the source. The Personal Noise Dosimeter (The Edge-5) device was placed onto the shoulder of workers responsible for woodcutting. Exchange rate was 5 dB for both devices as recommended by OSHA. Threshold limit value for Noise Exposure is 90 dBA for an 8-h work shift. For the impulse noise, exposure should not exceed 140 dB peak sound pressure level.

Measurements were A-weighted, slow response because it is the closest to human hearing. The Environmental Monitor (EVM-7) device was positioned at the center of the two cutting machines at 1.0 m above ground and at least 1.0 m away from the sources for monitoring dust levels. The Air Probe (Air Probe-9) device was attached on the EVM-7 to monitor air flow in the area.

The Heat Stress (QuesTemp36°) device was positioned in the center of the working area. The Light Meter (SDL400) device was used to monitor lighting on working machines and work areas. An 8-h sampling duration was administered. Table 3.2 shows log time, units and standards for the devices used.

Table 3.2: Devices

Device	Model	Log	Unit	Standards
Sound Level Meter	SE-400	1 min	dBA	OSHA
Personal Noise	The Edge-5	1 min	dBA	OSHA
Environmental Monitor	EVM-7	15 s	mg/m^3	ACGIH
Air Probe	Air Probe-9	15 s	m/s	ASHRAE
Heat Stress	QuesTemp36°	1 min	C°	NIOSH
Light Meter	SDL400	1 min	Lux	OSHA

The flow chart for the methods section can be found in Figure 3.1.

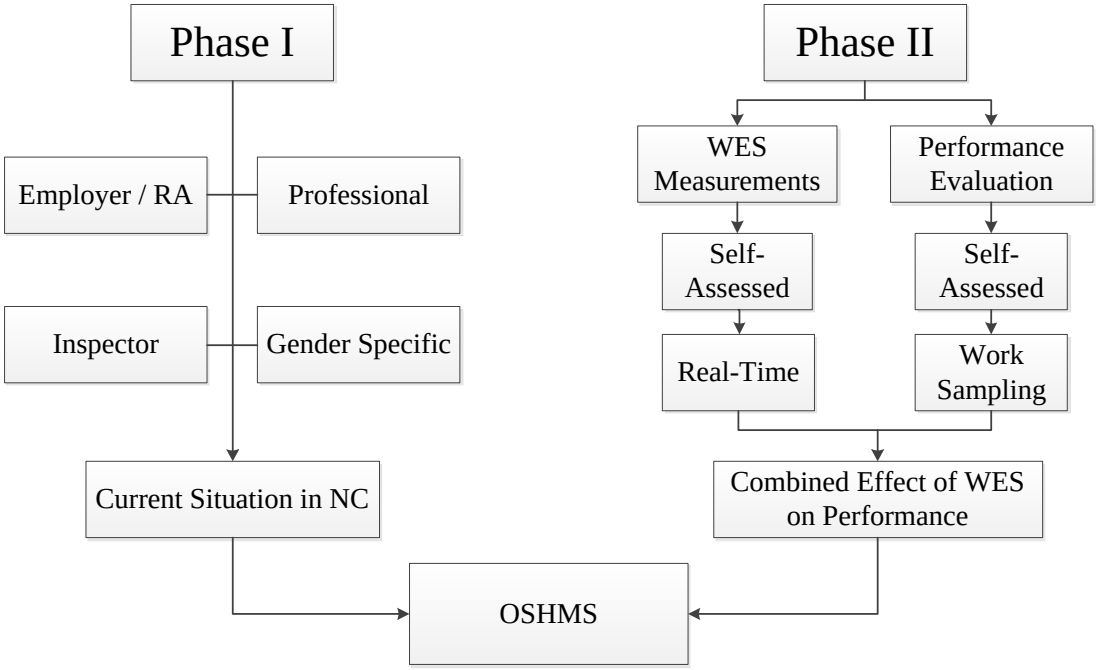


Figure 3.1: Flow Chart

3.3 Limitations

One limitation of this study is the limitation inherent in using questionnaires in the study design which relies on opinion rather than objective data. However, the consistency between the responses given by the OSH professionals and the inspectors suggests that this was not a major limitation. Additionally, the lack of proper OSH record keeping did not allow for researchers to correlate results of questionnaires with objective data. The choice of one manufacturing company as the study site could be a

concern for generalizability. However, based on the information gathered during the interviews, this site was representative of other manufacturing settings. Finally, within a long work day workers were considered to be doing the same task, however it is possible that work varied somewhat such as the type of board that was being cut or a worker moving from their own work areas to help with the assembly process whenever necessary. This different or additional work task could have potentially increased or decreased the worker need for a break. These were considered by the researchers to be rare events and therefore unlikely to affect the study results.

Chapter 4

RESULTS

4.1 Phase I Results

4.1.1 Interview Results

Employer or employer representatives from randomly selected 92 of 170 actively working construction and manufacturing companies were visited and interviewed. The manufacturing companies studied are classified based on their products including dairy, bakery, soft drinks/beverages, cleaning, metal, aluminum, wood and ship manufacturing and maintenance.

The employment years of the those interviewed ranged between 1 month and 35 years, holding job titles of managers with supervisory roles to company directors. Company directors are main shareholders of the company, with at a minimum of a high school education, most had a Bachelor's degree and a few had a Master's degree.

Table 4.1: Some Responses to the Interview Type Questionnaire

Questions	YES %	NO %	NO IDEA %
Is there an OSH law in North Cyprus?	21.7	75.0	3.3
Should there be an OSH law?	80.6	-	19.4
Do you (or did you ever) carry out RA in your workplace?	13.0	87.0	-
Do you have an OSH professional in your company or do you have an OSH professional from another company working for you?	10.9	89.1	-
Do you know how to reach a North Cyprus OSH professional?	7.6	92.4	-
Has a Labor office inspector ever visited your company for OSH preventive inspection?	1.1	98.9	-
Have you received any OSH training?	32.6	67.4	-

Are you giving or did you ever give OSH training to your employees?	44.6	55.4	-
Are you keeping records of accidents?	-	100	-
Did you know that accidents have to be reported to the Labor office within two days?	71.6	28.4	-

*survey was administered in Turkish – the native language of the population studied.

As seen in Table 4.1, only 21.7% employers or their representative stated that there is an OSH law in NC, 75% of the respondents were unaware of the NC OSH law and 3.3% had no idea. 80.6% of the respondents agreed that there should be an OSH law in NC, while 19.4% stated they had no idea.

Only a minority of respondents (13%) reported ever carrying out a RA in their workplace, while 87% said that they did not. They viewed the RA obligation as good, but in practice they did not meet this requirement. Some of the reasons for non-compliance with this requirement included considering RA unnecessary for their workplace, finding the cost of RAs prohibitive, and having the opinion that the precautions that they were already taking were adequate. They also stated that they were not informed of the law, that their workplace never received an OSH inspection, and for these reasons they did not benefit from the law.

Most respondents (89.1%) stated that their workplace did not have an OSH professional, or that they were not getting any OSH service from an outside professional, while a minority of respondents (10.9%) stated that they had. 92.4% of respondents did not know how to reach an OSH professional. Nearly all (99%) responding employers reported that they did not have a preventive inspection by a Labor office inspector. The majority of respondents (67.4%) had received OSH training, while 32.6% had not. Just over half of respondents (55.44%) reported giving

OSH training to their employees, while 44.6% had not. All of the respondents said that they did not keep any records of accidents, 71.6% knew they were required to report the accidents to the labor office within two days, and 28.4% were unaware of this requirement.

Most of the employers (77%) knew that hazards, if present, could cause serious harm and they were taking some precautions based on their practical knowledge. Employers recognized workplace hazards as including machinery, risk of fire, exposure to chemicals, excessive heat, noise, dust, pressurized devices, steam, risks associated with working at heights, heavy lifting, as well as objects falling from overhead.

Ninety eight percent of the companies stated that they have fire extinguishers, 38% said they provided PPE to their employees including masks, gloves and glasses. 7.6% reported to have machine and forklift operating procedures. None commented on any preventive measures they were taking.

Of note, companies did not provide any PPE to prevent hearing loss and they did not monitor noise levels. Of the respondents with OSH training, this training consisted of a one-day seminar from the chamber of commerce. Those who conducted RAs in their workplace were trained by an authorized OSH professional or a company providing the OSH service. Only two companies reported giving periodic OSH training to their employees.

The theme of responses to open-ended questions focused on the expectation employers (or their representatives) had from the government including the expectation that the government: (1) announce a fixed price for the RA service provided by OSH

professionals or other companies providing this service, (2) cover the cost of at least the first RA, (3) cover 70% of the expenses for a RA as an incentive to get it done, (4) cover the cost of safety warning signs, (5) provide companies with OSH related information, (6) offer OSH training, (7) train more OSH professionals so that companies can have their own engineers or staff trained and certified instead of getting OSH services from other companies, and (8) accept external international certification as meeting the OSH RA requirement.

4.1.2 Risk Assessment Questionnaire Results

The results of the RA questionnaire which was distributed to companies carrying out RAs in their workplace can be seen in Figures 4.1 to 4.10. The reliability test resulted in alpha = 0,903.

One hundred percent of the companies stated that, while performing RAs, they consider accident/incident risk, physical strain factors, ergonomic hazards, and other risk factors such as heavy lifting, improper work postures (question 4, Figure 4.1). Over 60% (66.7%) considered mental strain (fast working, excess / low workload, negative environment in the workplace, lack of job security, time constraints) in the RA, while a third (33.3%) did not. All of those stating that they did not consider mental strain in the RA thought that they should.

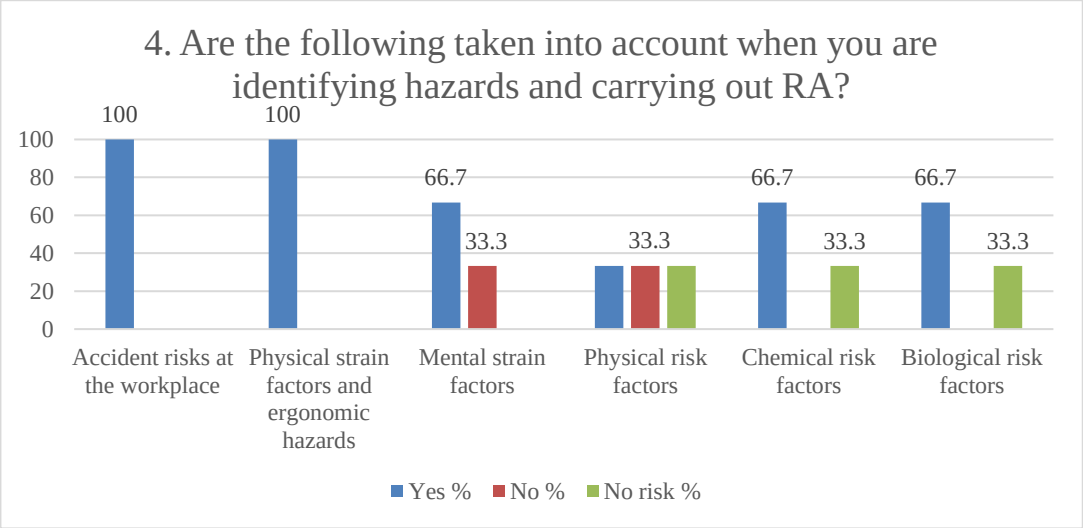


Figure 4.1: RA1-Factors Taking into Account During RA

Thirty three percent of the respondents stated that they consider physical risk factors (noise, vibration, heat, lighting), 33.3% responded that they did not but felt that they should, and 33.3% stated that they were not considered. For chemical (gas, steam, dust) and biological risk (mold, bacteria) factors, 66.7% stated that these were considered, while 33.3% said they were not considered while performing a RA.

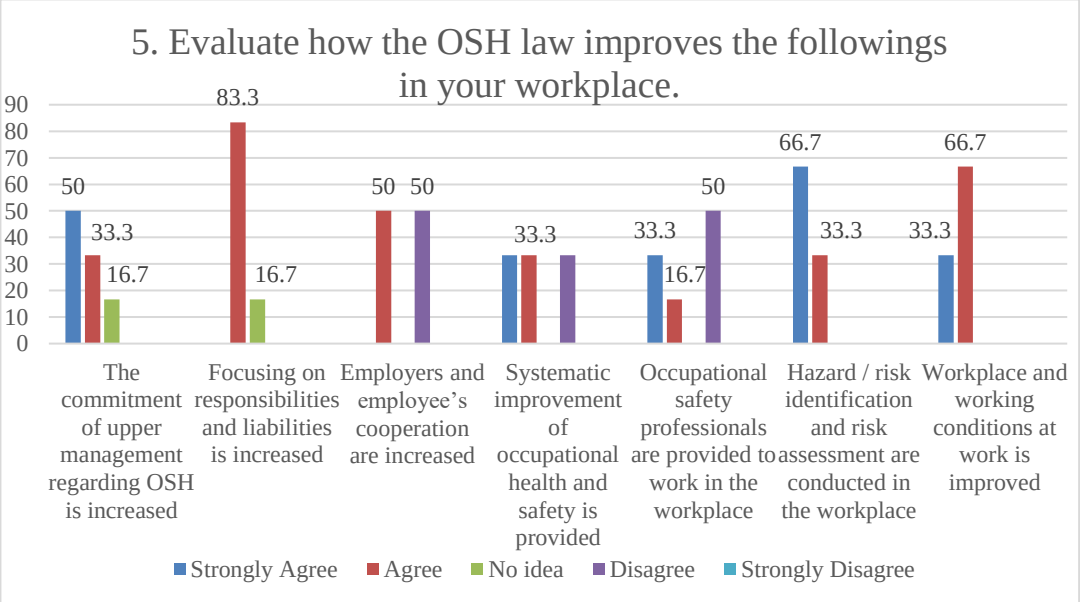


Figure 4.2: RA2-How the OSH Law Improves the Workplace

Eighty three percent of the companies strongly agreed or agreed that OSH law increased the commitment of upper management regarding OSH as well as responsibilities and liabilities, while 16.7 % had no idea (question 5, Figure 4.2).

The majority of respondents (67%) felt that the law promoted a systematic improvement of OSH in the company (strongly agreed or agreed) while the rest (33%) did not.

All respondents (100%) either strongly agreed or agreed that hazard identification and RA were made possible with the OSH law, that the work environment and the working conditions were improved due to the existence of this law.

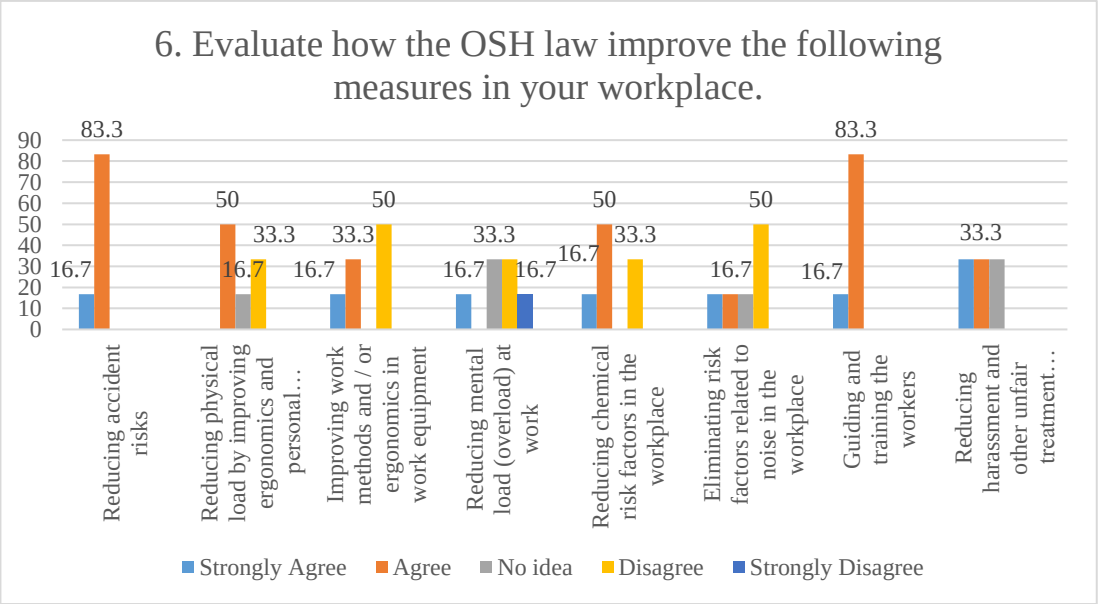


Figure 4.3: RA3-How the OSH Law Improves the Preventive Measures

As shown in Figure 4.3, according to employers OSH law is effective in reducing accident risk and half of all respondents (50%) felt that OSH law reduces physical load by improving ergonomics and personal workstations in the workplace.

There was no difference in the number (50%) of respondents who felt that (strongly agreed or agreed) the OSH law is effective for improving work methods and / or ergonomics in the work equipment and those (50%) that disagreed.

Likewise, 50% respondents didn't feel (disagree or strongly disagreed) that OSH law reduced mental overload at work.

Sixty seven percent of the respondents strongly agreed or agreed that OSH law improved reducing chemical risk factors in the workplace.

Half of the respondents (50%) disagreed that OSH law helped eliminate noise related risk factors in the workplace. All respondents felt that the OSH law helped guide and train workers (strongly agreed or agreed).

The majority of respondents (66.7%) strongly agreed or agreed that OSH law helped reduce harassment and other unfair treatment causing worker harm or health risk.

Figure 4.4: RA4-How the Law Improves the Workplace

All respondents (question 7, Figure 4.4) strongly agreed or agreed that OSH law has a positive impact on the following:

- emphasizing the employer RA obligation,
- conducting of a RA,
- determination and prevention of OSH hazards and harms.

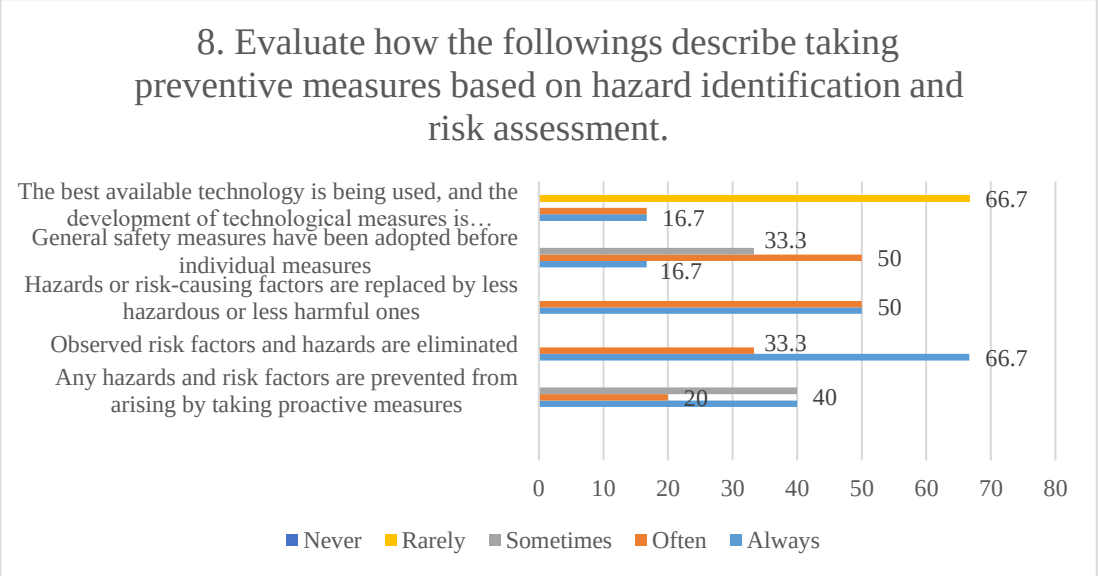


Figure 4.5: RA5-How the Preventive Measures are Taken

All respondents stated that risk factors are prevented by taking proactive measures based on hazard identification and RA results at least sometimes and that observed risk factors are eliminated or replaced with less hazardous ones (question 8, Figure 4.5).

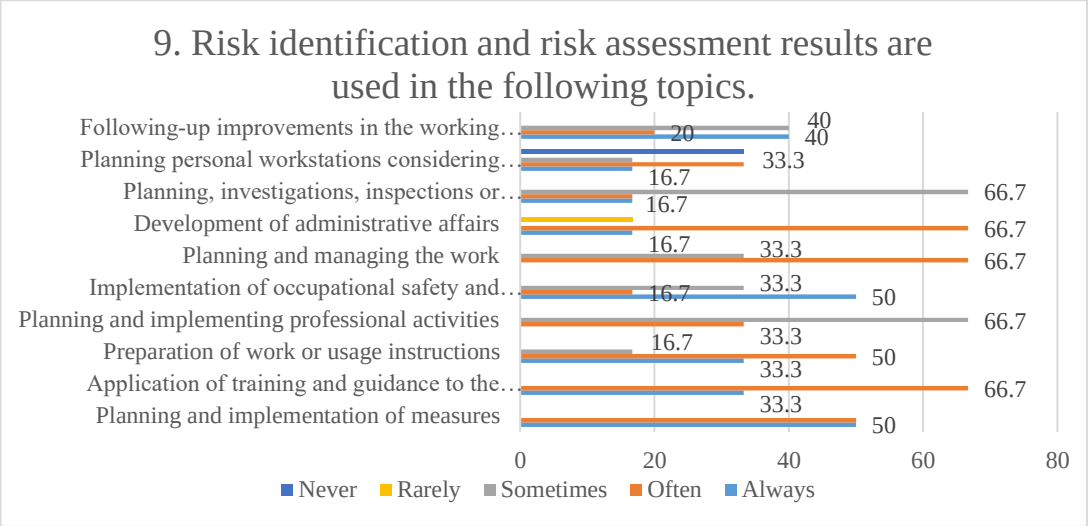


Figure 4.6: RA6-How the RA Results are Used

Over 60% of respondents always or often used all except 3 areas shown in Figure 4.6 in their RAs. The 3 areas not considered included planning personal workstations, planning and implementation of professional activities, and planning, investigations, inspections or measurements.

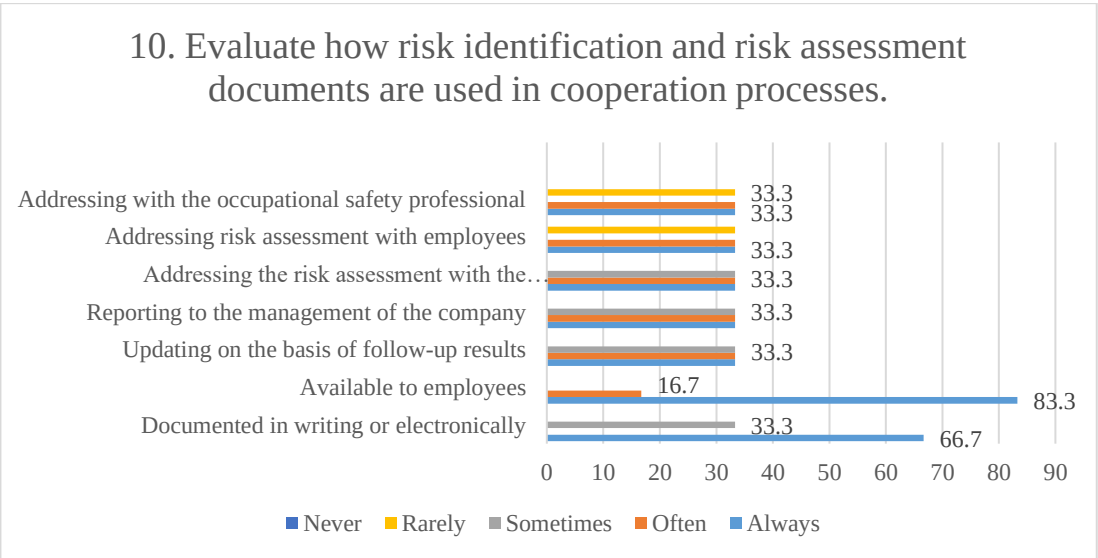


Figure 4.7: RA7-How the RA Documents are Used

Risk identification and RA documents are used in employee employer cooperation processes as shown in Figure 4.7 (question 10).

