

# **How to transform the workplace environment to prevent and control risk factors associated with non-communicable chronic diseases.**

**by**

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## Declaration

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own original work, that I am the sole author thereof (save to the extent explicitly otherwise stated). Reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

The dissertation includes 2 original papers published in a peer reviewed journal. Two unpublished papers are also included for submission for publication. The development and writing of the papers (published and unpublished) were the principal responsibility of myself and, for instance, where this is not the case, a declaration is included in the dissertation indicating the nature and extent of the contributions of the co-authors.

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Date

## Abstract

The underlying causes of premature morbidity and mortality in South Africa (SA) are related to unhealthy lifestyle behaviours, which are modifiable. Chronic non-communicable diseases (cardiovascular disease, respiratory disease, diabetes and cancer) are partly attributed to behavioural risk factors such as tobacco smoking, harmful alcohol use, physical inactivity and unhealthy eating, which if not controlled, results in an increase in metabolic risk factors.

The workplace is highlighted as an important setting for the prevention of non-communicable diseases (NCDs). The work environment directly shapes employee health, and health behaviours, and acts as an accelerator or preventer of chronic disease. Very little research in the African context has focused on how to transform the workplace environment to prevent and control the risk factors associated with NCDs. The aim of the research was to design, implement and evaluate a workplace health promotion program (WHPP) to prevent or reduce the risk factors for NCDs amongst the workforce at a commercial power plant in South Africa. The objectives were to monitor changes in NCD risk factors in the workforce, as well as monitor sick leave absenteeism and evaluate the costs and consequences of the workplace health promotion program.

The abstracts for the four articles presented for the doctoral degree are provided here.

### Article 1

#### Title

Risk factors for non-communicable diseases in the workforce at a commercial power plant in South Africa

#### Background

Non-communicable diseases (NCDs) account for more than half of annual deaths globally and nearly 40% of deaths in South Africa. The workplace can be an important setting for the prevention of NCDs.

#### Objectives

The objectives of this study were to describe the prevalence's of reported NCDs and previously identified risk factors for NCDs, as well as to assess risky behaviour for NCDs, and the 10-year risk for cardiovascular disease, amongst the workforce at a commercial power plant in the Western Cape province of South Africa.

#### Methods

A total of 156 employees was randomly selected from the workforce of 1 743. Questionnaires were administered to elicit self-reported information about NCDs, tobacco smoking, alcohol

use, diet, physical activity and psychosocial stress. Biometric health screening included measurements and calculations of blood pressure, total cholesterol, random glucose, body mass index (BMI), waist circumference and waist-to-hip ratio (WHR). The 10-year risk for cardiovascular disease was calculated using a chart-based validated non-laboratory algorithm.

## **Results**

The study participants had a mean age of 42.8 (25-64) years; 65.2% were male. A quarter (26.0%) smoked tobacco, 29.4% reported harmful or dependent alcohol use, 73.0% had inadequate fruit and vegetable intake, and 64.1% were physically inactive. Systolic and diastolic blood pressure was raised in 32.7% and 34.6% of the study participants, respectively, 62.2% had raised cholesterol, 76.9% were overweight or obese, and 27.1% had abdominal obesity. Overall, 17.4% were diagnosed with hypercholesterolaemia, 17.7% with hypertension, and 16.2% with depression. Around one third (34.1%) had a moderate-to-high 10-year cardiovascular disease risk.

## **Conclusion**

The prevalence's of both behavioural and physical risk factors for NCDs amongst the power station study participants were high. There is a need for effective workplace interventions to reduce risk for NCDs. The workplace is ideally suited for targeted interventions.

## **Article 2**

### **Title**

Transforming the workplace environment to prevent non-communicable chronic diseases: Participatory action research in a South African power plant.

### **Background**

The workplace is an important setting for the prevention of non-communicable diseases (NCDs). Policies for transformation of the workplace environment have focused more on what to do and less on how to do it. The aim of this study was to learn how to transform the workplace environment in order to prevent and control the risk factors for NCDs amongst the workforce at a commercial power plant in Cape Town, South Africa.

### **Methods**

The study design utilized participatory action research (PAR) in the format of a cooperative inquiry group (CIG). The researcher and participants engaged in a cyclical process of planning, action, observation and reflection over a 2-year period. The group used outcome mapping to define the vision, mission, boundary partners, outcomes and strategies required. At the end of the inquiry the CIG reached a consensus on their key learning.

