

**A TIME SERIES ANALYSIS OF PHYSICAL ABILITY
AMONG ESKOM DISTRIBUTION'S POWERLINE
ELECTRICIANS**

by

BONGIWE NGQANGWENI

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Supervisor: Prof. N. MALANGU

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DECLARATION

I declare that the work put into completion of the study “A TIME SERIES ANALYSIS OF PHYSICAL ABILITY AMONG ESKOM DISTRIBUTION POWERLINE ELECTRICIANS” hereby submitted to the University of Limpopo, for the degree of a Master in Public Health has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.

SIGNATURE: 

DATE: 29.03.2011

B Ngqangweni (Ms)

STUDENT NO: 200812833

DEDICATION

I dedicate this dissertation to the following special people in my life:

My late grandmother Nongam Nkompela for her wisdom and love.

My dear mother, Thandiwe Nkompela for bringing me into this world and being a rock on which, I have stood on for guidance and motivation and reminding me that , education presents opportunities were none sometimes exist, for standing strong till I could be the woman I am today and my education.

The Nkompela and Ngqangweni families for their love, support and constant encouragement.

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- **My family (mother) and friends for their encouragement support and understanding**

May the LORD pour out his blessings to you all, and that your torch will keep lighting the way for many more people crossing your path.

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LIST OF ABBREVIATIONS AND ACRONYMS

- PAA : Physical Ability Analysis
- DX : Distribution
- WHO : World Health Organisation
- WAI : Work Ability Index
- CHD : Coronary heart disease
- HIV : Human immunodeficiency virus
- AIDS : Acquired Immune Deficiency Syndrome
- HAART: Highly Active Antiretroviral Therapy
- REPC : Research Ethics and Publications Committee
- MREC : Medunsa Campus Research Ethics Committee
- BMI : Body Mass Index
- SBP : Systolic Blood Pressure
- DBP : Diastolic Blood Pressure

ABSTRACT

Physical Ability Analysis (PAA) is a physical work capacity indicator for the health and wellbeing of the organisational workforce. Employees doing powerline work and similarly physically demanding positions are assessed using a battery of tests called the physical ability analysis (PAA), inclusive of a cardiovascular test component, a strength component for upper body and lower body, the endurance component, and a record of health problems. The results are classified into five categories that are indicative of their physical work ability. It is therefore crucial that a high level of physical capacity is maintained to ensure a sustainable workforce.

Objective: The aim of the study was to determine the physical ability and common health problems among powerline electricians in Eskom Distribution over time, and determine the extent to which variations, if any exist, could be explained by the socio-demographic characteristics, health problems or lifestyle habits.

Methods: A cross-sectional analysis of Eskom Distribution's powerline electricians was done using occupational medical records found in the institutional database for the period of 2003, 2005 and 2008.

Results: A total of 50 records meeting the selection criteria were analyzed. At the time of the study, the power line electricians were old as 94% of them were over 50 years old, overweight (46%), and suffering from chronic conditions such as hypertension (22%), diabetes (8%). In addition, 19% suffered from back injuries, 2% from knee injuries, while 32% smoked cigarettes. Given their health profile, they became sicker for longer periods as reflected by the increasing number of sick leave days (95% of the cases that took leave had hypertension). The physical ability levels improved from baseline (46%) to 62% in 2008. A shift of PAA2 participants in the 47 – 51year age group was the reason for the increase and the youngest group of electricians remained in PAA category 1 throughout the study period. Muscle function was a strong predictor for meeting the required physical ability level, most measurements that were significantly associated with physical ability score, leg strength, noted as the strongest predictor among them (OR 123.00; $p = 0.00$, 95% CI, 9.22-1573.00), followed by abdominal endurance (OR 43.49; $p = 0.01$, 95% CI, 2.49-786.13) and grip strength of the right hands, with similar odds to the abdominal strength (OR 41.00; $p = 0.00$, 95% CI, 3.65-461.04) with back strength at (OR 28.50; $p = 0.01$, 95% CI, 2.37-342.61).

Conclusion: With regard to physical ability, the study concludes that age is a strong predictor for physical ability as the youngest group (≤ 49 years old) of electricians remained in PAA1 throughout the study period, and were approximately four times likely to meet the required

physical ability standard than their older counterparts and that regular physical assessment and rehabilitation have been effective in maintaining the physical ability of electricians.

CHAPTER 1

1. INTRODUCTION

1.1 Introduction/background

The physical ability of an individual to perform his physical task requirements can affect the individual's personal safety and the safety of those working with them. As a result this capacity may need to be identified and quantified and this can be assessed using physical fitness tests. This practice has been carried out for decades, in different institutions and settings. In the medical field the tests can be used as diagnostic tools and/or eligibility requirements in fields where physical ability is an inherent requirement for the performed tasks. The assessments take different forms, however within the occupational setting these assessments are designed in line with the criteria as set out in the, Occupational Health Services Convention, 1985 and the Occupational Health Services Recommendation, 1985, which highlights worker health surveillance in relation to work as a key function for the occupational health service, in turn upholding the protection of workers' health from their work environment and facilitating the promotion and improvement of working space and practice.¹

Eskom, the electricity distribution unit is one of the industries within which this practice has been applied, as field workers perform tasks that are physically demanding and as a result of their manual materials handling nature, the interaction between man and his environment has a potential of yielding positive or negative effects hence this regulation applies. As the demand for continued uninterrupted supply of electricity continues to increase, so do the technological and physical demands on the power line electricians who through creation of new power lines network and infrastructure maintenance and response on interrupted power supply play a crucial role in ensuring this is a reality. It is therefore crucial that the power line electricians in the Eskom's electricity Distribution business need to a certain extent have physical capacities that meet the standards as set out within the organisation.² This is particularly important as it widely documented how physically strenuous work can result to musculoskeletal disorders.³⁻⁴

Employees in this and similarly physically demanding⁵ positions are assessed using a battery of tests called the physical ability analysis(PAA), inclusive of a cardiovascular test component, a strength component for upper body and lower body, the endurance component, a record of health problems.⁶ The assessment is done before potential power line electricians are appointed and periodically and recorded as a physical ability score (PAA score), based on the established norms.²

This score gives an indication of whether employees have the physical capacity to perform required tasks, indicating difficulty or inability to perform certain tasks that are inherent to the job demands and potential of risk to injury and as the assessment is tailored to the functional requirements and risks of the job. ⁸⁻⁹

1.2 Statement of the problem and justification

Physical ability tests are conducted to give an indication of the health profile of the organization. Over the years changes in the PAA scores and health problems, sick leave largely attributed to chronic conditions⁵ and injuries were observed and this raised concerns regarding the state of health in this group of employees as it threatened the human resource sustainability of the organization. Among others, factors such as aging, appointment of women in the positions were assumed to contribute to the change. Job accommodation for these employees is a challenge as they cannot perform the minimum required job outputs.

Based on the PAA scores, the other assumption is that, the physical ability profile of the organization is reduced. However, the extent to which this is true has not been explored it was therefore the aim of this study to explore the possible associations physical ability profile of the business and, to see if it has been changing over the years and if so, how fast the change has been occurring.

The findings and recommendations arising from this study could be used by the organisation review its business strategies, practices and policy to ensure a sustainable human resource, by addressing the issues affecting the physical ability profile. The study will add to the body of knowledge currently available on this subject matter.

1.3 Purpose of the study

Physical ability levels during surveillance in the business currently give an indication of the sustainability of the business with regards to human capacity and have been presented to show which areas may need interventions or not. Though this has been the practice, there has not been an in depth analysis of the results, looking at other factors influencing the results which may be easier to manage and how they may in turn influence this sustainability, therefore the aim of the study was to determine the physical ability of the electricians over time and the extent to which variations, if any, can be explained by the socio-demographic characteristics, health problems or lifestyle habits among power line electricians.

1.4 Objectives

- To determine the physical ability and common health problems among power line electricians in Eskom Distribution
- To examine (year to year) trends in physical ability scores and find possible explanations of variations if any with regards to socio-demographic and health problems.

1.5 Operational definitions

Biokineticist: an exercise professional, concerned with preventative health care, the maintenance of physical abilities and final phase rehabilitation, by means of scientifically based physical activity programs, neuromuscular electrical stimulation, re-education of neuromuscular coordinative patterns.

Physical Ability Analysis: The process in determining the physical ability of the worker to perform the tasks required by his/her job.

Physical Ability Assessment: Examination of the critical physical parameters of workers according to the inherent physical requirements of his/her job.

Physical Work Capacity: Physical work capacity is the physical ability of the employee to perform the physical tasks required by his job.

Employee: Individual performing work for Eskom, this will also include prospective employees

Conditioning: Scientifically based intervention to improve the job related physical ability of the individual to the required standard set by his job demands. Reasonable conditioning is within a 3 month period.

Individual: Employee or prospective employee participated in the physical ability analysis procedure

1.6. Components of the reports

In the following pages, a review of the literature is presented in Chapter 2, and the methods in Chapter 3; while the results and their discussions are presented in Chapter 4 and 5. The last Chapter 6 presents the conclusions and recommendations.

CHAPTER 2

2 LITERATURE REVIEW

2.1 *Introduction*

In this study, the literature review was done before the data was collected for background information and insight into the concept under study and after data collection and analysis to compare the results of the present study to previous studies on this subject matter. This literature review highlights the trends observed with regards to physical ability in different settings and under different physical and physiological conditions and among different individuals but specifically on the issues that may seem to have an effect on physical ability including those factors in the workplace assumed to be associated with it such as health problems or clinical diseases, specifically age, clinical and physical limitations.

The literature review will be divided into three sections the first part covering physical ability in different occupational settings and the applications thereof. It will be concentrating on different socio-demographic elements that could affect physical work ability. The second part will be focusing on health aspects including clinical diseases and injuries prevalent within the work environment and how all these aspects relate to physical capacity.

Physical ability testing is not a new concept; in fact this practise has been carried out for decades in different institutions and settings using different measuring tools. Work ability refers to one's ability to cope with the demands of work where there is an interaction between individual factors and occupational factors. In the medical field the tests can be used as diagnostic tools and/or eligibility requirements in fields where physical ability is an inherent requirement for the performed tasks, where it can either be used as a recruitment tool or for surveillance purposes. The assessments take different forms, however within the occupational setting these assessments are designed in line with the criteria as set out in the, Occupational Health Services Convention, 1985 and the Occupational Health Services Recommendation, 1985, which highlights worker health surveillance in relation to work as a key function for the occupational health service, in turn upholding the protection of workers health from their work environment and facilitating the promotion and improvement of working space and practice. ¹

To our knowledge in the South African manual materials handling industry, physical work ability testing is not a widely used tool; in fact the organizations that conduct these tests do not publish their data. Therefore very little is known about the physical work ability state of the

South African industry.

There is vast information, old and new regarding work ability testing; however most of these studies commonly focus on the field of study of high performance or geriatrics. Furthermore, studies investigating physical ability for manual handling tasks using measuring equipment and not the generally used subjective questionnaire: work ability index (WAI)¹⁰ are limited, especially those conducted in the in the African continent. Ergonomists have attempted to direct their focus on this subject matter; however their efforts have been mostly directed to the assessment methods¹¹ and not necessarily the physical ability levels. To our knowledge at the time of the literature review only one time series study¹² has been conducted on this subject matter previously and two Canadian studies¹³⁻¹⁴ conducted in a similar occupational setting similar to that of the current study exist.