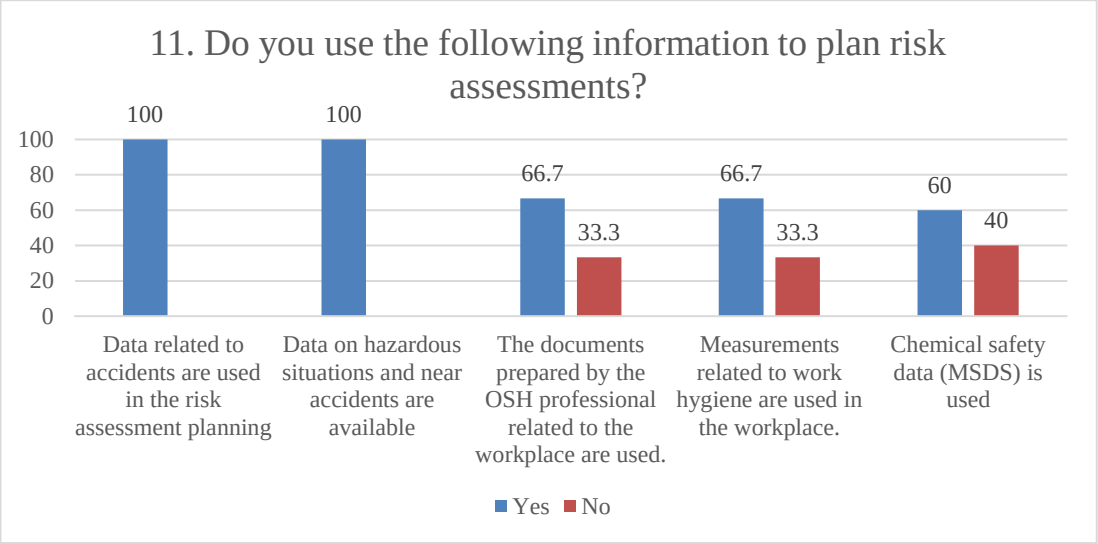


Figure 4.8: RA8-How the RA is Planned

All respondents said that they are using data related to accidents in the RA planning and that data on hazardous situations and near accidents are available. The majority of respondents (66.7%) stated that the workplace documents prepared by the OSH professional are used to plan RAs. Measurements related to work hygiene and Material Safety Data Sheets (MSDS) were reported to be used 66.7% and 60%, respectively (question 11, Figure 4.8).

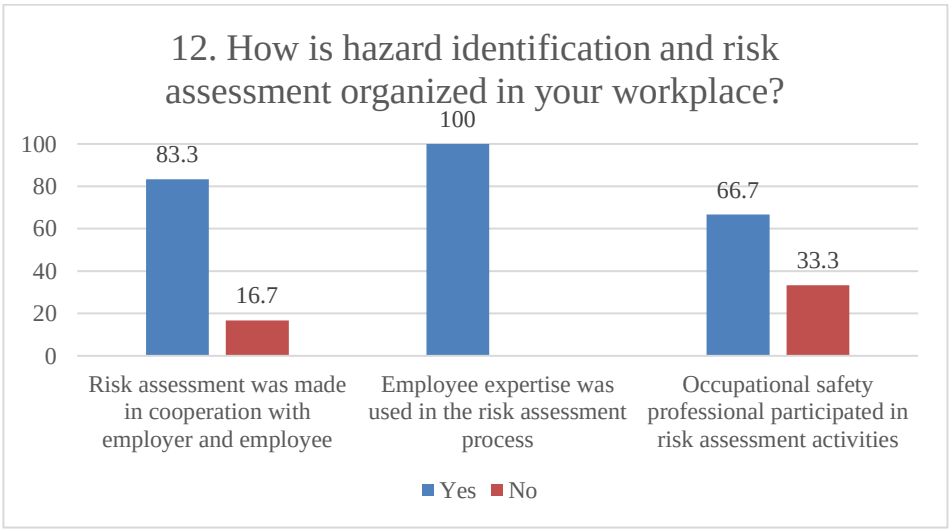


Figure 4.9: RA9-How RA is Organized

The majority of respondents (83.3%) stated that RAs were conducted with employer and employee cooperation and all the respondents stated employee expertise was used in the RA process. Two thirds of respondents (66.7%) stated that an occupational safety professional participated in RA activities (question 12, Figure 4.9).

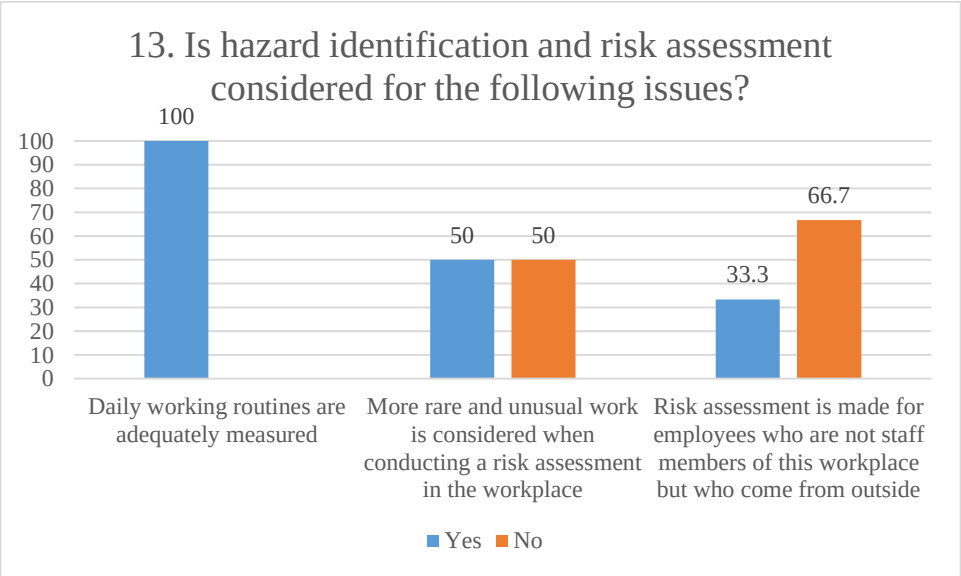


Figure 4.10: RA10-Issues Considered When Identifying Hazards

All the respondents reported that daily work routines are adequately measured when identifying hazards. Only 50% of respondents stated that rare and unusual work is considered when conducting RAs and 66.7% responded that RAs are not conducted on non-staff employees such as occasional contractors (question 13, Figure 4.10).

Based on the interview type and RA questionnaire results all of the hypotheses were supported as seen in Table 4.2 except hypothesis 4, here RAs are found to be effective but only for the companies conducting RAs, which applies to only 13% of the companies studied.

Table 4.2: RA Hypotheses

Hypotheses	Supported/ Not Supported
1: Most employers are unaware of the NC OSH law and RA requirement. **Interview results**: Seventy five percent of employers are unaware of the NC OSH law.	Supported
2: Workplace RAs are not being conducted. **Interview results**: Eighty seven percent of employers reported that they have never conducted a RA in their workplace.	Supported
3: Labor officers are not conducting preventive inspections. **Interview results**: Labor office inspectors visited only 1 out of 92 companies for preventive OSH inspection.	Supported
4: RAs are ineffective. **Questionnaire results**: Even though RAs helped make workplace improvements, physical risk factors, rare and unusual work tasks and temporary contract employees were only included in 33.3%, 50% and 33% of the RAs respectively. Additionally, on average, the RA results were not used adequately. Therefore, it can be concluded that the RAs are effective with these stated limitations.	Not Supported (RAs are effective with limitations)
5: Employers are not taking corrective actions based on RAs. **Interview results**: H5 is supported by the results - 87% of the employers interviewed reported that they did not conduct RA in their workplace.	Supported
6: The OSH law is ineffective in ensuring a safe and healthy work environment. **Questionnaire and interview results:** Companies that answered the questionnaire found the OSH law to be sufficient. However, since 75% of employers were unaware of the law, and with the lack of preventive inspections conducted by labor officers, one can conclude that in practice the law is ineffective.	Supported

4.1.3 OSH Professionals' Questionnaire Results

OSH professionals were asked to comment on whether the NC Occupational Safety and Health Law (35/2008) was sufficient to improve work environments (question 8). Out of 22 actively working OSH Professionals, eighteen professionals replied to the questionnaire and the results are reported in Figure 4.11 to Figure 4.15. Table 4.3 to Table 4.6 show the number of responses to each item, the mean of responses and the tendency based on the mean. The reliability test resulted in alpha = 0.85.

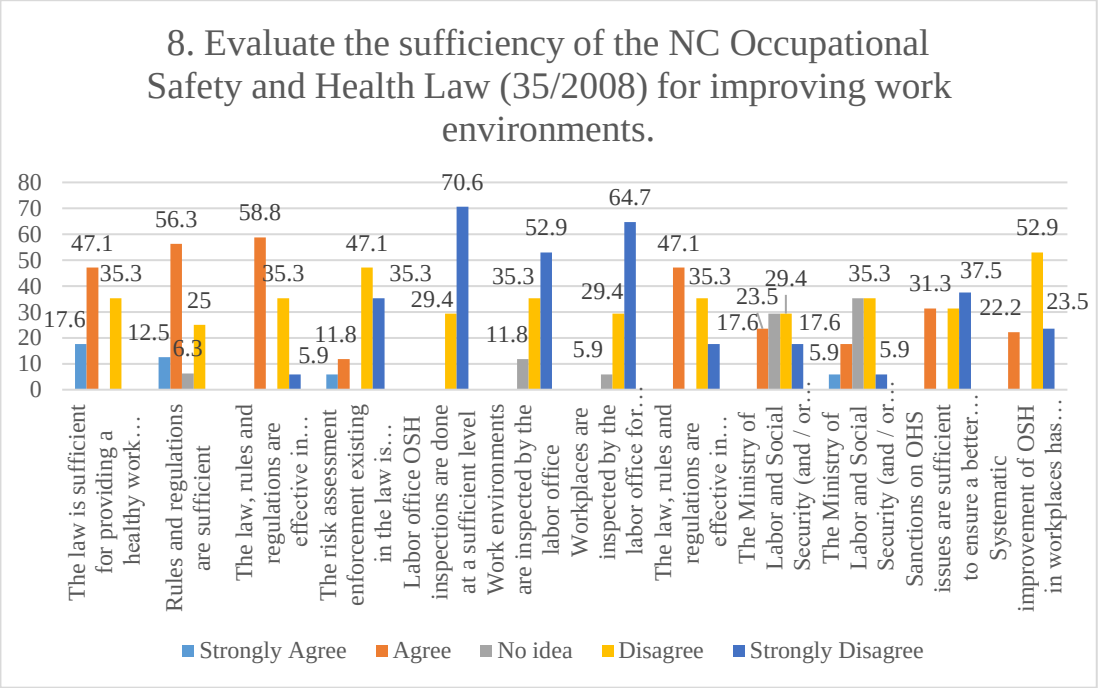


Figure 4.11: P1-Sufficiency of OSH Law for Improving Work Environment

As seen in Figure 4.11, 64.7% of the respondents strongly agreed or agreed that the law is sufficient for providing a healthy work environment while 35.3% disagreed.

Regarding the rules and regulations; 68.8% strongly agreed or agreed, 6.3% had no idea whereas 25% disagreed that rules and regulations are sufficient for providing a healthy work environment. The general tendency of the responses based on the mean is agree.

Based on the mean values of the responses as shown in Table 4.3; OSH professionals strongly disagreed or disagreed that;

- The RA enforcement existing in the law is implemented,
- Labor office OSH inspections are done at a sufficient level,
- Work environments are inspected by the labor office,
- Workplaces are inspected by the labor office for health and safety,

- Sanctions on OSH issues are sufficient to ensure a better working environment,
- Systematic improvement of OSH in workplaces has been ensured by the NC OSH law.

The rest of the responses to statements are ‘no idea.’

Table 4.3: P1-Descriptive Statistics on the Sufficiency of the OSH Law

	N	Mean of Responses	Std. Deviation	Based on Mean of Responses*
The law is sufficient for providing a healthy work environment	17	2,5294	1,17886	No idea
Rules and regulations are sufficient	16	2,4375	1,03078	Agree
The law, rules and regulations are effective in identifying hazards	17	2,8824	1,11144	No idea
The RA enforcement existing in the law is implemented	17	3,9412	1,19742	Disagree
Labor office OSH inspections are done at a sufficient level	17	4,7059	,46967	Strongly Disagree
Work environments are inspected by the labor office	17	4,4118	,71229	Disagree
Workplaces are inspected by the labor office for health and safety	17	4,5882	,61835	Strongly Disagree
The law, rules and regulations are effective in preventing OSH problems	17	3,2353	1,25147	No idea
The Ministry of Labor and Social Security (and / or its associated Labor Office) prepares guiding handbooks for OSH.	17	3,4118	1,06412	No idea
The Ministry of Labor and Social Security (and / or its associated Labor Office) prepares missing rules and regulations, if any.	17	3,1765	1,01460	No idea
Sanctions on OSH issues are sufficient to ensure a better working environment in the workplace	16	3,7500	1,29099	Disagree

Systematic improvement of OSH in workplaces has been ensured by the NC OSH law	17	3,7647	1,09141	Disagree
Valid N (listwise)	15			

*1-Strongly Agree, 2-Agree, 3-No Idea, 4-Disagree, 5-Strongly Disagree

Professionals were asked (question 9) how the enforcement of the NC OSH laws, rules and regulations can be improved, ranking their responses in order of importance (1= most important, 10 being least important). Results are displayed in Figure 4.12 and Table 4.4.

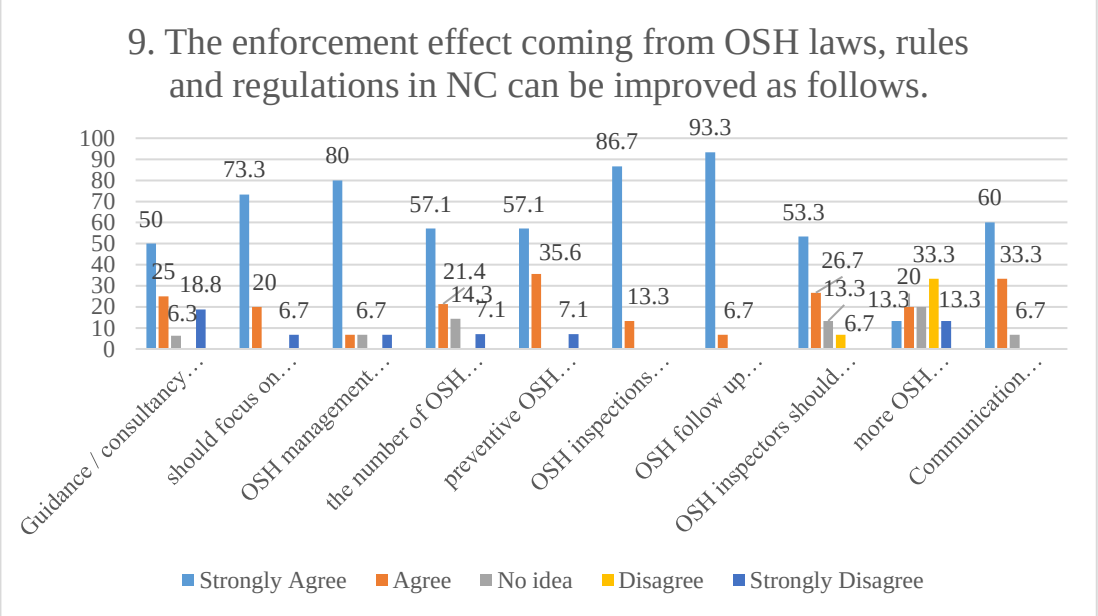


Figure 4.12: P2-How Enforcement of Legislation can be Improved

As seen in Figure 4.12 and Table 4.4, the OSH professionals think that enforcement of rules and regulations can be improved with guidance, by increasing the number of inspectors and performing inspections. OSH professionals ranked the following as most important in improving enforcement of rules and regulations – increasing the number of inspections performed and performing follow-up inspections, followed by review of workplace OSH management systems, increasing the number of inspectors,

and increasing the number of preventive OSH inspections performed. The general tendency of the responses is strongly agree or agree. Only a third (33.3%) think that there is a need to train more OSH professionals.

Table 4.4: P2-Descriptive Statistics of How Enforcement can be Improved and Their Order of Importance

order of IMP		N	Mean of Responses	Std. Deviation	Based on Mean of Responses*
6	Guidance / consultancy service should be provided / increased to workplaces	16	2,1250	1,54380	Agree
4	Should focus on inspecting working conditions	15	1,4667	1,06010	Agree
3	OSH management system of workplaces should be inspected	15	1,4667	1,12546	Agree
3	the number of OSH inspectors should be increased	14	1,7857	1,18831	Agree
4	preventive OSH inspections should be increased	14	1,6429	1,08182	Agree
1	OSH inspections should be increased	15	1,1333	,35187	Strongly Agree
2	OSH follow up inspections should be increased	15	1,0667	,25820	Strongly Agree
5	OSH inspectors should be trained	15	1,7333	,96115	Agree
8	more OSH professionals should be trained (and licensed)	15	3,1333	1,30201	No idea
7	Communication between OSH professionals and workplaces should be increased	15	1,4667	,63994	Agree
	Valid N (listwise)	13			

*1-Strongly Agree, 2-Agree, 3-No Idea, 4-Disagree, 5-Strongly Disagree

OSH professionals were asked whether a list of factors were considered when identifying hazards and conducting RAs (question 11). The percentage of responses can be seen in Figure 4.13.

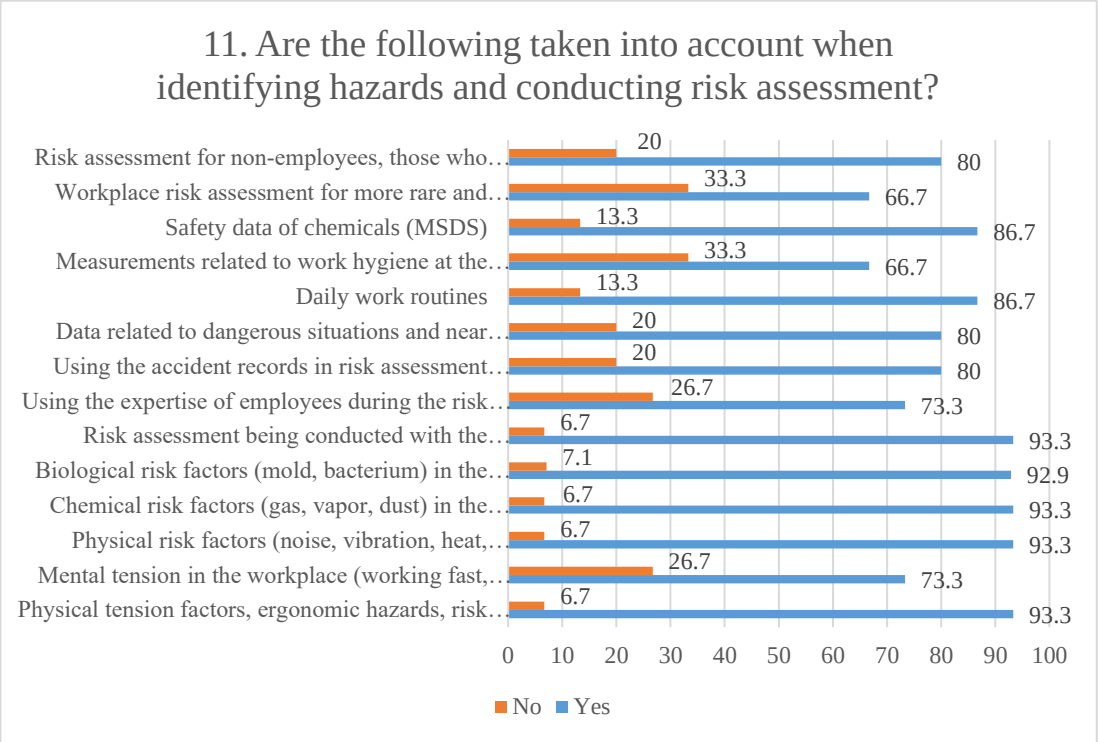


Figure 4.13: P3-How RA is Conducted

Responses show that when conducting RAs in the workplace OSH professionals considered:

- Physical tension factors, ergonomic hazards, risk factors (heavy lifting, improper work postures), 93.3%
- Mental tension (working fast, excess/low workload, negative work environment, lack of job security, time limitation), 73.3%
- Physical (noise, vibration, heat, lighting) and chemical risk factors (gas, vapor, dust), 93.3%
- Biological risk factors (mold, bacterium), 92.9%

- Conducting RA;
  - with employer-employee collaboration, 93.3%
  - utilizing the expertise of employees, 73.3%
- Data related to accidents, dangerous situations and near accidents (misses) are utilized, 80%
- Daily work routines, 86.7%
- Measurements related to work hygiene, 66.7%
- Safety data of chemicals – Material Safety Data Sheets (MSDS), 86.7%
- Workplace RA for more rare and unusual work, 66.7%
- RA for non-employees, contract workers, 80%.

OSH professionals were asked to evaluate the preventive measures taken by the workplaces as a result of the RA (question 12). The percentage of responses can be seen in Figure 4.14 and number of respondents, mean and tendency based on mean can be seen in Table 4.5.

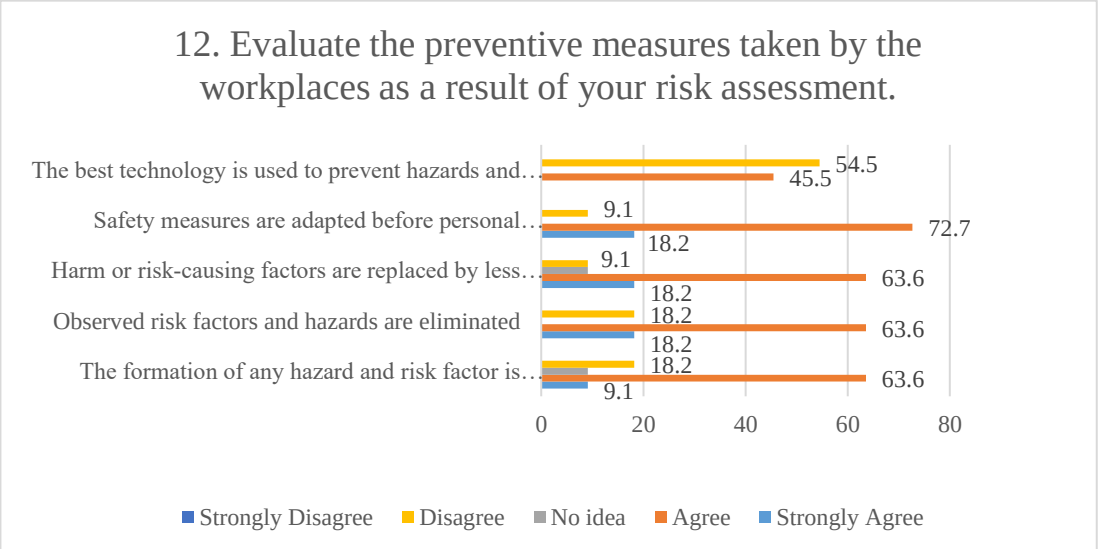


Figure 4.14: P4-Preventive Measures Taken as a Result of RA

The following preventive measures were taken as a result of the RA conducted by professionals based on strongly agree or agree responses as shown in Figure 4.14 and Table 4.5.

- the formation of any hazard and risk factors is prevented by taking proactive measures, 72.7%
- observed risk factors and hazards are eliminated, 81.8%
- harm or risk-causing factors are replaced by less dangerous or less harmful ones, 81.8%
- safety measures are adapted before personal protective measures, 90.9%
- 45.5% agreed that the best technology is used to prevent hazards and risk factors and the development of technological measures is taken into consideration, whereas 54.5% disagreed.

