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MUSCULOSKELETAL DISORDERS AND PHYSICAL STRAIN AMONG FOOD FACTORY WORKERS.

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MASTER'S THESIS

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ABSTRACT

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Key words: Musculoskeletal disorders, pain, physical strain, perceived exertion, work ability.
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BACKGROUND: There is an increasing trend of work absenteeism and early exit from work life as a result of ill health or disability, partly due to strain and pain at work.

AIM: To describe work related perceived strain and pain, and how this relates to perceived work ability.

METHOD: A cross-sectional study design was employed in the present study. Questionnaire data was collected in early 2009 (January – February) from 1,398 food factory workers (females, n= 890; males, n= 508) aged 20 – 66 years, comprising both blue collar (n= 1,074: females, n= 680; males, n=394) and white collar (n= 324: females, n= 210; males, n= 114) workers. Response rate was 72% of the total 1,481 questionnaires distributed, while the rest gave no consent to be studied. The mean age was 41.45, while standard deviation was 11.548. Data analysis was carried out by chi-square test and multinomial logistics regression, using SPSS versions 16.0 and 17.0.

RESULTS: All the variables within pain and physical strain categories were associated with work ability, before and after adjustment for potential confounders (age, gender and staff task group).

CONCLUSION: Musculoskeletal pain and perceived exertion has significant impact on perceived work ability among the food factory workers.

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CHAPTER ONE

1.0 BACKGROUND AND INTRODUCTION

Musculoskeletal Disorders (MSDs) were not recognized as having occupational etiologic factors before the beginning of the 18th century. However, it was not until the 1970's that occupational factors were examined using epidemiologic methods, and the work relatedness of these conditions began appearing regularly in the International Scientific literature. (Rosenstock, 1997). Since then the awareness has increased dramatically and though more than six thousand scientific articles addressing ergonomics in the workplace have been published, but the relationship between MSDs and work related factors still remain as a subject of considerable debate (Rosenstock, 1997). Likewise, the deficient recognition of occupational diseases seems complicated by the fact that more and more diseases tend to be not exclusively caused by work, but are "work related", thus making it more complex, identifying with any occupational background. Hence, the term "work related disease" initiates a broader concept than that of "occupational disease" since it refers to all diseases where work is a contributory cause. Therefore, this concept combines both work related and non work related factors. Herein, MSDs are among the most common types of work related diseases, though it is seldom possible to prove that it arise solely from work. Consequently, there is variation in methods of addressing work related diseases by country (Zimmer, 2008).

The term 'Musculoskeletal Disorder' denotes health problems of the locomotor apparatus – muscles, tendons, the skeleton, cartilage, the vascular system, ligaments and nerves, while work related MSDs include all musculoskeletal disorders that are induced or aggravated by work and the circumstances of its performance (EU-OSHA, 2010).

In other words, attempt was made in the present study to use the term work related musculoskeletal disorders to describe a musculoskeletal disorder that is work related, more so that the World Health Organization (WHO) has defined a work related disorder as one that results from a number of factors, and where the work environment and the performance of the work contribute significantly, but in varying magnitude, to the causation of the disease (Buckle and David, 2000; WHO, 2003).

Work related diseases often have long latent period (Nelson *et al.*, 2005; Nurminen & Karjalainen, 2001) possibly as a result of different work related factors such as prolonged working time (Caruso *et al.*, 2006) and excess workload (Åkerstedt *et al.*, 2004; Hamet & Tremblay, 2002). Moreover, exposures occurring now usually lead to ill health in the future (Hämäläinen *et al.*, 2009) maybe because either the level is underestimated or rather unknown or the risk posed by exposures (single or combination) is not properly recognized (Morrell *et al.*, 1998).

The cost implication of work related disorders is alarming. For example, the International Labour Organization (ILO) estimated the total costs of occupational accidents and work related diseases to be 4% of the Gross National Product (GNP; ILO Safety in numbers 2003). That interprets, the total GNP of the world was approximately 3.4×10^{12} USD in 2003 (Statistics Finland, 2005), which means that worldwide the annual cost of work related injuries and diseases is approximately 1.36×10^{12} USD (Hämäläinen *et al*., 2009).

The United States (US) Bureau of Labour and Statistics also reported that MSDs accounted for 26% of all workplace injuries at a cost of $45–60 billion in workers compensation and related costs in 2000. Even in Great Britain, approximately a million people reported MSDs in 1995 (Jones, Hodgson, & Elliott, 1998). In Italy the number of claims for MSDs has more than doubled from 1996 to 1999, whereas in France compensated MSDs increased over 20% during the same time period (Helliwell, 1996).

Despite the fact that the EU is currently focusing attention regarding work related diseases, it would be unjustified to ascribe their relevance only to highly industrialized or high income countries (ISSA, 2008). A recent study on global trend according to estimated number of occupational accidents and fatal work related diseases at country level conducted by Hämäläinen *et al*., (2009) revealed statistics and the need for awareness and better understanding of the importance of occupational health and safety at country and company levels.

However, there is no doubt that workplace injuries are preventable (CCIQ, 2009), or at least reduced to a bearable minimum that may pose as less injurious to workers in order to sustain productivity, and ultimately promote workers choosing to stay longer working. Unfortunately enough, the demographic changes in Europe's workforce is not encouraging. The number of young people entering employment is gradually depleting, while there is significant increase in older people, amidst a growing demand for increased productivity (EU-OSHA, 2010).

Another crucial event that brought about a shift in the employment scenario of Europeans is the recent global economic turndown in which 6 out of 10 Europeans expect deteriorating working conditions in respect of health and safety due to work related health hazards, physical and psychosocial challenges (EU-OSHA, 2010).

In consequential of this unprecedented and foundational impact which is quickly telling on the EU workforce, a resolve to embark upon the present study in order to understand some of the underlying factors that may contribute to injuries at the workplace is however inevitable.

This is targeted to complement to knowledge of the severity of work related disorders with the sole purpose that the information may be useful for developing viable strategies towards minimizing to the barest minimum of workplace injuries.

In as much as we understand and agree that workplace injuries could be prevented, then efforts should be directed towards promoting the growth or development of ideas that support such endeavour because ‘every employee is important, every factor is a prospective threat to well being at work, every worker is potentially vulnerable to workplace injuries, therefore every problem should be reported and must be taken into account’ no matter how seemingly inconsequential they may be.

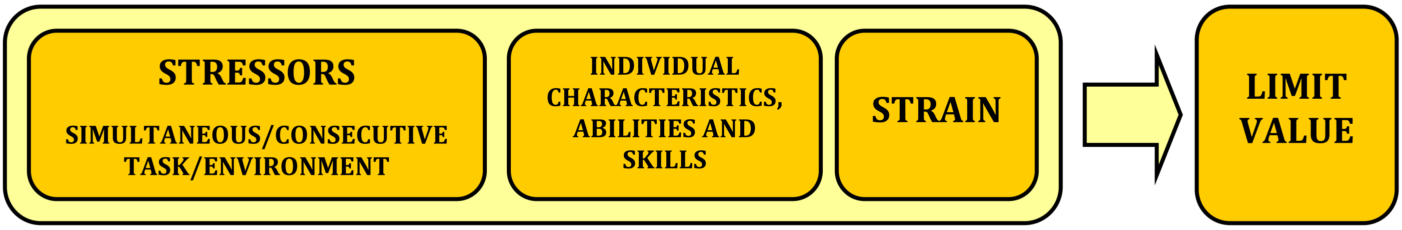
CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 THE STRESS-STRAIN CONCEPT – STUDY'S THOERETICAL FRAMEWORK

The basic philosophy of risk evaluation methods is described by Schaub (2009) in a classical stress – strain concept, as a new viable tool for risk assessment and management in work related MSDs (figure 1). This is in resonance with the stress – strain concept developed by Rutenfranz (1981) which has provided a very deep insight in respect of balancing between work stress factors and strain factors.

Figure 1: The Classical Stress – Strain concept



Source: Karlheinz Schaub, 2009 - Institute of Ergonomics; Darmstadt University of Technology, Germany.

The level of individual strain is an impacting factor that depends on both stress factors of work and on individual characteristics (Tuomi *et.al,* 1991a). This was expressed clearly in the Rutenfranz's stress - strain model which analyzes factors associated with a person's strain at work, although the relationship can be either suitable or injurious to health and work ability (Tuomi *et.al,* 1991b).

According to Ilmarinen (1984), the stress –strain concept is based on three physiological facts, being that stress can be objectively described from the measurement of oxygen consumption (VO_2) during work; there is variation in strain at a given VO_2 and it is subjective, depending on individual cardiopulmonary work capacity. This interprets that a VO_2 of 0.91 min^{-1} is a relative aerobic strain of 20% for an athlete, 45% for a 50 year old man and 90% for an 8 year old child. This also means that at this VO_2 level, strain measured by heart rate for the individuals mentioned will vary from 90 to 190 beats per minute.

There is therefore a direct relationship between effects of physical load on the cardiovascular system and individual work capacity (Rutenfranz, 1981). Although the defined acceptable level of physical load which varies from between 30 to 50% of the maximal VO_2 has been suggested to be 30% for prolonged physical work without breaks, the 50% level is the set upper limit if work breaks are available (Rutenfranz *et.al,* 1984) and hence, a recommended critical thresholds of aerobic overstrain in relation to work content as regards stress and strain when related to muscular work (Ilmarinen, 1984). Therefore, the use of stress – strain concept in describing the effect of physical load on cardiovascular system is highly recommended.

However, the present study deals majorly with the cognitive aspect of strain (intense feeling) along with pain, and hence will tend more towards the subjective aspect of the stress – strain concept (figure 2). This is because many jobs are generally physically very stressing and may cause dissatisfaction at various places of work, with physical work load being the more significant ones. This results to a decrease of the physical working capacity of an individual which causes many psychological problems. Nevertheless, the decrease of the physical working capacity as perceived by the subject has a non-linear growth with the decrease as measured by physical laboratory tests (Borg, 1970).

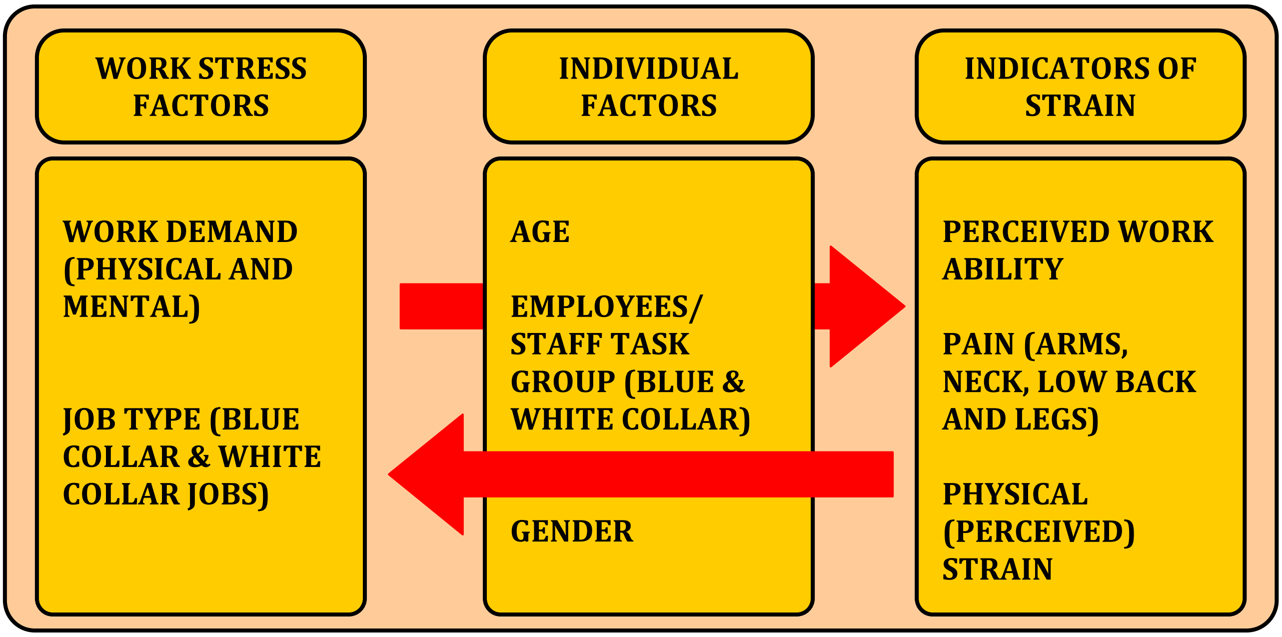


Figure 2: Stress – Strain Concept (Rutenfranz *et.al,* 1981, 1984) – Modified

2.2 WORK RELATED MUSCULOSKELETAL DISORDERS (WRMSDs)

Work related musculoskeletal disorders (WRMSDs) have been defined as a group of painful disorders of muscles, tendons, joints and nerves which can affect all parts of the body according to an European Risk Observatory Report (2010), so also has the United States Department of Labour (2001) defined it as injuries or disorders of the muscles, nerves, tendons, joints, cartilage and spinal discs associated with exposure to risk factors in the work place. However, WRMSDs has been accounted not to include disorders caused by slips, trips, falls, motor vehicle accidents or similar accidents (Bureau of Labour Statistics News (US), 2001).