The following were the findings:

2.2 *Determinants of Physical ability*

The South Africa labour force participation rates have been fluctuating since 2001 with more declines than increase.¹⁵ It is not really clear what the reasons for these changes are, however, a study published on the South African labour force attrition rates shows an 80% withdrawal rate by males after the age of 50 years.¹⁶ The low participation or attrition rates by mature workers have been attributed among other things to employee health status and physical incapacity playing a big role.¹

2.2.1 *Socio-demographic elements*

Individuals age, and as they do they undergo physical changes that can affect their ability to perform physically demanding tasks such as lifting and carrying. These changes include muscle mass and strength reductions, and increases in musculoskeletal conditions and chronic conditions of lifestyle such as diabetes or hypertension the rate and degree of these declines vary from individual to individual, which can lead to variability in their ability to perform tasks with heavy workloads. Indeed when looking at the comparisons of distribution of occupations according to age grouping, an inverse relationship is seen between sales and technical work as the workers progress with age in the sense that as the proportions of technical staff decrease the opposite happens with sales workers, a report compiled for the Ranking Minority Member, Subcommittee on Employer-Employee Relations, Committee on Education and the Workforce, House of Representatives in America confirms this observation.¹⁷

These observations exhibit this variability in ability and job accommodation thereof. This is an

approach that the organisation under study generally adopts in accommodating incapacitated workers.

Aging has been shown to result to reductions in physical work capacity, with significant differences between males and females regarding lifting strength.¹⁸⁻²⁰ There is no generally accepted age that defines an aging worker. Several studies in the United States of America have used > 55 years as the age (United States Bureau of Labour Statistics) while in the Australian literature uses > 45years as the preferred definition for aging (Australian Bureau of Statistics). The world health organization estimates that the start of decline in physical capacity is set arbitrarily at 45 years and starts to decline first, and at a faster rate when compared to mental or social capacities.²¹ In South Africa as stated earlier the workers begin to withdraw from employment from age 50 and studies reviewed that were conducted in a similar setting as the current studies also used this age group, therefore for the purposes of this study, an ageing worker will be defined as any worker over the age of 50 yrs.

Aging related changes can be brought about by the natural structural and functional losses occurring as people age; thereby resulting to decline in the function of the physiological and structural systems in the body. This would have a negative effect for tasks requiring physical effort especially considering that the aging worker requires more time for heart rate to return to normal rates following exertion, which could be due to recruitment of more muscle fibres during an activity attributed to compensation for reduced muscle mass among older workers.^{20,22-24} Physical capacity includes a range of anatomical and physiological factors such as aerobic capacity, muscle fitness and joint flexibility which are affected by individual, neurological and psychological factors. Muscle fitness refers to the combination of muscle strength and endurance. Physical strength is the ability of the muscle to exert force and endurance the muscular ability to perform for successive exertions.²⁵

Aerobic capacity is the ability of the cardiorespiratory system to deliver oxygenated blood to metabolizing tissues and the ability of these tissues to extract oxygen from the delivered blood. More than sixty (60) percent of the work done by powerline electricians is performed on a ladder. This among other things requires an element of cardiovascular fitness, given that these changes can contribute to decreased effort tolerance²⁶⁻²⁸ and that the electricians operate daily, this can prove as a challenge to the older worker as studies suggest difficulty in standing for long periods of time among older workers, even though in this particular study standing is not at heights¹⁹⁻²⁰. A Canadian study on older powerline electricians also suggests that significant differences can be found only for aerobic capacity, certain strength parameters.¹⁴

It is also true that in areas where line patrolling is required as part of the electrician work outputs, and long distances are walked on foot, that difficulty in walking would be challenging and time consuming particularly when workers are at risk of losing their balance as they age.⁹

Findings regarding aging and its deleterious effects to musculoskeletal function were found to be consistent in the literature under review. Compared to the younger workers, older workers need higher reserves for recovery. This makes the ageing worker more susceptible to fatigue and other adverse risks such as injuries.

Although physical capacity declines with age, the ageing worker has synergistic capacity that is the ability to perform tasks using a wealth of experience and knowledge.

2.2.2 Education & Marital status

Formal education can assist in the socialisation of a human being and lead to greater independence and autonomy and can also be a determining factor an individual's physical capacity. Studies reviewed in this area revealed that older respondents with no education report poor health, functional limitations, or both, than their educated counterparts²⁹ and increased work disability, a study conducted in America established that people with fewer than 8 years of schooling had a work disability rate of approximately 30 percent, compared with a rate of 4 percent for those with at least 16 years of education.³⁰

This is echoed by findings from another study that older workers with primary and secondary education are less productive than younger individuals.³¹ This group of workers is also less likely to be physically active in leisure time a lifestyle characteristic associated with improved functional capacity.³²

In South Africa, marriage includes any kind of a formal or informal cohabiting partnership. According to a study conducted in South Africa, young African men and women are less likely to be married compared to their white counterparts. Marital status is a significant predictor of sick leave, though it was not clear in this study what the determinants of sick leave were,³³ though one of the independent determinants of sickness absenteeism is hypertension.³⁴ Similarly to educational status some studies demonstrate that being married or living with a partner has been shown to be negatively associated with physical activity,³⁵ while others have found no correlations, and this finding was partly explained by a lack of information on parity.³⁶

2.2.3 Health status

2.2.3.1 Medical problems

Health problems in organisations can present differently. Power line electricians account for approximately forty five (45) percent of the total workforce and the bulk of the work of the organization depends on these individuals, it is therefore important to understand the health profile of these employees. It is estimated that over the age of fifty (50) the following medical conditions are prevalent in workforce: arthritis (53%), hypertension (42%) , 24%, found among manual physical labour workers and heart disease accounting for forty percent (40%),³⁷ with approximately 40% for those with body mass index (BMI), above 24 in Japanese men.³⁴

The main diseases leading to incapacity include malignancy, coronary artery disease, congestive heart failure, rheumatoid arthritis, bronchitis and mental illness. Coronary heart disease (CHD), one of the leading causes of premature, permanent disability in the labour force increases with work time among middle-aged men.³⁸ Working longer hours has also been linked to fatigue and occupational risk associated with increased injury rates. Keeping in mind that powerline electricians understudy work overtime and that exertion from the physically demanding nature of their work also considered stress is undertaken daily, the risk of a heart event could be increased especially considering that work stress is perceived to be high in the age group above 50 years.

Human immunodeficiency virus (HIV) or /AIDS is fast becoming a workplace health problem. One of the most occurring AIDS-defining conditions before highly active antiretroviral therapy (HAART), muscle wasting or weight loss had for some time affected the working population's functional ability as a result of reduced muscle strength. Up to the year 2006 less than 112 000 people needing HAART in South Africa received treatment.³⁹

Muscle atrophy results when a muscle's level of neuromuscular activity is reduced, but also in response to fasting and in many major disease states, of importance in this study are HIV/AIDS and diabetes,⁴⁰⁻⁴¹ and particularly important in this study as there are cases of HIV/AIDS and diabetes in the organisation. Altered fat distribution found in HIV/AIDS cases and type -2 diabetes contribute to high circulating levels of interleukin (IL)-6 and tumour necrotic factor (TNF)-alpha, which in turn is associated with muscle mass loss.

Several studies as indicated in earlier sections have shown declines in physical capacity as a result of reduced muscle mass.⁴²⁻⁴³ Physical capacity declines with age however after the age of 50 years, this decline is more marked.⁴⁴ A study conducted on middle aged African American

woman revealed reduced muscular strength for those who had reduced muscle mass as a result of Sarcopenia.⁴⁵

2.2.3.2 Injuries

Statistics for occupational injuries in South Africa are understated; however available statistics indicate a rate of disabling injuries at 0.98 per 100 workers.⁴⁶ These injuries may have an impact on the health profile of an organisation.

Due to awkward working position a characteristic of powerline electrician's joint tissue damage can be accelerated. This in turn to reduced working speed and reaction time. As a consequence of the repetitive nature of the task performed by the electricians, aging and long kilometres driven musculoskeletal disorders an inevitable.⁴⁷ A study done in the USA, in an electricity utility company revealed that line workers suffered a number of accumulative trauma injuries, in the upper extremities, neck knee and back injuries this is consistent with the findings in other studies not within a similar study setting though the percentages were not as high as in the case of the USA company which saw percentages of approximately 45% with almost 25% of them suffering from more than 2 injuries per worker.⁴⁸⁻⁴⁹

Factors such as the type of job and the associated physical exposures are important variables mediating the risk of occupational injury with forty hours or more of over time work per week showing a 300% increase in risk especially when the work is monotonous.^{9,50}

It also seems that the tenure of service within an organisation specifically a position is associated with frequency of injury⁵¹ in construction work; these injuries seem to increase with age.⁵² Injury risks of electricians are three times less that of Labourers, farmers, craftsmen and tradesmen however compared to executives, intellectual professionals and teachers the risk is three times higher.⁵³

Back injuries still remain among the highest occupational injuries and the physical determinants for back injury rates are back muscle strength and endurance and driving presenting a potential to worsen these risks.⁵⁴⁻⁵⁵

The above factors contribute to the higher work disability rates seen among ageing workers the physical prerequisites of functioning among them musculoskeletal symptoms are important factors in maintaining work ability.

2.2.4 *Lifestyle factors*

2.2.4.1 Rehabilitation

The goals of a rehabilitation plan are first to identify cases with significant impairments and then restore their functional capacity to enable them to safely return to vocation and recreational activities or at least provide information for modification of these activities contingent to the clinical status of the patient or on the risk factor itself. Physical activity is generally used as a treatment modality in this case and there is enough evidence to support the benefits of this kind of treatment some of which will be covered in this review.

Research shows that exercise can increase the size and strength of muscles, including the heart muscle.⁵⁶ Resistance training performed at least twice a week improves muscle strength though it may be caused by aging.⁵⁷ In addition to strength improvements, weight bearing exercises such as walking and strengthening exercises can also reduce the risk of type II diabetes, heart disease and other chronic illness.^{24,58-59}

One of the challenges in the workforce is the high proportion of injuries and the incapacitating effect on the worker thereby increasing sickness absence from work. As stated earlier back injuries are the most prevalent in the workplace. Greater trunk force, leg force and lifting ability have each been associated with improved return to work.

Improving these factors may lead to reduced limitations and improve functional capacity.⁶⁰⁻⁶¹

In brief, though studies are conducted on physical work ability, very few are concerned with occupational epidemiological application especially in physically demanding jobs and literature on the physical work ability of power line electricians is limited and very little is known about the physical work ability of the power line electricians in Eskom. This study attempted to provide data in this subject area.

CHAPTER 3

3 METHODOLOGY

3.1 Introduction

In this chapter, the research design and methodology used to achieve the research objectives stated earlier in chapter one will be described. The objectives were, to determine the physical ability and common health problems among power line electricians in Eskom Distribution, and to compare year to year physical ability scores and find possible explanations of variations if any with regards to socio-demographic and health problems.

3.2 Study design

This was a cross-sectional study based on the review of records of physical ability assessments of power line electricians found in Eskom Distribution's database quantitative data are recorded in the database, hence, quantitative approaches were used in the analysis. The record review approach was used because of its simplicity and the readiness of data.

3.3 Methodology

3.3.1 Study setting and Target population

The study was conducted within the Eskom's electricity distribution business, one of the two electricity distributors in South Africa, a geographically spread area covering all provinces in South Africa, but demarcated into the following regions, Northern, Central, Southern, Western, and Eastern and North Western regions. The selection criterion was that employees should have been assessed at least two more times from base line.

3.3.2 Sampling and sample size

No sampling was done for this study, a census of records of all employees assessed during the study period and who met the inclusion criteria we included. The study period was 2003, 2005 and 2008. A sample of 50 records was available for analysis since only 50 employees were assessed during the period under study.

3.3.3 Data collection

3.3.3.1 Ethical considerations and Permission to do the study

Because the electricians could not be reached as they work in disparate geographical areas, and no interviews nor questionnaires were sent to them, no informed consent was needed from them; the permission to access the records in the database was obtained from the Divisional Hr Manager (**annex: 3.6**). The institutional ethical standards requirements from the University of Limpopo were met as a pre-requisite to commencement of the study and a certificate of ethical clearance was obtained from Research, Ethics and Publications Committee (REPC) and Medunsa Campus Research Ethics Committee (MREC)(**annex: 3.5**).