Table 4.5: P3-Descriptive Statistics of Preventive Measures Taken as a Result of RA

	N	Mean of Responses	Std. Deviation	Based on Mean of Responses*
The formation of any hazard and risk factors is prevented by taking proactive measures	11	2,3636	,92442	Agree
Observed risk factors and hazards are eliminated	11	2,1818	,98165	Agree
Harm or risk-causing factors are replaced by less dangerous or less harmful ones	11	2,0909	,83121	Agree
Safety measures are adopted before personal measures	11	2,0000	,77460	Agree
The best technology is used to prevent hazards and risk factors and the development of technological measures is taken into consideration	11	3,0909	1,04447	No idea
Valid N (listwise)	11			

*1-Strongly Agree, 2-Agree, 3-No Idea, 4-Disagree, 5-Strongly Disagree

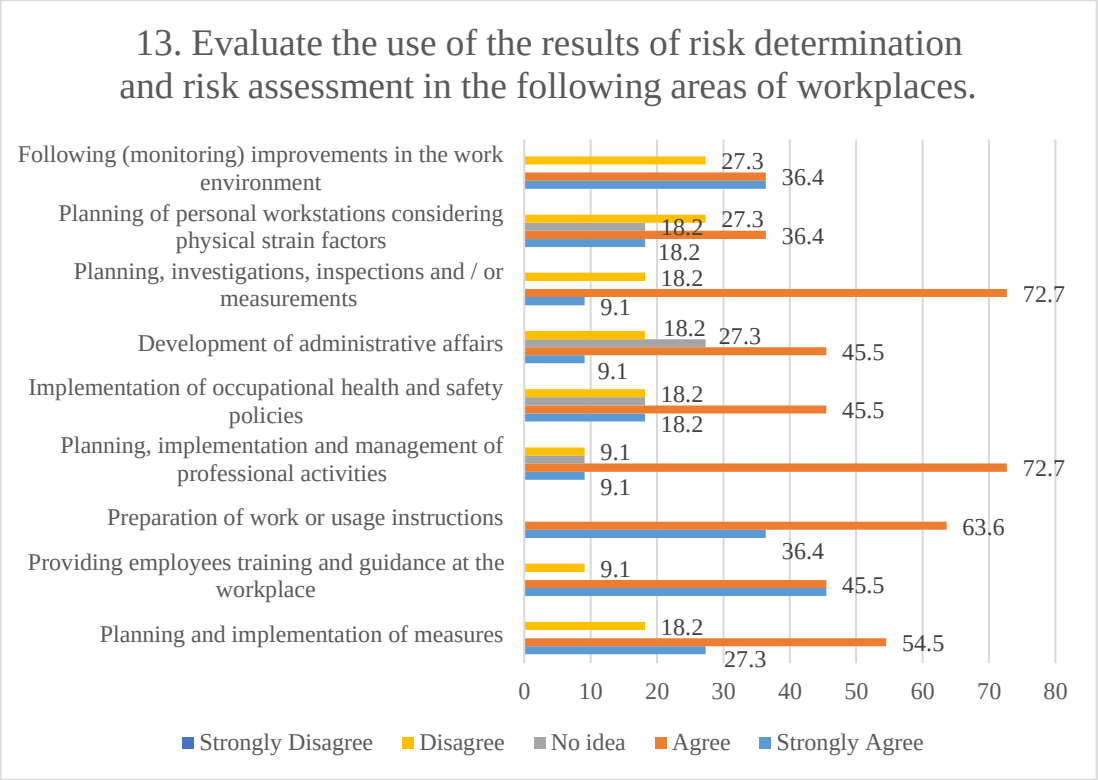


Figure 4.15: P5-How RA Results are Used

The last 5-point Likert scale question asked the professionals to evaluate (question 13, Figure 4.15) the utilization of the results of the risk determination and RA in specific aspects of the workplace such as planning and implementation of activities.

The ‘strongly agreed’ and ‘agreed’ responses show that the RA results are used in;

- the planning and implementation of preventive measures, 81.8%
- providing employee training and guidance 90.9%
- the preparation of work or usage instructions.
- the planning, implementation and management of professional activities, 81.8%
- the implementation of occupational health and safety policies, 63.6%
- the planning, investigations, inspections and / or measurements, 72.7%
- the monitoring of improvements in the work environment, 72,7%

which is also seen in Table 4.6 where the general tendency of these responses corresponds to ‘agree.’

For the remaining aspects;

- 54.5% strongly agreed or agreed that the results are used in the development of administrative affairs, while 27.3% had no idea, and 18.2% disagreed.
- 54.5% strongly agreed or agreed that the results are used when considering physical strain factors in the planning of personal workstations, whereas 18.2% had no idea, and 27.3% disagreed.

Table 4.6: P4-Descriptive Statistics How RA Results are Used

	N	Mean of Responses	Std. Deviation	Based on Mean of Responses*
Planning and implementation of measures	11	2,0909	1,04447	Agree
Providing employees training and guidance at the workplace	11	1,7273	,90453	Agree
Preparation of work or usage instructions	11	1,6364	,50452	Agree
Planning, implementation and management of professional activities	11	2,1818	,75076	Agree
Implementation of occupational health and safety policies	11	2,3636	1,02691	Agree
Development of administrative affairs	11	2,5455	,93420	No idea
Planning, investigations, inspections and / or measurements	11	2,2727	,90453	Agree
Planning of personal workstations considering physical strain factors	11	2,5455	1,12815	No idea
Following (monitoring) improvements in the working environment	11	2,1818	1,25045	Agree
Valid N (listwise)	11			

*1-Strongly Agree, 2-Agree, 3-No Idea, 4-Disagree, 5-Strongly Disagree

The hypotheses results of the OSH professionals questionnaire are shown in Table 4.7.

Table 4.7: P5-Hypotheses Results of Professionals

Hypotheses	Decisions	Based on
1.The OSH law is ineffective in ensuring a safe and healthy work environment.	Supported	Q8
2.Labor office is not conducting preventive inspections, guidance and other activities to support improving OSH in workplaces.	Supported	Q9
3.RAs are effective.	Supported	Q11 & Q12 & Q13
4.Number of inspectors are not enough.	Supported	Q9
5.RA results are not used effectively.	Not Supported	Q12 & Q13
6.Employers are not taking corrective actions based on RA results.	Not Supported	Q12 13
7.OSH professionals are not working sufficiently.	Supported	Q4 & Q5

4.1.4 OSH Inspectors' Questionnaire Results

Inspectors were asked to evaluate the sufficiency of the NC Occupational Safety and Health Law (35/2008) for improving work environments (question 8). The percentage of responses can be seen in Figure 4.16 to Figure 4.20 and number of respondents, mean and tendency based on mean can be seen in Table 4.8 to Table 4.11. The reliability test resulted in alpha = 0.914.

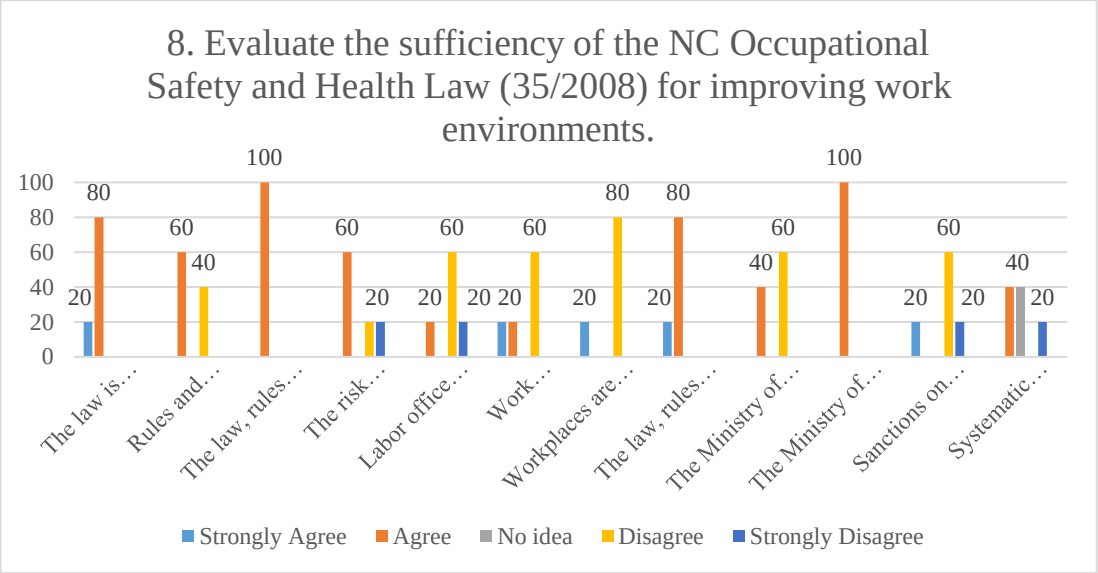


Figure 4.16: I1-Sufficiency of OSH Law for Improving Work Environment

A hundred percent of the respondents agreed that:

- the law is sufficient for providing a healthy work environment and law, rules and regulations are effective in preventing OSH problems,
- the law, rules and regulations are effective in identifying hazards,
- the Ministry of Labor and Social Security (and / or its associated Labor Office) writes any missing rules and regulations.

OSH inspectors had ‘no idea’ about whether;

- rules and regulations are sufficient
- RA enforcement existing in the law is implemented
- Work environments are inspected by the labor office
- Workplaces are inspected by the labor office for health and safety
- The Ministry of Labor and Social Security (and / or its associated Labor Office) prepares OSH handbooks
- Systematic improvement of OSH in workplaces has been ensured by law.

OSH inspectors disagreed that

- Labor office OSH inspections are done at a sufficient level
- Sanctions on OSH issues are sufficient to ensure a better work environment.

Table 4.8: I1- Descriptive Statistics of Sufficiency of the OSH Law

	N	Mean of Responses	Std. Deviation	Based on Mean of Responses*
The law is sufficient for providing a healthy work environment	5	1,8000	,44721	Agree
Rules and regulations are sufficient	5	2,8000	1,09545	No idea
The law, rules and regulations are effective in identifying hazards	5	2,0000	,00000	Agree
The risk assessment enforcement existing in the law is implemented	5	3,0000	1,41421	No idea
Labor office OSH inspections are done at a sufficient level	5	3,8000	1,09545	Disagree
Work environments are inspected by the labor office	5	3,0000	1,41421	No idea
Workplaces are inspected by the labor office for health and safety	5	3,4000	1,34164	No idea
The law, rules and regulations are effective in preventing OSH problems	5	1,8000	,44721	Agree
The Ministry of Labor and Social Security (and / or its associated Labor Office) prepares guiding handbooks for OSH.	5	3,2000	1,09545	No idea
The Ministry of Labor and Social Security (and / or its associated Labor Office) prepares missing rules and regulations, if any.	5	2,0000	,00000	Agree
Sanctions on OSH issues are sufficient to ensure a better work environment	5	3,6000	1,51658	Disagree
Systematic improvement of OSH in workplaces has been ensured by law	5	3,0000	1,22474	No idea
Valid N (listwise)	5			

*1-Strongly Agree, 2-Agree, 3-No Idea, 4-Disagree, 5-Strongly Disagree

Labor office inspectors were asked how the enforcement of OSH laws, rules and regulations in NC can be improved (question 9) and to rank their importance from 1 to 10 (1 being the most important, 10 being the least important).

The percentage of responses can be seen in Figure 4.17 and number of respondents, mean and tendency based on mean can be seen in Table 4.9.

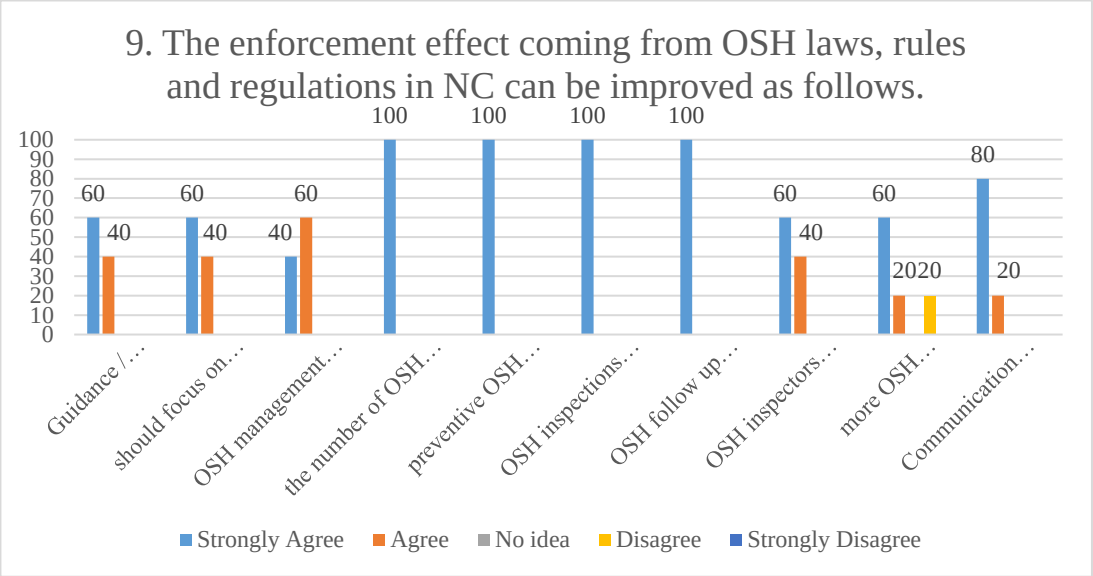


Figure 4.17: I2-How Enforcement of Legislation can be Improved

A hundred percent of the respondents strongly agreed or agreed that;

- Workplace guidance / consultancy service should be provided or increased
- Labor office should focus on inspecting working conditions.
- Workplace OSH management systems should be inspected.
- OSH inspectors should be trained.
- communication between OSH professionals and workplaces should be increased.

All respondents strongly agreed that;

- the number of trained OSH inspectors should be increased
- preventive OSH inspections should be increased
- overall OSH inspections should be increased
- OSH follow up inspections should be increased.

Eighty percent of the respondents strongly agreed or agreed that more OSH professionals should be trained (and licensed), while 20% disagreed.

Table 4.9: I2-Descriptive Statistics of How Enforcement can be Improved and Their Order of Importance

Order of IMP		N	Mean of Responses	Std. Deviation	Based on Mean of Responses*
6	Guidance / consultancy service should be provided / increased to workplaces	5	1,4000	,54772	Strongly Agree
8	Should focus on inspecting working conditions	5	1,4000	,54772	Strongly Agree
9	OSH management system of workplaces should be inspected	5	1,6000	,54772	Agree
1	the number of OSH inspectors should be increased	5	1,0000	,00000	Strongly Agree
2	preventive OSH inspections should be increased	5	1,0000	,00000	Strongly Agree
3	OSH inspections should be increased		1,0000	,00000	Strongly Agree
4	OSH follow up inspections should be increased	5	1,0000	,00000	Strongly Agree
6	OSH inspectors should be trained	5	1,4000	,54772	Strongly Agree
7	more OSH professionals should be trained (and licensed)	5	1,8000	1,30384	Agree
5	Communication between OSH professionals and workplaces should be increased	5	1,2000	,44721	Strongly Agree
	Valid N (listwise)	5			

*1-Strongly Agree, 2-Agree, 3-No Idea, 4-Disagree, 5-Strongly Disagree

Inspectors were asked to whether a list of factors were considered when identifying hazards and conducting RAs (question 11). The percentage of responses can be seen in Figure 4.18.

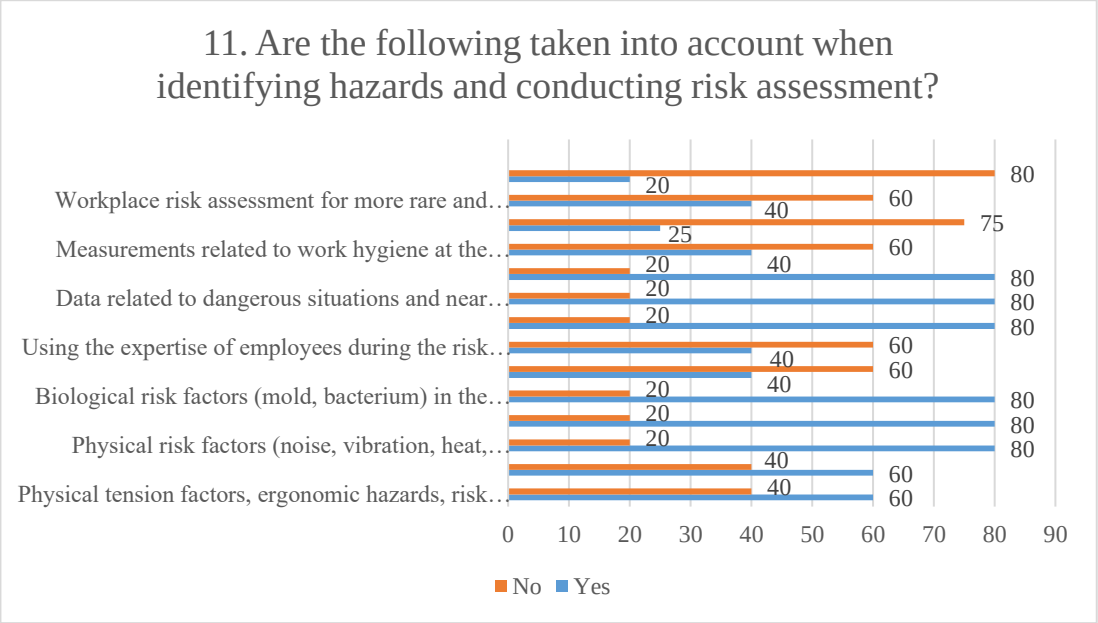


Figure 4.18: I3-How RA is Conducted

Sixty percent of the respondents stated that

- physical tension factors, ergonomic hazards, risk factors (heavy lifting, improper work postures) and
- mental tension in the workplace (working fast, excess/low workload, negative work environment, lack of job security, time limitation) are considered.

Eighty percent of the respondents stated that

- physical risk factors (noise, vibration, heat, lighting),
- chemical risk factors (gas, vapor, dust) and
- biological risk factors (mold, bacterium) in the workplace are considered.

Forty percent of the respondents stated that risk assessments were being conducted;

- with employer-employee collaboration,
- utilizing the expertise of employees.

Eighty percent of the respondents stated that

- accident records are utilized in RA planning,
- data related to dangerous situations and near accidents (misses) and
- daily work routines are considered.

Forty percent of the respondents stated that measurements related to work hygiene and workplace RA for more rare and unusual work are considered, while 60% said they are not.

Twenty five percent of the respondents stated that Material Safety Data Sheets (MSDS) for chemicals are considered, while 75% said they are not.

Twenty percent of the respondents stated that RA for non-employees (contract workers), while 80% said they are not.

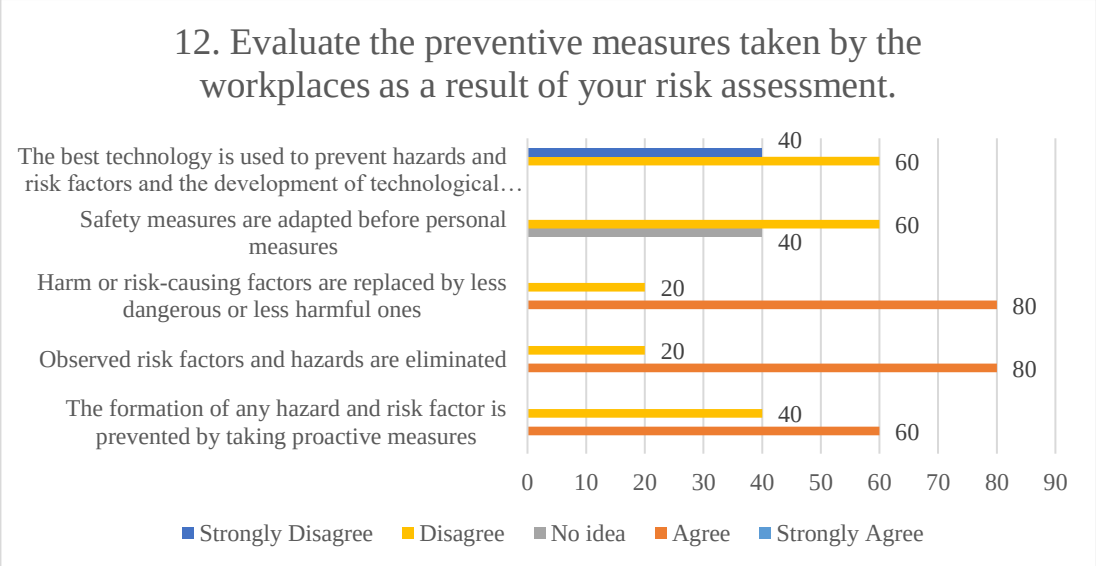


Figure 4.19: I4-Preventive Measures Taken as a Result of RA

Inspectors were asked to evaluate the preventive measures taken by the workplace as a result of the RA (question 12). The percentage of responses can be seen in Figure 4.19 and number of respondents, mean and tendency based on mean can be seen in Table 4.10.

Inspectors agreed that following preventive measures were taken as a result of the RA;

- Observed risk factors and hazards are eliminated
- Harm or risk-causing factors are replaced by less dangerous or less harmful ones.

Disagreed that;

- Safety measures are adapted before personal measures, and
- The best technology is used to prevent hazards and risk factors and the development of technological measures is taken into consideration.

Inspectors had 'no idea' whether the formation of any hazard and risk factors is prevented by taking proactive measures as a result of the RA.

Table 4.10: I3-Descriptive Statistics of Preventive Measures Taken As a Result of RA

	N	Mean of Responses	Std. Deviation	Based on Mean of Responses*
The formation of any hazard and risk factors is prevented by taking proactive measures	5	2,8000	1,09545	No idea
Observed risk factors and hazards are eliminated	5	2,4000	,89443	Agree
Harm or risk-causing factors are replaced by less dangerous or less harmful ones	5	2,4000	,89443	Agree
Safety measures are adapted before personal measures	5	3,6000	,54772	Disagree

The best technology is used to prevent hazards and risk factors and the development of technological measures is taken into consideration	5	4,4000	,54772	Disagree
Valid N (listwise)	5			

*1-Strongly Agree, 2-Agree, 3-No Idea, 4-Disagree, 5-Strongly Disagree

Inspectors were asked to evaluate (question 13) the utilization of the results of the risk determination and RA in specific aspects of the workplace (question 13). The percentage of responses can be seen in Figure 4.20 and number of respondents, mean and tendency based on mean can be seen in Table 4.11.

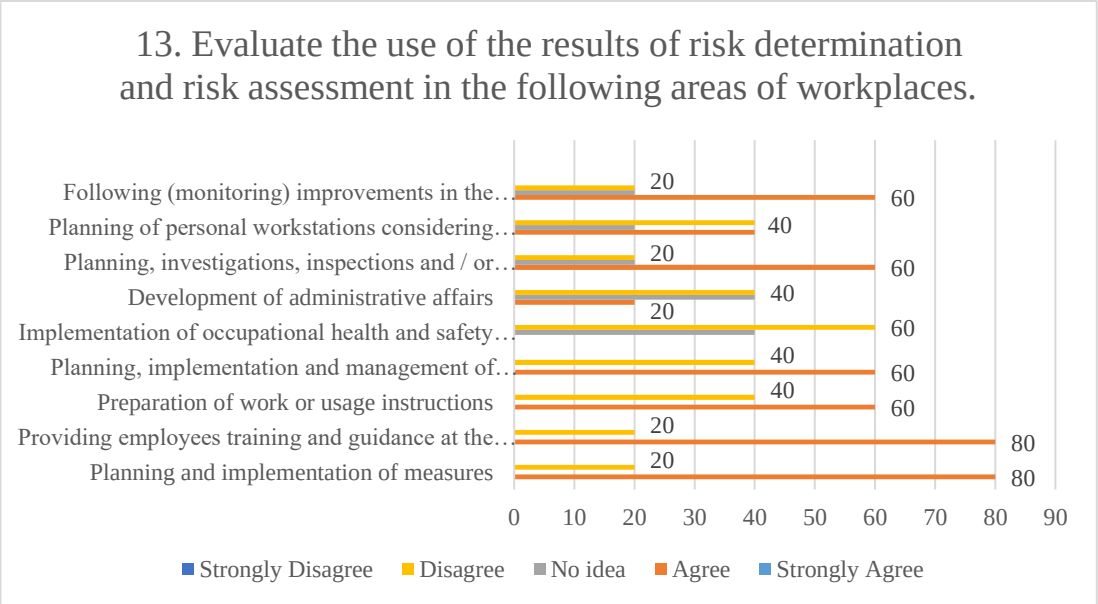


Figure 4.20: I5-How RA Results are Used

Respondents agreed that they utilized the results in the

- planning and implementation of preventive measures and
- providing employees training and guidance at the workplace.