## Results

Substantial change was observed in the boundary partners: catering services (78% of progress markers achieved), sport and physical activities (75%), health and wellness services (66%), and managerial support (65%). Highlights from a 10-point consensus on key learning included the need for: authentic leadership; diverse composition and functioning of the CIG; value of outcome mapping; importance of managerial engagement in personal and organizational change; and making healthy lifestyle an easy choice.

## Conclusion

Transformation included a multifaceted approach and an engagement with the organization as a living system. Future studies will evaluate changes in the risk profile of the workforce as well as the costs and consequences for the organization.

## Article 3

### Title

Changes in risk factors for non-communicable diseases associated with a Healthy Choices at Work program at a commercial power plant.

### Background

Globally, 71% of deaths are attributed to non-communicable diseases (NCD). The workplace is ideal for interventions aiming to prevent NCDs, however much of the current evidence is from high income countries.

### Objective

The aim of this study was to evaluate changes in NCD risk factors associated with a Healthy Choices at Work program (HCW) at a commercial power plant in South Africa.

### Methods

This was a before-and-after study in a randomly selected sample of 156 employees at baseline and 2-years. The HCW focused on catering, physical activity, health and wellness services and managerial support. Participants completed questionnaires on their participation in the HCW, tobacco smoking, harmful alcohol use, fruit and vegetable intake, physical activity, psychosocial stress and history of NCDs. Clinical measures included blood pressure, total cholesterol, random blood glucose, body mass index (BMI), waist circumference and waist-to-hip ratio. The 10-year cardiovascular risk was calculated using a validated algorithm. Data was analysed with the Statistical Package for the Social Sciences.

### Results

Paired data was obtained for 136 employees. Their mean age was 42.7 years (SD 9.7); 64% were male. The prevalence of sufficient fruit and vegetables increased from 27% to 64%

( $p < 0.001$ ), those meeting physical activity guidelines increased from 44% to 65% ( $p < 0.001$ ). Harmful alcohol use decreased from 21% to 5% ( $p = 0.001$ ). There were significant improvements in systolic and diastolic blood pressure (mean difference -10.2mmHg (95%CI: -7.3 to -13.2); and -3.9mmHg (95%CI: -1.8 to -5.8);  $p < 0.001$ ) and total cholesterol (mean difference -0.45mmol/l (-0.3 to -0.6)). There were no significant improvements in BMI. Psychosocial stress from relationships with colleagues, personal finances, and personal health significantly improved. There was a non-significant decrease of 4.5% in people with a high 10-year cardiovascular risk.

## **Conclusion**

The HCW was associated with significant reductions in behavioural, metabolic and psychosocial risk factors for NCDs.

## **Article 4**

### **Title**

Cost and consequence analysis of Healthy Choices at Work (HCW) program to prevent non-communicable diseases in a commercial power plant.

### **Abstract**

The workplace is identified as an ideal setting for the implementation of a Healthy Choices at Work program (HCW) to prevent and control NCDs. However, given the limited resources assigned to workplace health promotion programs in LMIC, this study aimed to conduct a cost and consequence analysis using participatory action learning to improve the NCD risk profiles at low cost.

### **Methods**

Incremental costs were obtained from the activities of the Healthy Choices at Work program at the commercial power plant over a two-year period. A total of 156 employees participated in the intervention but the affect was experienced by all employees. An annual health risk assessment at baseline and follow up was included in the consequence of the study.

### **Results**

The total incremental costs over the two-year period accumulated to \$3745 for 1743 employees. The cost per employee on an annual basis was \$1 resulting in -10.2mmHg in systolic blood pressure, -3.87mmHg in diastolic blood pressure, -0.45mmol/l in total cholesterol, significant improvements ( $p = 0.001$ ) for harmful alcohol use, fruit and vegetable intake and physical inactivity. There was no improvement in correlation between sickness absenteeism and risk factors for non-communicable diseases.

## **Conclusion**

The cost to implement the multicomponent HCW programs was considerably low as was the significant consequences in transforming the workplace environment. Findings of this study will be useful for small, medium and large (SML) organisations, the national department of health, and similar settings in LMIC.

## **Conclusion**

The high prevalence of behavioral and metabolic risk factors for NCDs amongst participants at the power station resulted in the design of an effective WHPP to reduce risks. A Healthy Choice at Work program (HCW) included a multifaceted approach and was associated with significant reductions in risk factors for NCDs. The cost to implement the HCW program was low with significant consequences in transforming the workplace environment, which are useful findings for small, medium and large organizations.