All captured data was kept confidential, and only the investigator and her team had access to the locked cupboard. All personnel handling the files were bound by a declaration to ensure the confidentiality of information at all times. Anonymity of participants' records was ensured, by making sure that no identifying (name) or personal details were written on the extraction sheet, but a numerical identifier (code) for the purposes of tracking was used.

3.3.3.2 Data collection tool

A data extraction sheet (**Annex: 3.7**) was used for collection of required data from the employee's medical files and database. Data collected included employee socio-demographic variables (age, gender, race, job title, marital status and educational level) and clinical data (height, weight, chronic medical conditions, injuries, physical ability score,...) and lifestyle information.

3.3.3.2.1 Reliability and validity

The data extraction sheet was adapted from the data collection sheet used during the physical ability analysis assessment. A pilot study was done on least five employee data, outside the study population, in order to improve the reliability of the data collection form. This enabled the researcher to make the necessary changes and adjustments to the data collection form. The data collected at this stage was analyzed and the necessary adjustments were made to the data collection tool.

3.3.3.2.2 Procedures of measurements taken as per data collection tool

Demographic information included anthropometric measures of height or stature and body mass and these were determined using the following methods and tools.

Stature: was measured using a stadiometer. The stretch stature method, which was used, requires that the participant stands with the feet together and with the heels, buttocks and upper part of the back touching the stadiometer/wall. The head when placed in the "Frankfort plane"(fig.3.1) need not be touching the stadiometer/wall.

The measurer places his/her hands along the jaw of the subject with the fingers reaching to the mastoid processes. The participant is instructed to take and hold a deep breath and while keeping the head in the Frankfort plane the measurer applies gentle upward lift through the mastoid processes. Measurement is taken at the end of a deep inward breath.

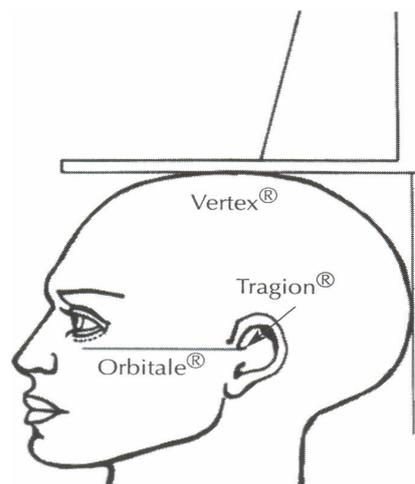


Figure 3.1 Frankfort Plane⁶²

Body mass: was measured using an electronic scale, calibrated and accurate to within 100g. The participant stands on the centre of the scale without any support and with the weight distributed evenly on both feet. The head is up and the eyes look directly ahead.

To classify the body composition of the participants, Body Mass Index (BMI) or Quetelet index, was calculated using the following formula:

Equation 3.1. Body Mass Index ⁶³

$$\frac{\text{BodyMass} \quad (\text{kg})}{\text{BodyHeight} \quad (\text{m})^2}$$

For age data had to be transformed into classes for categorisation and this was done using Sturges Formula⁶⁴, a formula used for transforming raw data into grouped data with the minimum possible loss of information.

$K = 1 + 3.3 \text{Log} (n)$, where

n = the total number of observations in the raw data set

R = Maximum observation – Minimum observation

$l = \frac{R}{K}$ =class length or class width

Other measurements as reflected on the data extraction sheet were measured as follows:

Blood Pressure: Blood pressure can be measured indirectly by making use of a Sphygmomanometer. The arterial blood pressure is always measured on the brachial artery, on the anterior surface of the elbow (fossa cubitalis), the participant should be seated. The inflatable cuff is placed around the upper arm of the right arm, with the lower edge of the cuff approximately 2 - 3 cm above the point where the stethoscope bell is placed (on the brachial artery, on the anterior surface of the elbow). The cuff is inflated to 30 mm Hg above the pressure required to completely block the blood flow through the brachial artery (no pulse can be heard through stethoscope) and deflated slowly while watching the pressure decrease on the sphygmomanometer (stethoscope in place). When the first thud is heard, the pressure on the sphygmomanometer indicates the systolic blood pressure (SBP). As the pressure in the cuff is decreased further, the blood in the artery will flow more and more freely until a point is reached when the thudding sounds disappear or fade drastically (soft thud). Both of these indicators indicate the diastolic blood pressure (DBP) (whichever comes first). In the case of Physical Ability Analysis, the participant is not allowed to take part in any of the physical tests if either his/her resting systolic blood pressure exceeds 170 mmHg or if the resting diastolic blood pressure exceeds 105 mmHg.

Resting heart rate: In the case of Physical Ability Analysis, the participant is not allowed to take part in any of the physical tests if his/her resting heart rate exceeds 110 beats per minute (bpm). If the heart rate recovers to below 110 bpm however the participant may proceed, the precise heart rate reading must be documented.

One minute sit-up test: This is a test to determine the endurance of the abdominal muscles. The test is performed by doing bent knees sit-ups with the feet firmly held by the assessor to the ground. The participant who has to perform the sit-ups lies flat on his back with his feet flat on the floor and the knees bent to 90 degrees. The hands are put behind the head and have to remain at least behind the ears at all times. The elbows have to point straight forward to allow them to touch the knees when doing the sit-ups. After the elbows have touched the knees during each sit-up, the participant has to return to the supine starting position (back flat on the floor). A sit-up is counted every time the elbows touch the knees. The objective is to perform as many sit-ups as possible in one minute. A clear command to "start" and "stop" the test is given as well as a time lapse every 15 seconds.

Strength assessments: were measured using a digital isokinetic (TAKEI) Hydraulic dynamometer. The muscle tests are regarded as indicative of the qualitative abilities of the body to perform physically demanding tasks. The muscle strength tests used in this evaluation were designed according to the physical impact of tasks on the various critical muscle groups that are involved in the execution of various job-related tasks.

Hand grip strength: This test is necessary to determine the amount of grip strength the participant has. It plays a vital role in the execution of tasks where grip strength is important, such as picking up, pulling, turning a spanner or valve, or just holding onto something. The handle of the grip dynamometer is adjusted according to the size of the hands of the participant, they should indicate a comfortable grip; the grip dynamometer is handled at the side of the body (away from the body) and pressed as hard as possible. Two attempts are allowed and the best result is recorded (fig 3.2).



Figure 3.2. Grip Strength

Arm & shoulder muscle strength: The participant pulls on the handlebar as hard as he/she can, without bending the knees or dropping the hips. This must be an effort involving only the shoulders and arms. The height of the chest cushion on the platform is established in the same manner as that applied in obtaining the saddle height: i.e. on the same level as the protruding part of the femur; The participant gets onto the platform and lays with his/her chest bone on the middle of the cushion that is attached to the crossbar; The arms are put over the crossbar, while the feet are put wide apart and as far back as possible on the platform - almost on the back corner edges of the platform; The handlebar is held tightly In an overhand grip; The dynamometer is hooked to the handlebar, by bending the arms to an angle of some 120-130 degrees; The assessor stands in front of the participant in order to observe the correct angle of the arms; It is also necessary to make sure that his armpits are kept open and not drawn towards his body during the pull.



Figure 3.3. Arm Shoulder Strength

Back muscle strength: The back muscle strength test must only involve a straight upward pull with the back muscles without any involvement of the arms, legs or mass. Adhere to the following procedure: a strap with a hook where the dynamometer is attached is placed across the back, just below the armpits. The participant bends forward to approximately 90 degrees; The chain that is attached to the handlebar is then hooked onto the dynamometer the participant places his/her feet shoulder width apart, just behind the attachment of the dynamometer to the platform. Throughout the test, the participant must look up and keep the eyes fixed on a spot in front. This is very important so as to ensure that the participant will pull on the dynamometer with a straight back and thus avoid risk of injury; The arms must be kept straight in line with the back with the hands some 30cm away from the body. This is necessary to avoid any participation of the arms in the pulling action. Backward leaning of the body, thus involving the body mass rather than the back muscles in the pulling action should be avoided and legs and back should be kept straight during the back muscle test.



Figure 3.4. Back Strength

Leg muscle strength: the strap is positioned over the upper part of the pelvis. Once again the strap can be adjusted by putting the crossbar in one of the loops on the strap; the feet are placed about shoulder width apart, just behind the attachment of the dynamometer onto the platform. Bend the upper body slightly forward (some 30 degrees) and grab the handlebar; Bend the knees between 100 - 110 degrees and hook the chain to the dynamometer; the participant pulls straight upwards straightening the legs; ensure no backward leaning is involved.



Figure 3.5. Leg Strength

Flexibility (sit and reach): This test is used to measure the flexibility of the hip joint and the stiffness of the hamstring muscles. A standard flexibility bench is used. The participant sits down flat on the floor in front of the box with straight legs and with the feet flat against the front of the box (without shoes). He/she puts the hands on top of each other and straightens the arm towards the sliding block on the flexibility box. The participant places the hands behind the sliding block (only the tip of the longest finger of each hand should touch the sliding block) put his/her head between the straight arms and push the sliding block as far as possible, all the while keeping the hands in the correct position and keeping the legs absolutely straight. The movement must be fluent without any jerking actions and the position at the furthest point must be held for 3 seconds.

3 min step test: A Reebok step bench, Metronome, Stethoscope and Stopwatch are used to conduct this assessment. The metronome is set on 100bpm (participant will step up and down 25 times per minute). The test lasts 3 minutes exactly. After the 3 minutes is completed the participant's heart rate is measured for 15 seconds and multiplied by 4 to get the beats per minute, immediately.

PAA Classification: The data received from the physical ability assessment is used to determine the risk category for each of the critical physical abilities required for the job. Each of the physical ability parameters are individually categorised into 4 scientifically based risk categories. The 4 risk categories are as follows:

- ***Category A: The individual's physical ability meets the required standard***
- ***Category B: The individual's physical ability meets the required standard and needs conditioning***
- ***Category C: The individual's physical ability does not meet the required standard and the standard could be acquired through conditioning.***
- ***Category D: The individual's physical ability does not meet the required standard and the standard can not be acquired through conditioning.***

The risk category for each physical parameter value assessed is determined by comparing the parameter value to the job related norm values. Norm Values for each job with inherent physical requirements are listed in Annex 3.3

- In the event that the physical ability parameter value of an employee is in Category C the Biokineticist determines if the specific parameter could be improved to Category B or A in three months. If it is the Biokineticist's professional opinion that the minimum requirement could be achieved through rehabilitation/conditioning, the physical parameter value is classified in category C. Otherwise it is classified in Category D.
- If the physical ability parameter cannot be assessed due to a contra-indication or any other reason restricting the employee of performing normal work duties, the parameter is classified in either Category C or D.

Each of these categories has a point weighting Once captured each parameter is allocated a point based on the risk stratification. Thereafter the number of points accumulated for each category is added up annex 3.1

The sum total of Category A, B and C captured in block above is converted into a percentage by using the conversion table as illustrated in annex 3.2. The point score in the table that corresponds with the percentage score is selected. This point represents the average Job related Physical Ability of the individual. The average job related physical ability percentage score of the individual is compared to the minimum job related physical ability percentage standard which is 52.6 % for all job levels.

The flow diagram found in Annex 3.4 is then used to determine the individual's physical ability

classification. According to the flow diagram there are two streams to follow after the average job related physical ability as calculated. Either the individual's average job related physical ability (%) is above the job related physical ability standard. After determining the correct stream the next step is to distinguish the number of parameters in Category C and D. With this information the right channel in this stream could be selected. The channel selected will lead to the final classification of the individuals job related physical ability.

3.4 Data analysis

Data was imported into an excel spreadsheet from SAP information system and biokinetics database. Statistical analysis was performed using the Stata10 package.⁶⁵ Descriptive statistics were used to present discrete and numerical data and were expressed as means (SD), and proportions and percentages were used to present categorical data. To compare year to year variations of data paired t-test were conducted. To explore possible associations, inferential statistics between physical ability score, socio-demographic and clinical data was performed using cross tabulations and relevant regression techniques.