MSDs arise from common movements such as bending, straightening, gripping, holding, twisting, clenching, squatting, kneeling and reaching.

These everyday movements are not particularly harmful in the ordinary activities of daily life, but what makes them hazardous in work situations is the continued repetition, often in a forceful manner, and most of all, the speed of the movements and the lack of time for recovery between them.

The range of health problems covered by MSDs are, but not limited to the following, being back pain/injuries and work related upper limb disorders, commonly known as "repetitive strain injuries" (RSI), while lower limb disorders are also not excluded. Lifting, poor posture and repetitive movements are among the causes of MSDs and some types of disorders are also associated with particular tasks or occupations (Figure 3).

Diverse groups of risk factors such as physical, biomechanical, organisational, individual, personal and psychosocial factors results to MSDs – being tagged as 'multifactorial' (Karjalainen, 1999; Ellis, 2001) in its causal pattern, but amongst all, the physical factors are probably best understood (NIOSH, 1997). Socio-organisational factors (job control, job demand and support) and personal factors (general and mental health) have also been studied but are less well understood. However, an emerging factor (a tendency to worry about disease - somatisation) is now under investigation in an international longitudinal study, Cultural and Psychosocial Influences on Disability (CUPID; Harcombe, 2010)

The relative importance of these factors and how they differ in their effects across common occupations, and internationally, is also not yet well understood (Harcombe, 2010). Interestingly, gradual interaction of these factors may aggravate to adverse effects (EU-OSHA, 2010), more so that the risk of MSDs can increase with the pace of work, low job satisfaction and job stress (EU-OSHA, 2007).

Another dimension to MSDs is that of Upper extremity musculoskeletal disorders (UEMSDs) related to work (Klussman *et.al,* 2010). They have also been recognised for many decades and are still common in the working population (Roquelaure *et.al,* 2006). The most frequent work related physical factors apart from computer work, heavy loads, high forces, awkward postures, and repetitive movements have been highlighted by Viikari-Juntura *et.al* (2001), Ryall *et.al* (2006), Andersen *et.al* (2007), Klussmann *et.al* (2008) and Grimby-Ekman (2009). Table 1 is a summary of few highlights of epidemiological studies conducted on UEMSDs.

Table 1: Summary of recent Epidemiological studies of Upper Extremity Work related MSDs.

Authors and Country	Sample	Study Design	Conclusions	Comments
Feuerstein et al, 1998[49] USA	8147 federal worker's compensation claims for UE WMSD with 1994 federal work force for controls	Cross-sectional study of prevalence of UE WMSD in 1994 and economic costs (not summarized in this review)	CTS and hand/wrist tendinitis most prevalent hand/wrist diagnoses; 40% of affected workers had multiple diagnoses or made multiple claims	As the authors point out, nonspecific diagnoses associated with longer duration of symptoms and work disability than clearly diagnosed disorders and may not be taken seriously by health care providers; multiple diagnoses are commonplace
Silverstein et al, 1998[100] USA	State worker's compensation claims for 100 449 hand/wrist disorders, 30 468 elbow disorders and 55 315 shoulder disorders (elbow and shoulder not summarized in this review)	Retrospective, 9-year study of claim incidence rates and costs (not summarized in this review) stratified by occupation	Industries characterized by manual handling and repetitive work have high incidence rates of hand/wrist disorders	This study illustrates the importance of considering regional industries when estimating risk and approaching interventions (also see Davis et al in Table 1)
Scheuerle et al, 2000[97] USA	145 sign language interpreters	Cross-sectional survey of self-report of pain/ discomfort using simple correlation analysis	Sign language interpreters susceptible to hand/wrist WMSDs, including CTS	Statistical analysis would be strengthened with logistic regression model rather than simple linear correlations; study makes good use of self-report symptom surveys including hand and body diagrams
Islam et al, 2001[62] USA	56 409 compensable work-related injuries/ illnesses with 632 282 state workers as controls	Retrospective, 1-year study comparing incidence rates for males and females	Females have greater risk of overexertion illnesses; Further research needs to identify specific work tasks associated with jobs performed by men and women	Findings are supportive of several other studies regarding susceptibility of women to work-related neuritis and other hand/wrist disorders and of those in the service industries
Leclerc et al, 2001[66] France (CTS results summarized in Table 1)	598 workers exposed to repetitive work in assembly, clothing and shoe industries, food (meat) industries, packaging, and supermarket cashiering	Prospective, 3-year study of lateral epicondylitis and wrist tendinitis using backward stepwise regression analysis	Combinations of risk factors, including biomechanical, psychosocial, and individual characteristics contribute to WMSD risk; workers with 3 or more UE disorders had higher incidence of lateral epicondylitis	Study supports repetitive, forceful hand use as contributing to WMSD; enthesopathies are associated with multiple diagnoses; illustrates the importance of considering workplace psychosocial and individual factors in determining risk
Gerr et al, 2002[57] USA	632 newly hired employees with >15 h/wk of computer use	Prospective, 3-year study of UE WMSD and musculoskeletal symptoms using regression and survival analysis	Hand/arm WMSD common among computer users, more than 50% reported symptoms within 1 year of starting a new job; 64% to 73% reporting symptoms had confirmed WMSD diagnosis	Control for confounding variables (eg, concurrent medical conditions) was carried out and strengthens study; results indicate that confirmed CTS develops more slowly than CTS symptoms or other WMSDs, such as tendinitis; combines self-report of symptoms with confirmation by physical examination, thereby reducing bias
Hagberg et al, 2002[59] Sweden	1283 computer users at 46 work sites	Cross-sectional survey of prevalence of WMSD symptoms and loss of productivity	UE WMSD prevalent among computer users with impact on productivity; prevention may reduce this impact	Main focus of study was decreases in productivity associated with WMSD symptoms; use of structured interviews reduced subject reporting bias; study supports others showing higher prevalence in women
Russo et al, 2002[92] Canada	211 sonographers with professional society membership	Cross-sectional survey of prevalence of WMSD symptoms	Findings suggest association between awkward, static postures and forceful hand-intensive activity and WMSD symptoms	92% response rate ensures representative sample; division of respondents into high and low level of pain and discomfort groups permitted analysis of exposure effects; use of nonpatients a strength of this study

Source: Barr *et.al* (2004)

2.3 CHALLENGES POSED BY MUSCULOSKELETAL DISORDERS

MSDs are an increasing problem in the European Union (EU) where it still remains as the most common occupational disease (EODS, 2000) and one of the most important causes of long-term sickness absences (EU-OSHA, 2010). According to the fourth European Working Conditions Survey (EWCS, 2005), MSDs accounts for more than 50% of all occupational diseases in Europe, it is a leading problem in nearly all industries in the Pacific (Harcombe *et al*., 2010) common in the general population (Punnett and Wegman, 2004) and at least in developed countries, the most frequent causes of physical disability (WHO, 2003).

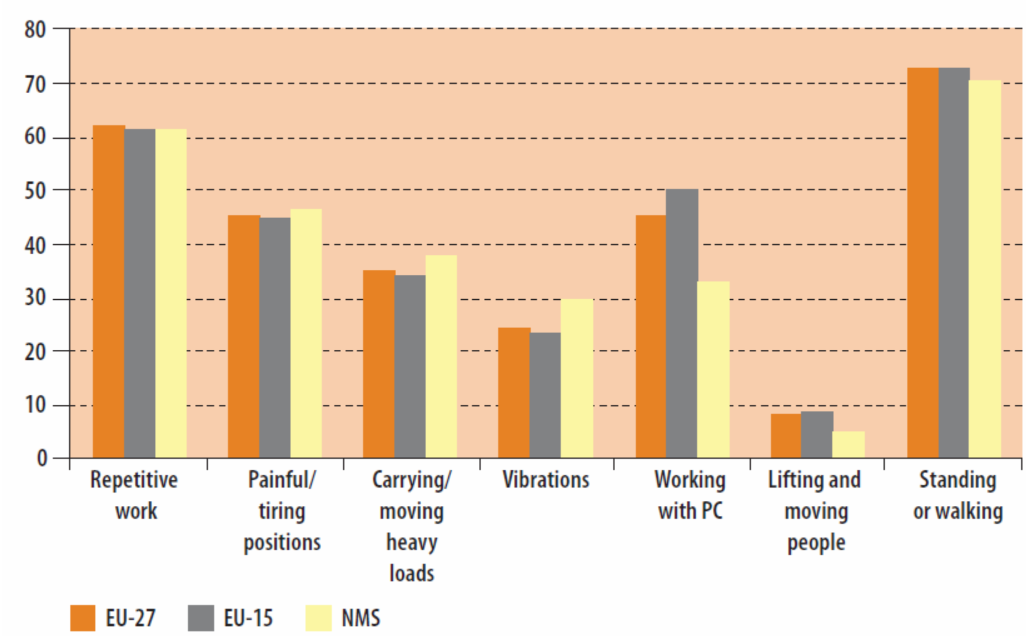
The 1999 adhoc module of European Statistics (Eurostat) Labour Force Survey (LFS) implicated MSDs to account for the highest in work related problems (Figure 4). This implies that aside the fact that workers in all sectors of occupations are at high risk, MSDs may lead to high costs to enterprises and the society as a whole (Takala, 2010), hence the overall cost implications may be grave at all levels, being individual, enterprise and society.

A few highlights of EU challenges (EU-OSHA, 2010) have identified MSDs and exposure to MSDs risk factors to be on the increase in the younger working populations. This has been put into consideration in the present study. Moreover, the role of gender was not exempted, more so that women are considerably exposed to workplace injuries but the effects are still underrecognised. Hence a detailed data extraction analysis was put in place to identify all the groups (blue and white collar) at risk so as to have a correct perception of the situation in specific industrial sectors, hence the food industry.

In fact, report has it that blue-collar and service workers tend to be more exposed to physical risks such as carrying or moving heavy loads, painful and tiring positions and vibrations, while repetitive work and working at high speed affect all occupations (EU-OSHA, 2010).

Hence, comparison in respect of age and the above stated entities were also studied as they are deemed necessary in providing a better insight on the present subject and allow for subsequent identification of emerging issues in workplace health.

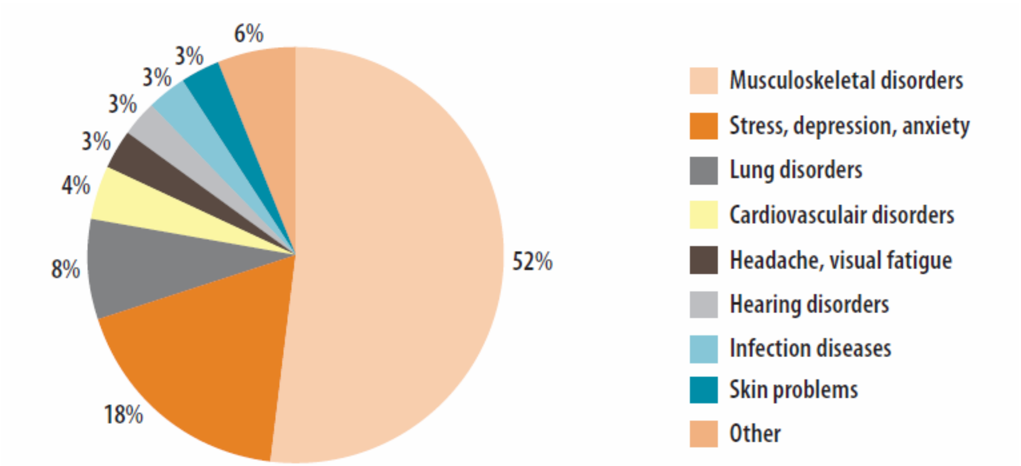
Figure 3: Risk factors for MSDs.