# Opsomming

Die onderliggende oorsake van voortydige morbiditeit en mortaliteit in Suid-Afrika (SA) is verwant aan ongesonde lewenstyl gedrag, wat bewerkbaar is. Chroniese nie-oordraagbare siektes (kardiovaskulêre siekte, respiratoriese siekte, diabetes en kanker) is deels toegeskryf aan gedrags risiko faktore soos tabak rook, skadelike alkohol gebruik, fisiese onaktiwiteit en ongesonde eetgewoontes, wat indien nie beheer word, lei tot 'n toename in metaboliese risiko faktore.

Die werkplek is uitgelig as 'n belangrike instelling vir die voorkoming van nie-oordraagbare siektes. Die werksomgewing vorm die werknemer se gesondheid en gesondheid gedrag, en dien as 'n versneller of verhoeding in die bepaling van chroniese siekte. Baie min navorsing in die Afrika konteks het gefokus op hoe om die werksomgewing te transformeer om die risiko faktore wat verband hou met nie-oordraagbare siektes te voorkom en beheer.

Die doel van die navorsing was om 'n werkplek gesondheidbevordering program te ontwerp, implementeer en te evalueer, en om die risiko faktore van nie-oordraagbaar siektes onder die werksmag by 'n kommersiële aanleg in Suid-Afrika, te voorkom of te verminder. Die doelstellings was om veranderinge in risikofaktore in nie-oordraagbaar siektes in die werksmag, sowel as siekteverlof te monitor, afwesigheid te monitor, en die koste en gevolge van die werkplek gesondheidbevordering program te evalueer.

## Artikel 1

### Titel

Risiko faktore vir kroniese siektes in werkers by n kommersiële kragentrale in Suid Afrika

### Agtergrond

Wereldwyd word meer as die helfte van jaarlikse sterftes toegeskryf aan chroniese siektes en in Suid Afrika is chroniese siektes die oorsaak van tot 40% van sterftes.

### Doel

Die doel van die studie was om die insidensie van chroniese siektes, die geassosieerde risiko faktore en gewoontes, asook die 10 jaar risiko profiel vir kardiovaskulêre siektes van werkers, in n kommersiële kragentrale, in die Wes Kaap provinsie, Suid Afrika te beskryf.

### Metodes

Honderd ses en vyftig werkers is willekeurig selekteer vanuit die totale werksmag van 1743 werkers. Hierdie werkers het vraelyste voltooi oor chroniese siektes, alkohol gebruik, tabak rook, dieet, fisiese aktiwiteit asook psigo-sosiale stress. Vir n

biometriese gesondheidsondersoek is die werkers se bloeddruk, totale cholesterol, ewekansige bloedglukose, liggaamsmassa-indeks, middellyfomvang en middel-tot-heupverhouding Om hulle 10 jaar kardiovaskulere risiko profiel te bepaal, is n grafiek gebaseerde gevalideerde nie-laboratorium algoritme gebruik.

## **Resultate**

Die gemiddelde ouderdom van die deelnemers was 42.8(25-64) jaar, en 65.2% was manlik. n Kwart (26%) was rokers, 29.4% het oormatige alkohol gebruik gerapporteer, 73% het ongesonde dieet met onvoldoende vrugte en groente inname gerapporteer en 64.1% was fisies onaktief. Die deelnemers se sistoliese en diastoliese bloeddruk was onderskeidelik verhoog in 32.7% en 34.6%, 62.2% se totale cholesterol was verhoog, 76.9% was oorgewig of vetsugtig, en 27.1% het abdominale vetsugtigheid gehad. As n geheel was 17.4% gediagnoseer met hipercholesterolemie, 17.7% met hipertensie en 16.2% met depresie. Naastenby 34.1% het n matige tot erge verhoogte kardiovaskulere risiko gehad.

## **Gevolgtreкке**

Die insidensie van gedraggebaseerde en fisiese risiko faktore vir chroniese siektes was duidelik verhoog in die studie populasie. Daar is n behoefte vir effektiewe werksplek gebaseerde intervensies om die risiko vir chroniese siektes te verlaag. Die werksplek is uiters geskik vir doelgerigte intervensies.

## **Artikel 2**

### **Titel**

Transformasie van n werksplek omgewing om kroniese siektes te voorkom: deelnemende aksienavorsing in n Suid Afrikaanse kommersiële kragssentrale.

### **Agtergrond**

Die werksplek is n belangrike plek om kroniese siektes te voorkom. Beleid vir die transformasie van die werkplekomgewing vir beroepsgesondheid en veiligheid in Suid-Afrika fokus meer op wat om te doen, en minder oor hoe om dit te doen. Tans is daar geen riglyne beskikbaar nie, en min bewyse oor hoe om werkplekgebaseerde intervensies vir chroniese siektes te implementeer nie.