Respondents had ‘no idea’ whether they utilized the RA results in the

- Preparation of work or usage instructions

- Planning, implementation and management of professional activities
- Development of administrative affairs
- Planning, investigations, inspections and / or measurements
- Planning of personal workstations considering physical strain factors
- Following (monitoring) improvements in the work environment.

Respondents disagreed that they utilized the results in the implementation of occupational health and safety policies.

Table 4.11: I4- Descriptive Statistics of How RA Results are Used

	N	Mean of Responses	Std. Deviation	Based on Mean of Responses*
Planning and implementation of measures	5	2,4000	,89443	Agree
Providing employees training and guidance at the workplace	5	2,4000	,89443	Agree
Preparation of work or usage instructions	5	2,8000	1,09545	No idea
Planning, implementation and management of professional activities	5	2,8000	1,09545	No idea
Implementation of occupational health and safety policies	5	3,6000	,54772	Disagree
Development of administrative affairs	5	3,2000	,83666	No idea
Planning, investigations, inspections and / or measurements	5	2,6000	,89443	No idea
Planning of personal workstations considering physical strain factors	5	3,0000	1,00000	No idea
Following (monitoring) improvements in the work environment	5	2,6000	,89443	No idea
Valid N (listwise)	5			

*1-Strongly Agree, 2-Agree, 3-No Idea, 4-Disagree, 5-Strongly Disagree

Table 4.12: I6-Hypotheses Results of Inspectors

Hypotheses	**Decisions**	**Based on**
1.The OSH law is ineffective in ensuring a safe	Supported	Q8

and healthy work environment.		
2.Labor office is not conducting preventive inspections, guidance and other activities to support improving OSH in workplaces.	Supported	Q9
3.RAs are effective.	Supported	Q11 & Q12 & Q13
4.Number of inspectors are not enough.	Supported	Q9
5.RA results are not used effectively.	Not Supported	Q12 & Q13
6.Employers are not taking corrective actions based on RA results.	Supported	Q12
7.OSH inspectors are not working sufficiently.	Supported	Q4 & Q5

4.1.5 Gender Specific OSH Legislation Results

Non-physician hospital employees were surveyed to understand OSH gender issues and to identify if men and women are equally protected from harm. Table 4.13 shows the job distribution of the respondents. The reliability test resulted in alpha = 0.69.

Table 4.13: G-Number of Workers with Departments

Job/Job Area/Dept	**Number* (# of male employees)**
Accounting	2
Administrative Chief	1
Cleaning	4
Esthetician	1
Information Desk	5
Kitchen	2 (M:1)
Laboratory	3 (M: 1)
Nurse	7 (M:1)
Radiography	1
Sales Manager	1
Secretary	2
Storage	1
Technician	4 (M:3)

*Two out of the 37 respondents did not report their jobs

Kruskal-Wallis test was used to analyze any significant difference between female and male responses, results show that 1) “Male employees experienced more back, shoulder, neck and arm pain” and 2) “Male employees have more missed days of work due to work related illness” with $p<0.05$ shown in Table 4.14.

Table 4.14: G-Significant Difference between Female and Male Responses

Ranks			
	Gender	N	Mean Rank
Work-related illness	Male	4	17,50
	Female	24	14,00
Back, shoulder, arm pain	Male	6	26,08
	Female	30	16,98
Test Statistics			
	Work-related illness		Back, shoulder, neck, arm pain
Chi-Square	6,000		4,235
df	1		1
Asymp. Sig.	,014		,040

The significant positive and negative correlation between the responses of only female respondents are given in Tables 4.15 and 4.16 and those of only male respondents in Tables 4.17 and 4.18.

Table 4.15: G-Only Women Responses -Significant Positive Correlation

Number of years at work	•finding gloves that fit	**
	•working at night	**
	•working different shifts	*
Work related injury/illness	•difficulty taking leave for menstrual symptoms	**
Lifting	•improper posture,	**
	•back, shoulder, neck & arm pain	**
Menstrual symptoms adversely affecting performance	•suboptimal environmental conditions (heating, cooling, lighting, ventilation, noise)	*
	•back, shoulder, neck & arm pain	*
	•standing more than 8 hours a day	*

Doing home responsibilities alone	•feeling stressed about home responsibilities	*
Working overtime	•report a noisy work environment	*

**Correlation is significant at the 0.01 level (2-tailed).; *Correlation is significant at the 0.05 level (2-tailed).

Table 4.16: G-Only Women Responses- Significant Negative Correlation

Having OSH training	work environment adversely affecting job performance	**
Assigned tasks outside of their usual job	report a noisy work environment	*
Work environment adversely affecting work performance	inadequate rest breaks	**

**Correlation is significant at the 0.01 level (2-tailed).; *Correlation is significant at the 0.05 level (2-tailed).

Table 4.17: G-Only Men Responses -Significant Positive Correlation

Standing	work related illness	**
Sitting	missed days of work due to illness	**
Going home with work clothes	illness	**
Sleeping enough	finding rest time sufficient	**
Lifting	awkward posture, burnout	**
Improper posture	burnout	**
Back, arm, neck& shoulder pain	employee given other tasks	*
Feeling stress due to home responsibilities	noise	*
Feeling stress	ventilation being sufficient	*
Work environment adversely affecting work performance	needing more OSH training	*

**Correlation is significant at the 0.01 level (2-tailed).; *Correlation is significant at the 0.05 level (2-tailed).

Table 4.18: G-Only Men Responses -Negative Positive Correlation

Having OSH Training	Work related illness	**

**Correlation is significant at the 0.01 level (2-tailed)

Table 4.19: G-Women Responses for Special Conditions

Question	**Yes (%)**	**No (%)**
Do you need to take sick leave during your menstrual period?	20	80
Do you have difficulty in getting permission for leave during pregnancy or breast feeding?	13	87
Do menstrual symptoms affect your work performance?	40	60
Did you work night shifts during your pregnancy?	15	85

Table 4.19 shows the responses of women addressing whether they faced difficulty at work when they are pregnant, breastfeeding or when they have menstrual pain.The answers to the questions related to menstrual period, pregnancy and breastfeeding showed that the majority of female employees are not facing difficulty taking time off during pregnancy or when breastfeeding but self-report a lower performance during their menstrual period.

Table 4.20: G- Frequency of Hazards Reported by Female and Male Respondents

Hazards/health issues	Female	Male
Infectious Diseases	12	-
Radiation	1	1
Penetrating & Cutting Tool Injury	1	-
Back Problems	3	-
Open Wound Infections	2	-
Work Stress-Working Conditions	-	1
No Hazard	1	1

Table 4.20 shows the female and male responses to the open-ended question "what are the hazards/risks associated with your job?" Three male and 17 female respondents said "yes" to "do you think you are protected enough from hazards?" where 4 of the females responded as "no." Nine of the woman respondents commented that they protect themselves personally by cleaning, using disinfectants, gloves and masks. Only one male employee answered the last open-ended question asking for any comments and suggestions and he suggested the need for security personnel.

Hypotheses testing results are shown in Table 4.21 where 6 of the 9 hypotheses were failed to reject by the study results.

Table 4.21: G-Hypotheses Results of Gender Specific OSH Legislation

Hypotheses	Failed to Reject/ Rejected	Based on
1: Management does not have a gender-sensitive approach for preventing employees from harm (GSRA)	Failed to Reject	Employer reported (Also no documented RA)
2: Women take more responsibilities outside of their job (such as home related work or other family issues).	Failed to Reject	Q12i, g, h
3: Working conditions, work environment or work tasks are not designed by taking into account women's physiological differences	Failed to Reject	Observation and employer
4: Women feel more pain in their arms, shoulder, back, and neck compared to men doing the same job.	Rejected	Q12f Men feel more pain *
5: Men get injured more than women at work.	Failed to Reject	Q10 and open-ended questions
6: Women feel more stress, fatigue and burnout as a result of a combination of work and home issues	Failed to Reject	Q12-a,g,h,I,k,l Q14-b,c,d,e,f
7: Women have more difficulty in finding PPE that properly fits (such as masks and gloves)	Rejected	Q12-b,c Majority finds PPE
8: Environmental conditions at work adversely affect job performance of men more than women.	Failed to Reject	Q13, Q12j $p<0.05$

9: Women have difficulty taking leave during their menstrual period, when pregnant or when breast feeding	Rejected	Q15

* Within the same study group but not exactly doing the same job

4.2 Phase II Results

Work environment stressors (WES) including heat, light, dust and noise were measured by using devices in the workplace and workers were asked to fill a questionnaire to reveal their own perceptions about work environment stressors, and also their own performance. Additionally, performance measurements were done by using work sampling (WS) method. The analysis of the data is categorized in 4 sections.

1. Analysis of Self-Assessed WES - Self-Assessed Performance
2. Analysis of Self-Assessed WES - WS Performance
3. Analysis of Real-Time Measured WES - Self-Assessed Performance
4. Analysis of Real-Time Measured WES - WS Performance.

The results of WES measurements were analyzed using a statistical software IBM SPSS Statistics 24. The data was analyzed using univariate analysis and linear regression.

Table 4.22 shows the average work sampling results for each worker which was calculated as observed Individual Working Time/Individual Total Working Time for each season while;

Individual Total Working Time=Individual Working Time + Individual Idle Time (3)

Table 4.22: Average Percentage of Individual Total Working Time of Workers in Seasons

Season % / Workers	Winter	Summer	Spring	Fall
W1	0,82	0,62	0,76	0,66
W2	0,86	0,62	0,86	0,73
W3	0,85	0,68	0,85	0,88
W4	0,90	0,68	0,72	0,86
W5	0,64	0,67	0,67	0,76
W6	0,75	0,58	0,71	0,80
W7	0,56	0,59	0,78	0,72
W8	0,57	0,58	0,77	0,78
W9	0,75	0,56	0,68	0,80
W10	0,79	0,58	0,72	0,79
W11	0,74	0,61	0,73	0,76
W12	0,76	0,68	0,78	0,80
W13	0,64	0,73	0,86	0,83
W14	0,77	0,74	0,86	0,77
W15	0,80	0,65	0,79	0,69
Average	0,75	0,64	0,77	0,88

Average percentage individual total working time for each worker was calculated for 5 days in each season from daily observations.

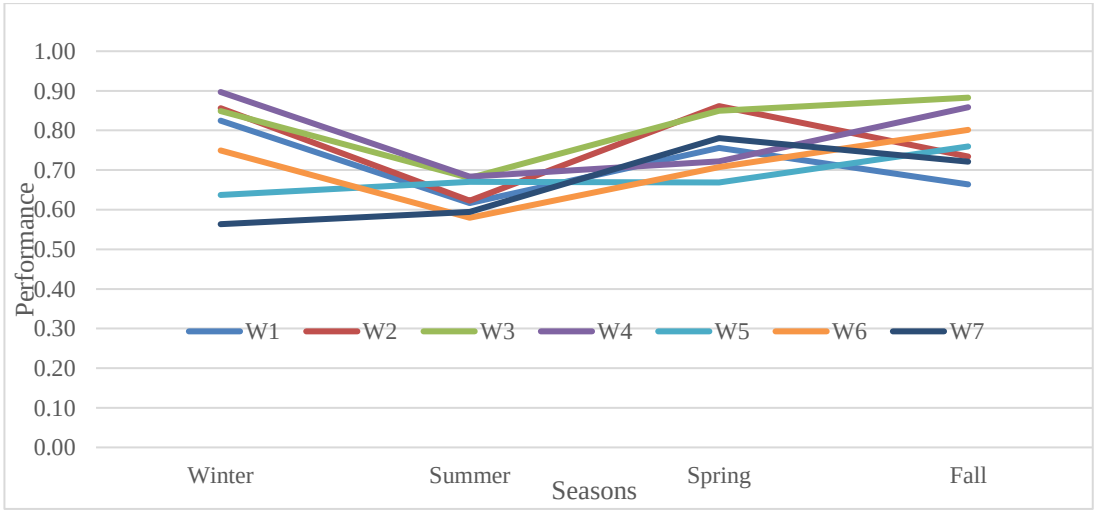


Figure 4.21: Performance vs Seasons for W1 to W7

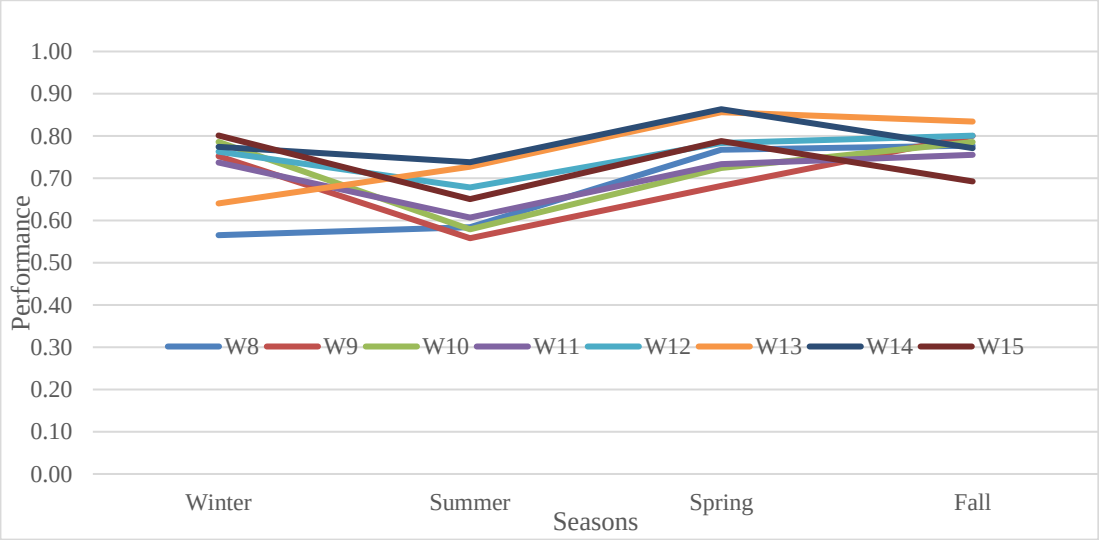


Figure 4.22: Performance vs Seasons for W8 to W15

As it is clearly seen in Figures 4.21 and 4.22 workers performance overall was higher in Winter, Spring and Fall. The seasonal variation of average percentage of workers performance evaluated with WS in Table 4.22 shows that a significant decrease in performance was noted in Summer due to a seasonal increase in environmental temperatures and the impact of the heat and other WES on workers. The best performance was seen in Fall.

Table 4.23: Variation of Measurements

	Noise (dBA)	**Heat (°C)**	**Dust (mg/m^3)**	**Light (lux)**
Winter	76,85±5,45	15,7±1,2	9,06±8,78	193,5±124,5
Summer	72,9±3,6	27,69±1,21	18,35±18,31	1192±312
Spring	72,35±3,05	21,77±3,57	29,185±28,875	241,5±132,5
Fall	83,9±12,5	22,4±3,3	4,015±3,925	657,5±210,5

Table 4.23 shows the variation of work environment stressors measurements at different seasons.

4.2.1 Analysis of Self-Assessed WES - Self-Assessed Performance

The performance measurement was done by asking workers to evaluate their perception about work environment stressors as independent variables and self-assessment (SA) of their own performance at the end of each day as dependent variable.

Table 4.24: SA WES vs SA Performance

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	602,849[a]	42	14,354	9,279	,000
Intercept	2306,755	1	2306,755	1491,238	,000
Heat	57,216	2	28,608	18,494	,000
Light	5,963	2	2,982	1,927	,148
Noise	2,807	2	1,404	,907	,405
Dust	3,208	2	1,604	1,037	,357
Heat * Light	6,324	4	1,581	1,022	,397
Heat * Noise	11,203	4	2,801	1,811	,128
Heat * Dust	5,572	4	1,393	,900	,465
Light * Noise	1,903	3	,634	,410	,746
Light * Dust	1,894	4	,473	,306	,874
Noise * Dust	4,319	4	1,080	,698	,594
Heat * Light * Noise	,000	0	.	.	.
Heat * Light * Dust	2,443	3	,814	,527	,665
Heat * Noise * Dust	8,074	5	1,615	1,044	,393
Light * Noise * Dust	,314	1	,314	,203	,653
Heat * Light * Noise * Dust	,000	0	.	.	.
Error	304,734	197	1,547		
Total	13668,000	240			
Corrected Total	907,583	239			

Dependent Variable: Performance_SA

The analysis of SA WES versus SA Performance shows that ‘Heat’ has significant effect on work performance where p=0,000.

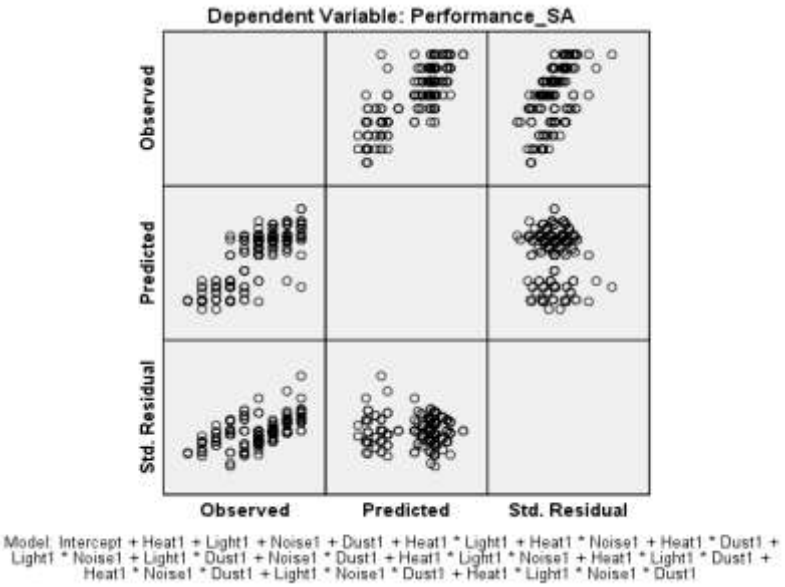


Figure 4.23: Observed * Predicted * Std. Residual Plot SA-SA

Figure 4.23 shows that residuals are constant.

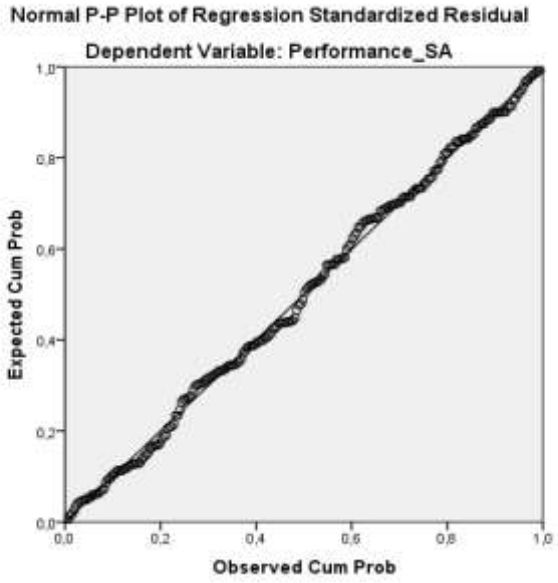


Figure 4.24: Normal P-P Plot of Regression Standardized Residual SA-SA

According to Figure 4.24 Standardized residuals are normally distributed.

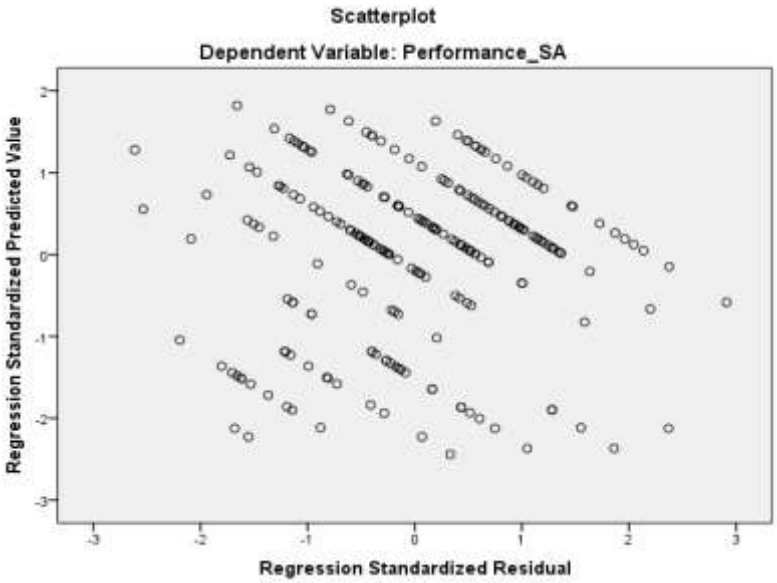


Figure 4.25: Standardized Residuals vs Standardized Predicted Values SA-SA

The regression plot of standardized residuals versus standardized predicted values shows that the points are randomly and uniformly distributed throughout the plot seen in Figure 4.25.

4.2.2 Analysis of Self-Assessed WES - WS Performance

The other performance measurement was done by using SA of workers about work environment stressors as independent variables and work sampling method for performance as dependent variable.

Table 4.25: SA WES vs WS Performance

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1,527[a]	42	,036	2,419	,000
Intercept	25,936	1	25,936	1725,971	,000
Heat	,040	2	,020	1,339	,264
Light	,048	2	,024	1,581	,208
Noise	,113	2	,056	3,753	,025
Dust	,043	2	,022	1,433	,241
Heat * Light	,076	4	,019	1,269	,284
Heat * Noise	,137	4	,034	2,283	,062

Heat * Dust	,050	4	,013	,837	,503
Light * Noise	,036	3	,012	,809	,490
Light * Dust	,038	4	,010	,638	,636
Noise * Dust	,054	4	,014	,901	,465
Heat * Light * Noise	,000	0	.	.	.
Heat * Light * Dust	,161	3	,054	3,573	,015
Heat * Noise * Dust	,237	5	,047	3,152	,009
Light * Noise * Dust	,053	1	,053	3,548	,061
Heat * Light * Noise * Dust	,000	0	.	.	.
Error	2,960	197	,015		
Total	130,913	240			
Corrected Total	4,487	239			

Dependent Variable: Performance_WS

The analysis of SA WES versus WS Performance shows that 'Noise' has significant effect on work performance where p=0.025. Additionally, the combined effect of 'Heat * Light * Dust' and 'Heat * Noise * Dust' have significant effect on work performance where p=0.015 and p=0.009, respectively.

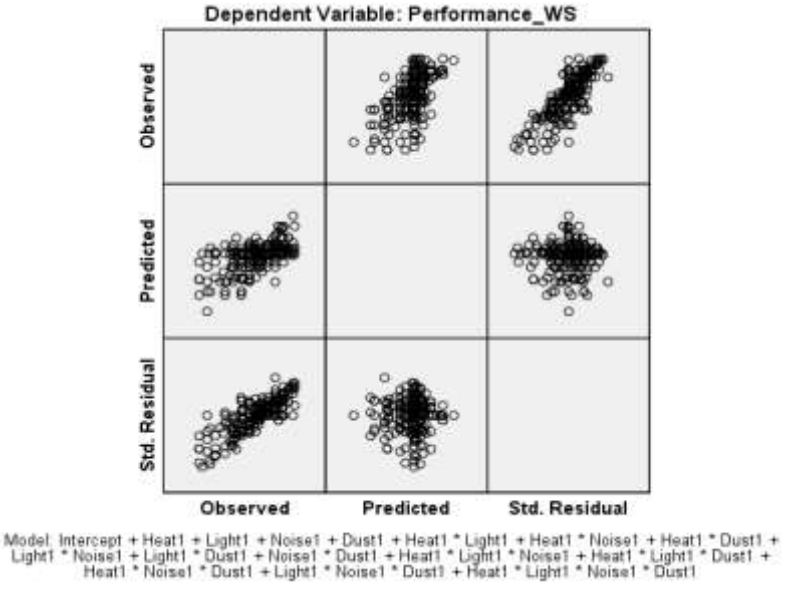


Figure 4.26: Observed * Predicted * Std. Residual Plot SA-WS

Figure 4.26 shows that residuals are constant.