***NMS - 10 countries that joined the European Union on 1 May 2004.**

Source: European Survey on Working Conditions (ESWC) 2005

Figure 4: Labour Force Survey (LFS) on work related problems



Source: Eurostat 1999

2.4 THE CONCEPT OF PERCEIVED EXERTION – AN INDICATOR OF PHYSICAL STRAIN

It is known that whenever a heavy muscular task is being performed, there is every tendency to receive sensations from the muscles, joints, somatosensory receptors, cardiovascular and respiratory systems, even from other bodily organs. This is followed by other physiological or psychological cues as well as memories of work situations (Borg, 1998), such as feelings of exertion. The concept of Perceived Exertion (PE) was one of the methods introduced at the end of the 1950's for measuring overall PE, local fatigue and breathlessness. The content and measuring are primarily given by common sense, personal experiences and empirical studies. The experiences given could range in the form of effort, breathlessness, fatigue, feelings of warmness, subjective weight and heaviness, subjective force, arousal and exercise intensity – all included so as to capture the concept (Borg, 1998).

Perceived exertion has been described as how hard one feels like when their body is working, and it is based primarily on the physical sensations a person experiences during physical activity, including increased heart rate, increased respiration or breathing rate, increased sweating and muscle fatigue (CDC, 2010).

The tremendous contribution of Gunner Borg (1970, 1982) and his insightful literature – Borg's Perceived Exertion and Pain Scales (1998), has aided the scientific understanding of subjective symptoms and their relationship to objective finding, particularly in the field of ergonomics. This necessitated the development of methods to quantify subjective symptoms, applicable to most people irrespective of their age, gender, circumstances and national origin.

Borg (1982) opined that perceived exertion is the single best indicator of the degree of physical strain. This prompted the need to investigate in the present study, what the intensity of physical strain and perceived pain is on a normal working day, in an effort to better understand man at work, more so that an individual's perception of exertion during physical work is also important in epidemiological evaluation of daily exercise intensities.

Participants in the present study were asked to rate their perception of strain (physical strain) and pain (numbness) on a normal working day. This feeling reflected how heavy or strenuous a work day feels like to them, combining all sensations and feelings of physical strain and pain by focusing on their total feeling of exertion at the arms, neck, low back and legs, according to the Borg Rating of Perceived Exertion Scale (RPE) as shown in the table 2.

Table 2: Borg Rating of Perceived Exertion Scale (RPE)

6	No exertion at all	**14**	
7	Very, very light	**15**	Hard
8		**16**	
9	Very light	**17**	Very hard
10		**18**	
11	Fairly light	**19**	Very, very hard
12		**20**	Maximal exertion
13	Somewhat hard		

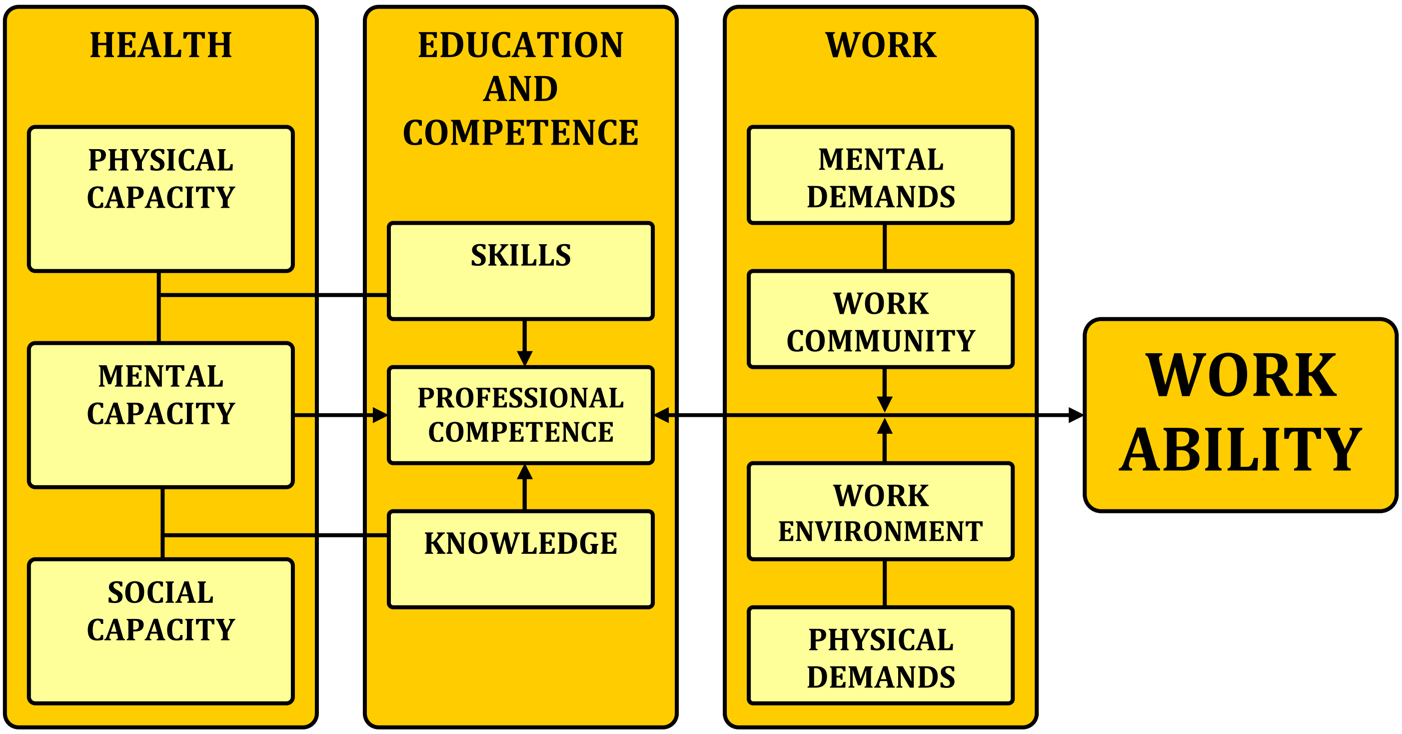
Source: Borg Gunner 1970, 1982, 1988; CDC, 2010.

However, it is good to note that the concise measurement of the degree of effective physical strain (exertion) at work could be difficult atimes, in a case where pathology is present. In such a situation, the concept of 'dangerous strain' may be viewed as a hypothetical construct that may be difficult to identify. Hence, substantive evidence may be obtained from both subjective and objective indicators, either of which may be incomplete or misleading when taken by itself (Borg, 1998).

2.5 PERCEIVED WORK ABILITY

The concept of perceived work ability is multifaceted (Camerino *et.al,* 2006) and it depends on many individual characteristics and work related factors (Ilmarinen, 1999). However, there may still be a requirement to promote individual resources in order to enhance their ability to work and cope with work. It was on this note that Pohjonen (2001) inferred that the concept of job performance, work capacity and work ability becomes confusing, while their operationalization becomes problematic, hence resulting in a lack of appropriate and valid measures for them. Possibly in the light of this and on the basis of Rutenfranz *et.al* (1981) stress – strain concept, Ilmarinen *et.al* (1991) defined work ability as a worker's capacity to manage his or her job demands. In the furtherance of understanding this concept, a comprehensive conceptual model of work ability was constructed (figure 5), reflecting the close interaction between individual resources and work factors (Pohjonen, 2001), so also was a questionnaire based method (Work Ability Index – WAI) developed in order to operationalize the concept (Tuomi *et.al,* 1991b, 1994, 1998). But the work ability concept, to be candid, is it feasible more in principle or in practice? There seems to be a need for clarity about this, owing to factors such as choice and interest on the part of workers.

Figure 5: Conceptual Model of Work Ability (Ilmarinen, 1999) – Modified (Pohjonen, 2001)



Work ability is a complex concept which can be assessed by the use of the Work Ability Index (Ilmarinen, 1997). Though the basis for this tool is on the assumption that work ability is explained by an individual's perception of demands of the work environment and their ability to cope with them (Camerino *et.al,* 2006), but perceived ability to cope with these demands still rely solely on functional capacities in terms of mental, physical and social resources, so does the individual's health, competence, attitudes and values (Ilmarinen, 2004a). There is also a thought that the subjective experience of work ability is as a result of congruency between perceived demands of the work environment and individual perceptions about personal resources (De Zwart *et.al,* 2002).

It is based on this concept that the present study sets out to investigate how perceived work ability is influenced by some specific work related factors in order to corroborate efforts made so far in addressing the challenges being faced at work places.

2.6 AGE, GENDER, WORK AND INJURIES

2.6.1 AGE OR AGEING

We will age, that is obvious! It is no longer news, though it is silently salient! It is in the news, it is being researched and it will come to everyone. As each day passes, from our homes, to our work places, thereafter to our different locations of leisure to relax after work, eventually back to our homes and to begin again the next day, there is no doubt, we will age one way or the other, as we go by our routine lifestyle.

But as age comes, amidst pressures of social responsibilities and challenges, work (demands, environment and organization), so also is the plausibility of increased risk to workplace and work related injuries (in its inevitability).

In fact, Mackey *et.al* (2007) confirmed that older workers are more likely to have a work injury than younger workers, with a higher overhead injury cost (WorkCover Authority, 2003-2004). Whenever this takes place, workers (blue or white collar) will go on sick leaves – some once in a while, others intermittently. But for those who may encounter permanent injuries or a form of disability, it will be time to exit work. In other words, the possibility for people in their few or more numbers, to exit work at an age lower than the stipulated is unpredictable. However, the burden of their responsibility will still lie solely upon individuals, governments and the society at large.

In EU for instance, with the tremendous speed at which ageing is accelerating and workforce shrinking, the prediction is that in the coming decades, economic and social impact of the ageing of Europe's population will be pronounced (Hartmut and Bernd, 2003). This is a result of the pronounced longevity growth and lower fertility rates, combined with the retirement of the 'baby boomers', causing a sudden worsening of old age dependency rate (Hartmut and Bernd, 2003). Thus, as a consequence of the increasing number of ageing workers, came the dire interest in the interaction between an employee's age and work related factors (WHO, 1993; Griffiths, 1997; Robertson and Tracy, 1998; Wegman, 1999; Ilmarinen, 1999; Shephard, 2000).

2.6.2 AGE AND WORK INJURIES

There is knowledge that age is only associated with physical capacity and the prevalence of diseases (Pohjonen, 2001), but an age related decline in physiological functions may affect work capacity, only when work performance is primarily dependent on such functions (Westerholm and Kilborn, 1997). Therefore, a decline in work capacity as a result of ageing will be higher in physically demanding jobs (blue collar) than in mentally demanding ones (Ilmarinen *et.al,* 1997). This has been exemplified in the work done by Kemmlert (2001) and Ahern (2005) that amongst older workers, sprain and strain, to musculoskeletal tissues are the most common types of work injury, while body stressing and slips, trips and falls are the leading mechanisms of injury.

It is very much recognised, when considering the occupational health and safety implications of the ageing workforce that ageing brings about a number of changes in physiological and cognitive abilities (Mackey, 2007). It is also a known fact that physical capacity declines with age, however, this decline become more pronounced after 50 years of age (Brooks *et.al,* 1996; Ilmarinen, 1999; Savinainen *et.al,* 2004). It has even been established that age associated changes in postural system can also make it difficult for some individuals to adopt certain working positions (Bosek *et.al,* 2005).

The ingenuity of a conceptual explanation of ageing and injury as given by Mackey *et.al* (2007) cannot but be referred to (figure 6). It was argued that observed reduction in physical capacity with ageing cannot be limited to naturally occurring physiological deterioration alone, but in part, as a result of lower levels of physical activity in older individuals.

Figure 6: Conceptual Model of Ageing and Injury (Mackey, 2007)

Therefore, there is no doubt the conformity with the fact that age related decline in physical capacity is a major concern for workers involved in physically demanding jobs. Hence if a worker's physical capacity cannot meet the task demands, it may cause excess fatigue, resulting to poor productivity, coupled along with an increased risk of individual accidents (Shephard, 1999). This somehow explains for the reason why, compared to the younger workers, older workers need higher reserves for recovery and thus the more the susceptibility of an ageing worker to fatigue and other adverse symptoms (Mackey *et.al,* 2007). Therefore one can agree with the conclusion that physically demanding work does not maintain or improve physical capacity among ageing workers (Nygård *et.al,* 1991; Brooks *et.al,* 1996).