### **Doel**

Die doel van hierdie studie was om te leer hoe om die werkplek omgewing te transformeer om kardio-metaboliese risikofaktore vir kroniese siektes onder die werksmag te voorkom en te beheer in n kommersiële kragstasie in Kaapstad, Suid-Afrika.

## **Metodes**

Die studie metode is deelnemende aksie navorsing in die formaat van 'n koöperatiewe ondersoek groep. Die navorser en deelnemers het in 'n sikliese proses van beplanning, aksie, waarneming en refleksie oor 'n tydperk van twee jaar gewerk. Die groep het uitkoms-kartering gebruik om die visie, missie, grensvennote, uitkomst en strategieë te definieer. Aan die einde van die ondersoek het die groep 'n konsensus bereik oor hul sleutelleer.

## **Resultate**

Aansienlike veranderinge is waargeneem in die grensvennote: spysenieringsdienste (78% van vooruitgangspunte behaal), sport- en fisieke aktiwiteite (75%), gesondheids- en welsynsdienste (66%) en bestuursondersteuning (65%). Hoogtepunte uit 'n 10-punts konsensus oor sleutelleer het die behoefte aan: outentieke leierskap ingesluit; diverse samestelling en funksionering van die kooperatiewe ondersoek groep; waarde van uitkoms kartering; belangrikheid van bestuursbetrokkenheid in persoonlike en organisatoriese verandering; en om n gesonde leefstyl 'n maklike keuse te maak.

## **Gevolgtrekking**

Suksesvolle transformasie vereis 'n veelvoudige benadering en 'n betrokkenheid by die organisasie as 'n lewende sisteem. Toekomstige studies sal die veranderinge in die risikoprofiel van die werksmag, sowel as die koste en gevolge vir die organisasie navors.

## **Artikel 3**

### **Titel**

Veranderinge in risikofaktore vir nie-oordraagbare siektes wat geassosieer word met 'n Gesonde Keuse by die Werk program by 'n kommersiële kragstasie

### **Agtergrond**

Wereldwyd word 71% van sterftes toegeskryf aan nie-oordraagbare siektes. Die werkplek is n ideale plek vir intervensies gemik daarop om nie -oordraagbare siektes te voorkom. Meeste van die huidige relevante navorsing is egter gedoen in hoë inkomstelende.

### **Doel**

Die doel van hierdie studie was om die veranderinge in die risikofaktore vir kroniese siektes wat verband hou met 'n Gesonde Keuses by die Werkprogram by 'n kommersiële kragstasie in Suid-Afrika, te evalueer.

## Metodes

Dit was 'n voor-en-na-studie in 'n lukraak gekose steekproef van 156 werknemers by basislyn en opvolg na 2 jaar. Die program het gefokus op spyseniering, fisiese aktiwiteit, gesondheids- en welsynsdienste en bestuursondersteuning. Deelnemers het vraelyste voltooi oor hul deelname in die program, tabakrook, skadelike alkoholgebruik, vrugte en groente-inname, fisieke aktiwiteit, psigo-sosiale stres en geskiedenis van kroniese siektes. Kliniese observasies het ingesluit bloeddruk, totale cholesterol, ewekansige bloedglukose, liggaamsmassa-indeks, middellyfomvang en middel-tot-heupverhouding. Die 10-jarige kardiovaskulêre risiko van deelnemers is bereken deur gebruik te maak van 'n gevalideerde algoritme. Data is geanaliseer met die Statistiese Pakket vir die Sosiale Wetenskappe

## Resultate

Gepaarde data is verkry vir 136 werknemers. Hul gemiddelde ouderdom was 42.7 jaar (SD 9.7); en 64% was manlik. Die inname van voldoende vrugte en groente het toegeneem van 27% tot 64% ( $p < 0.001$ ). Die werkers se fisiese aktiwiteit volgens die riglyne, het gestyg van 44% tot 65% ( $p < 0.001$ ). Skadelike alkoholgebruik het van 21% tot 5% afgeneem ( $p = 0.001$ ). Daar was beduidende verbeteringe in sistoliese en diastoliese bloeddruk (gemiddelde verskil  $-10.2\text{mmHg}$  (95% CI:  $-7.3$  tot  $-13.2$ ) en  $-3.9\text{mmHg}$  (95% CI:  $-1.8$  tot  $-5.8$ ),  $p < 0.001$ ) en totale cholesterol (gemiddelde verskil  $-0.45\text{mmol/l}$  ( $-0.3$  tot  $-0.6$ )). Daar was geen beduidende verbeteringe in BWI nie. Psigososiale stres van verhoudings met kollegas, persoonlike finansies en persoonlike gesondheid is aansienlik verbeter. Daar was 'n nie-beduidende afname van 4,5% in mense met 'n hoë 10-jaar kardiovaskulêre risiko