Variables were all dichotomised for this purpose and binary logistic regression models were used to determine the predictive nature and contribution of demographical parameters, medical conditions and injuries, and other physical and physiological characteristics to the total variation of PAA score where the measure of effect ,the odds ratio (OR) and 95% confidence intervals were determined. A P-value less than or equal to 0.05, was considered as significant.

CHAPTER 4

4 RESULTS

4.1 Introduction

This chapter presents the results of the study whose purpose was to determine the physical ability of the power line electricians over time and the extent to which variations, if any, could be explained by the socio-demographic characteristics or health problems and lifestyle habits among these power line electricians. The chapter begins with the description of characteristics of the study sample, followed by reporting on the analysis conducted to establish associations where some exist. These will be presented in subsections as guided by the study objectives which were as follows:

- To determine the physical ability and common health problems among power line electricians in Eskom Distribution.
- To compare year to year physical ability scores and find possible explanations of variations if any with regards to socio-demographic and health problems.

All data extracted was included in the analysis and descriptive and analytic statistics were performed.

4.2 Summary of Socio – Demographics and Age Characteristics of study participants

4.2.1 At baseline

From the raw data, the values of, mean, standard deviation (SD), and confidence intervals (CI), of the variables measured, were evaluated from all 50 of the reviewed records. The socio-demographical characteristics of the participants presented in Table 4.1, 4.2 and Figure 4.1 are that of measurements at baseline (year 2003). All participants were males, with two out of the fifty as white males. The age, body mass and BMI values are presented in Table 4.1.

Age was categorized using **Sturges Formula**, a formula used for transforming raw data into grouped data with the minimum possible loss of information.

$K = 1 + 3.3\text{Log}(n)$, where

n = the total number of observations in the raw data set

R = Maximum observation – Minimum observation

$l = \frac{R}{K}$ =class length or class width

Table 4.1: Socio – Demographic and Age Characteristics data of Eskom Distribution

(Dx) Powerline electricians at baseline

		Frequency (%)	95 % CI
Age (yrs)	32 – 36	2(4%)	0.5 - 13.7
	37 – 41	1(2%)	0.1 – 10.6
	42 – 46	4(8%)	2.2 – 19.2
	47 – 51	22(44%)	30.0 – 58.7
	52 – 57	14(28%)	16.2 – 42.5
	58 – 62	3(6%)	1.3 – 16.5
	63 – 66	4(8%)	2.2 – 19.2
Marital status	Unmarried	3(6%)	1.3 – 16.5
	Married	44(88%)	75.7 – 95.5
	Widowed	2(4%)	0.5 – 13.7
	Divorced	1(2%)	0.1 – 10.6
Education	Primary level	30(60%)	45.3 – 73.6
	High school	15(30%)	17.9 – 44.6
	Tertiary	5(10%)	3.3 – 21.8

Table 4.1. Demographic and Age Characteristics data of Eskom Distribution (Dx) Powerline electricians

The mean age of the study participants at baseline was (51.02±6.36) years, with the electricians aged between 32 and 65 years old. The highest proportion of participants was aged between 47 and 51 years (44%), followed by 52 to 57 years (28%), this is illustrated in figure 4.1. Approximately 94% of the electricians fall in the older worker category (above the age of 50 years old).

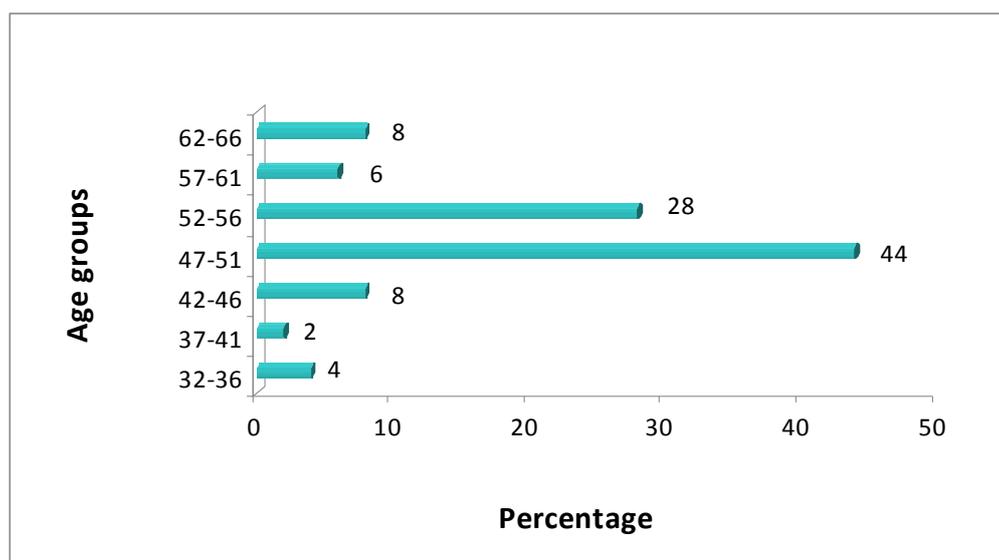


Figure 4.1. Age Characteristics

A greater proportion of the participants (88%) were married with a very small percentage of

divorcees . Of note regarding the level of education attained by the participants, only 5% of the participants had achieved a national certificate level, while the majority (60%) had an educational level of primary school education or less.

Table 4.2: Physical characteristics of Eskom distribution Powerline electricians at baseline

	Mean(n = 50)	SD
Height (centimetres)	170.8	47.99
Body mass(kilograms)	79.8	15.81
BMI(kg/m ²)	25.9	5.19

Table 4.2. Physical Characteristics of Eskom Dx Powerline electricians

Looking at the physical characteristics as presented in table 4.2, the mean height was (170.83cm±47.99) and body mass averaged at (79.8kg±15.81) . Among those examined, 24% were obese (BMI ≥ 30 kg/ m²), with 2% underweight a characteristic not favorable for work in the physically demanding environment. On average the group were considered overweight (BMI 25 – 29.9 kg/ m²).

4.3 Description of Physical Characteristics and Lifestyle Habits

This section describes the physical characteristics, with regards to; the physical ability scores, medical conditions, orthopaedic injuries and lifestyle habits as observed throughout the study period. It outlines the changes observed where the changes exist and these are presented in table 4.3.

As illustrated in fig 4.2, the number of electricians with the required physical ability level (PAA1) increased over the years; a larger proportion of the electricians fell in this category. The number increased by 10% in 2005 from 46% in 2003 and by 16% in 2008 from baseline. The change in numbers was primarily provided for by the shift of category two (PAA2) participants to category 1(PAA1), mostly which fall in the age group 47 – 51years old. This is illustrated in Table 4.3 and the explanation for such and other shifts will be reported later in this chapter.

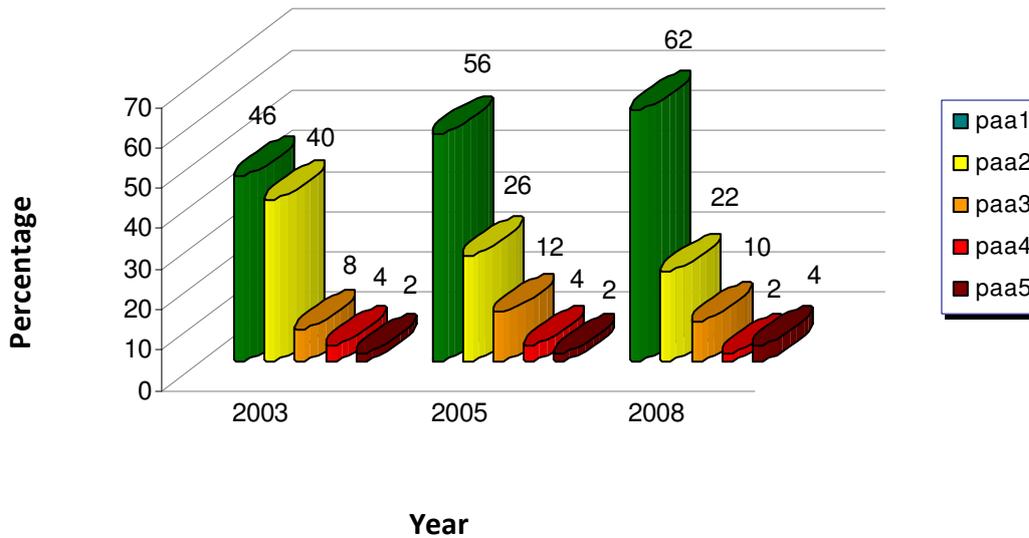


Figure 4.2. PAA Categories over the Years

Though the percentages of electricians who do not have the required physical ability level to perform the specified tasks for the position (PAA5) were small (2% in 2003), the number increased by 100% of the original number in 2008. There was a marked decline in the number of electricians who needed rehabilitation to improve their physical capacity. This number declined from 40% in 2003 to 22% in 2008 an observation consistent with the 12 electricians who were rehabilitated in the stated period. This is illustrated in figure 4.3.

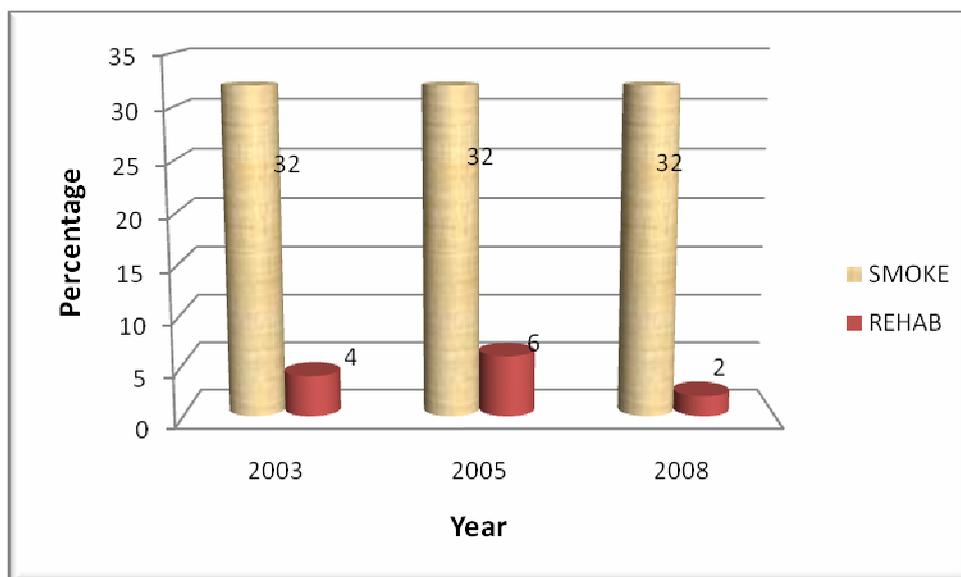


Figure 4.3. Lifestyle characteristics

This figure also presents a habit of lifestyle, smoking; 32% of the participants were smokers. A few participants engaged in physical rehabilitation, a number which increased by 2% from baseline in 2005 and dropped by a 4% amount in 2008 as the number of electricians falling in PAA category 2 decreased.

Age	2003					2005					2008				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
32 - 36	2	0	0	0	0	2	0	0	0	0	2	0	0	0	0
37 - 41	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0
42 - 46	3	1	0	0	0	4	0	0	0	0	4	0	0	0	0
47 - 51	11	9	1	0	1	13	7	1	0	1	16	5	0	0	1
52 - 57	6	7	1	0	0	7	5	2	0	0	6	5	1	1	1
58 - 62	0	3	0	0	0	1	1	1	0	0	1	1	1	0	0
63 - 66	0	0	2	2	0	0	0	2	2	0	1	0	3	0	0
Total	23	20	4	2	1	28	13	6	2	1	32	11	5	1	2

Table 4.3. Frequencies of Changes in PAA Score by age groups

Medical information is presented as in figure 4.4; at baseline 20% of the participants had hypertension and taking their medication, and this number increased to 24% in consecutive years in study. On average blood pressure numbers were normal ($\leq 139/89$), this is shown in table 4.4 and these results suggest controlled hypertension for even the confirmed hypertensive cases.