Summarily, the prospects of workforce shortage and ageing seems unavoidable because over the next two decades, the number of people in the 20 – 29 age band will fall by 20%, while those in the 50 – 64 age group will increase by 25% (Hartmut and Bernd, 2003). Even though there are a number of efforts being made to avoid this catastrophe, one important strategy that was coined out, was to enable and motivate the baby boomers to remain in work, by 3 – 5 years longer than applicable. Brilliant idea, isn't it? Thus, Europe is ensuring that proper adjustment(s) to working practices to an ageing workforce, coupled along with investment in the continued employability and productivity of the older workers (Hartmut and Bernd, 2003) is put in place.

2.6.3 GENDER ASPECT OF WORK AND INJURIES

The last 50 years have seen a rise in equality in the participation of genders in paid economic activities, with Sweden championing this course with a higher percentage of employed females in comparison to most countries (Lindqvist *et.al,* 1999). As at 1995, 76% of females and 80% of males aged 16 – 64 were fully employed (Östlin, 1997).

Even with the converging trend of labour force participation between men and women (Smith and Mustard, 2004), they still differ in the functional and psychological damage they suffer as a consequence of exposure to occupational hazards (Hensing *et.al,* 1995; Messing, 2000; Alexanderson, 2002). This is because different occupations and industries have different hazard exposures and also require different physical demands, both of which influence the risk of work related injury (Smith and Mustard, 2004).

However, there is still a greater likelihood for men to be injured at work (Bureau of Labour Statistics, 1998; Human Resources Development Canada, 1999; Dupre, 2002), possibly as a result of different job tasks and exposures that are more predominantly associated with male labour force participation, rather than personal characteristics of male labour force participants (Murata *et.al,* 2000; Islam *et.al,* 2001; DeLeire *et.al,* 2001; Payne *et.al,* 2002).

In another development, young people 15 to 24 years old entering the formal labour market are a public health concern due to work injuries and illnesses, as both teenagers and young adults have rates of work injury that are typically 1.2 to two times that of older workers (Laflamme and Menckel, 1995; Salminen, 2004; Breslin and Smith, 2005). This elevated risk is more marked for young males than young females (Breslin *et.al,* 2007). Also, because young workers are more likely to work part-time or seasonally, injury rates based on number of hours worked (rather than per worker) showed an elevated youth risk more consistently (Castillo *et.al,* 1994; Ruser, 1998). This invariably creates clear health and economic consequence as a result of the work injuries which the youths sustain (Breslin *et.al,* 2007).

This however creates an avenue for more studies to be conducted, just as the risk factors for work place disorders are increasing in the younger working populations.

2.7 PAIN AS A SYMPTOM OF MUSKULOSKELETAL DISEASE

Pain (musculoskeletal pain) is very common, especially as a result of damage, dysfunction or disease of any of the components of the so-called muscle-tendon unit. It is usually a symptom of an underlying disease process, such as injury, inflammation, or degeneration of one of the components of the muscle–tendon unit and may also be part of an illness, namely a chronic pain syndrome (Littlejohn, 2005).

The International Association for the Study of Pain (2009) described musculoskeletal pain as a known consequence of repetitive strain, overuse, and work related musculoskeletal disorders, with injuries including a variety of disorders that cause pain in bones, joints, muscles, or surrounding structures. It can be acute or chronic, focal or diffuse, with low back pain being the most common example of the chronic musculoskeletal pain, the most prevalent, the most common work-related injury in Western societies and the most costly work related musculoskeletal disorder.

Of a fact, the musculoskeletal system possesses abundance of nociceptors with thresholds set to respond to injury stimuli which activate the pain system before any corresponding tissue damage. This allows for immediate reflex withdrawal of the threatened part, as well as activation of pain sensations with cognitive appraisal of the threat. This basic pain system therefore provides warning and subsequent protection from potential tissue damage, though through other mechanisms, there is regional spread of pain beyond the injured tissue. Also, through 'uncertain' mechanisms, central influences activate these processes. Cognitions, personality, emotions, stress-centre activation, sleep dysfunction, and other influences such as psychosocial factors may all contribute to different degrees in different people's response to this (Littlejohn, 2005).

Moreover, background musculoskeletal sensory inputs, which are affected by fitness, posture, injury, or disease, are further contributions to this equation. The pain involved in these common moderate to chronic musculoskeletal pain syndromes thus represents, not a symptom of tissue damage but, an essential feature of a disorder of function of the pain system as a whole – from mind to body and back (Littlejohn, 2005).

2.7.1 PAIN AND OUR WORK

It is quite interesting how a mere simple but uncalculated movement in a part of the body could end up in a pain (moderate, severe or chronic), that people will end up managing for the rest of their lives. This kind of pain can be very overwhelming and atimes impossible to deal with, most especially when one is ageing.

In Finland for example, pain problems are common among employees (Saastamoinen *et.al,* 2009) and it is the most likely key element causing disability related to musculoskeletal diseases (Lötters and Burdof, 2006). Musculoskeletal diseases, being among the most common causes of sickness absence, account for a third of all long-term absences in Finland (Kuusisto, 2006). In a 2005 study conducted by Saastamoinen *et.al,* approximately 15% of 40–60-year-old municipal employees suffer from acute pain and 29% from chronic pain. In addition, pain is strongly associated with poor health-related functioning (Saastamoinen *et.al*, 2006) which is closely related to work disability and subsequent sickness absence.

Aside the human costs of pain, there is the economic cost impact. In 2005, the total costs of long-term (>9 week days) sickness absence alone was €705 million, with each sickness absence spell costing an average of €2000 in Finland (Kuusisto, 2006).

2.7.2 GENDER ROLE(S) IN PAIN PERCEPTION

Another interesting aspect of pain and work is about gender differences in perception. There is no doubt the influence of gender on the experiences of pain. There has been review of studies of clinical and laboratory pain and there is the general conclusion that women and men perceive and experience pain differently (Riley *et.al,* 1998; Fillingim, 2000; Robinson *et.al,* 2000; Rollman *et.al,* 2000; Berkley *et.al,* 2006). In 1996 for instance, research reviewed on clinical pain by Unruh revealed that the likelihood for women to experience recurrent, frequent, sever and longer-lasting pain, compared to men, is more. In the same review, it was found that the tendency to experience pain related disability was more in women than in men.

Despite these facts, some studies of clinical pain and experimental pain did not demonstrate gender differences in pain perception (Jackson *et.al,* 2002). Although explanations given, such as methodological considerations in respect of sample size, leaves much to be desired, drawing such seemingly outrageous inferences. Discrepant findings also suggest that gender per se may be less important than factors related to gender in explaining connections between gender and pain (Jackson *et.al,* 2002).

Notwithstanding, less is known about the specific mechanisms that underlie the differences in responsiveness to pain, even though self-efficacy has been argued to be a plausible factor which may mediate such relationship (Jackson *et.al,* 2002) - self-efficacy, having been defined by Bandura (1997), as an expectation that one can successfully perform behaviours necessary to produce a successful outcome. Although the impact of physical self-efficacy on pain perception is yet to be investigated, it may sound reasonable to speculate that people who perceive themselves to be more physically capable should perform better on physically challenging tasks that demand strength and endurance in the face of pain than those who view themselves as less physically capable (Jackson *et.al,* 2002). This concept creates a divide in even in our contemporary modern societies.

CHAPTER THREE

3.0 AIMS AND OBJECTIVES

3.1 STUDY AIMS

The main aim is to study the association between perceived physical strain, pain and work ability among the workers.

3.2 SPECIFIC OBJECTIVES

Specific objectives of the present study are:

(i) To analyze the distribution of pain, physical strain and work ability among the workers in terms of different age categories, gender and staff task group – Study 1

(ii) To describe work related perceived strain and pain with work ability – Study 2

(iii) To describe the association between perceived strain, pain and work ability in respect of age, gender and staff task group – Study 3

(iv) To determine if high strain or high pain results to poor work ability – Study 4

CHAPTER FOUR

4.0 MATERIALS AND METHODS

4.1 MATERIALS

Concise systematic review of literatures was conducted in the present study to further explore and also have more insight to the understanding of the topics of interest. This was made possible by the use of the following listed, in search for keywords related to the present study – musculoskeletal disorders, pain, physical strain, work related musculoskeletal disorders, musculoskeletal pain, and perceived exertion. The main references were selected either by combining the search words and scanning through the results to select journal titles of interest and then evaluating by proper reviewing (reading) of the articles.

(a) **QUERTLE** – a new and unprecedented, smart and easy literature search tool that uses advanced semantics to find quality results. It dissects sentences to find relevant articles from other search engines like PubMed and NIH. It also automatically identifies key concepts in documents and provides links to Open Access documents (QUERTLE, 2011).

(b) **BioMed Central** – an online based open access journal and article database and publisher of 212 peer-reviewed journals. Searches include PubMed Central, BMC Musculoskeletal Disorders and PubMed (BioMed Central, 2011).

(c) **Google Scholar** – a web-based search tool which provides a simple way to broadly search for relevant and scholarly literature across diverse disciplines and sources – to include articles, theses, books, abstracts from academic publishers, professional societies, online repositories, universities and other web sites (Google Scholar, 2011).

(d) **NELLI** – this is a portal through which higher institutions across Finland can access electronic resources available at each institution's library. It offers simultaneous cross-searches of multiple databases and link services from databases to full text resources.

The search is usually conducted by selecting public health reference databases or electronic journals to be searched from such examples as BioMedCentral, PubMed (MEDLINE), PubMED Central, National Institute for Occupational Safety and Health (NIOSH) – to mention a few.

4.2 METHODS

4.2.1 STUDY DESIGN AND SETTING

The study was a descriptive cross-sectional (year 2009) survey of workers in the production facility of a leading private-sector food manufacturing company in Finland by the use of a self-completion questionnaire. Overall number of all employees was 1939.

A total respondent to the questionnaire was 1481 out of which 1398 consented to being studied, in all giving a 72% response rate. It was conducted in collaboration with the Tampere School of Public Health and headed by the Programme Director.

4.2.2 STUDY POPULATION

The study participants were blue and white collar workers within the food factory, out of which 1074 were blue collar workers (76.8%) and 324 were white collar workers (23.2%). The questionnaire was distributed on behalf of the research team, while completed questionnaires were later returned to the research team after collation. The data represents a total of 890 females (63.7%) of which 680 were blue collar workers (48.6%) and 210 were white collar workers (15.6%) , while there were in total, 508 males (36.3%) out of which 394 were blue collar workers (28.2%) and 114 were white collar workers (8.2%).

4.2.3 QUESTIONNAIRE DESIGN AND DISTRIBUTION

Questionnaire items were derived by the research team, while subsequent consultations, literature review, discussions with management of the food factory were conducted respectively by the team.

4.2.4 MEASUREMENTS – VARIABLE SELECTION AND DESCRIPTION

For the purpose of the present study, the following listed were the variables selected and are described accordingly.

(i) **Physical Strain**: this variable was defined based on the Borg Rating of Perceived Exertion Scale (RPE), in order to measure each worker's intensity or feeling of strain on a normal work day. Although being a subjective measure of a person's exertion rating, it provides a fairly good estimate of the actual heart rate during physical activity (Borg, 1998).

Participants were asked to rate '***how much strain do you feel in different parts of your body***'. Based on the result obtained from the cut-off point for scaling in the present study, slight modification were made to the RPE scale 6 – 20 and categorised as – very light strain, slightly hard strain and very hard strain.

(ii) **Pain**: the question was asked of '***did you have pain, ache or numbness during the last 7 days in the following parts of your body***' and each participant was required to rate their perceived pain on a scale according to McCaffery and Pasero (1999) Numerical Pain Rating Scale (NPRS) shown in figure 8. The 11-point numerical pain rating scale is a measure of pain in which workers have to rate their pain ranging from 0 through 10 (Downie *et.al,* 1978; Jensen *et.al,* 1994; Price *et.al,* 1994; Katz and Melzack, 1999) and it has been shown to have concurrent and predictive validity as a measure of pain intensity (Jensen *et.al,* 1994, 1999).