## Gevolgtrekking

Die program was geassosieer met 'n beduidende afname in gedrags-, metaboliese en psigo-sosiale risikofaktore vir nie-oordraagbare siektes

## Artikel 4

### Titel

Koste- en gevolganalise van die “Gesonde Keuses by die Werk” program om nie-oordraagbare siektes in 'n kommersiële kragstasie te voorkom in Suid-Afrika

### Agtergrond

Die werkplek word geïdentifiseer as 'n ideale instelling vir die implementering van 'n Gesonde Keuses by die Werk program om nie-oordraagbare siektes te voorkom en te beheer. In die lig van die beperkte hulpbronne wat beskikbaar is vir gesondheidsbevorderingsprogramme in die werkplek in lae en middelklas inkomste lande, het hierdie studie 'n koste- en gevolganalise uitgeoefen deur middel van deelnemende aksie om die nie oordraagbare siekte -risikoprofiel van werkers te verbeter teen 'n lae koste.

## **Metodes**

Inkrementele koste is oor 'n tydperk van twee jaar verkry uit die aktiwiteite van die “Gesonde Keuses by die Werk”-program by 'n kommersiële kragssentrale. Altesame 156 werknemers het deelgeneem aan die intervensie, maar die effek is deur alle werknemers ervaar. 'n Gesondheidsrisiko-evaluasie by basislyn en jaarlikse opvolg is ingesluit in die resultate van die studie

## **Resultate**

Die totale inkrementele koste oor die twee jaar tydperk vir 1745 werknemers het \$ 3745 beloop. Die koste per werknemer op 'n jaarlikse basis was \$ 1, wat gelei het tot -10.2mmHg in sistoliese bloeddruk, -3.87mmHg in diastoliese bloeddruk, -0.45mmol / l in totale cholesterol, beduidende verbetering ( $p = 0.001$ ) in skadelike alkoholgebruik, vrugte en groente-inname en fisiese onaktiwiteit. Daar was egter geen verbetering in die korrelasie tussen siekte afwesigheid en risikofaktore vir nie-oordraagbare siektes nie.

## **Gevolgtrekking**

Die koste vir die implementering van die multi-komponent program, asook die beduidende gevolge van die omskakeling van die werkplekomgewing was laag. Die bevindinge van hierdie studie sal nuttig wees vir klein, medium en groot organisasies, die nasionale departement van gesondheid en soortgelyke instellings in lae en middle inkomste lande.

## **Gevolgtrekking**

Die hoë voorkoms van gedrags en metaboliese risiko faktore vir NCDs onder deelnemers by die kragstasie het gelei tot die ontwerp van 'n doeltreffende WHPP om risiko's te verminder. 'N gesonde keuse by werk program (HCW) ingesluit 'n veelvlakkige benadering en is geassosieer met 'n aansienlike vermindering in die risiko faktore vir NCDs. Die koste om die HCW program te implementeer was laag met beduidende gevolge in die transformasie van die werkplek omgewing, wat nuttige bevindinge vir klein, medium en groot organisasies hou.

## **Dedication**

I dedicate this work to my three kids, Michael, Jordan and Hannah. You have allowed me to follow my passion hereby sacrificing quality time I should have spent with you on the three years I have worked on my PhD. I dedicate 1 year to each of you. We are a team, and together we have accomplished this thesis. This is for us. I love you for a thousand years and will love you for a thousand more.

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# Table of Contents

<b>Declaration</b> .....	ii
<b>Abstract</b> .....	iii
<b>Article 1</b> .....	iii
<b>Title</b> .....	iii
<b>Background</b> .....	iii
<b>Objectives</b> .....	iii
<b>Methods</b> .....	iii
<b>Results</b> .....	iv
<b>Conclusion</b> .....	iv
<b>Article 2</b> .....	iv
<b>Title</b> .....	iv
<b>Background</b> .....	iv
<b>Methods</b> .....	iv
<b>Results</b> .....	v
<b>Conclusion</b> .....	v
<b>Article 3</b> .....	v
<b>Title</b> .....	v
<b>Background</b> .....	v
<b>Objective</b> .....	v
<b>Methods</b> .....	v
<b>Results</b> .....	v
<b>Conclusion</b> .....	vi
<b>Article 4</b> .....	vi
<b>Title</b> .....	vi
<b>Abstract</b> .....	vi
<b>Methods</b> .....	vi
<b>Results</b> .....	vi
<b>Conclusion</b> .....	vii
<b>Conclusion</b> .....	vii
<b>Opsomming</b> .....	viii
<b>Artikel 1</b> .....	viii
<b>Titel</b> .....	viii
<b>Agtergrond</b> .....	viii
<b>Doel</b> .....	viii