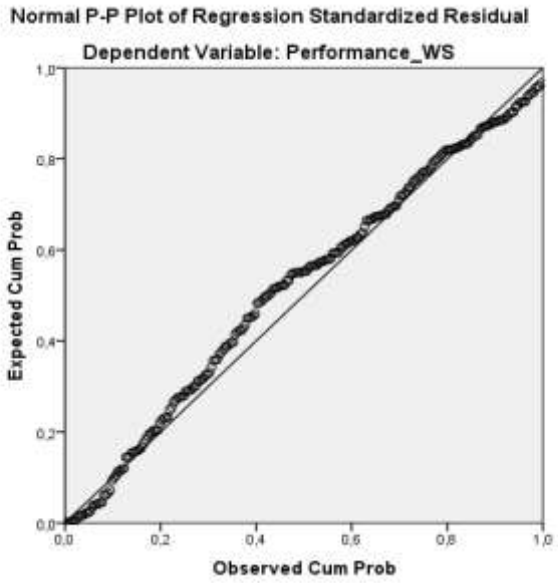


Figure 4.27: Normal P-P Plot of Regression Standardized Residual SA-WS

According to Figure 4.27 Standardized residuals are normally distributed.

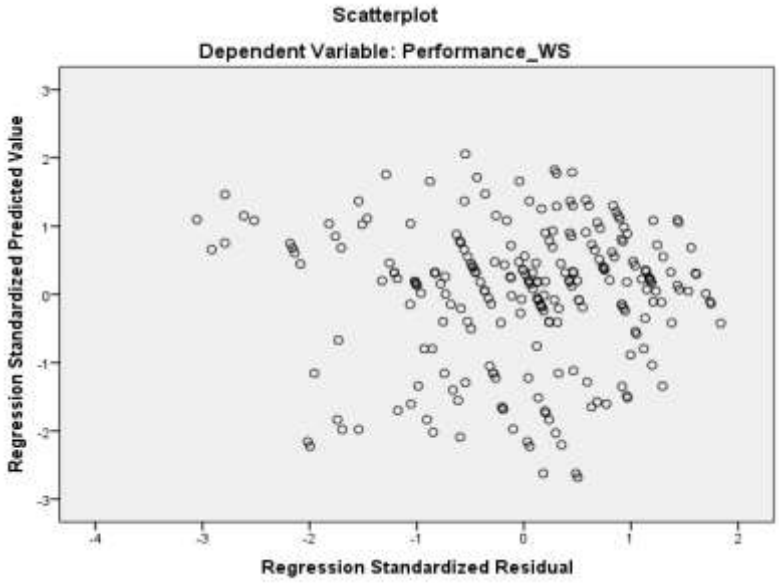


Figure 4.28: Standardized Residuals vs Standardized Predicted Values SA-WS

The regression plot of standardized residuals versus standardized predicted values shows that the points are randomly and uniformly distributed throughout the plot seen in Figure 4.28.

4.2.3 Analysis of Real-Time Measured WES - Self-Assessed Performance

The other performance measurement was done by using real time measurements of WES as independent variables and SA of workers at the end of each day as dependent variable.

Table 4.26: Real-Time Measured WES vs SA Performance

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	616,517[a]	15	41,101	31,631	,000
Intercept	12760,417	1	12760,417	9820,202	,000
Noise	,600	1	,600	,462	,498
Heat	299,267	1	299,267	230,311	,000
Dust	,267	1	,267	,205	,651
Light	201,667	1	201,667	155,199	,000
Noise * Heat	8,817	1	8,817	6,785	,010
Noise * Dust	,150	1	,150	,115	,734
Noise * Light	,150	1	,150	,115	,734
Heat * Dust	,417	1	,417	,321	,572
Heat * Light	88,817	1	88,817	68,352	,000
Dust * Light	8,817	1	8,817	6,785	,010
Noise * Heat * Dust	4,267	1	4,267	3,284	,071
Noise * Heat * Light	1,067	1	1,067	,821	,366
Noise * Dust * Light	,600	1	,600	,462	,498
Heat * Dust * Light	,267	1	,267	,205	,651
Noise * Heat * Dust * Light	1,350	1	1,350	1,039	,309
Error	291,067	224	1,299		
Total	13668,000	240			
Corrected Total	907,583	239			

Dependent Variable: Performance_SA

According to analysis of work environment stressors on work performance with self-assessment of workers, Table 4.26 shows that ‘Heat’ and ‘Light’ have significant effect on work performance where p=0.000 and p=0.000, respectively. In addition to this, combined effect of ‘Noise and Heat’ where p=0.010, ‘Heat and Light’ where p=0.000, ‘Dust and Light’ where p=0.010 have significant effect on work performance.

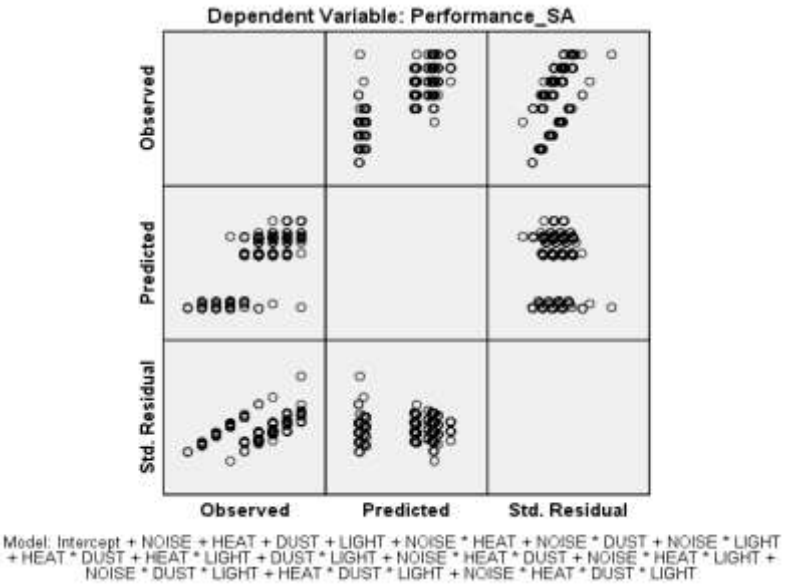


Figure 4.29: Observed * Predicted * Std. Residual Plot RT-SA

Figure 4.29 shows that residuals are constant.

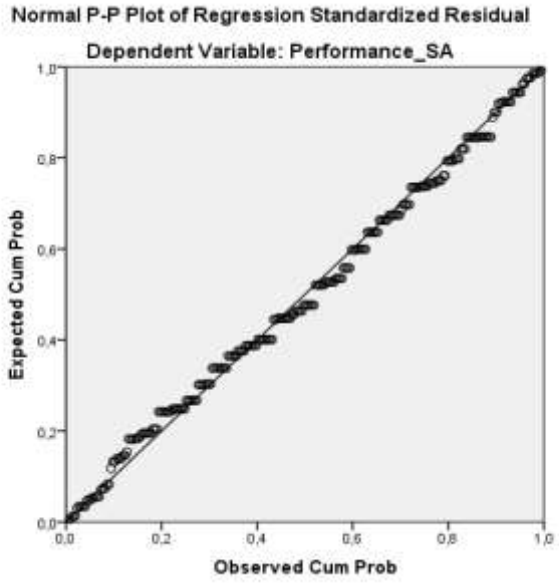


Figure 4.30: Normal P-P Plot of Regression Standardized Residual RT-SA

According to Figure 4.30 Standardized residuals are normally distributed.

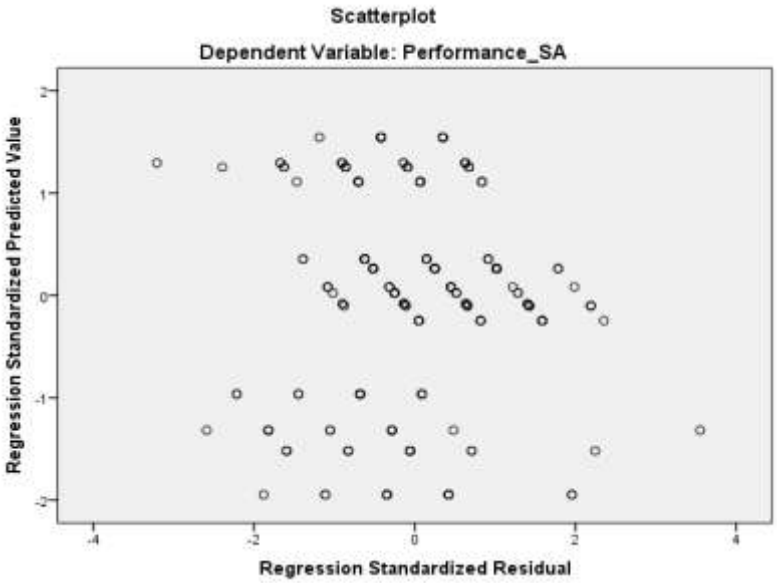


Figure 4.31: Standardized Residuals vs Standardized Predicted Values RT-SA

The regression plot of standardized residuals versus standardized predicted values shows that the points are randomly and uniformly distributed throughout the plot seen in Figure 4.31.

4.2.4 Analysis of Real-Time Measured WES - WS Performance

The performance of workers studied as dependent variable defined by using work sampling (WS) method and independent variables are work environment stressors; noise, heat, dust and light real time measurements.

Table 4.27: Real-Time Measured WES vs WS Performance

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1,344[a]	15	0,090	6,386	0,000
Intercept	126,426	1	126,426	9009,756	0,000
Noise	0,028	1	0,028	1,992	0,160
Heat	0,133	1	0,133	9,479	0,002
Dust	0,009	1	0,009	0,607	0,437

Light	0,147	1	0,147	10,442	0,001
Noise * Heat	0,013	1	0,013	0,930	0,336
Noise * Dust	0,163	1	0,163	11,599	0,001
Noise * Light	0,000	1	0,000	0,016	0,900
Heat * Dust	0,027	1	0,027	1,901	0,169
Heat * Light	0,428	1	0,428	30,471	0,000
Dust * Light	0,009	1	0,009	0,659	0,418
Noise * Heat * Dust	0,005	1	0,005	0,379	0,539
Noise * Heat * Light	0,162	1	0,162	11,525	0,001
Noise * Dust * Light	0,144	1	0,144	10,232	0,002
Heat * Dust * Light	0,062	1	0,062	4,447	0,036
Noise *Heat * Dust * Light	0,016	1	0,016	1,106	0,294
Error	3,143	224	0,014		
Total	130,913	240			
Corrected Total	4,487	239			

Dependent Variable: Performance_WS

According to analysis of work performance stressors on work performance with work sampling, Table 4.27 shows that ‘Heat’ and ‘Light’ have significant effect on work performance where p=0.002 and p=0.001, respectively. In addition to this, combined effect of ‘Noise and Dust’ where p=0.001, ‘Heat and Light’ where p=0.000, ‘Noise, Heat and Light’ where p=0.001, ‘Noise, Dust and Light’ where p=0.002, and ‘Heat, Dust and Light’ where p=0.036 have significant effect on work performance.

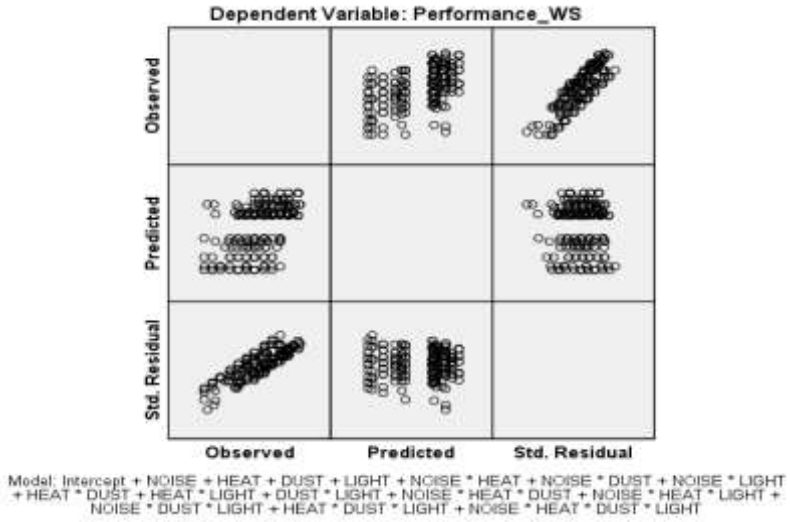


Figure 4.32: Observed * Predicted * Std. Residual Plot_WS

Figure 4.32 shows that residuals are constant.

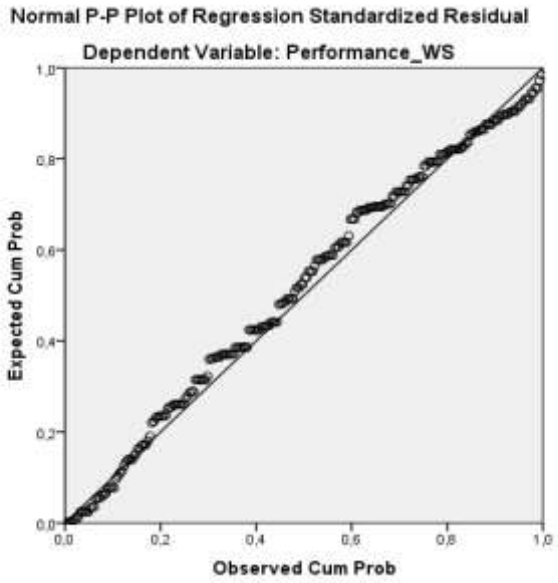


Figure 4.33: Normal P-P Plot of Regression Standardized Residual_WS

According to Figure 4.33, Standardized residuals are normally distributed.

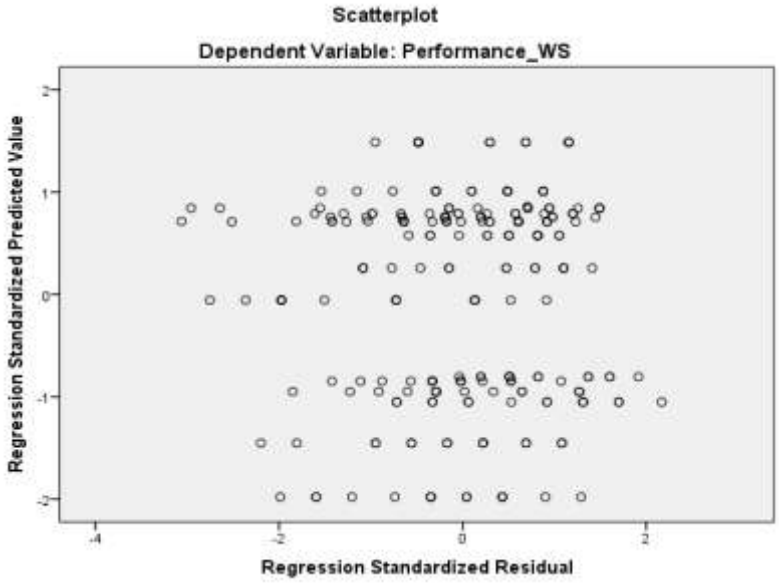


Figure 4.34: Standardized Residuals vs Standardized Predicted Values

The regression plot of standardized residuals versus standardized predicted values shows that the points are randomly and uniformly distributed throughout the plot seen in Figure 4.34.

Table 4.28: ANOVA for Real Time Measured WES vs WS Performance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,627	4	,157	9,535	,000[b]
	Residual	3,861	235	,016		
	Total	4,487	239			

a. Dependent Variable: Performance_WS
b. Predictors: (Constant), Light, Noise, Dust, Heat

Table 4.28 shows that regression is significant where p=0,000.

Table 4.29: Results of Regression Analysis with 4 Factors

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,533	,121		4,415	,000
	Noise	,003	,001	,160	2,389	,018
	Heat	,001	,002	,019	,218	,827
	Dust	,001	,001	,167	2,630	,009
	Light	,000	,000	-,339	-4,210	,000

a. Dependent Variable: Performance_WS

According to standardized coefficients in Table 4.29;

Performance = [Noise]*,160 + [Heat]*,019+ [Dust]*,167 -[Light]*,339 (4)

4.3 Occupational Safety and Health Management System Model

The findings in this PhD thesis has shown that an effective occupational safety and health management system (OSHMS) is necessary for NC industry which cannot be fully achieved without effective regulations and enforcement. A model is developed to help government regulators and companies achieve compliance with regulations and

create a better work environment that will increase the employee well-being and performance. For the model to work all parties (government regulators, inspectors, OSH professionals, employers and employees) need to be properly engaged.

OSHMS can be defined as a set of all organized practices in an establishment (company, institution, organization etc) for managing safety and health at work (ISO, 2018; Reese, 2008). An effective OSHMS helps prevent incidents and comply with regulations (Andersen et al., 2019).

Generally small and medium sized enterprises (SMEs) mostly lack an OSHMS due lack of commitment on the part of management, as well as the lack of resources and qualified staff to enforce OSH practices. This is likely why SMEs tend to have more OSH issues (Fabiano et al., 2004; Sørensen et al., 2007; Nordlöf et al., 2017) than larger companies. This is especially a serious problem in NC and other developing countries where the majority of companies are SMEs and where legislation may not be enforced. Regardless of company size, an OSHMS is necessary within every organization. Bonafede et al. (2016) in their study suggested that legislation might be tailored to meet the differing characteristics of SMEs when compared to larger enterprises, such as the use of simplified RA documents, thus making it easier for SMEs to comply with legislation. OSH research has mostly focused on large companies, and studies examining OSH issues of SMEs are scarce in the literature. OHSAS 18000 (Occupational Health and Safety Assessment Series-British Standard for Occupational Safety and Health) certified companies are known to have significantly better OSHM practices than those without this certification (Mohammadfam et al., 2017).

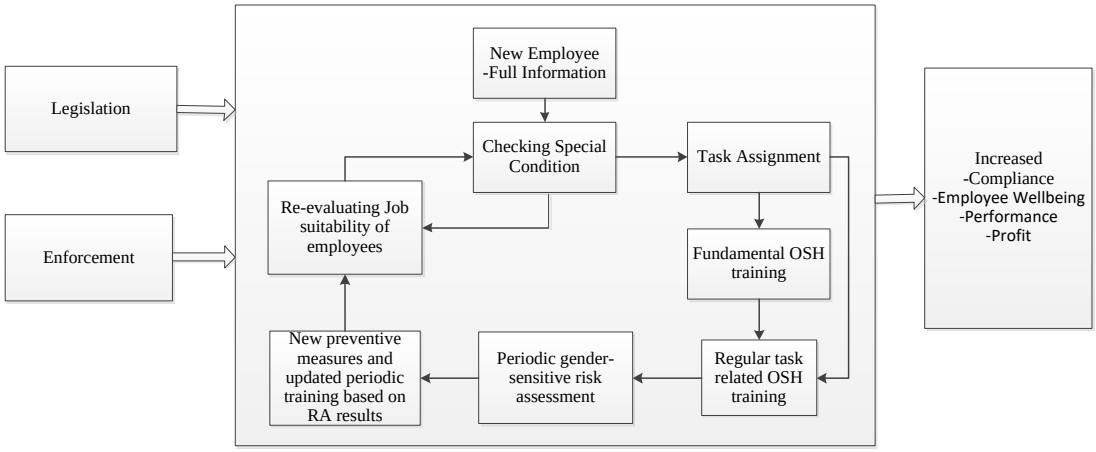


Figure 4.35: OSH Management System Model

The proposed model includes the company's occupational safety and health management system (OSHMS) with externally set legislation (law, regulations, standards) and enforcement as seen in Figure 4.35. The benefit of such a model will be increased well-being of staff leading to increased performance and profit to the company. The OSHMS cannot be fully effective without proper regulations and enforcement (Niskanen et al, 2012) even if there exists management commitment towards a better work environment. Therefore, the government officials need to establish any new or revised regulations and standards based on the needs of the industry. The first phase of this thesis has shown that there are written regulations and an OSH law of which most (75%) of the studied companies were not aware, making legislation insufficient. In this model the recommendation is to have all companies registered to an online OSH information system where there would be the flow of information in both directions. With this online system employers, or their representatives which can be the OSH professional they are working with or an employee responsible from OSH, could be kept up to date on any OSH training, other educational offerings or change in regulations. All related documents, guidance and training program schedules will be on a web site. Attendance of training programs for

employers, and employees would be mandatory and designed based on specific sectors. Another issue which can make a big difference in the workplace towards better working conditions is the RA obligation. The RA, OSH professional and inspector questionnaire and the employer interview type survey results has shown that, the companies are not conducting RA's. The companies can be enforced to meet this obligation, in this model the employers must enter their OSH professional name and contact info to the labor office system. Those who cannot find an OSH professional would be assigned one by the labor office. This would assure that they get proper guidance and conduct RA's. After completion of the RA, this would be reported online and allow for easier follow up and government labor office approval. This study showed that NC employers never bothered with WES measurements when manufacturing in small areas, which in the long run can cause serious health problems and affect employee performance as studied in this thesis. Identifying the inspection problem is one of the most important findings from the first phase of this study. Most OSH problems will be solved with proper enforcement such as regular preventive and follow up inspections.

The OSHMS includes full information collection of a new employee, understanding special conditions and gender specific differences. The OSH training and education starts as soon as the person is hired and continues during the entire employment period. Training programs should be general and task specific and could be tailored based on the employee needs. The employers will meet the RA obligation since there would be preventive inspections and an OSH professional would be working for them. Periodic RAs would help understand the work environment better, identify any new hazards, any risks from current situations and missing preventive measures would be revealed. Additionally, the work environment monitoring for environmental stressors would be

planned. The RA results would be used for planning proper preventive programs, revising the current programs, and building training programs. The employees job suitability would be re-evaluated based on new information both as working conditions and personnel.

Being a small island is an advantage to more easily build an effective OSH management system. North Cyprus can be an example for other small developing countries with SME's. There is insufficient attention given to SME's (Hasle et al., 2009) and the challenges they face. Increasing the number of studies on SMEs can help identify and solve important problems that would contribute to the economy of developing countries.

Chapter 5

DISCUSSION AND CONCLUSIONS

North Cyprus (NC), with a population of 326.000 (2017 census) is only recognized by Turkey while South Cyprus is part of the EU. According to the NC Labor Office, the manufacturing industry is second to the construction industry in the number of reported occupational accidents and injuries.

Workforce in the industrial sector consists of regular Cypriot staff and migrant workers and some contract workers. Perhaps similar to other developing countries, NC has mostly small and medium sized enterprises (SME). Compared to larger companies SME are known to have different characteristics, fewer resources, qualified staff, knowledge and management commitment towards OSH. As such they face increased challenges to meeting OSH standards, putting them at increased risk for OSH related issues.

The early stages of Phase I of this study identified a lack of enforcement of the NC OSH law based on interviews of employers of the construction and manufacturing industries. These interviews specifically revealed a lack of knowledge of the NC OSH law, few preventive risk assessments and the lack of OSH preventive inspections by government inspectors. In order to get a better understanding of these findings subsequent investigations in Phase I of this study included surveys of government trained OSH professionals and government inspectors. The results of these

investigations confirmed the information gathered from employers that government preventive inspections, guidance and other activities to support improving OSH in workplace was not taking place. Moreover, inspections only occurred when an occupational accident or incident occurred. Both OSH professionals and inspectors commented that the lack of preventive services was in part due to an inadequate number of government inspectors to perform these inspections. When RAs were occurring, these were considered to be effective in improving OSH in the workplace. In Phase I of this study it was also recognized that there was no monitoring of work environmental conditions including stressors like light, noise, dust, temperature or any other toxic chemical exposure. In Phase II of this study the focus was to understand the combined effect of heat, light, noise, and dust on worker performance.