However, modification was made to the scale in respect of the inter-quartile range in this study as: Not Pained, Low Pained, Moderately Pained and Highly Pained.

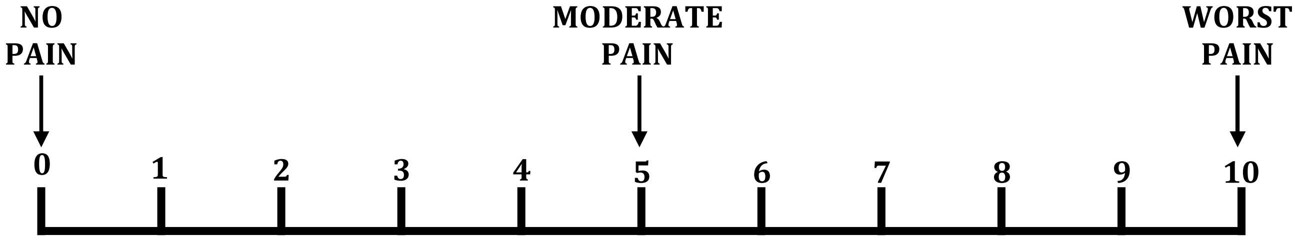


Figure 8: Numerical Pain Rating Scale (NPRS) from McCaffery and Pasero (1999). Copyrighted by Mosby, Inc.

(iii) **Work ability**: this term in this study is meant as perceived work ability and was used alternately. Participants were asked to rate their work ability based on a question that '***assume your work ability at its best has a value of 10 points, how many points would you assign to your current work ability***' on a unidimensional scaling method (Likert Scale) with a range from 0 – 10 (Tuomi *et.al,* 1991a; Nygård *et.al,* 2005; Social Research Methods, 2006). Work ability, in the present study was rated based on the cut-off point of the percentile and categorised into four classes namely: Poor work ability, Moderate work ability, Good work ability and Excellent work ability, all conforming to the work ability index (Gould *et.al,* 2000)

(iv) **Age, Gender and Staff Task Group**: the age structure of the present study is 20 to 66 years and was categorised to four groups based on the information drawn from the percentile (Table 3). Mean age was 41.45 with Standard Deviation of 11.548 (figure 9).

4.2.5 DATA ENTRY AND ANALYSIS

Responses were entered by the appropriate unit of the Department, where it was checked for data quality and consistency. No major issues in the accuracy of data entry were detected. Descriptive analyses were conducted using frequency tables. Continuous variables were not normally distributed. Therefore median values were calculated and used to determine cut-off points for percentiles of the categories. Analyses of distribution of categorical variables were conducted and tested using the chi-square test, while their levels of significance recorded respectively.

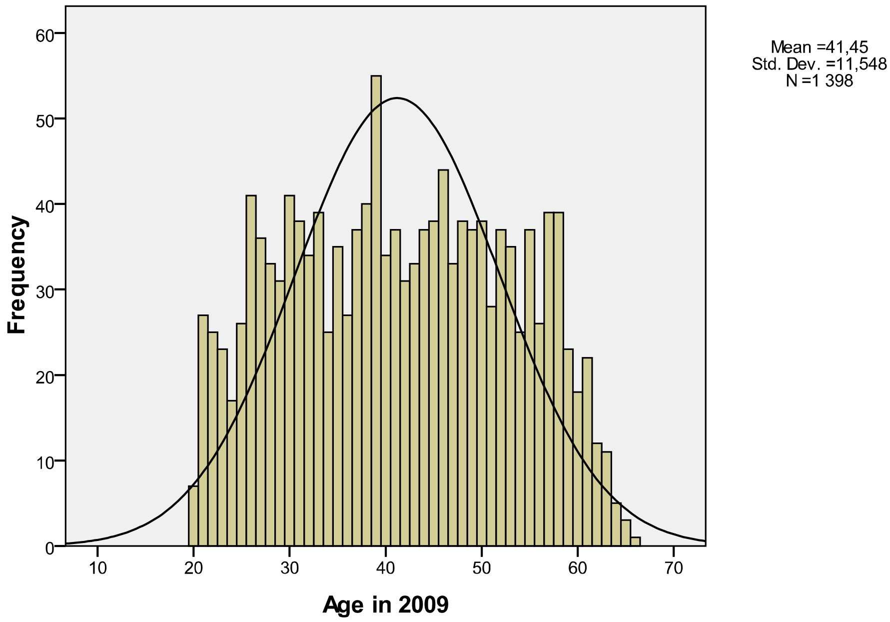
Multinomial analysis by logistic regression was first used to explore the association between physical strain and pain with work ability and later used to further examine the association between same variable by adjusting for potential confounders such as age, gender and staff task group. Statistical significance was defined as a two sided *p-value* < 0.05, while odds ratios (OR) were presented with their 95% confidence intervals (CI) and the *p*-levels recorded to provide an additional measure of statistical significance.

All analyses were solely conducted with the use of SPSS statistical software (versions 16.0 and 17.0).

Table 3: Age (categorised) distribution

Age (years)	Frequency	Percent	Valid Percent	Cumulative Percent
< 30	307	22.0	22.0	22.0
31 - 40	364	26.0	26.0	48.0
41 - 50	366	26.2	26.2	74.2
> 50	361	25.8	25.8	100.0
Total	1398	100.0	100.0	

Figure 9: Distribution of Age before being categorised



CHAPTER FIVE

5.0 RESULTS

STUDY 1

5.1 DISTRIBUTION OF PAIN WITHIN AGE, GENDER AND STAFF TASK GROUP

There exist high levels of significance in the distribution of Pain in Arms as regards Age categories (table 3), Gender (table 4) and Staff Task Group (table 5), with the highest proportion of highly pained going to workers who are greater than 50 years of age (30.7%). The increasing trend of high pain in the arms across the age categories is also of interest - < 30 years (14.3%), 31 to 40 years (23.9%), 41 to 50 years (25.3%) and > 50 years (30.7%) respectively. A twofold increase in high pain in the arms was also recorded among females (29%) as compared to males (14.9%) while blue collar workers and white collar workers had 25.2 percent and 19.7 percent high pain respectively.

The distribution of pain in the legs showed high significance as regards age and staff task group. Again, workers – blue collar (19.8%) and white collar (7.8%), especially those within the age more of than 50 years (20.3%) had more number of those who were highly pained in the legs, compared to the other age categories that had 17.4 percent (41 – 50 years) and 15 percent (31 – 40, < 30 years) respectively.

Although the record of workers having high pain in low back had a *p-value* of < 0.001, indicative of a very high level of statistical significance between task and pain, pain in low back had no statistical significance in respect of age and gender, however, the account of those with low pain in low back, in the same respect, showed higher frequencies as compared to those with moderate pain and high pain, with close to 40 percent of workers that are above 50 years old. The distribution of gender within pain in the neck also showed a very high statistical significance, compared to age and staff task group.

5.2 DISTRIBUTION OF PHYSICAL STRAIN WITHIN AGE, GENDER AND TASK GROUP

Results obtained from the analysis of the distribution of perceived strain among the different age categories (table 6) showed no statistical significance even though the percentage of those with a very high strain was much among all the age groups.

However, there was high statistical significance in perceived strain with gender and staff task group. More females (46.0%) and blue collar workers (52.5%) felt strained very hard at work than males (35.9%) and white collar workers (9.3%).

Table 3: Distribution of Pain within Age categories

Age (years)	Pain				p-value
	NP (%)	LP (%)	MP (%)	HP (%)	
Arms					
< 30	33.2	29.2	23.3	14.3	< 0.001
31 – 40	25.6	25.3	25.3	23.9	
41 – 50	19.4	26.7	28.6	25.3	
> 50	16.2	27.3	25.9	30.7	
Neck					
< 30	17.3	28.0	27.3	27.3	0.621
31 – 40	15.6	29.4	24.2	30.8	
41 – 50	16.1	28.0	28.3	27.7	
> 50	12.4	30.5	24.7	32.5	
Low Back					
< 30	26.6	31.2	25.2	16.9	0.467
31 – 40	24.4	31.4	25.6	18.6	
41 – 50	23.7	34.0	23.1	19.2	
> 50	19.8	38.8	22.4	19.0	
Legs					
< 30	29.9	35.2	19.9	15.0	0.004
31 – 40	31.8	33.4	19.8	15.0	
41 – 50	24.1	39.5	19.0	17.4	
> 50	18.0	37.4	24.3	20.3	

Table 4: Distribution of Pain within Gender

Gender	Pain				p-value
	NP (%)	LP (%)	MP (%)	HP (%)	
Arms					
Females	20.1	25.3	25.6	29.0	< 0.001
Males	28.8	30.0	26.4	14.9	
Neck					
Females	12.9	26.7	25.9	34.6	< 0.001
Males	19.4	33.1	26.5	21.0	
Low Back					
Females	22.9	32.9	25.1	19.2	0.413
Males	24.7	35.7	22.3	17.3	
Legs					
Females	24.8	35.5	21.2	18.5	0.157
Males	27.6	38.1	20.1	14.2	

Table 5: Distribution of Pain within Staff Task Group

Task Group	Pain				p-value
	NP (%)	LP (%)	MP (%)	HP (%)	
Arms					
Blue Collar	20.4	27.3	27.2	25.2	< 0.001
White Collar	32.5	26.3	21.6	19.7	
Neck					
Blue Collar	14.0	29.7	26.9	29.3	0.087
White Collar	19.3	26.7	23.3	30.7	
Low Back					
Blue Collar	20.8	32.7	26.5	19.9	< 0.001
White Collar	32.5	37.8	15.9	13.8	
Legs					
Blue Collar	20.5	35.8	24.0	19.8	< 0.001
White Collar	43.3	38.6	10.3	7.8	

NP – Not pained
LP – Low pained
MP – Moderately pained
HP – Highly pained

Table 6: Physical Strain Distribution within Age, Gender and Task Group

	Physical Strain			
	VL (%)	SH (%)	VH (%)	*p-value*
Age (years)				
< 30	24.0	33.3	42.7	
31 – 40	25.5	29.1	45.4	0.283
41 – 50	26.4	33.6	40.0	
> 50	30.8	28.0	41.2	
Gender				
Females	25.1	29.0	46.0	0.001
Males	29.7	34.3	35.9	
Task Group				
Blue Collar	15.1	32.4	52.5	< 0.001
White Collar	64.7	26.0	9.3	

VL – Very Light
SH – Slightly Hard
VH – Very Hard

Table 7: Work ability Distribution within Age, Gender and Task Group

	Work ability				
	Poor (%)	Moderate (%)	Good (%)	Excellent (%)	*p-value*
Age (years)					
< 30	13.9	22.2	29.5	34.4	
31 – 40	15.5	28.0	36.8	19.7	< 0.001
41 – 50	19.9	32.7	33.0	14.4	
> 50	29.6	33.2	27.6	9.6	
Gender					
Females	19.8	29.0	33.7	17.5	0.157
Males	20.2	29.8	28.6	21.4	
Task Group					
Blue Collar	22.0	28.7	29.5	19.9	< 0.001
White Collar	13.3	31.3	39.6	15.8	

Table 8: Physical Strain Distribution by Work ability

		VL (%)	SH (%)	VH (%)
Work ability	Poor	18.1	30.6	51.3
	Moderate	24.1	31.8	44.1
	Good	28.7	30.3	41.0
	Excellent	36.0	31.8	32.2

p-value = < 0.001
VL – Very Light
SH – Slightly Hard
VH – Very Hard

5.3 DISTRIBUTION OF WORK ABILITY WITHIN AGE, GENDER AND STAFF TASK GROUP

Age and staff task group showed high statistical significance level in the distribution of work ability (table 7), while there was no significance in respect of gender. Among workers' age categories of those who had excellent work ability, there was a decreasing trend across the group. Excellence in work ability was highest among workers less than 30 years of age (34.4%), whereas it was almost 4fold lower in comparison to workers of the age group that were older than 50 years (9.6%). Good levels of work ability were shown highest among workers within the age group 31 – 40 years (36.8%) and white collar staffs (39.6%).