The data also show that, there was a higher proportion of electricians suffering from hypertension (BP) more than they did for diabetes mellitus (DIA), with a recorded 8% of cases and followed by 6% recorded cases for Human Immunodeficiency Virus (HIV), a percentage which did not change from baseline, suggesting zero infections for HIV and no new cases of diabetes in subsequent years after baseline.

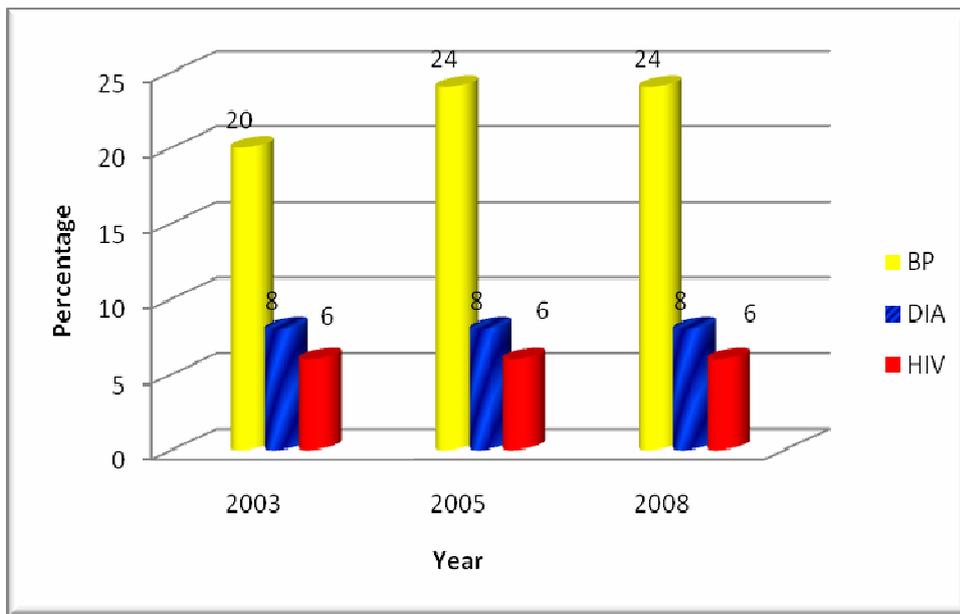


Figure 4.4. Medical conditions as captured from participant’s record

The following figure 4.5 presents injuries as recorded in the study period. There were no knee injuries recorded in 2003 and 2008 with only 4% recorded in 2005. Hip injuries on the other hand were recorded in 2005 and 2008 period. Back injuries however were reported in all the years, with a 20% of cases reported at baseline, a 22% in 2005 and a 16% decline in 2008. Wrist injuries were reported in all the years, with a 4% of cases reported at baseline, a 2% in 2005 and a 0% decline in 2008.

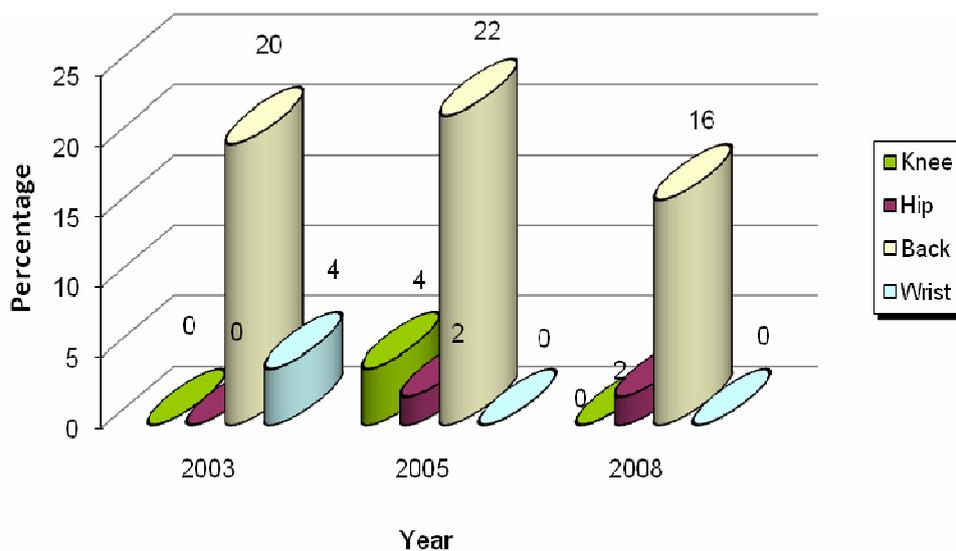


Figure 4.5. Injuries as reported by participants

Wrist injuries, 4% were only reported at baseline. This suggests that the year 2005 had the most incidences of injuries at 26% and 2008 was the least with half the number of incidents that occurred in 2005 with back injuries as the most prevalent injuries.

4.4 Comparisons of physical characteristics of participants

Comparisons of physical characteristics with regard to the physical ability scores, medical conditions, orthopaedic injuries and lifestyle habits were made. A paired t-test was conducted to compare means of the variables measured in the following tables. Presented in table 4.4 are the results of changes in medical and physical characteristics from baseline to year 2005. Significant changes were noted on three of the characteristics under study.

Table 4.4: Changes in medical and physical characteristics of the participants at baseline (2003), and two years later (2005)

Characteristic (n=50)	2003 (Baseline)		2005		T	P	
	Mean	SD	Mean	Mean Diff			SD
Medical Factors:							
1. Sick days	0.3	0.81	2.8	2.5	3.75	4.64	0.00*
2. HR rest(BPM)	73.3	10.01	72.4	-0.9	9.46	-0.66	0.26
3. Systolic BP(mmHg)	122.5	16.42	123.2	0.7	14.63	0.33	0.37
4. Diastolic BP(mmHg)	81.5	10.24	81.5	0	8.96	0.00	1.00
Physical Characteristics							
1. Body Mass(kg)	75.7	15.8	79.8	4.1	7.98	3.65	0.00*
2. Flexibility (cm)	38.5	9.52	38.2	-0.3	7.43	-0.30	0.38
3. Stamina(BPM)	116.8	17.26	115.7	-1.1	20.41	-0.38	0.35
4. Grip strength Right(kg/f)	43.5	9.52	45.0	1.5	7.28	1.48	0.07
5. Grip strength Left(kg/f)	42.7	8.67	43.1	0.4	6.24	0.41	0.34
6. Arm shoulder strength	104.5	24.22	104.8	0.3	11.94	0.15	0.44
7. Back strength	80.0	47.21	91.8	11.7	22.01	3.77	0.00*
8. Leg strength	236	67.65	228.5	-7.5	61.12	-0.87	0.20
9. Abdominal strength	22.3	11.03	21.8	-0.5	9.35	-0.35	0.37

Notes: BPM (beats per minute), kgf(kilograms of force)statistically significant* $P < 0.05$

Table 4.4. Changes in medical and physical characteristics of the participants at baseline (2003), and two years later (2005)

Among those found to have significantly changed over the years, the body mass of the participants increased significantly from 2003 ;75.7 kg to 78.99 kg through 2008, with year 2005 having a marked mean difference, with a mean body mass of (79. 84kg \pm 15.82, $p = 0.00$). Sick days, and back strength were also significantly ($p=0.00$) increased from baseline in 2005.

Though not significant declines in flexibility, stamina, leg strength, and abdominal strength: all of which contribute to the final PAA score, were noted in 2005. In 2008, a different picture was demonstrated as seen in table 4.5, where the stamina significantly increased ($1.6\text{bpm}\pm 21.59$, $p = 0.00$) by approximately 2bpm.

Table 4.5: Changes in medical and physical characteristics of the participants at baseline(2003) and five years later(2008)

Characteristic (n=50)	2003 (Baseline)		2008		SD	T	P
	Mean	SD	Mean	Mean Diff			
Medical Factors:							
1. Sick days	0.3	0.81	5.3	5.0	14.80	2.37	0.01*
2. HR rest(BPM)	73.3	10.01	72.6	-0.6	11.44	-0.40	0.35
3. Systolic BP(mmHg)	122.5	16.42	122.5	-0.0	27.15	-0.00	0.50
4. Diastolic BP(mmHg)	81.5	10.24	79.2	-2.3	11.79	-1.34	0.09
Physical Characteristics:							
1. Body mass(kg)	75.7	15.8	79.0	3.3	10.18	2.28	0.01*
2. Flexibility (cm)	38.5	9.52	40.4	1.9	9.45	1.45	0.08
3. Stamina(BPM)	116.8	17.26	118.4	1.6	21.59	0.52	0.00*
4. Grip strength Right(kg/f)	43.5	9.52	46.0	2.5	4.95	3.53	0.00*
5. Grip strength Left(kg/f)	42.7	8.67	44.2	-1.5	6.90	1.49	0.07
6. Arm shoulder strength	104.5	24.22	103.3	-1.2	19.67	-0.43	0.33
7. Back strength	80.0	47.21	94.5	14.45	26.97	3.79	0.00*
8. Leg strength	236	67.65	218.2	-17.77	63.38	-1.98	0.03*
9. Abdominal strength	22.3	11.03	19.1	-3.18	9.97	-2.26	0.01*

Notes: BPM (beats per minute), kg/f(kilograms of force)statistically significant* $P < 0.05$

Table 4.5. Changes in medical and physical characteristics of the participants at baseline(2003) and five years later(2008)

Table 4.5, presents the changes as in table 4.4, however after 5 years from baseline. There were no significant changes from baseline on the medical parameters except for sick leave taken which increased to approximately (5 days ± 14.8 , $p = 0.01$) on average. Generally improvements in strength were observed, with the right grip strength increased by (2.5 kg/f ± 4.95 , $p = 0.00$) from baseline. Back strength also increased by (14.45kg/f ± 26.97 , $p = 0.00$). A decline in strength of the legs and abdomen was however noticed, a decline of (17.77kg/f ± 63.38 , $p = 0.03$)

for the legs and approximately (3 sit ups per minute \pm 9.97, $p = 0.01$) for the abdominal endurance. Though not significant, arm shoulder strength also declined.

Table 4.6: Changes in medical and physical characteristics of the participants from 2005 to 2008

Characteristic (n=50)	2005		2008		SD	T	P
	Mean	SD	Mean	Mean Diff.			
Medical factors:							
1. Sick days	2.8	4.00	5.3	2.5	13.96	1.27	0.11
2. HR rest(BPM)	72.4	10.83	72.6	0.2	9.43	0.18	0.43
3. Systolic BP(mmHg)	123.2	17.78	122.5	-0.7	23.16	-0.21	0.42
4. Diastolic BP(mmHg)	81.5	11.85	79.2	-2.2	12.44	-1.27	0.10
Physical characteristics							
1. Body mass(kg)	79.9	15.82	79.0	-0.9	4.80	-1.25	0.11
2. Flexibility (cm)	38.2	10.97	40.4	2.3	8.79	1.81	0.04*
3. Stamina(BPM)	115.7	24.26	118.4	2.7	31.81	0.60	0.28
4. Grip strength Right(kg/f)	45.0	9.43	46.0	1.0	6.65	1.01	0.16
5. Grip strength Left(kg/f)	43.1	8.53	44.2	1.1	5.11	1.50	0.07
6. Arm shoulder strength	104.8	28.13	103.3	-1.5	23.0	-0.45	0.33
7. Back strength	91.8	50.89	94.5	2.7	34.07	0.56	0.29
8. Leg strength	228.5	73.68	218.2	-10.3	50.30	-1.44	0.08
9. Abdominal strength	21.8	10.02	19.1	-2.7	8.84	-2.18	0.02*

Notes: BPM (beats per minute), kg/f (kilograms of force) statistically significant* $P < 0.05$

Table 4.6. Changes in medical and physical characteristics of the participants from 2005 to 2008

In table 4.6, the changes between 2005 and 2008 are presented. There were only two characteristics whose changes were significant in this period, hip flexibility and abdominal strength. While the flexibility increased to (40.4cm \pm 8.79, $p = 0.04$), the abdominal strength decreased by approximately (3 sit-ups per minute \pm 8.84, $p = 0.02$). The findings in this section suggest that time had an influence in physical characteristics, especially strength changes which could be observed in between 2003 and 2005, as well as between 2003 and 2008. It can be noted also that the electricians became sicker for longer; as indicated by the increased sick leave days taken in the subsequent year.