It is well known that OSH is important for the safety and health of employees. Good OSH practices increase well-being and performance at work. This study addressed OSH practices in NC, the effectiveness of the OSH law, investigated the reasons employers do not comply with regulations, made real time measurements of work environmental stressors (heat, light, dust, noise) and found their combined effect on employee performance which had not been previously studied in an industrial setting.

Risk assessment is the most important employee obligation in the NC OSH law. Risks are minimized with effective RAs. Eighty seven percent of the companies interviewed in the first phase of this thesis study did not conduct a RA. Most employers (75%) were unaware of the law and employer obligations, but the main reason identified for not conducting RAs was the lack of enforcement or to be more precise lack of government preventive inspections. Almost all employers (98.9%) said that an inspector never visited their company for preventive OSH inspection. The NC OSH

law (35/2008) is found to be sufficient as written but is ineffective since it is not enforced. Labor office inspectors should have organized visits to companies to disseminate information regarding the law and guide companies to improve the work environment before focusing on penalties. This will increase knowledge and contribute towards building a culture of work safety. It is known that with or without penalties inspections improve work environments, and inspections with penalties are more effective (Tompa et al., 2016). Therefore, after a period of adaptation, citations and fines should be given to companies not complying with the current legislation. The lack of OSH management systems (OSHMS) can be overcome by regulations enforcing the establishment of an OSHMS in companies. This will be achieved by getting service from a government licensed OSH professional. The expenses of the first RA can be covered by the government and serve as an incentive to perform a RA.

The hypotheses set for the first part of the first phase of this thesis all supported except RAs being ineffective. RAs were found to be effective for those companies conducting RAs. The weaknesses identified are rare and unusual work tasks not being considered during a RA and the RA results not being used often enough in planning for improvement. The minority of companies conducting RAs (13%) use the results in taking preventive measures. The OSH professional and OSH inspector questionnaires which were designed to check the same hypotheses, gave the same results except for the sixth hypothesis (employers are not taking corrective action based on RA results). The OSH professional responses did not support this where the inspectors supported. This can be explained by the fact that OSH professionals are conducting RAs for companies and guiding them to make improvements. In this part of the thesis study the inspectors and inspections were evaluated as insufficient. Future research can aim to determine the number of government inspectors needed to conduct regular effective

preventive inspections and the number of certified OSH professionals necessary to conduct periodic RAs for the industries in NC.

Occupational risk of women is an area of limited research (Choi, 2005; EU-OSHA, 2014; Park et al., 2018) and growing interest worldwide. It was recognized by Phase I of this study that employees of the industrial sector were all male workers. ILO (2013) and EU-OSHA (2014) guidelines have started to incorporate gender sensitive RA recommendations and NC included an OSH regulation in 2015. To investigate this further a pilot study was conducted at a hospital in NC. The scope of this study and small sample size limits generalizability and conclusive gender comparisons, however, several important points were identified and worth emphasizing. Discussions with the hospital leadership and further observations confirmed that, overall, minimal attention is placed on OSH preventive measures, record keeping of occupational incidents (accidents, injuries, illnesses, near misses) is lacking, and gender differences are not considered when designing the work environment and work schedules. Women, who often have additional home responsibilities, such as child or elder care, cooking and cleaning, may have increased stress and less time to rest between work shifts compared to male workers. Stress and fatigue may contribute to increased occupational risk for women. While the majority of women with dysmenorrhea and those who are pregnant or breast feeding don't report difficulty taking time off, some of these women did report difficulty taking time off this issue may need further investigation with a larger sample size. This pilot study can be expanded and applied to other work settings to have a better understanding of gender related OSH issues in NC.

None of the companies in this study monitored work environment for stressors (WES), which if not monitored and controlled can lead to health problems, accidents and

decrease in the employee performance. In the literature, WES were studied mainly in offices with experimental setups by including and controlling one or two stressors at a time (Shi et al., 2013; Geng et al., 2017; Tanabe et al, 2015; Abbasi et al., 2020). There have been very few attempts to find the combined effect of stressors (Dianat et al., 2016; Realyvásquez et al., 2016; Hygge & Knez, 2001; Chao et al., 2013; Chen et al., 2007; Kang et al., 2017). This study is the first of its kind, carried out in the manufacturing setting during production with real time WES measurements and the first-time performance is measured using the work sampling (WS) method. Although the work sampling method has been used in different industries such as automotive, healthcare, apparel, clothing (Everhart, 1997; Güner & Ünal, 2010; Gunesoglu & Meric, 2007; Martinec et al., 2017; Mehta, 2017; Sittig, 1993), as well as one behavioral study (Besterfield-Sacre et al., 2004) , and one study comparing the time study and work sampling methods in the development of automated labor performance (Van Blommenstein et al., 2011), to date, there has not been a study measuring worker performance with WS in the manufacturing industry, with real time measures of WES.

When the average seasonal performance evaluated with WS for each worker was plotted, a significant decrease in performance was noted in Summer compared to other seasons. There were several approaches to determining the combined effect of WES: 1) self-assessed WES and performance self-assessment 2) self-assessed WES and WS performance measurement, 3) real-time WES measurements and performance self-assessment, and 4) real-time WES measurement and WS performance measurement. The analysis of self-assessed WES and self-assessed performance showed that heat has a significant effect on performance which is consistent with the literature (Geng et al., 2017; Tanabe, et al., 2015). Workers own perceptions also show that heat affects their work performance which is consistent with the seasonal variation of their average

work performance evaluated with WS. Workers self-identified heat as a primary contributor to a decline in work performance. In the company studied, observations show that workers tend to complete the job on time despite their work conditions which is consistent with the literature (Wellens & Smith, 2006).

According to the analysis of self-assessed WES and WS measure of performance: noise, heat-light-dust, and heat-noise-dust have a significant effect on performance. This shows that even though the workers reported being mainly disturbed by thermal conditions, other factors were also affecting their work performance. Another set of analyses took place between the real time measured WES and self-assessed performance. Here, heat, light, noise-heat, heat-light, and dust-light had a significant effect on work performance. These represent actual environmental conditions. Finally, when the results of real time WES measurements and work performance obtained with WS were analysed a significant effect on performance was found with heat, light, noise-dust, heat-light, noise-heat-light, noise-dust-light, and heat-dust-light. Future studies can include monitoring these environmental stressors and their long-term effects on worker health. Additionally, the study of the impact of these WES can be expanded to other industries outside of manufacturing.

It is extremely important to provide a healthy and safe work environment, and this is not possible without understanding the level of exposure of each stressor. For example, in the studied work environments, the noise level may not be very high for an eight hour shift, but a noise dosimeter placed on the shoulder of a worker using the cutting machine showed an exposure of 140 dBA impulse noise which is the maximum the device can measure and none of the workers in the manufacturing unit were wearing PPE to prevent hearing loss. Even when the noise exposure is at the permissible

exposure limit (PEL) the non-auditory effects such as headache, annoyance, hypertension can be a problem. Furthermore, people are also exposed to noise after work (Fink, 2017) making it important to control the amount of exposure with proper administrative controls mainly by monitoring and designing work schedules to prevent excessive noise exposure and potential harm. On the other hand, climate change and global warming is a progressive global issue and countries like NC with hot Summers already experience problematic working conditions in the workplace, especially with SME without air conditioning. Global warming is likely to continue to impact job performance as well as health and safety. Government OSH inspectors can ensure that work environments are monitored for environmental stressors which are currently mostly ignored. Our proposed OSHMS model has the potential to solve most of the OSH management problems and contribute to improving OSH in the workplace. This features of this OSHMS model has the potential to not only benefit companies in NC but is generalizable to all settings. The effectiveness of this model will be the focus of future investigation.

The combined effect of WES on employee job performances in a manufacturing company is an important contribution to the literature as these measurements were made in real time compared to researcher-controlled stressors that have been previously reported in the literature. Additionally, this study addresses the combined effect of four environmental stressors in a manufacturing setting compared to two or three stressors in an office setting. Moreover, the use of the WS method to evaluate performance is studied for the first time in a manufacturing environment. The design and results of this thesis will form the basis for future research in this field.

REFERENCES

Abbasi, A. M., Motamedzade, M., Aliabadi, M., Golmohammadi, R., & Tapak, L. (2020). Combined effects of noise and air temperature on human neurophysiological responses in a simulated indoor environment. *Applied Ergonomics*, *88*, 103189. https://doi.org/10.1016/j.apergo.2020.103189

Abbasi, M., Yazdanirad, S., Habibi, P., Arabi, S., Fallah Madvari, R., Mehri, A., Ghaljahi, M. (2019). Relationship among noise exposure, sensitivity, and noise annoyance with job satisfaction and job stress in a textile industry. *Noise & Vibration Worldwide*, *50*(6), 195–201. https://doi.org/10.1177/0957456519853812

Abdou, O. A. (1997). Effects of luminous environment on worker productivity in building spaces. *Journal of Architectural Engineering*. https://doi.org/10.1061/(asce)1076-0431(1997)3:3(124)

Abulude, F. O., Fagbayide, S. D., & Akinnusotu, A. (2018). Assessments of noise levels from noise sources in akure, Nigeria: A preliminary study. *Iraqi Journal of Science*. https://doi.org/10.24996/IJS.2018.59.4C.6

Al-Arja, O. A., & Awadallah, T. S. (2020). Assessment of occupational noise exposure in coffee grinding shops. *Applied Acoustics*, *158*, 107047. https://doi.org/10.1016/j.apacoust.2019.107047

Al Horr, Y., Arif, M., Kaushik, A., Mazroei, A., Katafygiotou, M., & Elsarrag, E.

(2016). Occupant productivity and office indoor environment quality: A review of the literature. *Building and Environment*. https://doi.org/10.1016/j.buildenv.2016.06.001

Ali, S. A. (2011). Industrial noise levels and annoyance in Egypt. *Applied Acoustics*. https://doi.org/10.1016/j.apacoust.2010.11.001

Andersen, J. H., Malmros, P., Ebbehoej, N. E., Flachs, E. M., Bengtsen, E., & Bonde, J. P. (2019). Systematic literature review on the effects of occupational safety and health (OSH) interventions at the workplace. *Scandinavian Journal of Work, Environment and Health*. https://doi.org/10.5271/sjweh.3775

Anjorin, S. A., Jemiluyi, A. O., & C, A. T. (2015). Evaluation of industrial noise: a case study of two nigerian industries. *European Journal of Engineering and Technology*, *3*(6). Retrieved from www.idpublications.org

Annan, J. S., Addai, E. K., & Tulashie, S. K. (2015). A call for action to improve occupational health and safety in ghana and a critical look at the existing legal requirement and legislation. *Safety and Health at Work*. https://doi.org/10.1016/j.shaw.2014.12.002

Asfahl, C. R. (2003). *Industrial Safety and Health Management*. Retrieved from https://www.goodreads.com/book/show/3958898-industrial-safety-and-health-management

Atmaca, E., Peker, I., & Altin, A. (2005). Industrial noise and its effects on humans.

Polish Journal of Environmental Studies.

Attarchi, M., Dehghan, F., Safakhah, F., Nojomi, M., & Mohammadi, S. (2012). Effect of exposure to occupational noise and shift working on blood pressure in rubber manufacturing company workers. *Industrial Health*. https://doi.org/10.2486/indhealth.MS1321

Barnes, R. M. (1980). *Motion and Time Study: Design and Measurement of Work,* 7th Edition | Wiley.

Baron, R. A., Rea, M. S., & Daniels, S. G. (1992). Effects of indoor lighting (illuminance and spectral distribution) on the performance of cognitive tasks and interpersonal behaviors: The potential mediating role of positive affect. *Motivation and Emotion*. https://doi.org/10.1007/BF00996485

Basner, M., Babisch, W., Davis, A., Brink, M., Clark, C., Janssen, S., & Stansfeld, S. (2014). Auditory and non-auditory effects of noise on health. *The Lancet, 383*(9925), 1325–1332. https://doi.org/10.1016/S0140-6736(13)61613-X

Basner, M., Brink, M., Bristow, A., De Kluizenaar, Y., Finegold, L., Hong, J., Sörqvist, P. (2015). ICBEN review of research on the biological effects of noise 2011-2014. *Noise and Health*. https://doi.org/10.4103/1463-1741.153373

Bedi, R. (2006). Evaluation of occupational environment in two textile plants in Northern India with specific reference to noise. *Industrial Health*. https://doi.org/10.2486/indhealth.44.112

Bellia, L., Bisegna, F., & Spada, G. (2011). Lighting in indoor environments: Visual and non-visual effects of light sources with different spectral power distributions. *Building and Environment*, *46*(10), 1984–1992. https://doi.org/10.1016/j.buildenv.2011.04.007

Benjamin Stein, John S. Reynolds, Walter T. Grondzik, A. G. K. (2010). *Mechanical and Electrical Equipment for Buildings*. Retrieved from https://books.google.com.tr/books?id=ZIdvdyPMhI8C&printsec=frontcover&redir_esc=y#v=snippet&q=the recommended level of daylight factor&f=false

Beutel, M. E., Jünger, C., Klein, E. M., Wild, P., Lackner, K., Blettner, M., Münzel, T. (2016). Noise annoyance is associated with depression and anxiety in the general population- the contribution of aircraft noise. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0155357

Blazejczyk, K., Baranowski, J., & Blazejczyk, A. (2014). Heat stress and occupational health and safety - Spatial and temporal differentiation. *Miscellanea Geographica*, *18*(1), 61–67. https://doi.org/10.2478/mgrsd-2014-0011

Bonafede, M., Corfiati, M., Gagliardi, D., Boccuni, F., Ronchetti, M., Valenti, A., Iavicoli, S. (2016). OHS management and employers' perception: Differences by firm size in a large Italian company survey. *Safety Science*. https://doi.org/10.1016/j.ssci.2016.05.012

Boudreau, P., Dumont, G. A., & Boivin, D. B. (2013). Circadian adaptation to night shift work influences sleep, performance, mood and the autonomic modulation of

the heart. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0070813

Brammer, A. J., & Laroche, C. (2012). Noise and communication: A three-year update. *Noise and Health*. https://doi.org/10.4103/1463-1741.104894

Brauer, R. L. (2006). *Safety and Health for Engineers, 2nd Edition | Wiley*. Retrieved from https://www.wiley.com/en-us/Safety+and+Health+for+Engineers%2C+2nd+Edition-p-9780471750932

Burgess, H. J., Sharkey, K. M., & Eastman, C. I. (2002). Bright light, dark and melatonin can promote circadian adaptation in night shift workers. *Sleep Medicine Reviews*, *6*(5), 407–420. https://doi.org/10.1053/smrv.2001.0215

CCOHS. (2016). Hot Environments - Health Effects and First Aid : OSH Answers. Retrieved November 11, 2020, from https://www.ccohs.ca/oshanswers/phys_agents/heat_health.html

CCOHS. (2018). Risk Assessment : OSH Answers. Retrieved November 9, 2020, from https://www.ccohs.ca/oshanswers/hsprograms/risk_assessment.html

CCOHS. (2020). Lighting Ergonomics - General : OSH Answers. Retrieved December 2, 2020, from https://www.ccohs.ca/oshanswers/ergonomics/lighting_general.html

Chao, P. C., Juang, Y. J., Chen, C. J., Dai, Y. T., Yeh, C. Y., & Hu, C. Y. (2013). Combined effects of noise, vibration, and low temperature on the physiological

parameters of labor employees. *Kaohsiung Journal of Medical Sciences*. https://doi.org/10.1016/j.kjms.2013.03.004

Chen, C. J., Dai, Y. T., Sun, Y. M., Lin, Y. C., & Juang, Y. J. (2007). Evaluation of auditory fatigue in combined noise, heat and workload exposure. *Industrial Health*. https://doi.org/10.2486/indhealth.45.527

Ciuha, U., Pogačar, T., Bogataj, L. K., Gliha, M., Nybo, L., Flouris, A. D., & Mekjavic, I. B. (2019). Interaction between indoor occupational heat stress and environmental temperature elevations during heat waves. *Weather, Climate, and Society*. https://doi.org/10.1175/WCAS-D-19-0024.1

De Giuli, V., Da Pos, O., & De Carli, M. (2012). Indoor environmental quality and pupil perception in Italian primary schools. *Building and Environment*. https://doi.org/10.1016/j.buildenv.2012.03.024

Dianat, I., Vahedi, A., & Dehnavi, S. (2016). Association between objective and subjective assessments of environmental ergonomic factors in manufacturing plants. *International Journal of Industrial Ergonomics*. https://doi.org/10.1016/j.ergon.2015.12.004

Dobie, R. A. (2008). The burdens of age-related and occupational noise-induced hearing loss in the United States. *Ear and Hearing*. https://doi.org/10.1097/AUD.0b013e31817349ec

Dzhambov, A., & Dimitrova, D. (2017). Occupational noise exposure and the risk for

work-related injury: A systematic review and meta-analysis. *Annals of Work Exposures and Health*. https://doi.org/10.1093/annweh/wxx078

Dzhambov, A. M., & Dimitrova, D. D. (2016). Occupational noise and ischemic heart disease: A systematic review. *Noise and Health*. https://doi.org/10.4103/1463-1741.189241

Dzhambov, A. M., Dimitrova, D. D., & Dimitrakova, E. D. (2014). Noise exposure during pregnancy, birth outcomes and fetal development: meta-analyses using quality effects model. *Folia Medica*. https://doi.org/10.2478/folmed-2014-0030

Edimansyah, B. A., Rusli, B. N., Naing, L., Azwan, B. A., & Aziah, B. D. (2009). Indoor air quality in an automotive assembly plant in selangor, malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health*, *40*(1).

Eleftheriou, P. C. (2002). Industrial noise and its effects on human hearing. *Applied Acoustics*. https://doi.org/10.1016/S0003-682X(01)00022-6

EU-OSHA. (1989). Directive 89/391/EEC - OSH "Framework Directive" - Safety and health at work - EU-OSHA. Retrieved July 18, 2020, from https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1#:~:text=The aim of this Directive,or certain civil protection services.

EU-OSHA. (2014). Mainstreaming gender into occupational safety and health practice - Safety and health at work - EU-OSHA. Retrieved July 18, 2020, from https://osha.europa.eu/en/publications/reports/mainstreaming-gender-into-

occupational-safety-and-health-practice/view

European Agency for Safety and Health at Work. (2013). New risks and trends in the safety and health of women at work. In *Occupational Medicine*. Retrieved from https://osha.europa.eu/en/publications/reports/new-risks-and-trends-in-the-safety-and-health-of-women-at-work

Fabiano, B., Currò, F., & Pastorino, R. (2004). A study of the relationship between occupational injuries and firm size and type in the Italian industry. *Safety Science*. https://doi.org/10.1016/j.ssci.2003.09.003

Fisk, W. J. (2000). Health and productivity gains from better indoor environments and their relationship with building energy efficiency. *Annual Review of Energy and the Environment*. https://doi.org/10.1146/annurev.energy.25.1.537

Flouris, A. D., Dinas, P. C., Ioannou, L. G., Nybo, L., Havenith, G., Kenny, G. P., & Kjellstrom, T. (2018). Workers' health and productivity under occupational heat strain: a systematic review and meta-analysis. *The Lancet Planetary Health*. https://doi.org/10.1016/S2542-5196(18)30237-7

Geng, Y., Ji, W., Lin, B., & Zhu, Y. (2017). The impact of thermal environment on occupant IEQ perception and productivity. *Building and Environment*, *121*, 158–167. https://doi.org/10.1016/j.buildenv.2017.05.022

Goetsch, D. L. (2008). *Occupational Safety and Health for Technologists, Engineers, and Managers*. Pearson education.

Haapakangas, A., Helenius, R., Keskinen, E., & Hongisto, V. (2008). Perceived acoustic environment , work performance and well-being - survey results from Finnish offices. *9th International Congress on Noise as a Public Health Problem (ICBEN)*.

Haapakangas, A., Keränen, J., Nyman, M., & Hongisto, V. (2012). Lighting improvement and subjective working conditions in an industrial workplace. *Light and Engineering*.

Hasle, P., Kines, P., & Andersen, L. P. (2009). Small enterprise owners' accident causation attribution and prevention. *Safety Science*. https://doi.org/10.1016/j.ssci.2007.12.005

Havenith, G. (2005). Temperature regulation, heat balance and climatic stress. Retrieved November 11, 2020, from https://www.researchgate.net/publication/226977672_Temperature_Regulation_Heat_Balance_and_Climatic_Stress

Hawes, B. K., Brunyé, T. T., Mahoney, C. R., Sullivan, J. M., & Aall, C. D. (2012). Effects of four workplace lighting technologies on perception, cognition and affective state. *International Journal of Industrial Ergonomics*, *42*(1), 122–128. https://doi.org/10.1016/j.ergon.2011.09.004

Health and Safety Executive. (1997). Lighting at work. *Regulation*. https://doi.org/10.6100/IR639378

Hemphälä, H., & Eklund, J. (2012). A visual ergonomics intervention in mail sorting facilities: Effects on eyes, muscles and productivity. *Applied Ergonomics*. https://doi.org/10.1016/j.apergo.2011.05.006

Hoffmann, G., Gufler, V., Griesmacher, A., Bartenbach, C., Canazei, M., Staggl, S., & Schobersberger, W. (2008). Effects of variable lighting intensities and colour temperatures on sulphatoxymelatonin and subjective mood in an experimental office workplace. *Applied Ergonomics*, *39*(6), 719–728. https://doi.org/10.1016/j.apergo.2007.11.005

Houtman, I., Douwes, M., de Jong, T., Meeuwsen, J.M., Jongen, M., Brekelmans, F., Nieboer-Op de Weegh, M., et al. (2007). New forms of physical and psychosocial health risks at work study. *Policy Department Economy and Science*.

Hume, K. (2010). Sleep disturbance due to noise: Current issues and future research. *Noise and Health*. https://doi.org/10.4103/1463-1741.63206

Hygge, S., & Knez, I. (2001). Effects of noise, heat and indoor lighting on cognitive performance and self-reported affect. *Journal of Environmental Psychology*, *21*(3), 291–299. https://doi.org/10.1006/jevp.2001.0222

IHSA. (n.d.). *Construction Health and Safety Manual Heat Stress*. Retrieved from www.labour.gov.on.ca/english/hs/pubs/gl_heat.php

ILO. (2008). *Fundamental Principles of Occupational Health and Safety*.