STUDY 2

5.4 DISTRIBUTION OF PHYSICAL STRAIN AND PAIN BY WORK ABILITY

Physical strain showed a high level of statistical significance in respect of work ability (table 8). The highest percentage of workers (51.3%) was recorded against those that were strained very hard and also had poor work ability, including those who had moderate work ability (44.1%), good work ability (41.0%), even excellent work ability (32.2%) respectively. Increased trend in physical strain translated to lesser and lesser number of workers in the work ability spectrum of categories, so also was an increasing trend in work ability across the spectrum of workers with very low strain

The distribution of pain (table 9) at different sites of the body revealed a very strong statistical significance across the work ability categories. There was improvement in work ability rates within workers that were not pained either in the Arms, Neck, Low Back or Legs, so also was there a decreasing trend in work ability among workers that were highly pained in the body sites mentioned.

Table 9: Pain Distribution by Work ability

		Pain in Arms (%)				Pain in Neck (%)				Pain in Low Back (%)				Pain in Legs (%)			
		NP	**LP**	**MP**	**HP**	**NP**	**LP**	**MP**	**HP**	**NP**	**LP**	**MP**	**HP**	**NP**	**LP**	**MP**	**HP**
Work ability	Poor	9.6	18.4	35.3	36.8	6.7	19.0	33.1	41.3	8.8	24.9	28.9	37.4	10.9	25.9	29.9	33.2
	Moderate	19.4	25.2	27.5	28.0	12.4	26.8	25.3	35.4	18.8	34.8	25.9	20.6	23.4	38.2	22.9	15.5
	Good	25.2	33.3	21.8	19.7	16.1	32.6	27.5	23.9	25.1	38.7	25.1	11.1	28.7	41.8	17.2	12.2
	Excellent	40.9	28.6	19.7	10.8	27.3	36.5	18.1	18.1	44.2	33.7	14.7	7.4	41.0	35.9	13.7	9.4

p-value = < 0.001

NP – Not pained
LP – Low pained
MP – Moderately pained
HP – Highly pained

Table 10: Association between Physical Strain and Work ability

Independent Variables	**Dependent Variables**						
	Work ability						
	*Poor	Moderate		Good		Excellent	
† Physical Strain		**OR 95% CI**	***p-value***	**OR 95% CI**	***p-value***	**OR 95% CI**	***p-value***
Very Light	1.0	1.55 (1.03 – 2.33)	0.037	1.99 (1.34 – 2.95)	0.001	3.18 (2.05 – 4.94)	< 0.001
Slightly Hard	1.0	1.21 (0.85 – 1.72)	0.296	1.24 (0.87 – 1.76)	0.236	1.66 (1.10 – 2.49)	0.016
Very Hard	1.0	*	*	*	*	*	*
‡ Physical Strain							
Very Light	1.0	1.21 (0.75 – 1.94)	0.435	1.48 (0.93 – 2.35)	0.047	3.63 (2.17 – 6.05)	< 0.001
Slightly Hard	1.0	1.13 (0.78 – 1.62)	0.521	1.15 (0.80 – 1.65)	0.465	1.66 (1.09 – 2.55)	0.019
Very Hard	1.0	*	*	*	*	*	*

* ***Reference category***; **† before adjustment; ‡ after adjustment for Age, Gender and Staff Task Group**

STUDY 3

5.5 ASSOCIATION OF PHYSICAL STRAIN AND WORK ABILITY

There exists an association (*p-value* 0.037) between work ability (moderate – OR 1.55) and workers with very light strain (table 10), hence the more tendency for other workers to experience good (OR 1.99) and excellent (OR 3.18) work abilities on a normal work day as compared to those that feel very hard physical strain but are more prone to poor work ability (table 10). Interestingly enough, adjusting for potential confounders (age, gender and staff task group), an attempt to ascertain their effect on the association between work ability (moderate) and physical strain (very light), further decreased the OR (1.21), though there was no statistical significance between them. Moreover, while there remained association between work ability and physical strain (*p-value* 0.047), the odds ratio still decreased to 1.48, an indication of the effect of the confounders. However, excellent work ability remained statistically significant, with increased probability of perceived excellence in ability to work (3.18 to 3.63) even while attempt was made to evaluate the effect of individual factors on its association with physical strain.

5.6 ASSOCIATION OF PAIN AND WORK ABILITY

(a) Pain in Arms – in comparison to workers that were highly pained in the arm, those with low pain has 1.80 fold higher probability of having moderate work ability against those who has poor work ability (table 11). Although there was association between pain in arm and work ability, workers that reported moderate work ability (OR 1.02) has almost the same probability to experience moderate pain in the arm compared to those with poor work ability, even though when the potential confounders were adjusted for.

(b) Pain in Neck – there is association between pain in neck and work ability (table 12) with an exception of workers that expressed moderate pain, thereby having non-significant statistical values in respect of the association with the work ability categories. For instance, workers with moderate pain are less probable to experience moderate workability (OR 0.89), compared to those with poor work ability, even when adjusted for by confounders (OR 0.92).

(c) Pain in Low Back – there is no doubt, pain in low back was associated with work ability, even when adjusted for confounders (table 13).

(d) Pain in legs – there was association between pain in legs and workability (table 14), except for the non significance of the statistical values for good (OR †1.57, ‡1.58) and excellent (OR †1.62, ‡1.62) categories of work ability, whose odd ratios remained constant even after adjustment for age, gender and staff task group.

Table 11: Association between Pain in arms and Work ability

Independent Variables	*Poor	Moderate		Good		Excellent	
		Dependent Variables (Work ability)					
		OR 95% CI	***p-value***	**OR 95% CI**	***p-value***	**OR 95% CI**	***p-value***
†Pain in Arms							
Not Pained	1.0	2.67 (1.59 – 4.49)	< 0.001	4.92 (2.94 – 8.24)	< 0.001	14.56 (7.99 – 26.52)	< 0.001
Low Pained	1.0	1.80 (1.17 – 2.78)	0.008	3.37 (2.19 – 5.19)	< 0.001	5.29 (3.04 – 9.18)	< 0.001
Moderately Pained	1.0	1.02 (0.70 – 1.50)	0.908	1.15 (0.77 – 1.72)	0.496	1.90 (1.11 – 3.25)	0.020
Highly Pained	1.0	*	*	*	*	*	*
‡Pain in Arms							
Not Pained	1.0	2.47 (1.45 – 4.20)	0.001	4.45 (2.61 – 7.57)	< 0.001	12.01 (6.46 – 22.31)	< 0.001
Low Pained	1.0	1.80 (1.16 – 2.80)	0.009	3.35 (2.22 – 5.37)	< 0.001	4.98 (2.83 – 8.77)	< 0.001
Moderately Pained	1.0	1.02 (0.69 – 1.51)	0.909	1.17 (0.78 – 1.78)	0.447	1.80 (1.03 – 3.12)	0.038
Highly Pained	1.0	*	*	*	*	*	*

* ***Reference category*; † before adjustment; ‡ after adjustment for Age, Gender and Staff Task Group**

Table 12: Association between Pain in Neck and Work ability

Independent Variables	*Poor	Moderate		Good		Excellent	
		Dependent Variables (Work ability)					
		OR 95% CI	***p-value***	**OR 95% CI**	***p-value***	**OR 95% CI**	***p-value***
†Pain in Neck							
Not Pained	1.0	2.16 (1.19 – 3.91)	0.011	4.15 (2.32 – 7.44)	< 0.001	9.32 (5.01 – 17.31)	< 0.001
Low Pained	1.0	1.65 (1.09 – 2.50)	0.019	2.97 (1.96 – 4.51)	< 0.001	4.40 (2.72 – 7.12)	< 0.001
Moderately Pained	1.0	0.89 (0.61 – 1.30)	0.550	1.44 (0.98 – 2.11)	0.063	1.25 (0.76 – 2.04)	0.378
Highly Pained	1.0	*	*	*	*	*	*
‡Pain in Neck							
Not Pained	1.0	2.20 (1.20 – 4.02)	0.010	4.59 (2.53 – 8.35)	< 0.001	10.22 (5.37 – 19.46)	< 0.001
Low Pained	1.0	1.76 (1.15 – 2.69)	0.009	3.51 (2.28 – 5.40)	< 0.001	5.15 (3.11 – 8.52)	< 0.001
Moderately Pained	1.0	0.92 (0.62 – 1.34)	0.651	1.55 (1.04 – 2.30)	0.030	1.28 (0.77 – 2.11)	0.334
Highly Pained	1.0	*	*	*	*	*	*

* ***Reference category*; † before adjustment; ‡ after adjustment for Age, Gender and Staff Task Group**

Table 13: Association between Pain in Low Back and Work ability

Independent Variables	Dependent Variables: Work ability						
	*Poor	Moderate		Good		Excellent	
†Pain in Low Back		**OR 95% CI**	***p-value***	**OR 95% CI**	***p-value***	**OR 95% CI**	***p-value***
Not Pained	1.0	3.88 (2.25 – 6.70)	< 0.001	9.65 (5.52 – 16.89)	< 0.001	25.50 (13.20 – 49.26)	< 0.001
Low Pained	1.0	2.54 (1.68 – 3.83)	< 0.001	5.25 (3.37 – 8.18)	< 0.001	6.87 (3.83 – 12.31)	< 0.001
Moderately Pained	1.0	1.63 (1.06 – 2.46)	0.021	2.93 (1.87 – 4.59)	< 0.001	2.58 (1.38 – 4.8)	0.003
Highly Pained	1.0	*	*	*	*	*	*
‡Pain in Low Back							
Not Pained	1.0	3.73 (2.15 – 6.46)	< 0.001	9.29 (5.25 – 16.42)	< 0.001	27.44 (13.92 – 54.07)	< 0.001
Low Pained	1.0	2.56 (1.69 – 3.88)	< 0.001	5.50 (3.49 – 8.66)	< 0.001	7.87 (4.31 – 14.36)	< 0.001
Moderately Pained	1.0	1.64 (1.08 – 2.49)	0.020	2.98 (1.88 – 4.69)	< 0.001	2.56 (1.35 – 4.85)	0.004
Highly Pained	1.0	*	*	*	*	*	*

* ***Reference category*; † before adjustment; ‡ after adjustment for Age, Gender and Staff Task Group**

Table 14: Association between Pain in Legs and Work ability

Independent Variables	Dependent Variables: Work ability						
	*Poor	Moderate		Good		Excellent	
†Pain in Legs		**OR 95% CI**	***p-value***	**OR 95% CI**	***p-value***	**OR 95% CI**	***p-value***
Not Pained	1.0	4.58 (2.71 – 7.73)	< 0.001	7.15 (4.24 – 12.07)	< 0.001	13.27 (7.24 – 24.32)	< 0.001
Low Pained	1.0	3.15 (2.05 – 4.85)	< 0.001	4.40 (2.85 – 6.81)	< 0.001	4.91 (2.85 – 8.48)	< 0.001
Moderately Pained	1.0	1.64 (1.05 – 2.55)	0.029	1.57 (0.99 – 2.49)	0.055	1.62 (0.89 – 2.95)	0.115
Highly Pained	1.0	*	*	*	*	*	*
‡Pain in Legs							
Not Pained	1.0	4.03 (2.35 – 6.93)	< 0.001	5.81 (3.41 – 10.06)	< 0.001	11.78 (6.26 – 22.17)	< 0.001
Low Pained	1.0	3.05 (1.98 – 4.72)	< 0.001	4.24 (2.72 – 6.61)	< 0.001	5.05 (2.88 – 8.87)	< 0.001
Moderately Pained	1.0	1.64 (1.06 – 2.56)	0.028	1.58 (0.99 – 2.52)	0.055	1.62 (0.88 – 2.99)	0.124
Highly Pained	1.0	*	*	*	*	*	*

* ***Reference category*; † before adjustment; ‡ after adjustment for Age, Gender and Staff Task Group**

STUDY 4

5.7. PHYSICAL STRAIN, PAIN AND WORK ABILITY

All the variables tested for determination of the effect of high strain and/or high pain with work ability was unconditionally significant statistically and associated (table 15) regardless of adjustment with age, gender or staff task group.