4.5 Associations among Physical ability analysis score and socio-demographic characteristics, lifestyle habits and medical conditions

This section of the results focuses on the associations that exist between the physical ability analysis score and the socio demographic characteristics, health conditions and physical or physiological characteristics. The relative contribution of these parameters in the context of physical ability was assessed using multivariate logistic regression analysis. Given that the logistic regression equation cannot determine variables with frequencies at least less than 5; as is generally accepted by most statisticians. For such variables actual frequencies were used to present the data. These results are summarized in Table 4.7.

4.5.1 PAA in the Socio - demographic context

Age, body mass index, job type, marital status and education were the five variables considered for the analysis.

Using the categorized age as explained in the earlier sections of this chapter, the relative contribution of age to physical ability level was measured in conjunction with other socio-demographic variables. Of all socio-demographic variables, age was the only parameter shown to strongly influence physical ability score (odds ratio [OR] 3.75; $p = 0.003$, 95% confidence interval [CI], 1.55-9.05).

This shows that electricians younger than 50 years old were approximately four times likely to meet the required physical ability standard

Though the association was not significant, education was still influential over the resultant physical ability score (OR 3.64; $p = 0.14$, 95% CI, 0.66-19.93) as electricians who only have a primary school educational level are 3 times more likely to have a higher physical ability level.

Electricians who had normal body composition (BMI) were approximately 2 times more likely to be physically able to perform the tasks (OR 1.64; $p = 0.56$, 95% CI, 0.32-8.48).

Table 4.7: Association between the Physical Ability Score(PAA) and socio demographics, medical conditions and injuries (n=50)

		Odds ratio	95% CI	P- Value
Socio- demographics:	Age cat	3.75	1.55 - 9.05	0.003*
	Job type	0.71	0.06 - 8.77	0.79
	BMI	1.64	0.32 - 8.48	0.56
	Marital status	1.07	0.10 - 11.64	0.95
	Education	3.64	0.66 – 19.93	0.14
Medical conditions:	Hypertension	0.52	0.10- 2.72	0.44
	Diabetes	0.70	0.06 - 8.24	0.78
	HIV	*	*	*
	Sick leave	1.08	0.22 - 5.31	0.92
Injuries:	Back injury	0.34	0.05 - 2.23	0.26
	Hip injury	*	*	*
Lifestyle:	Rehabilitation	*	*	*
	Smoke	1.71	0.29 - 10.15	0.55
Physical characteristics	Abdominal	43.49	2.49 – 768.13	0.01*
	Arm shoulder	*	*	*
	Back	28.50	2.37 - 342.61	0.01*
	Leg	123.00	9.62 - 1573.00	0.00*
	Stamina	2.25	0.34 - 14.62	0.40
	Grip right	41.00	3.65- 461.04	0.00*
	Flexibility	7.83	0.55 – 111.92	0.13
	Systolic blood	*	*	*
	Diastolic blood	*	*	*
	Resting heart	1.03	0.95 – 1.12	0.51

Table 4.7. Association between the Physical Ability Score (PAA) and socio demographics, medical conditions and injuries

The relationship between job type and marital status to physical ability was not strong (OR 0.71; p = 0.79, 95% CI, 0.66-8.77) and (OR 1.07; p = 0.95, 95% CI, 0.10-11.64) respectively.

4.5.2 PAA in the medical conditions context and injuries

Regarding the medical profile of the electricians associations with physical ability were investigated. The presence of hypertension, diabetes mellitus, (HIV) and sickness absenteeism were considered in the analysis.

None of the medical conditions had strong significant association with the physical ability score, though the odds ratios for all were still above 1. This suggests that though insignificant, hypertension (OR 0.52; $p = 0.44$, 95% CI, 0.10-2.72), diabetes (OR 0.70; $p = 0.78$, 95% CI, 0.06-8.24), and sickness absenteeism (OR 1.08; $p = 0.92$, 95% CI, 0.22-5.31) have some influence on the physical capacity of the electricians. The parameters for the relationship between HIV and physical ability could not be calculated due to the small number of people who were HIV-positive, however all those who were HIV positive met the physical ability standard. Similarly, though cases of wrist injuries were reported in 2003, none influenced the physical ability outcome, the same was true knee injuries, where of the 2 cases reported, their physical ability score was not in category 1 and one received rehabilitation and improved to a category 1. The single case of hip injury in 2005 was also a category 2 candidate.

4.5.3 PAA in the context of lifestyle habits

There were only two parameters in this category that could be investigated, smoking status and whether the electricians had undergone rehabilitation or not. None of the lifestyle habits were influential over the outcome of physical ability. The odds ratio expressing the relationship between rehabilitation and physical ability was undetermined due to the small frequencies of those involved in rehabilitation. The two electricians who underwent rehabilitation in 2003 shifted to PAA1 in 2008, the same was true for 2005, suggesting a success rate of 100% for rehabilitation.

Results for smoking however do suggest that smoking almost doubled (OR 1.71; $p = 0.55$, 95% CI, 0.29-10.15) for people in the physical ability category one (PAA1).

4.5.4 PAA in the context of physical and physiological characteristics

In this section, physical in the form of muscle function properties and physiological characteristics in the form of cardio-respiratory properties were investigated.

Physiological characteristics: Stamina did not interact strongly with physical ability score (OR 2.25; $p = 0.40$, 95% CI, 0.34-14.62) though the odds remained almost tripled that, electricians that had good stamina would meet the required level of physical ability. This was also true for the resting heart rate (OR 1.03; $p = 0.51$, 95% CI, 0.95-1.12), though the odds were much lower compared to stamina.

Physical characteristics: generally muscle function was a strong predictor for meeting the required physical ability level. There were only two measurements that were not significantly associated with physical ability score, grip strength left: odds were undetermined and flexibility results (OR 7.83; $p = 0.13$, 95% CI, 0.55-111.92), though not significant still suggested that an electrician whose flexibility was good was approximately 8 times likely to meet the physical ability standard.

The leg strength, was the strongest predictor for meeting the physical ability standard (OR 123.00; $p = 0.00$, 95% CI, 9.22-1573.00), among all the other muscle function tests, followed by abdominal endurance (OR 43.49; $p = 0.01$, 95% CI, 2.49-786.13), suggesting that good abdominal endurance contributes to achieving a high level of physical capacity.

Grip strength of the right hands, with similar odds to the abdominal strength (OR 41.00; $p = 0.00$, 95% CI, 3.65-461.04), showed a similar trend.

Back strength was the least strong predictor of physical capability (OR 28.50; $p = 0.01$, 95% CI, 2.37-342.61) though the relationship was still a strong one.

Of all the measurements that were considered in this study to explain true changes in physical ability score through out the years, socio-demographical factors specifically age, muscle function, including injuries and rehabilitation explained the changes.

CHAPTER 5

5 DISCUSSION OF RESULTS AND LIMITATIONS OF THE STUDY

5.1 *Introduction*

This chapter discusses the results presented in the preceding chapter. The discussion will be done taking into account the context of the study as well as the literature reviewed.

5.2 *Prevalence and importance of physical ability in power electricians*

The aim of the study was to determine the physical ability and common health problems among powerline electricians in Eskom Distribution over time, and determine the extent to which variations, if any exist, could be explained by the socio-demographic characteristics, health problems or lifestyle habits. This was done to highlight differences in physical ability analysis (PAA) scores and the factors: physical or habitual that predicts PAA outcomes in order to make appropriate recommendations were necessary to have better future PAA outcomes.

PAA is a physical work capacity indicator for the health and wellbeing of the organisational workforce. It is therefore crucial that a high level of physical capacity is maintained to ensure a sustainable workforce. It is evident in the literature reviewed how crucial it is in manual material handling tasks such as lifting and/or carrying of loads, that the performer of the task possess the some acceptable level of physical work capacity in this context a higher index for PAA.

In this study, from the baseline in 2003, the percentage of study subjects with required physical ability level to perform the specified tasks kept increasing from 46% to 56% in 2005, to 62% in 2008. This is in contrast with the percentage of those with limited ability whose percentage was steady from 2003 to 2005, but that doubled to 4% in 2008. These findings suggest that the recruitment processes as well as the follow-up performed have been effective in appointing people with the required ability and the work performed in terms of rehabilitation was useful.

5.2.1 *Factors influencing physical ability*

5.2.1.1 Physical ability: The effect of age

There are several plausible ways in which time can influence the human body. Among those are the physiological, behavioural or psychosocial changes. When comparisons were made in this study it was to establish which of those changes, within the context of the study objectives, if any occurred.

The electricians showed a high level of physical ability throughout the study period. This trend was still evident as the number of electricians with the required physical ability level (PAA1) increased over the years from 46% to 62% in 2008. A shift of PAA2 participants in the 47 – 51 years old age group was the reason for the increase. Consistently age, remained one of the predictors of physical work capacity, this is evident in the literature reviewed and the study findings. Aging affects the body both physically and physiologically. Muscle function, namely, strength, and endurance are a function of physical work ability; this study showed a strong influence of age on the physical work ability in the form of PAA score, demonstrating that electricians younger than 50 years old were approximately four times likely to meet the required physical ability standard (Table 4.7).^{18-19,21-23} It should be noted that in this study, that the youngest group of electricians remained in PAA category 1 throughout the study period (Table 4.3). This finding suggests the need to put emphasis in recruiting young people as they would provide many years of work with little decrease in their physical ability

The leg strength was the strongest predictor of PAA1 among all the other muscle function tests, followed by abdominal endurance, suggesting that good abdominal endurance and leg strength contribute to achieving a high level of physical capacity: significant declines in leg strength were demonstrated throughout the years. The same was true for grip strength of the right hand; with similar odds to the abdominal strength, and back strength was the least predictor of physical ability though the relationship was strong. The declines in strength especially the larger muscle groups and the contribution of muscle function to physical work capacity are consistent with the body of work in this field of study.

Two other parameters did not have an association with PAA and these were the left arm grip strength and arm shoulder strength in fact odds ratio could not be determined. With regard to flexibility, the findings suggest that a electrician whose flexibility was good was approximately 8 times likely to meet the physical ability standard, PAA category 1 (Table 4.7) In contrast, stamina demonstrated much lower odds for the likelihood to meet the required level of physical

ability (Table 4.7).

It seems that the percentages though small of electricians who did not have the required physical ability level to perform the specified tasks for the position the number doubled from 2003 to 2008. These electricians fell in the older worker category where rehabilitation could have yielded minimal positive results during the recommended conditioning period in the organisation as they are considered to heal and improve at a much longer rate as a result of their relatively slow metabolism and healing process. The decline in physical ability is a trend noticed in many organisations whose workers fall within the aging workforce, it was also true in this case that the added percentage was within the older worker category. Though the benefits of rehabilitation are known, it is rather a challenge to rehabilitate older workers considering that rehabilitation requires some level of motivation from the part of the worker, effectiveness and efficiency of the conditioning program especially considering that 12-14 weeks of strength training only yields muscle mass improvements and no strength improvements.^{24,58,66,68}

Rehabilitation played a very crucial role and was one of the considered possible reasons for the shift. None of the studies reviewed had looked at the effect of time on physical work ability with the same people; therefore it was difficult to compare the results in this study with of the predecessors in the field. The effect of rehabilitation on the improvement of PAA outcome is consistent with the outcomes of physical rehabilitation as has been used for decades in physical therapy and seemed to show some improvement though no significant association was found.^{59,69} The two electricians who underwent rehabilitation in 2003 shifted to PAA1 in 2008, the same was true for 2005, suggesting a success rate of 100% for rehabilitation.