ILO. (2013). *10 Keys for gender sensitive OSH practice – Guidelines for gender mainstreaming in occupational safety and health*. Retrieved from http://www.ilo.org/global/topics/safety-and-health-at-work/resources-library/publications/WCMS_324653/lang--en/index.htm

ISO. (2013). ISO 1999:2013 - Acoustics — Estimation of noise-induced hearing loss. Retrieved November 16, 2020, from https://www.iso.org/standard/45103.html

ISO. (2018). ISO 45001:2018 - Occupational health and safety management systems — Requirements with guidance for use. Retrieved December 4, 2020, from https://www.iso.org/standard/63787.html

Jaakkola, M. S., Quansah, R., Hugg, T. T., Heikkinen, S. A. M., & Jaakkola, J. J. K. (2013). Association of indoor dampness and molds with rhinitis risk: A systematic review and meta-analysis. *Journal of Allergy and Clinical Immunology*. https://doi.org/10.1016/j.jaci.2013.07.028

Jabbari, K., Nassiri, P., Monazzam Esmaeelpour, M. R., Azam, K., Faridan, M., & Heidari, L. (2016). The relationship between occupational noise exposure and noise induced hearing loss (NIHL) in small-scale industries: A case study in the city of Damavand, Iran. *Biotechnology and Health Sciences*, *3*(4). https://doi.org/10.17795/bhs-40735

Jackson, L. L., & Rosenberg, H. R. (2010). Preventing heat-related illness among agricultural workers. *Journal of Agromedicine*. https://doi.org/10.1080/1059924X.2010.487021

Jamrozik, A., Ramos, C., Zhao, J., Bernau, J., Clements, N., Vetting Wolf, T., & Bauer, B. (2018). A novel methodology to realistically monitor office occupant reactions and environmental conditions using a living lab. *Building and Environment*. https://doi.org/10.1016/j.buildenv.2017.12.024

Juslén, H., & Tenner, A. (2005). Mechanisms involved in enhancing human performance by changing the lighting in the industrial workplace. *International Journal of Industrial Ergonomics*, *35*(9), 843–855. https://doi.org/10.1016/j.ergon.2005.03.002

Kang, S., Ou, D., & Mak, C. M. (2017). The impact of indoor environmental quality on work productivity in university open-plan research offices. *Building and Environment*, *124*, 78–89. https://doi.org/10.1016/j.buildenv.2017.07.003

Katabaro, J. M., & Yan, Y. (2019). Effects of lighting quality on working efficiency of workers in office building in Tanzania. *Journal of Environmental and Public Health*. https://doi.org/10.1155/2019/3476490

Kenney, L. W. D. C. and J. H. (2015). *Physiology of Sport and Exercise, 6th Edition*. Retrieved from https://www.abebooks.co.uk/9781450477673/Physiology-Sport-Exercise-6th-Edition-1450477674/plp

Kjellstrom, T., Holmer, I., & Lemke, B. (2009). Workplace heat stress, health and productivity-an increasing challenge for low and middle-income countries during climate change. *Global Health Action*, *2*(1). https://doi.org/10.3402/gha.v2i0.2047

Kjellstrom, T., Kovats, R. S., Lloyd, S. J., Holt, T., & Tol, R. S. J. (2009). The Direct Impact of Climate Change on Regional Labor Productivity. *Archives of Environmental & Occupational Health*, *64*(4), 217–227. https://doi.org/10.1080/19338240903352776

Kwong, Q. J., Abdullah, J., Tan, S. C., Thio, T. H. G., & Yeaw, W. S. (2018). A field study of indoor air quality and occupant perception in experimental laboratories and workshops. *Management of Environmental Quality: An International Journal*. https://doi.org/10.1108/MEQ-04-2018-0074

Laird, I., Olsen, K., Harris, L. A., Legg, S., & Perry, M. J. (2011). Utilising the characteristics of small enterprises to assist in managing hazardous substances in the workplace. *International Journal of Workplace Health Management*. https://doi.org/10.1108/17538351111143312

Lao, X. Q., Yu, I. T. S., Au, D. K. K., Chiu, Y. L., Wong, C. C. Y., & Wong, T. W. (2013). Noise exposure and hearing impairment among chinese restaurant workers and entertainment employees in Hong Kong. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0070674

Lee, S. Y., & Brand, J. L. (2005). Effects of control over office workspace on perceptions of the work environment and work outcomes. *Journal of Environmental Psychology*, *25*(3), 323–333. https://doi.org/10.1016/j.jenvp.2005.08.001

Levin, J. L., Curry, W. F., Shepherd, S., Nalbone, J. T., & Nonnenmann, M. W. (2016).

Hearing loss and noise exposure among commercial fishermen in the gulf coast. *Journal of Occupational and Environmental Medicine*. https://doi.org/10.1097/JOM.0000000000000642

Lie, A., Skogstad, M., Johannessen, H. A., Tynes, T., Mehlum, I. S., Nordby, K.-C., Tambs, K. (2016). Occupational noise exposure and hearing: a systematic review. *International Archives of Occupational and Environmental Health*, *89*(3), 351–372. https://doi.org/10.1007/s00420-015-1083-5

Liebl, A., & Jahncke, H. (2017). Review of research on the effects of noise on cognitive performance 2014-2017. *Icben 2017*.

Lowden, A., Öztürk, G., Reynolds, A., & Bjorvatn, B. (2019). Working Time Society consensus statements: Evidence based interventions using light to improve circadian adaptation to working hours. *Industrial Health*, *57*(2), 213–227. https://doi.org/10.2486/indhealth.SW-9

Lundgren, K., & Kjellstrom, T. (2013). Sustainability challenges from climate change and air conditioning use in urban areas. *Sustainability (Switzerland)*. https://doi.org/10.3390/su5073116

Lundgren, K., Kuklane, K., Gao, C., & Holmér, I. (2013). Effects of Heat Stress on Working Populations when Facing Climate Change.

Lusk, S. L., Gillespie, B., Hagerty, B. M., & Ziemba, R. A. (2004). Acute effects of noise on blood pressure and heart rate. *Archives of Environmental Health*.

https://doi.org/10.3200/AEOH.59.8.392-399

Mapuranga, M., Maziriri, E. T., Letshaba, R. K., & Chitamba, A. (2020). Does occupational noise matter amongst manufacturing (Small and medium enterprises) workers? empirical evidence from Magaba, Mbare, Zimbabwe. *South African Journal of Communication Disorders*. https://doi.org/10.4102/sajcd.v67i2.680

Martinez, L. F. (2012). Can you hear me now? Occupational hearing loss, 2004-2010 : Monthly Labor Review: U.S. Bureau of Labor Statistics. Retrieved November 16, 2020, from https://www.bls.gov/opub/mlr/2012/article/can-you-hear-me-now-occupational-hearing-loss-2004-2010.htm

Michael N. Sawka, 1 C. Bruce Wenger, Andrew J. Young, and K. B. P. (1993). *Physiological Responses to Exercise in the Heat*. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK236240/

Mohammadfam, I., Kamalinia, M., Momeni, M., Golmohammadi, R., Hamidi, Y., & Soltanian, A. (2017). Evaluation of the quality of occupational health and safety management systems based on key performance indicators in certified organizations. *Safety and Health at Work*. https://doi.org/10.1016/j.shaw.2016.09.001

Morata, T. C., Themann, C. L., Randolph, R. F., Verbsky, B. L., Byrne, D. C., & Reeves, E. R. (2005). Working in noise with a hearing loss: Perceptions from workers, supervisors, and hearing conservation program managers. *Ear and*

Hearing. https://doi.org/10.1097/01.aud.0000188148.97046.b8

Mukhopadhyay, K., Ramasamy, R., Mukhopadhyay, B., Ghosh, S., Sambandam, S., & Balakrishnan, K. (2014). Use of ventilation-index in the development of exposure model for indoor air pollution—A Review. *Open Journal of Air Pollution*. https://doi.org/10.4236/ojap.2014.32004

Münzel, T., Gori, T., Babisch, W., & Basner, M. (2014). Cardiovascular effects of environmental noise exposure. *European Heart Journal*. https://doi.org/10.1093/eurheartj/ehu030

Muzammil, M., Ahmad, S., Khan, A. A., & Hasan, F. (2011). Design of a workstation and its evaluation under the influence of noise and illumination for an assembly task. *Work*. https://doi.org/10.3233/WOR-2011-1145

NC Labor Office. (1992). İş Yasası. Retrieved November 9, 2020, from http://calisma.gov.ct.tr/Portals/33/Mevzuat/22-1992.pdf?ver=2016-08-25-164840-890

NC Labor Office. (2008). İş Sağlığı ve Güvenliği Yasası. Retrieved November 9, 2020, from http://calisma.gov.ct.tr/Portals/33/Mevzuat/35-2008 Iş Sağliği ve Güvenliği Yasasi.pdf?ver=2016-08-26-094629-347

Nelson, D. I., Nelson, R. Y., Concha-Barrientos, M., & Fingerhut, M. (2005). The global burden of occupational noise-induced hearing loss. *American Journal of Industrial Medicine*. https://doi.org/10.1002/ajim.20223

Nevalainen, A., Partanen, P., Jääskeläinen, E., Hyvärinen, A., Koskinen, O., Meklin, T., Aune, M. (2003). Indoor air quality and student performance. *Indoor Air*.

NIOSH. (2016). *Criteria for a recommended standard: occupational exposure to heat and hot environments - revised criteria 2016.* https://doi.org/10.26616/NIOSHPUB2016106

Niskanen, T., Naumanen, P., & Hirvonen, M. L. (2012). An evaluation of EU legislation concerning risk assessment and preventive measures in occupational safety and health. *Applied Ergonomics*. https://doi.org/10.1016/j.apergo.2011.12.003

Nordlöf, H., Wiitavaara, B., Högberg, H., & Westerling, R. (2017). A cross-sectional study of factors influencing occupational health and safety management practices in companies. *Safety Science*. https://doi.org/10.1016/j.ssci.2017.02.008

Nserat, S., Al-Musa, A., Khader, Y. S., Abu Slaih, A., & Iblan, I. (2017). Blood pressure of jordanian workers chronically exposed to noise in industrial plants. *International Journal of Occupational and Environmental Medicine*. https://doi.org/10.15171/ijoem.2017.1134

Occupational Safety and Health Branch Labour Department. (2008). Lighting assessment in the workplace. Retrieved July 18, 2020, from https://www.labour.gov.hk/eng/public/oh/Lighting.pdf

Occupational Safety and Health Branch Labour Department. (2017). *Guidelines for*

Good Occupational Hygiene Practice in a Workplace-Lighting Item Task position or area Optimum average illumination in lux Notes.

OSHA. (n.d.). Occupational Noise Exposure - Standards | Occupational Safety and Health Administration. Retrieved November 11, 2020, from https://www.osha.gov/noise/standards

OSHA. (2006). OSHA Technical Manual (OTM) | Section III: Chapter 5 - Noise | Occupational Safety and Health Administration. Retrieved November 16, 2020, from https://www.osha.gov/dts/osta/otm/new_noise/#auditory

OSHA Factsheet. (2008). Factsheet 81 - Risk assessment — the key to healthy workplaces - Safety and health at work - EU-OSHA. Retrieved November 9, 2020, from https://osha.europa.eu/en/publications/factsheet-81-risk-assessment-key-healthy-workplaces/view

Parsons, K. (2009). Maintaining health, comfort and productivity in heat waves. *Global Health Action*, *2*(1). https://doi.org/10.3402/gha.v2i0.2057

Parsons, K. (2014). Human thermal environments: The effects of hot, moderate, andcold environments on human health,comfort, and performance, third edition. In *Human Thermal Environments: The Effects of Hot, Moderate, and Cold Environments on Human Health, Comfort, and Performance, Third Edition*. https://doi.org/10.1201/b16750

Pauley, S. M. (2004). Lighting for the human circadian clock: Recent research

indicates that lighting has become a public health issue. *Medical Hypotheses*. https://doi.org/10.1016/j.mehy.2004.03.020

Picard, M., Girard, S. A., Simard, M., Larocque, R., Leroux, T., & Turcotte, F. (2008). Association of work-related accidents with noise exposure in the workplace and noise-induced hearing loss based on the experience of some 240,000 person-years of observation. *Accident Analysis and Prevention*. https://doi.org/10.1016/j.aap.2008.05.013

Pitarma, R., Lourenço, M., & Ramos, J. (2016). Improving occupational health by modelling indoor pollutant distribution. *Facilities*, *34*(5–6), 289–301. https://doi.org/10.1108/F-07-2014-0061

Pogačar, T., Casanueva, A., Kozjek, K., Ciuha, U., Mekjavić, I. B., Kajfež Bogataj, L., & Črepinšek, Z. (2018). The effect of hot days on occupational heat stress in the manufacturing industry: implications for workers' well-being and productivity. *International Journal of Biometeorology*, *62*(7), 1251–1264. https://doi.org/10.1007/s00484-018-1530-6

Preto, S., & Gomes, C. C. (2019). Lighting in the workplace: Recommended illuminance (lux) at workplace environs. *Advances in Intelligent Systems and Computing*. https://doi.org/10.1007/978-3-319-94622-1_18

Pyko, A., Eriksson, C., Oftedal, B., Hilding, A., O¨stenson, C. G., Krog, N. H., Pershagen, G. (2015). Exposure to traffic noise and markers of obesity. *Occupational and Environmental Medicine*. https://doi.org/10.1136/oemed-

2014-102516

Realyvásquez, A., Maldonado-Macías, A., García-Alcaraz, J., Cortés-Robles, G., & Blanco-Fernández, J. (2016). Structural Model for the Effects of Environmental Elements on the Psychological Characteristics and Performance of the Employees of Manufacturing Systems. *International Journal of Environmental Research and Public Health*, *13*(1), 104. https://doi.org/10.3390/ijerph13010104

Reese, C. D. (2008). Occupational Health and Safety Management. In *Occupational Health and Safety Management*. https://doi.org/10.1201/b12822

Reese, C. D., & Eidson, J. V. (2006). Handbook of OSHA Construction Safety and Health. In *Handbook of OSHA Construction Safety and Health*. https://doi.org/10.1201/9781420006230

Reijula, K. (2008). Healthy air, better work - Now and forever. *Scandinavian Journal of Work, Environment and Health, Supplement*, (4).

Reinhold, K., Järvis, M., & Tint, P. (2015). Practical tool and procedure for workplace risk assessment: Evidence from SMEs in Estonia. *Safety Science*. https://doi.org/10.1016/j.ssci.2014.09.016

Ristovska, G., Laszlo, H. E., & Hansell, A. L. (2014). Reproductive outcomes associated with noise exposure - A systematic review of the literature. *International Journal of Environmental Research and Public Health*. https://doi.org/10.3390/ijerph110807931

Sawka, M. N., Leon, L. R., Montain, S. J., & Sonna, L. A. (2011). Integrated physiological mechanisms of exercise performance, adaptation, and maladaptation to heat stress. *Comprehensive Physiology*, *1*(4), 1883–1928. https://doi.org/10.1002/cphy.c100082

Seppänen, O., Fisk, W., & Lei, Q. (2006). Effect of temperature on task performance in office environment. *Lawrence Berkeley National Laboratory*.

Sherwood, L. (2016). Human physiology from cells to systems Ninth Edition. *Appetite*.

Shi, X., Zhu, N., & Zheng, G. (2013). The combined effect of temperature, relative humidity and work intensity on human strain in hot and humid environments. *Building and Environment*. https://doi.org/10.1016/j.buildenv.2013.07.016

Singh, J. (1996). Impact of indoor air pollution on health, comfort and productivity of the occupants. *Aerobiologia*, *12*(2), 121–127. https://doi.org/10.1007/BF02446604

Smolders, K. C. H. J., & de Kort, Y. A. W. (2014). Bright light and mental fatigue: Effects on alertness, vitality, performance and physiological arousal. *Journal of Environmental Psychology*, *39*, 77–91. https://doi.org/10.1016/j.jenvp.2013.12.010

Sørensen, O. H., Hasle, P., & Bach, E. (2007). Working in small enterprises - Is there a special risk? *Safety Science*, *45*(10), 1044–1059.

https://doi.org/10.1016/j.ssci.2006.09.005

Spector, J. T., Krenz, J., & Blank, K. N. (2015). Risk Factors for Heat-Related Illness in Washington Crop Workers. *Journal of Agromedicine*, *20*(3), 349–359. https://doi.org/10.1080/1059924X.2015.1047107

Spector, J. T., Masuda, Y. J., Wolff, N. H., Calkins, M., & Seixas, N. (2019, December 1). Heat Exposure and Occupational Injuries: Review of the Literature and Implications. *Current Environmental Health Reports*, Vol. 6, pp. 286–296. https://doi.org/10.1007/s40572-019-00250-8

Stansfeld, S. A., & Matheson, M. P. (2003). Noise pollution: Non-auditory effects on health. *British Medical Bulletin*. https://doi.org/10.1093/bmb/ldg033

Stranks, J. (2002). *The Handbook of Health and Safety Practice*.

Sundstrom, E., Town, J. P., Rice, R. W., Osborn, D. P., & Brill, M. (1994). Office Noise, Satisfaction, and Performance. *Environment and Behavior*, *26*(2), 195–222. https://doi.org/10.1177/001391659402600204

Tanabe, S., Haneda, M., & Nishihara, N. (2015a). Workplace productivity and individual thermal satisfaction. *Building and Environment*, *91*, 42–50. https://doi.org/10.1016/j.buildenv.2015.02.032

Tanabe, S. ichi, Haneda, M., & Nishihara, N. (2015b). Workplace productivity and individual thermal satisfaction. *Building and Environment*, *91*, 42–50.

https://doi.org/10.1016/j.buildenv.2015.02.032

Tessier-Sherman, B., Galusha, D., Cantley, L. F., Cullen, M. R., Rabinowitz, P. M., & Neitzel, R. L. (2017). Occupational noise exposure and risk of hypertension in an industrial workforce. *American Journal of Industrial Medicine*. https://doi.org/10.1002/ajim.22775

Tewari, M., & Sudarshan, A. (2014). *Working Paper 278 The Economic Impacts of Temperature on Industrial Productivity : Evidence from Indian Manufacturing Anant Sudarshan Meenu Tewari*. (278).

Tomei, G., Fioravanti, M., Cerratti, D., Sancini, A., Tomao, E., Rosati, M. V., Tomei, F. (2010). Occupational exposure to noise and the cardiovascular system: A meta-analysis. *Science of the Total Environment*. https://doi.org/10.1016/j.scitotenv.2009.10.071

Tompa, E., Kalcevich, C., Foley, M., McLeod, C., Hogg-Johnson, S., Cullen, K., Irvin, E. A systematic literature review of the effectiveness of occupational health and safety regulatory enforcement. *American Journal of Industrial Medicine* (2016).

Tzivian, L., Winkler, A., Dlugaj, M., Schikowski, T., Vossoughi, M., Fuks, K., Hoffmann, B. (2015). Effect of long-term outdoor air pollution and noise on cognitive and psychological functions in adults. *International Journal of Hygiene and Environmental Health*. https://doi.org/10.1016/j.ijheh.2014.08.002

US EPA. (2013). Questions About Your Community: Indoor Air.

Van Blommenstein, D., Matope, S., & Van Der Merwe, A. F. (2011). *Review and Analysis of Work Sampling Methods: The Case of an Automated Labour Performance System using the Work Sampling Method*. Retrieved from Journal for New Generation Sciences, Vol 9, Issue 1: Central University of Technology, Free State, Bloemfontein website: http://ir.cut.ac.za/handle/11462/583

Van Bommel, W. J. M., & van den Beld, G. J. (2004). Lighting for work: A review of visual and biological effects. *Lighting Research and Technology*. https://doi.org/10.1191/1365782804li122oa

Van Tran, V., Park, D., & Lee, Y. C. (2020, April 2). Indoor air pollution, related human diseases, and recent trends in the control and improvement of indoor air quality. *International Journal of Environmental Research and Public Health*, Vol. 17. https://doi.org/10.3390/ijerph17082927

Varghese, B. M., Hansen, A., Bi, P., & Pisaniello, D. (2018, December 1). Are workers at risk of occupational injuries due to heat exposure? A comprehensive literature review. *Safety Science*, Vol. 110, pp. 380–392. https://doi.org/10.1016/j.ssci.2018.04.027

Venugopal, V., Rekha, S., Manikandan, K., Latha, P. K., Vennila, V., Ganesan, N., Chinnadurai, S. J. (2016). Heat stress and inadequate sanitary facilities at workplaces–an occupational health concern for women? *Global Health Action*. https://doi.org/10.3402/gha.v9.31945

W. Larry Kenney. (2015). Heat and Cold. Retrieved November 11, 2020, from

http://www.ilocis.org/documents/chpt42e.htm

Wargocki, P., Sundell, J., Bischof, W., Brundrett, G., Fanger, P. O., Gyntelberg, F., Wouters, P. (2002). Ventilation and health in non-industrial indoor environments: Report from a European Multidisciplinary Scientific Consensus Meeting (EUROVEN). *Indoor Air*. https://doi.org/10.1034/j.1600-0668.2002.01145.x

Wellens, B. T., & Smith, A. P. (2006). Combined workplace stressors and their relationship with mood, physiology, and performance. *Work and Stress*. https://doi.org/10.1080/02678370601022712

WHO/ILO. (1950). *Joint ILO/WHO Committee on Occupational Health*. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/40212/WHO_TRS_66.pdf?sequence=1&isAllowed=y

WHO. (2006). World Health Organization.

WHO. (2011). WHO | Burden of disease from environmental noise - Quantification of healthy life years lost in Europe.

WHO. (2018). Climate change and health. Retrieved November 14, 2020, from https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

Wolkoff, P., & Nielsen, G. D. (2017). Effects by inhalation of abundant fragrances in indoor air – An overview. *Environment International*, Vol. 101. https://doi.org/10.1016/j.envint.2017.01.013

Wyon, D. P. (2004). The effects of indoor air quality on performance and productivity. *Indoor Air, Supplement*. https://doi.org/10.1111/j.1600-0668.2004.00278.x

Yoon, J. H., Hong, J. S., Roh, J., Kim, C. N., & Won, J. U. (2015). Dose - Response relationship between noise exposure and the risk of occupational injury. *Noise and Health*. https://doi.org/10.4103/1463-1741.149578

APPENDICES

Appendix A: NC OSH Law and RA Studies at Workplaces -Interview with Employers- Questionnaire

The employer (or representative) must answer the following questions.

1. Information about the company
   a. Name of the company
   b. Fields of activity
   c. Number of employees
2. Information about the person who will answer the questions
   a. Job description
   b. Working years
   c. Education level
3. Is there an OSH Law in the NC?
   A. If the answer is yes,

      What information do you have regarding the employer obligations in the law?

   B. If the answer is no,

      Do you think there should be an OSH law? What should it include according to you?

4. Do you conduct risk assessment is your workplace?
   A. If the answer is yes,

      What do you think about RA? Can you tell us what kind of hazards you have in your workplace?

   B. If the answer is no,

      What is your reason for not conducting RA?

   C. Conducting RA is a legal requirement. What do you think about that?
   D. Can you tell us what kind of hazards you have in your workplace?

5. What precautions did you take against the hazards in your workplace? (If precautions are not taken, what is the reason?)

6. Do you have an OSH expert, or do you get service from any institution in this regard?

   A. If the answer is no,

      Do you know how to reach OSH experts in NC?

7. Did an inspector come to your workplace to inspect regarding OSH from the labor office?

   A. If the answer is yes,

      What did he/she suggest about OSH?

8. Did you take OSH training from the labor office, chamber of commerce/industry or any person or institute?

   A. If the answer is yes,

      How did you get training and where?

9. Did you give training, or do you give training periodically to your employees?

   A. If the answer is yes,

      Can you explain how this training is given, where and by whom?

10. What kind of accidents happen in your workplace? Do you keep records of accidents in your workplace?

11. Did you know that you should report accidents and occupational diseases to the labor office within two days after accidents occur?

12. What are your suggestions or problems regarding OSH and RA in your workplace? What would you like to learn about these topics?

Appendix B: NC OSH Law and RA Studies at Workplaces Questionnaires -Companies Conducting RA-

The questionnaire must be completed by the employer or employer representative.