Table 15: High physical strain, pain and work ability

Independent Variables	Dependent Variables Work Ability: Poor OR 95% CI	Poor *p-value*	Moderate OR 95% CI	Moderate *p-value*	Good OR 95% CI	Good *p-value*	*Excellent
† Physical Strain							
Very Light	*	*	*	*	*	*	1.0
Slightly Hard	1.92 (1.21 – 3.05)	0.006	1.50 (1.01 – 2.23)	0.046	1.20 (0.82 – 1.76)	0.358	1.0
Very Hard	3.18 (2.05 – 4.94)	< 0.001	2.05 (1.40 – 3.02)	< 0.001	1.60 (1.10 – 2.33)	0.014	1.0
‡ Physical Strain							
Very Light	*	*	*	*	*	*	1.0
Slightly Hard	2.18 (1.31 – 3.62)	0.003	2.03 (1.31 – 3.16)	0.002	1.69 (1.10 – 2.58)	0.016	1.0
Very Hard	3.63 (2.17 – 6.05)	< 0.001	3.00 (1.90 – 4.74)	< 0.001	2.45 (1.58 – 3.80)	< 0.001	1.0
† Pain in Arms							
Not Pained	*	*	*	*	*	*	1.0
Low Pained	2.76 (1.58 – 4.82)	< 0.001	1.86 (1.22 – 2.83)	0.004	1.89 (1.28 – 2.78)	0.001	1.0
Moderately Pained	7.67 (4.44 – 13.26)	< 0.001	2.94 (1.89 – 4.58)	< 0.001	1.80 (1.17 – 2.77)	0.008	1.0
Highly Pained	14.56 (7.99 – 26.52)	< 0.001	5.46 (3.28 – 9.07)	< 0.001	2.96 (1.79 – 4.90)	< 0.001	1.0
‡ Pain in Arms							
Not Pained	*	*	*	*	*	*	1.0
Low Pained	2.41 (1.36 – 4.27)	0.003	1.76 (1.14 – 2.71)	0.010	1.87 (1.26 – 2.78)	0.002	1.0
Moderately Pained	6.69 (3.82 – 11.72)	< 0.001	2.77 (1.76 – 4.38)	< 0.001	1.77 (1.14 – 2.75)	0.012	1.0
Highly Pained	12.01 (6.46 – 22.31)	< 0.001	4.87 (2.88 – 8.23)	< 0.001	2.70 (1.61 – 4.54)	< 0.001	1.0
† Pain in Neck							
Not Pained	*	*	*	*	*	*	1.0
Low Pained	2.12 (1.14 – 3.93)	0.018	1.62 (1.02 – 2.55)	0.040	1.52 (1.00 – 2.31)	0.052	1.0
Moderately Pained	7.47 (3.99 – 13.97)	< 0.001	3.08 (1.87 – 5.10)	< 0.001	2.59 (1.62 – 4.15)	< 0.001	1.0
Highly Pained	9.32 (5.01 – 17.31)	< 0.001	4.32 (2.64 – 7.06)	< 0.001	2.24 (1.39 – 3.62)	0.001	1.0
‡ Pain in Neck							
Not Pained	*	*	*	*	*	*	1.0
Low Pained	1.99 (1.05 – 3.76)	0.035	1.59 (0.99 – 2.55)	0.054	1.52 (0.99 – 2.33)	0.057	1.0
Moderately Pained	7.96 (4.17 – 15.20)	< 0.001	3.31 (1.98 – 5.55)	< 0.001	2.68 (1.66 – 4.34)	< 0.001	1.0
Highly Pained	10.22 (5.37 – 19.46)	< 0.001	4.65 (2.79 – 7.74)	< 0.001	2.23 (1.36 – 3.63)	0.001	1.0
† Pain in Low Back							
Not Pained	*	*	*	*	*	*	1.0
Low Pained	3.71 (2.16 – 6.39)	< 0.001	2.43 (1.63 – 3.61)	< 0.001	2.02 (1.40 – 2.92)	< 0.001	1.0
Moderately Pained	9.88 (5.50 – 17.74)	< 0.001	4.14 (2.58 – 6.64)	< 0.001	3.00 (1.91 – 4.72)	< 0.001	1.0
Highly Pained	25.50 (13.20 – 49.26)	< 0.001	6.57 (3.68 – 11.72)	< 0.001	2.64 (1.46 – 4.78)	0.001	1.0
‡ Pain in Low Back							
Not Pained	*	*	*	*	*	*	1.0
Low Pained	3.49 (2.00 – 6.08)	< 0.001	2.40 (1.59 – 3.61)	< 0.001	2.06 (1.42 – 3.01)	< 0.001	1.0
Moderately Pained	10.70 (5.84 – 19.61)	< 0.001	4.72 (2.89 – 7.70)	< 0.001	3.42 (2.15 – 5.45)	< 0.001	1.0
Highly Pained	27.44 (13.92 – 54.07)	< 0.001	7.37 (4.07 – 13.34)	< 0.001	2.95 (1.62 – 5.40)	< 0.001	1.0
† Pain in Legs							
Not Pained	*	*	*	*	*	*	1.0
Low Pained	2.70 (1.62 – 4.50)	< 0.001	1.86 (1.27 – 2.73)	0.001	1.66 (1.16 – 2.38)	0.006	1.0
Moderately Pained	8.20 (4.65 – 14.45)	< 0.001	2.94 (1.82 – 4.75)	< 0.001	1.80 (1.12 – 2.90)	0.016	1.0
Highly Pained	13.27 (7.24 – 24.32)	< 0.001	2.90 (1.68 – 5.02)	< 0.001	1.86 (1.07 – 3.21)	0.027	1.0
‡ Pain in Legs							
Not Pained	*	*	*	*	*	*	1.0
Low Pained	2.33 (1.38 – 3.95)	0.002	1.77 (1.19 – 2.63)	0.005	1.69 (1.16 – 2.46)	0.006	1.0
Moderately Pained	7.29 (4.03 – 13.17)	< 0.001	2.97 (1.79 – 4.90)	< 0.001	1.97 (1.20 – 3.23)	0.008	1.0
Highly Pained	11.78 (6.26 – 22.17)	< 0.001	2.92 (1.65 – 5.17)	< 0.001	2.01 (1.14 – 3.55)	0.015	1.0

*** *Reference category*; † before adjustment; ‡ after adjustment for Age, Gender and Staff Task Group**

CHAPTER SIX

6.0 DISCUSSION AND CONCLUSIONS

6.1 DISCUSSION

This study, especially in regards of work ability as it relates to gender differences and age is reflective of the outcome of the Health 2000 Survey conducted by Gould *et.al* (2008), although it stood out in respect of the significance of work ability within the staff task group (table 7). For instance, by inferring, gender differences showed no significance in relation to perceived work ability (p=0.157). An explanation for this from previous studies was that men and women perceive work ability to be approximately the same (Ilmarinen *et.al,* 1997; Perkiö-Makelä *et.al,* 2008; Gould *et.al,* 2008), however this may be applicable only to the Nordic countries, especially Finland (Gould *et.al,* 2008), being an egalitarian society and the fact that women are highly empowered and given more priority over men, mostly in job postings, except for some other occupations which may probably be dominated more by men (construction jobs), which may show more significance. An extensive study conducted in the United States (Islam *et.al,* 2001) revealed gender differences in job types and also gender differences in the association of age with work load and functioning (Aittomäki *et.al*, 2005) thus confirming the effect of work ability on job content (Tuomi *et.al,* 2001).

The clarity in terms varying perceived work ability in the different age groups is another interesting observation in the present study. Younger workers (34.4%) had excellent perception of their work ability compared to how the older workers (9.6%) did, while 13.9% of younger workers (< 30 years) had a poor perception of their workability compared to the older workers (> 50 years) who perceived their work ability as poor (29.6%). Obviously, this is in resonance with the studies conducted by Ilmarinen and Tuomi (1992), Ilmarinen *et.al* (1997), Ilmarinen and Tuomi (2004), Goehard and Goehard (2005), Gould *et.al* (2008) as well as Gamperiene *et.al* (2008), where the inference have been drawn that work ability decreases with growing age.

Another interesting dimension of the present study was the high statistical significance of perceived exertion (physical strain) with age, gender, staff task group (table 6) and work ability (table 8). It was quite overwhelming to note that many jobs still remain physically strenuous, given the recent trend in global technological drive in an effort to reduce job demands on workers. Despite the expectation that these technological advances would have reduced physical demands at work, in the working populations, physical work load still continues to be very common (Ilmarinen, 1999; Paoli *et.al*, 1992; Fallentin *et.al*, 2001).

This trend could be implicating to overall well-being, to the extent that the dependency on machines to replace our daily activities, in a sense moving towards automating many manual labour jobs, may result indirectly to competition between human (workers) and machines. Hence if the work load, being repetitive in nature, becomes too much and there are few employees compared to the intensity of work, coupled with other feasible risk factors may eventually result to injuries. There is even a saying that when you do the same thing, the same way, the same pattern, over and over again in a repetitive manner, it may result to boredom and exertion. The complexity of this will extend to intense physical strain and pain, an association that is already evidenced in the present study (tables 8 and 10) and has also been well documented (NIOSH, 1997; van der Windt *et.al*, 2000; Häkänen *et.al*, 2001; Sluiter *et.al*, 2001; Manninen *et.al*, 2002; Hoozemans *et.al*, 2002; Hoogendoorn *et.al*, 2002).

Furthermore, Borg (1970) admitted that physical work load is one of the more significant job stressors which cause dissatisfaction at various places of work. He therefore identified a unique concept – intensity levels of interest such as adaptation, preference levels and stress zones. He then stated categorically that '*when we try to adapt to a work situation, the load must not be so high that we, in relation to our present maximal working capacity, come too near the stress zone*'.

One other perspective to analyzing this case scenario may be that if an individual worker lacks proper initiative capacity to take decisions within an ample time, in a situation that warrants immediate action, especially during work, it may be difficult in some way to implement the concept of job control, which has recently been fingered as one of the important factors among industrial workers to be associated with increased number of all sickness absence spells (Arola *et.al*, 2003) possibly due to the contribution of work place ill health. However, there is also need to develop ideas that may complement the knowledge base on potential strategies that will address the challenges posed by feelings of exertion at work, such as work structuring, job analysis, itemization approach, prioritization of work, delegative and participative capabilities, to be assessed for in individual worker, where there is insufficiency, to make provision for empowerment through education.

It is on this note that there is need to identify other prospective factors that may have effect on the significance of the present study, such as physical working capacity, environmental factors (strain), psychosocial factors, and previous health conditions which may influence these associations. However, this does not underscore the importance of perceived exertion on work, more so that physical working capacity is known to decline with such factor as age (Borg, 1970), even as confirmed in the present study.

The perception of pain is usually two-way dimensional, in the sense that it is either being experienced by a particular individual at the receiving end as a result of pressures from the inducing factor or being interpreted by another entity who is trying to simulate the response in order to give a good description of the pain feelings (figure 10).

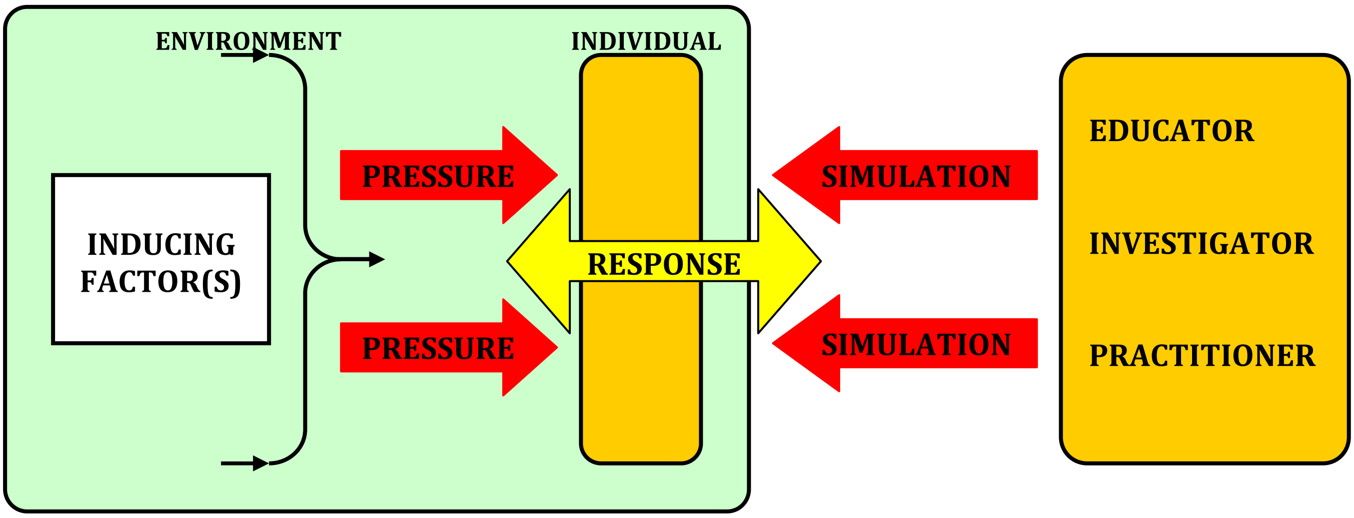


Figure 10: Pain Perception Model

The pain perception model was developed purposely for the present study and in the course of the study, in an attempt to deeply understand the distribution of pain among workers by using statistical analyses to probe possible variations in pain at multiple sites of the body. From the findings, pain distribution reached maximum statistical significant levels (table 9) which warranted further examination of its association with work ability. Workers who had poor work ability were most pained at the neck (41.3%), followed by arms (36.8%), low back (37.4%) and legs (33.2), while those that were highly pained but had excellent work ability scored low percentages, worst in the low back (7.4%), followed by the legs (9.4%), the arms (10.8%) and the neck (18.1%). Among workers in the categories of job type (blue and white collar) there was also high level of significance in respect of pain arms, low back and legs, except for neck in which there were a little less than a percent in the difference between the workers' experience of pain in the neck.