5.2.1.2 Influence of the state of health and prevalent health conditions

Obesity was among the clinical medical conditions found among the electricians with 24% percent of classified as such. This percentage is almost equal to the 24.8% general population in South African males.⁷⁰

Almost 32% of the participants were smokers, though no association existed regarding the ability to perform the recommended task of an electrician. It was no surprise therefore to see to see 50% of hypertensive electricians were smokers as smoking and hypertension are closely related in fact this study found that electricians who smoked were 5 times more likely to be hypertensive, and this influence was significant.⁷¹ It seems that overweight and obesity is prevalent in the electricity distribution business, two studies conducted also found on a relatively high prevalence compared to the 46% found in this study.^{14,72} This could be as a result of the awkward hours

worked by the electricians as they do shift work, that they either are too exhausted to participate in physical activity or do not find the time to do so and considering their level of education that they may not necessarily have information about healthy eating, this was not investigated in this study.

Hypertension was found to be the most prevalent clinical condition in this study a confirmation of the robust literature in the subject area. It should be pointed out that during testing the blood pressure levels were normal,⁶ suggesting controlled hypertension for the confirmed hypertensive cases.

Diabetes mellitus and Human Immunodeficiency Virus (HIV) were also among the medical conditions prevalent among the electricians. It was not surprising that all 75 % of the diabetic cases also had hypertension, combined obesity, age, gender and smoking habits this raises an alarm regarding the cardiac risk profile of this group of workers.⁵⁹

Though with other medical conditions an increase in cases was noted, HIV cases remained the same from baseline suggesting zero new infections over the years. None of the medical conditions had strong associations with the physical ability score. The relationship between HIV and physical ability could not be determined however noted, was that all the cases who reported HIV as a condition still met the physical ability requirements. Given that the effects of HIV are known some of which can include redistribution of fat or muscle wasting,⁷³ the findings in this study suggest that these effects may have not taken effect, possibly as a result of successful disease management or other unknown reasons.

Generally sick leave is used as a measure of a poor health state. The duration of sick leave may be greatly influenced by among others socioeconomic status, work conditions, health characteristics and personal characteristics.^{33,74-76} In the organisation where the current study was conducted, sick leave is considered as a symptom of either employee health state or morale (anecdote). Based on the findings of this study the electricians became sicker for longer over the years where days increased to approximately 5 days on average per year in 2008. This is still below the organisational target of 6.5 days on average per year used within the human resources sustainability index (HRSI). Among the medical conditions considered, blood pressure and sick leave days taken were the only medical conditions where change was noted, in fact 95% of the cases that took leave had hypertension.

Injuries, specifically musculoskeletal injuries may negatively affect the physical capacity of workers as they may present some level of functional limitations; the severity and location of the injury being the determining factor in limiting or disabling function.⁷⁷⁻⁷⁸ Back injuries, are consistently leading disabling musculoskeletal injuries and this is true for different work settings. Even in this study back injuries were the highest occurring type of injury followed by hip, then knee injuries with very few upper limb injuries; the year 2005 had the most incidences of injuries at 26% in total.

In an organisation where manual materials handling accounts for approximately 60% of the work tasks and copious amount of kilometres are driven, this trend can be expected.⁵⁴⁻⁵⁵ A Scandinavian study suggested that these numbers can increase by approximately 10% especially in men between the ages of 50 and 54 years.⁷⁹ In fact the same study discovered that, every second man reported a diagnosed musculoskeletal disease by age 54 and that was the case with back injuries in our study. The 6% decline in back injuries was influenced by engaging in physical rehabilitation in 2005.

Based on the logistic regression analysis none of the other injuries occurred could predict the risk for meeting the physical ability standard. Though cases of wrist injuries were reported in 2003, none influenced the physical ability outcome, the same was true knee injuries, where of the 2 cases reported, their physical ability score was not in category 1 and one received rehabilitation and improved to a category 1. The single case of hip injury in 2005 was also a category 2 candidate. This suggests some level of influence by these injuries on the physical ability score and a need for rehabilitation.

5.2.1.3 Physical ability and other socio-demographic characteristics

So far, age, various physical characteristics and rehabilitation were able to explain some of the changes observed in the increased PAA score. Having considered age as one of the socio-demographic factors, the rest of the socio-demographics investigated in the study did not show significance in relation to physical ability. Formal education can assist in the socialisation of a human being and lead to greater independence and autonomy, there were more electricians without a high school education a trend similar to that observed in Nairobi, and South Africa and Cameroon in fact in the latter study, higher percentages of respondents with little or no education and those unmarried (divorced or widowed) reported poor health, functional limitations, or both, than their educated or married counterparts.²⁹

Education and training and voluntary testing and training are among the interventions that have

been shown to promote zero new infections on HIV reported cases and these could have been also the reason for the unchanged numbers. Mortality rates due to noncommunicable diseases were shown to be on the rise in a study conducted in South Africa found with stroke and diabetes as the highest contributing diseases at 22% and hypertension seemingly increasing before all the other diseases.^{80-81,}

An economic study conducted in South Africa ascertained that economic conditions can influence disability rates, despite that they may react only a year after a change occurs in Consumer Confidence, and three months after a change in Unemployment.⁸² The last year of the study was at the beginning of the economic downturn in South Africa, therefore based on their pronouncement; any change would have occurred outside of the study period. It would have however been interesting to see how this would have influenced the organisational disability

5.2.1.4 Perspectives of the study findings in the broader context

The findings of our study did not however find an association between educational level, marital status and PAA. Literacy is particularly important as health promoting activities such as nutrition and physical activity information, both associated with physical work capacity are generally presented in English, this is especially through in the organisation. In turn, this could limit the electricians further with regards to attaining the recommended physical ability levels.

The physical assessments are used to establish one's physical ability to perform a given task. They therefore can be a determining factor for an electrician to continue with their duties. Behaviour can be affected by multiple levels of influence, those including institutional or organisational influences, the individual's perception of vulnerability, or their perception of benefits and costs. Therefore if an employee knows this they may push harder so as not to jeopardise their chances for work and getting allocated for standby work, especially the latter as it is believed to compliment the income.

Most studies have found that physically demanding work does not maintain or increase the musculoskeletal capacity of the individual^{49,83-86} therefore learned behaviour could also explain the increase in the numbers for PAA1 as these assessments are conducted every second years.

Given that the workers get to know what the required levels of strength are they try with all they have to meet the required standards, which brings about pride and satisfaction, a source of

intrinsic reinforcement.⁸⁷ In order for learning to be successful, a level motivation is necessary and this in part is influenced by the intrinsic reinforcement. This introduces a behavioural aspect to the improvement of PAA score, inspirational motivation; an element which as a result of the workers expectations and the importance of various works tasks which can promote a sense of confidence and drive to perform better. In a Finnish study, three specific factors labelled enjoyment (reinforcing factor), lack of skill (enabling factor) and lack of knowledge (predisposing factor) all of which are elements of motivation predicted 9% of the variance of physical activity during a 12 month period,⁸⁸ concomitant with other demonstrations of improvement in performance.⁸⁹⁻⁹⁰

5.2.1.5 Limitations of the study

While care was taken to exercise control over the study protocol, certain limitations which were beyond the control of the researcher as outlined below.

Sampling method:

No sampling was conducted; a census of cases with data from the study period was undertaken. Since some cases did not usable data for the study period, they were dropped; this could have increased the risk of selection bias. Study findings can therefore not be generalised as representing the entire population of power line electricians at Eskom.

Data collection method:

As stated above, given that the method of data collection was a record review which involved records of employees from written medical reports and computerized medical databases. Despite using the two sources some data were not found on some subjects. Moreover, computerized databases present a challenge of less accurate data at the level of individual data recording as the possibility of clerical error associated with the process of transcribing the data from the medical file to the database may be high.⁹¹⁻⁹² To verify data correctness, data from the computerised database was verified by manually checking the written reports the data abstraction and coding process data was handled by the researcher and verified in the same manner. The process was swift as only 50 records were considered complete enough to be used for the study.

CHAPTER 6

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 *Introduction*

In chapter 5, the results of the study were discussed and interpreted in the context of the objectives outlined in chapter 1 of the study. The limitations of the study were also presented and from the discussions trends were identified. This chapter will present the conclusions and recommendations drawn from them.

6.2 *Conclusions*

The physical ability of an individual to perform his physical task requirements can affect the individual's personal safety and the safety of those working with them. As a result this capacity may need to be identified as it gives an indication of whether employees have the physical capacity to perform required tasks, indicating difficulty or inability to perform certain tasks that are inherent to the job demands and potential of risk to injury.

The conclusions of this study are as follows:

- At the time of the study, the power line electricians were old as 94% of them were over 50 years old, overweight (46%), and suffering from chronic conditions such as hypertension (22%), diabetes (8%). In addition, 19% suffered from back injuries, 2% from knee injuries, while 32% smoke cigarettes.
- Given their health profile, they become sicker for longer periods as reflected by the increasing number of sick leave days (95% of the cases that took leave had hypertension).
- With regard to their physical ability, the study concludes that age is a strong predictor for physical ability as the youngest group (≤ 49 years old) of electricians remained in PAA1 throughout the study period, and were approximately four times likely to meet the required physical ability standard than their older counterparts.
- That the regular physical assessment and rehabilitation have been effective in maintaining the physical ability of electricians as approximately 16% of the electricians moved from being physically unfit to becoming physically fit over the 5 years period.

In brief, the physical ability of power line workers was strongly influenced by their age and to a lesser extent by their health profile. Their ability was improved by rehabilitation which assisted those who were unfit to become physically fit during the 5 years period.

6.3 Recommendations

- Because the health profile of electricians shows a high prevalence of chronic diseases, it is recommended that they should be enrolled in Employee Wellness Programmes whereby they can benefit from health education on relevant topics and be supported in their treatment. Organisational changes should be made to accommodate this need.
- More work is needed to explore the possible explanations regarding non-participation in rehabilitation by the electricians when there is evidence supporting benefits of doing so.
- Because all electricians are required to drive vehicles, and back injuries are prevalent in this group of people, it is important that specific training should be provided to them in how to minimize the risks of back injury. Moreover, active follow-up should be instituted in young recruits to assist them in preventing and delaying the onset of back injuries.
- Given the success of rehabilitation, more resources should be invested in this work and all employees in need should be encouraged to use the services.

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ANNEXURES

Annexure 3.0.1. Category Point Calculation

PARAMETER	CAT A	CAT B	CAT C	CAT D
Systolic Blood Pressure (mmHg.)	3	2	1	0
Diastolic Blood Pressure (mmHg.)	3	2	1	0
Stamina (beats/min.)	3	2	1	0
Back Muscle Strength (kg.)	3	2	1	0
Leg Muscle Strength (kg.)	3	2	1	0
Arm/Shoulder Muscle Strength (kg.)	3	2	1	0
Grip Strength – Right (kg.)	3	2	1	0
Grip Strength – Left (kg.)	3	2	1	0
Flexibility (mm.)	3	2	1	0
Trunk Muscle Endurance (rep/min.)	3	2	1	0
Lifting strength above head	3	2	1	0
Lifting from floor – Right (kg.)	3	2	1	0
Lifting from floor – Left (kg.)	3	2	1	0
Arm adduction strength (kg.)	3	2	1	0
Shoulder endurance – Right (kg.)	3	2	1	0
Shoulder endurance – Left (sec.)	3	2	1	0
Balance (sec.)	3	2	1	0
TOTAL				

Add the total points for Category A, B and C together to get a summary point as indicated below.