1. What is your duty in this workplace?

2. In which area does your workplace operate?

3. How many employees are working in this workplace?

4. Are the followings considered in identifying hazards and performing risk assessment?

In the workplace;	Yes, it is considered.	No, but it should be considered.	No, it is not considered because there is no risk.
1. Accident/Incident Risk			
2. Physical strain factors, ergonomic hazards, risk factors (heavy lifting, improper work postures)			
3. Mental strain (fast working, excess / low workload, negative environment in the workplace, lack of job security, time constraints)			
4. Physical risk factors (noise, vibration, heat, lighting)			
5. Chemical risk factors (gas, steam, dust)			
6. Biological risk factors (mold, bacteria)			

5. Evaluate how the OSH law improves the followings in your workplace.

	Strongly Agree	Agree	No Idea	Disagree	Strongly Disagree
1. The commitment of upper management regarding OSH is increased					
2. Focusing on responsibilities and liabilities is increased					

3. Employers and employee's cooperation are increased					
4. Systematic improvement of occupational health and safety is provided					
5. Occupational safety professionals are provided to work in the workplace					
6. Hazard / risk identification and risk assessment are conducted in the workplace					
7. Workplace and working conditions at work is improved					

6. Evaluate how the OSH law improve the following measures in your workplace.

	Strongly Agree	Agree	No Idea	Disagree	Strongly Disagree
1. Reducing accident risks					
2. Reducing physical load by improving ergonomics and personal workstations in workplaces					
3. Improving work methods and / or ergonomics in work equipment					
4. Reducing mental load (overload) at work					
5. Reducing chemical risk factors in the workplace					
6. Eliminating risk factors related to noise in the workplace					
7. Guiding and training the workers					
8. Reducing harassment and other unfair treatment causing harm or risk to the health of workers					

7. Evaluate how the law works in your workplace, in practice, from the following aspects.

	Strongly Agree	Agree	No Idea	Disagree	Strongly Disagree
1. Determination of OSH hazards and harms					
2. Conducting the risk assessment					

3. Obligations of the employers in risk assessments					
4. Preventing OSH hazards and harms					

8. Evaluate how the followings describe taking preventive measures based on hazard identification and risk assessment.

	Always	Often	Sometimes	Rarely	Never
1. Any hazards and risk factors are prevented from arising by taking proactive measures					
2. Observed risk factors and hazards are eliminated					
3. Hazards or risk-causing factors are replaced by less hazardous or less harmful ones					
4. General safety measures have been adopted before individual measures					
5. The best available technology is being used, and the development of technological measures is considered when preventing hazards and risk factors					

9. Risk identification and risk assessment results are used in the following topics.

	Always	Often	Sometimes	Rarely	Never
1. Planning and implementation of measures					

2. Application of training and guidance to the employees in the workplace					
3. Preparation of work or usage instructions					
4. Planning and implementing professional activities					
5. Implementation of occupational safety and health policies					
6. Planning and managing the work					
7. Development of administrative affairs					
8. Planning, investigations, inspections or measurements					
9. Planning personal workstations considering physical strain (stress) factors					
10. Following-up improvements in the working environment					

10. Evaluate how risk identification and risk assessment documents are used in cooperation processes.

	Always	Often	Sometimes	Rarely	Never
1. Documented in writing or electronically					
2. Available to employees					
3. Updating on the basis of follow-up results					
4. Reporting to the management of the company					
5. Addressing the risk assessment with the responsible person					
6. Addressing risk assessment with employees					
7. Addressing with the occupational safety professional					

11. Do you use the following information to plan risk assessments?

	Yes	No
1. Data related to accidents are used in the risk assessment planning		
2. Data on hazardous situations and near accidents are available		
3. The documents prepared by the OSH professional related to the workplace are used.		
4. Measurements related to work hygiene are used in the workplace.		
5. Chemical safety data (MSDS) is used		

12. How is hazard identification and risk assessment organized in your workplace?

	Yes	No
1. Risk assessment was made in cooperation with employer and employee		
2. Employee expertise was used in the risk assessment process		
3. Occupational safety professional participated in risk assessment activities		

13. Is hazard identification and risk assessment considered for the following issues?

	Yes	No
1. Daily working routines are adequately measured		
2. More rare and unusual work is considered when conducting a risk assessment in the workplace		
3. Risk assessment is made for employees who are not staff members of this workplace but who come from outside		

14. Is there anything you would like to add / suggest or comment on this questionnaire and other OSH issues?

Appendix C: A Questionnaire about North Cyprus (NC) Occupational Safety and Health (OSH) Law and Workplace Risk Assessments- to be Administered to NC OSH Professionals

This questionnaire is prepared by Işıl Nurdan Işık from Eastern Mediterranean University Department of Industrial Engineering as part of her PhD thesis, aiming to improve the work environments in NC. The research results generated from survey answers can be published as a scientific article but your personal and company information will never be shared.

In this questionnaire;
OSH: Occupational Safety and Health and
OSH Law: are used as numbered 35/2008 NC Occupational Safety and Health Law.

1) Where do you work?

2) What is your highest education level?

   Undergraduate __

   Graduate __

   PhD __

   Other, specify: _____

3) Where did you get your OSH professional license from?

4) How many workplaces have you provided consultancy services on occupational safety and health after becoming an OSH professional?

5) In how many workplaces did you conduct risk assessment after becoming an OSH professional?

6) Are you providing service to a special industry/field as an OSH professional? (you can select more than one field/industry)

   construction__ health and social services __
   production (general) __ commercial__
   agriculture and forestry __ restaurants and accommodation __
   transportation __ government institutions and organizations __
   municipalities __
   Other, specify:_____

7) What are the main problems / difficulties you face while conducting a risk assessment? _____

8) Evaluate the sufficiency of the NC Occupational Safety and Health Law (35/2008) for improving work environments.

Evaluate the current OSH law, rules and regulations	Strongly Agree	Agree	No idea	Disagree	Strongly Disagree
a) The law is sufficient for providing a healthy work environment					
b) Rules and regulations are sufficient					
c) The law, rules and regulations are effective in identifying hazards					
d) The risk assessment enforcement existing in the law is implemented					
e) Labor office OSH inspections are done at a sufficient level					
f) Work environments are inspected by the labor office					
g) Workplaces are inspected by the labor office for health and safety					
h) The law, rules and regulations are effective in preventing OSH problems					
i) The Ministry of Labor and Social Security (and / or its associated Labor Office) prepares guiding handbooks for OSH.					
j) The Ministry of Labor and Social Security (and / or its associated Labor Office) prepares missing rules and regulations, if any.					
k) Sanctions on OSH issues are sufficient to ensure a better working environment in the workplace.					
l) Systematic improvement of OSH in workplaces has been ensured by law					

9) The enforcement effect coming from OSH laws, rules and regulations in NC can be improved as follows.

Also number the following from 1 to 10 in order of importance (1 being the most important, 10 being the least important).

#	**By the labor office;**	Strongly Agree	Agree	No idea	Disagree	Strongly Disagree
	a) Guidance / consultancy service should be provided / increased to workplaces					
	b) should focus on inspecting working conditions					
	c) OSH management system of workplaces should be inspected					
	d) the number of OSH inspectors should be increased					
	e) preventive OSH inspections should be increased					
	f) OSH inspections should be increased					
	g) OSH follow up inspections should be increased					
	h) OSH inspectors should be trained					
	i) more OSH professionals should be trained (and licensed)					
	j) Communication between OSH professionals and workplaces should be increased					

10) Write your suggestions (if any) in addition to those in question 9.

11) Are the following taken into account when identifying hazards and conducting risk assessment?

	Yes	No
a) Physical tension factors, ergonomic hazards, risk factors (heavy lifting, improper work postures)		
b) Mental tension in the workplace (working fast, excess/low workload,		

negative work environment, lack of job security, time limitation)		
c) Physical risk factors (noise, vibration, heat, lighting) in the workplace		
d) Chemical risk factors (gas, vapor, dust) in the workplace		
e) Biological risk factors (mold, bacterium) in the workplace		
f) Risk assessment being conducted with the employer employee collaboration		
g) Using the expertise of employees during the risk assessment process		
h) Using the accident records in risk assessment planning		
i) Data related to dangerous situations and near accidents (misses) are used		
j) Daily work routines		
k) Measurements related to work hygiene at the workplace		
l) Safety data of chemicals (MSDS)		
m) Workplace risk assessment for more rare and unusual work		
n) Risk assessment for non-employees, those who are coming from other companies (outside) to work		

12) Evaluate the preventive measures taken by the workplaces as a result of your risk assessment.

	Strongly Agree	Agree	No idea	Disagree	Strongly Disagree
a) The formation of any hazard and risk factor is prevented by taking proactive measures					
b) Observed risk factors and hazards are eliminated					
c) Harm or risk-causing factors are replaced by less dangerous or less harmful ones					
d) Safety measures are adapted before personal measures					
e) The best technology is used to prevent hazards and risk factors and the development of technological					

measures is taken into consideration					

12) Evaluate the use of the results of risk determination and risk assessment in the following areas of workplaces.

	Strongly Agree	Agree	No idea	Disagree	Strongly Disagree
a) Planning and implementation of measures					
b) Providing employees training and guidance at the workplace					
c) Preparation of work or usage instructions					
d) Planning, implementation and management of professional activities					
e) Implementation of occupational health and safety policies					
f) Development of administrative affairs					
g) Planning, investigations, inspections and / or measurements					
h) Planning of personal workstations considering physical strain factors					
i) Following (monitoring) improvements in the work environment					

13) Is there anything you would like to add / suggest or comment on this survey and other OSH issues?

Appendix D: A Questionnaire about North Cyprus (NC) Occupational Safety and Health (OSH) Law and Workplace Risk Assessments- to be Administered to NC OSH Inspectors

This questionnaire is prepared by Işıl Nurdan Işık from Eastern Mediterranean University Department of Industrial Engineering as part of her PhD thesis, aiming to improve the work environments in NC. The research results generated from survey answers can be published as a scientific article but your personal and company information will never be shared

In this questionnaire;
OSH: Occupational Safety and Health and
OSH Law: are used as numbered 35/2008 NC Occupational Safety and Health Law.

1) Where do you work?

2) What is your highest education level?

   Undergraduate __
   Graduate __
   PhD __
   Other, specify: _____

3) In which year and where did you start OSH inspection?

4) After becoming an OSH inspector, how many jobs have you inspected on occupational safety and health issues? or how many businesses do you inspect per month / year? How many of these are within the scope of preventive inspection (non-investigation)?

5) Have you been trained to become an OSH inspector? If yes, where do you explain?

6) Are you providing service to a special industry/field as an OSH inspector? (you can select more than one field/industry)

   construction__ health and social services __
   production (general) __ commercial__
   agriculture and forestry __ restaurants and accommodation __
   transportation __ government institutions and organizations __
   municipalities __ Other, specify: _____

7) What are the main problems / difficulties you face while doing inspection? _____

8) Evaluate the sufficiency of the NC Occupational Safety and Health Law (35/2008) for improving work environments.

Evaluate the current OSH law, rules and regulations	Strongly Agree	Agree	No idea	Disagree	Strongly Disagree
a)The law is sufficient for providing a healthy work environment					
b) Rules and regulations are sufficient					
c) The law, rules and regulations are effective in identifying hazards					
d) The risk assessment enforcement existing in the law is implemented					
e) Labor office OSH inspections are done at a sufficient level					
f) Work environments are inspected by the labor office					
g) Workplaces are inspected by the labor office for health and safety					
h) The law, rules and regulations are effective in preventing OSH problems					
i) The Ministry of Labor and Social Security (and / or its associated Labor Office) prepares guiding handbooks for OSH.					
j) The Ministry of Labor and Social Security (and / or its associated Labor Office) prepares missing rules and regulations, if any.					
k) Sanctions on OSH issues are sufficient to ensure a better working environment in the workplace.					
l) Systematic improvement of OSH in workplaces has been ensured by law					

9) The enforcement effect coming from OSH laws, rules and regulations in NC can be improved as follows.

Also number the following from 1 to 10 in order of importance (1 being the most important, 10 being the least important).

#	**By the labor office;**	Strongly Agree	Agree	No idea	Disagree	Strongly Disagree
	a) Guidance / consultancy service should be provided / increased to workplaces					
	b) should focus on inspecting working conditions					
	c) OSH management system of workplaces should be inspected					
	d) the number of OSH inspectors should be increased					
	e) preventive OSH inspections should be increased					
	f) OSH inspections should be increased					
	g) OSH follow up inspections should be increased					
	h) OSH inspectors should be trained					
	i) more OSH professionals should be trained (and licensed)					
	j) Communication between OSH professionals and workplaces should be increased					

10) Write your suggestions (if any) in addition to those in question 9.

.

11) Are the following taken into account when identifying hazards and conducting risk assessment?

	Yes	No
a) Physical tension factors, ergonomic hazards, risk factors (heavy lifting, improper work postures)		
b) Mental tension in the workplace (working fast, excess/low workload, negative work environment, lack of job security, time limitation)		
c) Physical risk factors (noise, vibration, heat, lighting) in the workplace		
d) Chemical risk factors (gas, vapor, dust) in the workplace		
e) Biological risk factors (mold, bacterium) in the workplace		
f) Risk assessment being conducted with the employer employee collaboration		
g) Using the expertise of employees during the risk assessment process		
h) Using the accident records in risk assessment planning		
i) Data related to dangerous situations and near accidents (misses) are used		
j) Daily work routines		
k) Measurements related to work hygiene at the workplace		
l) Safety data of chemicals (MSDS)		
m) Workplace risk assessment for more rare and unusual work		
n) Risk assessment for non-employees, those who are coming from other companies (outside) to work		

12) Evaluate the preventive measures taken by the workplaces as a result of your risk assessment.

	Strongly Agree	Agree	No idea	Disagree	Strongly Disagree
f) The formation of any hazard and risk factor is prevented by taking proactive measures					
g) Observed risk factors and hazards are eliminated					
h) Harm or risk-causing factors are					

replaced by less dangerous or less harmful ones					
i) Safety measures are adapted before personal measures					
j) The best technology is used to prevent hazards and risk factors and the development of technological measures is taken into consideration					

13) Evaluate the use of the results of risk determination and risk assessment in the following areas of workplaces.

	Strongly Agree	Agree	No idea	Disagree	Strongly Disagree
j) Planning and implementation of measures					
k) Providing employees training and guidance at the workplace					
l) Preparation of work or usage instructions					
m) Planning, implementation and management of professional activities					
n) Implementation of occupational health and safety policies					
o) Development of administrative affairs					
p) Planning, investigations, inspections and / or measurements					
q) Planning of personal workstations considering physical strain factors					
r) Following (monitoring) improvements in the work environment					

14) Is there anything you would like to add / suggest or comment on this survey and other OSH issues?

Appendix E: Gender Specific Questionnaire

This questionnaire was prepared by Emine Atasoylu and Işıl Nurdan Işık from the Eastern Mediterranean University Industrial Engineering Department in order to determine whether the male and female hospital workers in the Turkish Republic of Northern Cyprus are equally protected in terms of Occupational Health and Safety. If the survey results are published as scientific papers, your private, personal or corporate information will not be shared.

Personal Information						
1	Sex	Male	Female			
2	Age	18-25		26-49		50 and over
3	Your height and weight					
4	Your highest education level	High school	Academy	Undergraduate	Graduate	Other, specify
5	How long have you been working in this workplace	1-3 years	4-6 years	7-9 years	10-14 years	15 years and over
6	What is your duty in this workplace					
7	How many years have you worked before and where?					
8	On average, how many hours a day do you work standing/sitting?	Standing		Sitting		
9	What are the number of days that you have not been able to come to work due to the following reasons in the last year?	Family issues:	Own health problems:	Work-related injury:	Work-related illness:	
10	Have you had any work-related illnesses or injuries?	Yes, explain.		No		
11	How many times have you worked overtime in the last year?					
12	How many hours do you sleep on average per day?					

13. How often;	Always	Usually	Sometimes	Rarely	Never
Are you exposed to violence during your work?					
Do you find suitable gloves?					
Do you find suitable mask that fit properly?					
Do you lift weight?					
Do you make improper posture (bending/twisting)?					
Do you feel back, shoulder, arm pain?					
Do you take family responsibilities alone?					
Do you think that you cannot achieve a balance of responsibility between home and work?					
Do you feel stressful because of your responsibilities at home?					
Does the inconvenience of your work environment (temperature, noise, lighting, ventilation) adversely affect your work performance?					
Do you feel burn-out?					
Are you asked by your employer to do other tasks/work other than your job?					

14. To work comfortably in your workplace;	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Heating is sufficient.					
Cooling is sufficient.					
Lighting is sufficient.					
Ventilation is sufficient.					
Cleaning is sufficient.					
There is no noise.					

15.	Yes	No
Are you going home with your work clothes?		
Did you have any training on Occupational Safety and Health and prevention methods from harm?		
Are you working overtime?		
Do you work at different shifts?		
Is your break or rest time sufficient?		
Do you work at night?		
If you were trained on Occupational Safety and Health, do you think you need more training?		

How many cigarette breaks do you have on average per day?	1	2	3	4	5	6	6+	I do not smoke.

16. question needs to be filled only by women.

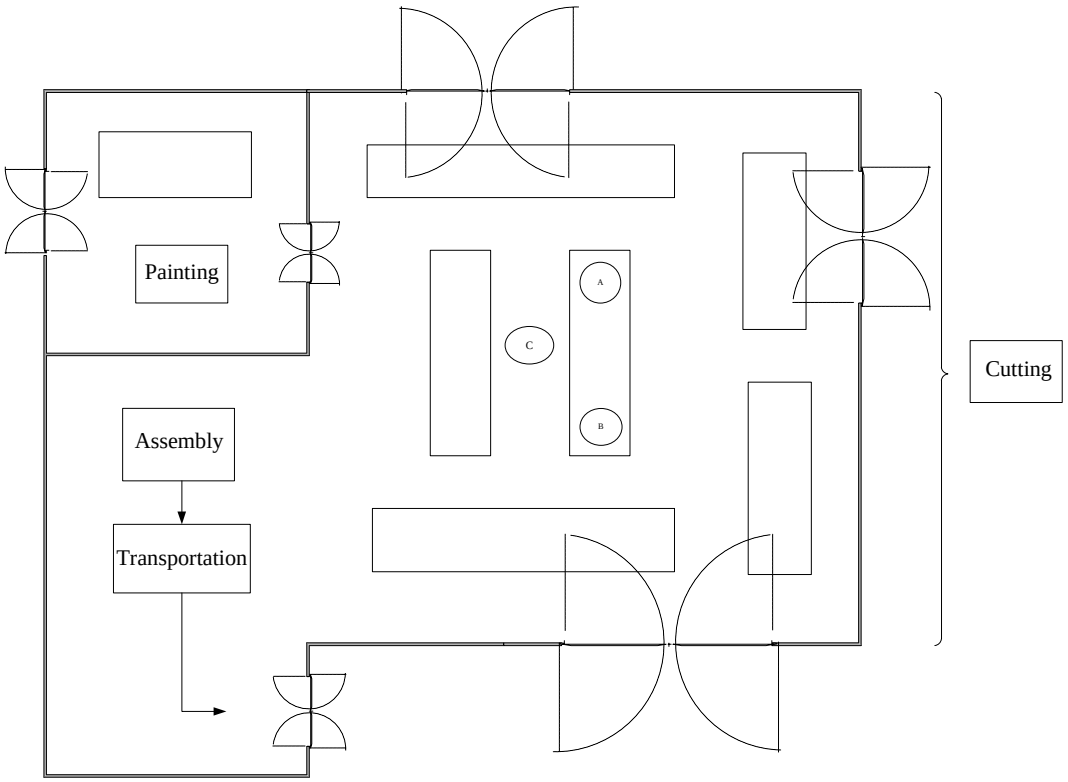
16.	Yes	No
Do you need to get permission for leave during the menstrual period?		
Do you have difficulty to get permission for leave during pregnancy and breast-feeding?		
Do menstrual symptoms affect your work performance?		
Did you work night shifts when you were pregnant?		

17. What are the hazards/risks associated with your job?

18. Do you think you are protected enough from hazards? Are preventive measures sufficient?

19. Do you have any comments of suggestions you want to add?

Appendix F: Working Area Plan



Appendix G: Questionnaire on Job Performance and Work Environment

This questionnaire has been prepared for research purposes by Işıl Nurdan Işık and Emine Atasoylu from the Department of Industrial Engineering of Eastern Mediterranean University, with the aim of contributing to the improvement of the working environment in NC. If the results of the questionnaire are published as a scientific article, your private, personal or corporate information will not be shared.

1. What is your age?

2. What is your education level? (select the appropriate one)
   Primary School __ Secondary School __ High School __ Undergraduate __ Master __
   Other, please specify: _____

3. What is your height and weight?

4. Are you paying attention to your diet?

5. Do you exercise regularly?

6. Is your sleep regular?

7. Do you have a diagnosed high blood pressure, heart disease or other condition?
   If yes, when was the diagnosis made?

8. How long did you work in which sector / sectors before?

9. How long have you been working in this workplace?
   a. Less than 1 year
   b. 1-3 years
   c. More than 3 years

10. How many hours do you work in a day?
    a. Less than 4 hours
    b. 5-7 hours
    c. 8 hours and more

11. Do you work overtime? If you are working overtime, how many hours do you work per week on average?

12. Do you work in a job other than this workplace?
    If yes, where and how many hours do you work?

13. How long do you need to rest after work?

14. How would you evaluate your general health status?
    a. Excellent
    b. Very good
    c. Good
    d. Not so good
    e. Bad

Questions About Working Life

Evaluate the questions below about your way of working and your work environment.

	Always	Often	Sometimes	Rarely	Never
15. How often do family members' demands affect your work life?					
16. How often do the demands in your work life affect family members?					
17. Is it difficult to get permission to deal with personal or family matters during work hours?					
18. Does your job require you to work very fast?					
19. Do you do different jobs at work?					
20. Do you usually work alone?					
21. Does your job / work require group work?					

	Always	Often	Sometimes	Rarely	Never
22. How often are there not enough staff to complete the job?					
23. Are you provided with the necessary assistance and equipment to do your job?					
24. Do you do movements that require physical strength?					
25. Do you perform repeated lifting, pushing, pulling or bending / rotation movements as required by your job					
26. Do you make normal repetitive or forceful hand movements for your job?					
27. Do you make regular repetitive inappropriate postures due to your job?					
28. How often do you have pain in your hands, wrists, arms or shoulders for a week or more than a week?					
29. Are conditions at work adequate for you to be productive?					

Evaluate the questions about your health below.

	Always	Often	Sometimes	Rarely	Never
30. How often have you had trouble sleeping or staying asleep in the past 12 months?					
31. How often do you find your job stressful?					
32. How often in the last month did you feel exhausted at the end of the day?					

33. How many days have you not been in good physical health (including injuries and illnesses) in the last 30 days?
_____ days

34. How many days was your mental health (including stress, depression and emotional problems) not good in the last 30 days?
_____ days

35. In the last 30 days, how many days could you not do the activities you usually do (your own care, work or entertainment) due to your poor physical and mental health?
_____days

36. Have you been injured in your workplace in the last 1 year?
If your answer is yes, how many times have you been hurt?
_____

How many days did you not come to work because of this?
_____

37. How would you evaluate your satisfaction with your work life in general?
a. Very pleased
b. Satisfied
c. No idea
d. Not glad
e. Not satisfied at all

	Yes	No
38. Have you got training on occupational health and safety?		
39. Do you know that there is an occupational health and safety law in NC??		
40. Does your employer take preventive measures for accidents and diseases?		
41. Is there dust in your workplace?		
42. Is there any odor in your workplace?		
43. Is ventilation good in your workplace?		
44. Is the heating good in your workplace?		
45. Is the cooling good in your workplace?		

Appendix H: Self-Assessment

Evaluate your workplace temperature, light level, noise disturbance, odor and dust and also your sleepiness and work performance for today.

1. Thermal comfort

1	2	3	4	5	6	7	8	9
Very Cold	Cold	Cool	Slightly Cool	Neutral	Slightly Warm	Warm	Hot	Very Hot

2. Light level

1	2	3	4	5	6	7
Much too Dark	Too Dark	Comfortably Dark	Comfortable	Comfortably Bright	Too Bright	Much too Bright

3. Noise Annoyance

0	1	2	3	4	5	6	7	8	9	10
Not at All	Very Low	Moderately Low	Low	Slightly Low	Normal	Slightly High	High	Moderately High	Very High	Extremely High

4. Odor

0	1	2	3	4	5	6
No Odor	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

5. Dust

0	1	2	3	4	5	6
No Dust	Very Weak	Weak	Distinct	Strong	Very Strong	Extremely Strong

6. Sleepiness Scale

1	2	3	4	5	6	7	8	9
Extremely Alert	Very Alert	Alert	Rather Alert	Neither Alert nor Sleepy	Some Sign of Sleepiness	Sleepy but no Difficulty Remaining Awake	Sleepy, Some Effort to Keep Awake	Extremely Sleepy-Fighting Sleep

7. Work performance

0	1	2	3	4	5	6	7	8	9	10
Much Less Productive than Average	Less Productive than Average	Not Productive	Moderately Less Productive than Average	Slightly Less Productive than Average	About Average	Slightly Productive than Average	Moderately Productive than Average	Productive than Average	More Productive than Average	Much More Productive than Average