Pain experience according to the age groups (table 3) revealed that older workers have a higher tendency of experiencing high pain at work, compared to the younger workers. Even though age-related response to pain is a controversial topic (Farell, 2000), there are still a number of factors which has been proposed that may alter pain perception and response in the elderly (Stotts *et.al*, 2007). They include, but are not limited to psychological alterations that affect the meaning of pain (Weiner, 2002; Gibson, 2003), pain stimuli, environmental factors and study designs, which may account for differences in outcomes (Farell, 2000). In any case, the much pronounced statistical significance and associations in the present study are subject to further verifications, in order to ascertain the exact impact of pain at work. This is because it may be too early to draw conclusions based on the outcomes of this study, hence it is subject to scrutiny as regards virile investigations in order to substantiate the findings in this study, more so that it is very subjective.

6.1.1 LIMITATIONS OF THE PRESENT STUDY

The present study was cross-sectional, hence there is need for a longitudinal study to be conducted such that the trend in work ability, pain or strain according to the age groups, gender and staff task group could be properly observed, analysed and compared. Since the data collected was meant for a leading food manufacturing company, this study could also be expanded to other outfits and compare results alongside each other to observe for differences or similarities.

Furthermore, having understood the work ability implications of pain and strain from a cognitive point of view, even though it is subjective, there is also a need to intensify studies as regards objective measurements to addressing the position of the findings of the present study.

There is no doubt that other studies may have been conducted in accordance with the aims and objectives of this study, there is still a dire need for further investigations on other occupations, hopefully it may open up another avenue to compare results and draw more conclusive inferences, even though this present study may not necessarily be exclusive in its findings.

6.2 CONCLUSIONS

The results obtained from the present study threw more light to the furtherance of understanding on the concept of perceived work ability, musculoskeletal disorders such as pain at different sites of the body and perceived exertion or physical strain in respect of age, gender and different work groups as presented in the occupation of interest. Nevertheless, it may be very essential to digress a little bit and rub a match on its box and illuminate on an important aspect of work life that also requires much attention, given the outcomes of this study, with the aim of expanding our consciousness beyond the walls of our constraint. Without making much ado, a quick reference to this, falls within the scope of the present study.

Often times, we talk of 'hard work' but given the role that this has to play in our daily activities and work life, more so that people will be required to undertake jobs that will necessitate repetitive movements or bad postures and predispose them to the risk of injuries that may become permanent, on this note the concept of 'hard work' urgently need be retracted from our ways of thinking and working.

There has been the question of 'what work really is, if indeed it is meant to be hard work?

From a personal perspective and from this wise, under no circumstance should any worker be subjected to unnecessary pressure to work because working hard will hamper our health and consequently shorten our work life. A brief and unreserved tribute to a Los Angeles woman (Rebecca Wells, 51) who died in her cubicle at work but her body was not discovered until the following day ($11^{th}/12^{th}$ of February, 2011). She was found slumped over on her desk at work. Her colleagues even confirmed that 'she was always working….always working' (Caulfield, 2011).

Although as at the time of filing this report, her autopsy was yet to be completed, but one may wonder how many more may be working hard, also for their sustenance.

An anonymous writer once argued that 'the working hard……is an old age thinking'. If indeed this is more of a cultural thing that people have normalised or adjusted to, then something need be done. For instance, being in a particular job for a long time can be very distressing and living this type of lifestyle leaves people unsatisfied and constantly waiting for something better to come around. Everyone is always talking about working hard or harder.

This mindset is destructive. If we think about it, living about a third of our lives "working hard" and not truly enjoying what we do or not making out enough time for rest can result to psychological damages.

To corroborate these thoughts, a recent project is being conducted at the Centre for the Study of Human Cognition in Oslo (CSHC), titled cognition and plasticity throughout the human lifespan. It was stated that throughout life, our mental capacities and brains are under continuous alteration, regardless of health, sickness or injuries. While some changes are part of positive development, others are debilitating. Though too little is known about the mechanisms underlying different types of change in brain and cognition, and whether, and how, human beings can initiate, enhance or slow them.

The project seeks to uncover markers and mechanisms underlying changes in brain and cognitive behaviour throughout the lifespan. The goal is to detail the nature of age changes in brain anatomy, activity and cognitive processes, such as attention and memory. This is done both within healthy individuals from 7 to 90 years of age, as well as in kids with biomedical risk factors and elderly with memory problems (mild cognitive impairment and Alzheimer disease). A related project focuses on how cognitive training can affect cognitive abilities and brain structure and function (CSHC, 2010). Hopefully, the study may help to explain how such normal thoughts like 'working hard' which has been normalised, can aid negatively in such a way that people may choose to exit work life earlier than expected, possibly as a result of work place injuries. Whatever the case may be, it will be worthwhile to know that we should probably work good or work well, but not work hard. However, questions may still arise, as to resolving the following:

(a) What is it to work, if to live is a choice?

(b) If to live is a choice, and there is need to work, then is working a choice or a necessity?

(c) Should working be imposed?

(d) If there is need to work, then there is need to rest, but what happens when in the effort to work hard, we sustain injuries?

(e) Who really is to be blamed for the injuries we sustain at work, while working hard?

(e) Do we really need to work hard so as to earn a living or our living?

(f) Is rest independent of time or relative to the amount of work time?

A plausible explanation for the above given is referenced to a programme* launched in 2004 tagged 'senior programme' with the sole aim of extending the careers of workers over 55 years of age by easing their workload. This strategic and laudable measure was adopted, at the discretion and decision of the individual worker, even without decrease in their pay.

Moreover, if an employee is noted to have health-related or other special reasons, every attempt was made to exempt them from working three shifts in addition to the fact that they are not also required to participate in job rotation unless they wish to be included.

Having implemented this, there evolved a drastic change in their employee age structure, increasing the share of 60 year olds from 3.5% to 6.3% in the course of the programme. Fortunately enough, the project has inspired other branches of the company and other food industries to be duplicated.

In conclusion, sustainable work place health promotion programmes that will raise the awareness level of accidents/injuries at work, aid and foster development of intervention strategies of reducing or preventing them, at the same time encouragement of moderate level physical activity such as that developed by the UKK Institute (appendix I) coupled along with job control mechanisms, altogether directed towards avoiding as much as possible every potential work place injuries, are inevitable in the effort to have a successful work life free of ill health such as musculoskeletal disorders and physical strain.

**See website for more information - http://www.sitra.fi/NR/rdonlyres/07ECA4E0-C3B0-46F3-9D0C-D52DF49E5A9C/0/20101007_Tyoelamapalkinto_tiedote_en.pdf*

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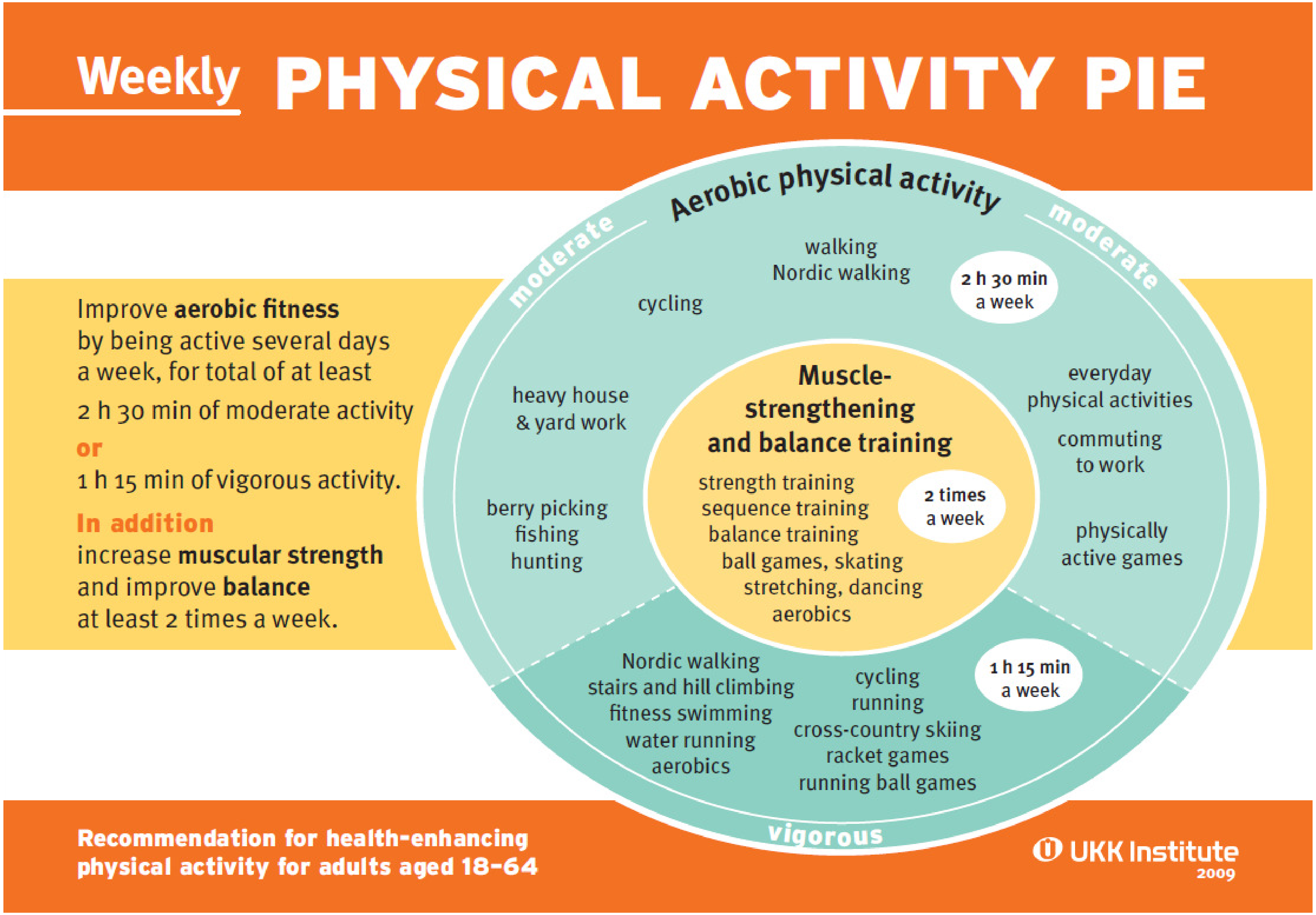
APPENDIX



Weekly PHYSICAL ACTIVITY PIE
Improve **aerobic fitness** by being active several days a week, for total of at least
2 h 30 min of moderate activity
or
1 h 15 min of vigorous activity.
In addition
increase **muscular strength** and improve **balance** at least 2 times a week.
Aerobic physical activity
moderate
moderate
walking
Nordic walking
2 h 30 min a week
cycling
heavy house & yard work
berry picking
fishing
hunting
everyday physical activities
commuting to work
physically active games
Muscle-strengthening and balance training
strength training
sequence training
balance training
ball games, skating
stretching, dancing
aerobics
2 times a week
Nordic walking
stairs and hill climbing
fitness swimming
water running
aerobics
cycling
running
cross-country skiing
racket games
running ball games
1 h 15 min a week
vigorous
Recommendation for health-enhancing physical activity for adults aged 18–64
UKK Institute 2009