Sum of Category A, B and C total points	
=	

Annexure 3.0.2. Percentage conversion table for PAA score

SCORE	1	2	3	4	5	6	7	8	9	10
PERCENTAGE	2.0%	3.9%	5.9%	7.8%	9.8%	11.8%	13.7%	15.7%	17.7%	19.6%

SCORE	11	12	13	14	15	16	17	18	19	20
PERCENTAGE	21.6%	23.5%	25.5%	27.5%	29.4%	31.4%	33.3%	35.3%	37.3%	39.2%

SCORE	21	22	23	24	25	26	27	28	29	30
PERCENTAGE	41.2%	43.1%	45.1%	47.1%	49.0%	51.0%	52.9%	54.9%	56.9%	58.9%

SCORE	31	32	33	34	35	36	37	38	39	40
PERCENTAGE	60.8%	62.8%	64.7%	66.7%	68.6%	70.6%	72.5%	74.5%	76.5%	78.4%

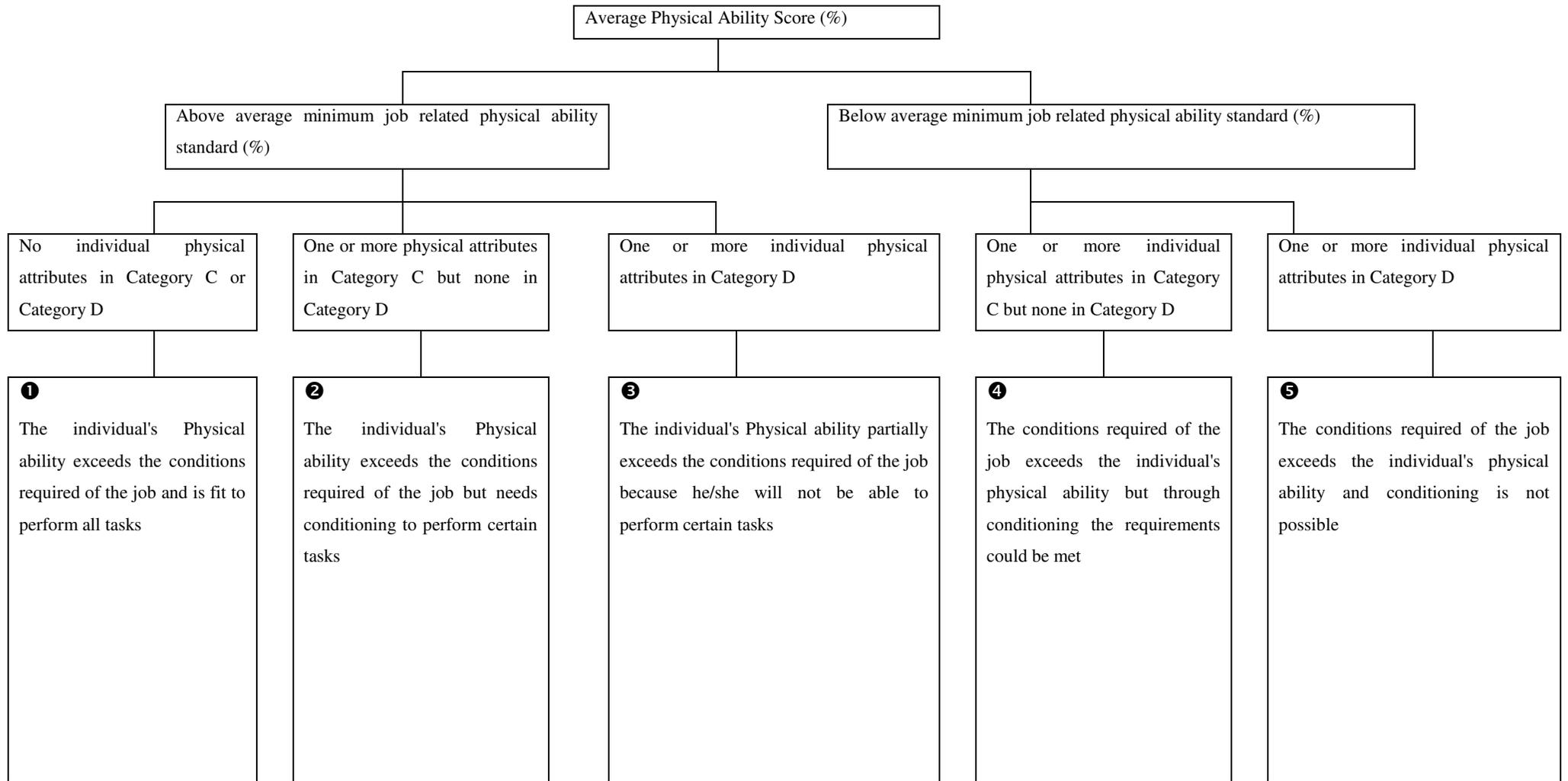
SCORE	41	42	43	44	45	46	47	48	49	50
PERCENTAGE	80.4%	82.4%	84.3%	86.3%	88.2%	90.2%	92.2%	94.1%	96.1%	98.0%

SCORE	51
PERCENTAGE	100%

Annexure 3.0.3. Physical ability analysis category norm

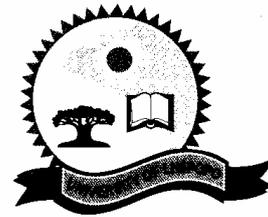
physical parameter	STANDARD	Category A	Category B	Category C or D
Systolic Blood Pressure (mmHg.)	126	< 136	136 - 141	> 141
Diastolic Blood Pressure (mmHg.)	81	< 87	87 – 90	> 90
Stamina (beats/min.)	120	< 130	130 – 136	> 136
Back Muscle Strength (kg.)	103	> 86.8	77.0 – 86.8	< 77.0
Leg Muscle Strength (kg.)	220	> 188.3	169.2 – 188.3	< 169.2
Arm/Shoulder Muscle Strength (kg.)	93	> 80.2	72.3 – 80.2	< 72.3
Grip Strength – Right (kg.)	41	> 36.9	34.3 – 36.9	< 34.3
Grip Strength – Left (kg.)	40	> 35.9	33.3 – 35.9	< 33.3
Flexibility (mm.)	40	> 35.4	32.5 - 35.4	< 32.5
Trunk Muscle Endurance (rep/min.)	22	> 17	13 – 17	< 13

Annexure 3.0.4. Flow diagram to determine an individual's job related physical ability according to the average job related physical



Annexure 3.0.5. MREC Clearance certificate

UNIVERSITY OF LIMPOPO
Medunsa Campus



MEDUNSA RESEARCH & ETHICS COMMITTEE

CLEARANCE CERTIFICATE

P O Medunsa
Medunsa
0204
SOUTH AFRICA

MEETING: 06/2009

PROJECT NUMBER: MREC/PH/101/2009: PG

PROJECT :

Title: A time series analysis of physical ability among Eskom Distribution's Power Line Electricians

Researcher: Ms B Ngqanqwani
Supervisor: Dr N Malangu
Department: Epidemiology
School: Public Health
Degree: MPH

Tel: 012 - 521 4000
Fax: 012 - 560 0086

DECISION OF THE COMMITTEE:

MREC approved the project.

DATE: 05 August 2009




PROF. G.A. OGUNBANJO
CHAIRPERSON MREC

Note:

- i) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee.
- ii) The budget for the research will be considered separately from the protocol. PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

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Annexure 3.0.6: Approval letter from Institution

(2010/07/23) Bongiwe Ngqangweni - re Bio Masters research work

From: Thoko Ndlovu
To: H&W managers
CC: Bongiwe Ngqangweni; Dick Huyser; Sylvia Mamorare
Date: 2009/09/16 04:27 PM
Subject: re Bio Masters research work

Good day,

Bongiwe, a bio in N/W came to the HRC today for approval to extract data from medical records for the purpose of her studies. No identity of employees will be disclosed, and consent for bio data already got when the bios conduct PAAs

This after discussion at HRC was approved and found to align to Section 9 of the Health Act; (purpose of data is valid, she is professionally registered, will benefit the business)

For her study, it will be bio data, and chronic medical condition info that OHN may hold in medical files. The study involve comparing information and factors that contribute to employees conditions e.g. moving from Cat 2 progressing to 5..what causes this? etc..The employees identified currently are about 50 across regions.

OHNs where identified employees for study, will need to give her this information.

After this study, next year she will share general findings, at HRC, H&W managers forum and Bio forum so as for us to see where improvement need to be made etc..not mentioning names but as general information.

She will be in future talk to your OHNs via you please. So assist her.

Regards

Thoko Ndlovu
Health & Wellness Manager
Eskom Distribution -Head Office
Tel: 011 800 3828
Fax: 0866458854
Cell: 0728663620
Pax: 8131-3828
Email: thoko.ndlovu@eskom.co.za

Annexure 3.7: Data collection confirmation Sheet



**FACULTY OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH
STUDENT RESEARCH PROJECT MANAGEMENT
DATA COLLECTION CONFIRMATION SHEET**

1. Researcher declaration

Name of Researcher: B. NGQANGWENI

Title of Study:
A TIME SERIES ANALYSIS OF PHYSICAL ABILITY AMONG Eskom DISTRIBUTIONS POWER

Research project Number:.....

I B. NGQANGWENI hereby declare that I collected data according to the specifications of the approved proposal

2. Research site

Name of institution: UNIVERSITY OF ~~E~~ Eskom DISTRIBUTION

Type of institution

NGO	Clinical	<u>PARA-STATAL</u>	
-----	----------	--------------------	--

Town (name): <u>GAUTENG * KWAZULU-NATAL</u>	Country: <u>SOUTH AFRICA</u>
---	------------------------------

3. Study site

I, being the (position) of the above organization/institution, hereby declare that the researcher named in 1 above collected data as indicated below

3.1. Main data collection activities (sign against all applicable)

interviews	Focus groups	Record reviews <input checked="" type="checkbox"/>	Questionnaire administration
------------	--------------	--	------------------------------

Data collection dates

Date	21.10.2009	[Signature]	19.10.09						
Signature			[Signature]	A. MTHETHWA					
Date			21.10.09						
Signature		[Signature]		F. TLAGAE					

3.2. Other people involved in data collection: None

3.3. Contact details of organization/representative

① ~~Postal~~/Physical address: 1 Portland Road,
Mkondeni, 3212

Telephone: 033-395 3512

Facsimile: 033-395 3632

Email: mthethap@eskom.co.za

② 21 LAKEVIEW CRESENT
KLEINFONTEIN OFFICE PARK
BENONI
1501

Annexure 3. 0.8. Data extraction Sheet

Employee data

ID			
Date of Birth	YYYY	MM	DD
Gender	Male(1)		Female(2)
Job Title			
Body Mass Index			
PAA SCORE			

Medical Information:

Cardiac	Gout	Pulmonary	Hypertension	Hyperlipedemia	Peripheral Vascular Disease	Diabetic
Obesity	Pregnancy	Depression	Stress	Other		

Orthopaedic Cases

Neck	Back	Shoulder	Elbow	Wrist / Hand	Hip	Knee
Ankle	Foot	Other				

Physical Measurements

Height (cm)				
Weight (kg)				
Resting Heart Rate (beats / min)				
Resting systolic BP (mmHg)				
Resting diastolic BP (mmHg)				
Flexibility (cm)				
Heart Rate (b / min) 6min @ 100W				
Grip Strength Right (kg)				
Grip Strength Left (kg)				
Arm / Shoulder Muscle Strength (kg)				
Back Muscle Strength (kg)				
Leg Muscle Strength (kg)				
Stomach Muscle Endurance (reps/min)				