<b>Metodes</b> .....	viii
<b>Resultate</b> .....	ix
<b>Gevolgtrekke</b> .....	ix
<b>Artikel 2</b> .....	ix
<b>Titel</b> .....	ix
<b>Agtergrond</b> .....	ix
<b>Doel</b> .....	ix
<b>Metodes</b> .....	x
<b>Resultate</b> .....	x
<b>Gevolgtrekking</b> .....	x
<b>Artikel 3</b> .....	x
<b>Titel</b> .....	x
<b>Agtergrond</b> .....	x
<b>Doel</b> .....	x
<b>Metodes</b> .....	xi
<b>Resultate</b> .....	xi
<b>Artikel 4</b> .....	xi
<b>Titel</b> .....	xi
<b>Agtergrond</b> .....	xi
<b>Metodes</b> .....	xii
<b>Resultate</b> .....	xii
<b>Gevolgtrekking</b> .....	xii
<b>Dedication</b> .....	xiii
<b>Acknowledgements</b> .....	xiv
<b>CHAPTER 1</b> .....	1
<b>INTRODUCTION AND OVERVIEW OF THE THESIS</b> .....	1
<b>1.1 INTRODUCTION</b> .....	1
<b>1.2 THE SOCIAL VALUE OF THE STUDY</b> .....	1
<b>STUDY SETTING OF THE THESIS</b> .....	4
<b>1.3 KNOWLEDGE GAP AND SCIENTIFIC VALUE OF THE STUDY</b> .....	4
<b>1.4 OVERVIEW OF THE THESIS</b> .....	4
<b>1.5 ETHICAL CONSIDERATIONS</b> .....	6
<b>1.6 CONCLUSION</b> .....	6
<b>1.7 REFERENCES</b> .....	6
<b>CHAPTER 2</b> .....	9
<b>SCIENTIFIC VALUE OF THE STUDY</b> .....	9

<b>2.1 INTRODUCTION</b> .....	9
<b>2.2 WHAT IS A WORKPLACE HEALTH PROMOTION PROGRAMME</b> .....	10
<b>2.3 EFFECTIVENESS OF WORKPLACE HEALTH PROMOTION PROGRAMS – DO THEY WORK?</b> .....	10
<b>Evidence regarding the effect of WHPPs on behavioural and metabolic risk factors</b> .....	10
<b>2.4 TRANSFORMING THE WORKPLACE ENVIRONMENT – HOW DO THEY WORK</b> .....	15
<b>2.5 THE CONCEPTUAL FRAMEWORK</b> .....	17
<b>2.6 THE KNOWLEDGE GAP – WHAT IS IT WE DON'T KNOW AND NEED TO STUDY</b> .....	19
<b>2.7.1 AIM</b> .....	20
<b>2.7.2 OBJECTIVES</b> .....	20
<b>2.8 THE SOUTH AFRICAN WORKPLACE CONTEXT</b> .....	21
<b>2.9 THE STUDY SETTING</b> .....	22
<b>2.10 CONCLUSION</b> .....	23
<b>2.11 REFERENCES</b> .....	23
<b>CHAPTER 3</b> .....	29
<b>3.1 Article 1:</b> .....	30
<b>Risk factors for non-communicable diseases in the workforce at a commercial power plant in South Africa</b> .....	30
<b>3.1.1 INTRODUCTION</b> .....	30
<b>3.1.2 METHODS</b> .....	31
<b>3.1.3 DATA COLLECTION</b> .....	32
<b>3.1.4 DATA MANAGEMENT AND ANALYSIS</b> .....	32
<b>3.1.5 RESULTS</b> .....	33
<b>3.1.6 RISKY BEHAVIOURS FOR NCDs</b> .....	33
<b>3.1.7 RISK FACTORS FOR CARDIOVASCULAR DISEASE</b> .....	35
<b>3.1.8 NON-COMMUNICABLE DISEASES</b> .....	36
<b>3.1.9 DISCUSSION</b> .....	37
<b>3.1.10 LIMITATIONS</b> .....	38
<b>3.1.11 RECOMMENDATIONS</b> .....	39
<b>3.1.12 CONCLUSION</b> .....	39
<b>3.1.13 ACKNOWLEDGEMENTS</b> .....	39
<b>3.1.14 DECLARATION</b> .....	39
<b>3.1.15 REFERENCES</b> .....	40
<b>3.2 Article 2:</b> .....	43
<b>Transforming the workplace environment to prevent non-communicable chronic diseases: participatory action research in a South African power plant</b> .....	43

<b>3.2.1 BACKGROUND</b> .....	43
<b>3.2.2 METHODS</b> .....	44
<b>Study design</b> .....	44
<b>The setting</b> .....	44
<b>Forming the co-operative inquiry group</b> .....	44
<b>Initiating the inquiry</b> .....	45
<b>Action and observation</b> .....	45
<b>Reflection and planning</b> .....	46
<b>Documentation of research</b> .....	46
<b>Building of final consensus</b> .....	46
<b>3.2.3. RESULTS</b> .....	47
<b>Caterer and food supplier</b> .....	47
<b>External service providers</b> .....	48
<b>Health and wellness</b> .....	49
<b>Managers and decision makers</b> .....	49
<b>Consensus of CIG</b> .....	50
<b>3.2.4 DISCUSSION</b> .....	51
<b>Strengths and limitations</b> .....	53
<b>Recommendations</b> .....	55
<b>3.2.4 CONCLUSION</b> .....	55
<b>3.2.5 ACKNOWLEDGMENTS</b> .....	55
<b>Author contributions</b> .....	56
<b>Disclosure statement</b> .....	56
<b>Ethics and consent</b> .....	56
<b>Funding information</b> .....	56
<b>Paper context</b> .....	56
<b>ORCID</b> .....	56
<b>3.2.6 REFERENCES</b> .....	56
<b>3.3 Article 3:</b> .....	60
<b>Changes in risk factors for non-communicable diseases associated with a Healthy Choices at Work program at a commercial power plant.</b> .....	60
<b>3.3.1 INTRODUCTION</b> .....	60
<b>3.3.2 METHODS</b> .....	62
<b>Study design</b> .....	62
<b>Setting</b> .....	62
<b>Study population and sample size calculation</b> .....	62

Recruitment .....	62
Intervention.....	63
Data collection.....	64
Data analysis .....	65
Ethical considerations.....	65
<b>3.3.3 RESULTS .....</b>	<b>65</b>
Participation in wellness activities .....	65
Change in psychosocial stress factors.....	66
Behavioural risk factors .....	67
Metabolic risk factors .....	67
Non-communicable diseases .....	67
Cardiovascular risk.....	68
<b>3.3.4 DISCUSSION .....</b>	<b>68</b>
<b>3.3.5 LIMITATIONS.....</b>	<b>70</b>
<b>3.3.6 RECOMMENDATIONS .....</b>	<b>71</b>
<b>3.3.7 CONCLUSION .....</b>	<b>71</b>
<b>3.3.8 ACKNOWLEDGMENTS .....</b>	<b>71</b>
<b>3.3.9 COMPETING INTERESTS .....</b>	<b>72</b>
<b>3.3.10 AUTHORS' CONTRIBUTIONS.....</b>	<b>72</b>
<b>3.3.11 REFERENCES .....</b>	<b>72</b>
<b>3.4 Article 4: .....</b>	<b>79</b>
<b>Cost and consequence analysis of Healthy Choices at Work (HCW) program to prevent non communicable diseases in a commercial power plant, South Africa .....</b>	<b>79</b>
<b>3.4.1 INTRODUCTION .....</b>	<b>79</b>
<b>3.4.2 METHODS.....</b>	<b>81</b>
Study design.....	81
Setting .....	81
The health choices at work program .....	81
Evaluation of incremental costs.....	82
Evaluation of changes in risk factors for NCDs .....	82
Evaluation of changes in sick leave .....	83
Ethical considerations.....	84
<b>3.4.3 RESULTS .....</b>	<b>84</b>
Incremental costs .....	84
Changes in risk factors .....	84
Changes in sick leave.....	86

<b>3.4.4 DISCUSSION</b> .....	87
<b>Affordability</b> .....	87
<b>Capacity to implement</b> .....	87
<b>Feasibility according to national circumstances</b> .....	88
<b>Impact on health equity of interventions</b> .....	88
<b>The need to implement a combination of population-wide policy interventions and individual interventions</b> .....	88
<b>3.4.5 LIMITATIONS</b> .....	89
<b>3.4.6 RECOMMENDATIONS</b> .....	89
<b>3.4.7 CONCLUSION</b> .....	89
<b>3.4.8 ACKNOWLEDGMENTS</b> .....	89
<b>3.4.9 COMPETING INTERESTS</b> .....	90
<b>3.4.10 AUTHORS' CONTRIBUTIONS</b> .....	90
<b>3.3.11 REFERENCES</b> .....	90
<b>CHAPTER 4</b> .....	95
<b>CONCLUSIONS AND RECOMMENDATIONS</b> .....	95
<b>4.1 INTRODUCTION</b> .....	95
<b>4.2 CONCLUSIONS RELATED TO THE OBJECTIVES</b> .....	95
<b>4.2.1 Objectives 1 and 2</b> .....	95
<b>How to transform the business, psychosocial and physical environments to help prevent and control NCDs</b> .....	95
<b>4.2.3 Objective 3: To evaluate changes in behavioural and metabolic risk factors in the workforce</b> .....	98
<b>4.2.4 Objective 4: To monitor changes in sick leave in the workforce</b> .....	98
<b>4.2.5 Objective 5: To evaluate the costs and consequences of the intervention</b> .....	98
<b>4.3 CONCLUSIONS RELATED TO CONCEPTUAL FRAMEWORK</b> .....	98
<b>4.4 CONTRIBUTION TO METHODOLOGY</b> .....	100
<b>4.4.1 Participatory action research</b> .....	100
<b>4.4.2 Systems thinking</b> .....	102
<b>4.5 RECOMMENDATIONS</b> .....	103
<b>4.5.1 Recommendations for the design of WHPPs</b> .....	103
<b>Education</b> .....	103
<b>Persuasion</b> .....	103
<b>Incentivisation</b> .....	104
<b>Training</b> .....	104
<b>Restriction</b> .....	104

<b>Environmental restructuring</b> .....	104
<b>Modelling</b> .....	104
<b>Enablement</b> .....	105
<b>4.5.2 Recommendations for future design and development of HCW program</b> .....	106
<b>4.5.3 Recommendations for the health sector</b> .....	106
<b>4.5.4 Future research</b> .....	106
<b>4.6 IMPACT OF THE FINDINGS</b> .....	107
<b>4.7 CONCLUSION</b> .....	107
<b>4.8 REFERENCES</b> .....	108
<b>ADDENDUMS</b> .....	107
<b>A. ETHICS APPROVAL LETTER</b> .....	107
<b>B. PERMISSION TO CONDUCT STUDY</b> .....	114
<b>C. CIG INFORMED CONSENT FORM</b> .....	115
<b>D. PARTICIPANT INFORMED CONSENT FORM</b> .....	118
<b>E. WELLNESS SCREENING FORM</b> .....	121
<b>F. GPAQ FORM</b> .....	122
<b>G. AUDIT – ALCOHOL SCREENING FORM</b> .....	124

# CHAPTER 1

## INTRODUCTION AND OVERVIEW OF THE THESIS

### 1.1 INTRODUCTION

This chapter describes the rationale for the study and the importance of undertaking this research in South Africa. The chapter makes an argument for the social value of the study and provides an overview of the thesis.

### 1.2 THE SOCIAL VALUE OF THE STUDY

Non-communicable diseases (NCD) are the leading cause of deaths globally, accounting for 71% of deaths and 85% of premature deaths (< 70 years) in low- and middle-income countries (LMIC) (1)(2)(3). In 2014, cardiovascular diseases (stroke and heart attacks), cancer, respiratory diseases (chronic obstructive pulmonary disease and asthma), and diabetes accounted for 43% of all deaths in South Africa (4). These diseases are expected to increase by 17% by 2025 (5) and particularly affect LMIC if action is not taken (3). The prevalence of NCDs increases with age, due to a combination of physiological and genetic factors, as well as with environmental and behavioural factors (1).

Tobacco smoking, harmful use of alcohol, physical inactivity and unhealthy diets are four key modifiable behavioural risk factors that contribute to morbidity and mortality from NCDs (3). Tobacco smoking is responsible for 7.2 million deaths per annum globally, excess salt for 4.1 million deaths, harmful alcohol use for 3.3 million deaths and insufficient physical activity for 1.6 million deaths (5). A systematic analysis for the global burden of disease (1990-2-15), found that systolic blood pressure (192.7 million – 231.1 million), smoking (134.2 million to 163.1 million), fasting plasma glucose (125.1 million to 163.5 million), high BMI (83.8 million to 158.4 million), high total cholesterol (74.6 million to 105.7 million) alcohol use (77.2 million to 93.0 million) and excess salt use (49.3 to 127.5 million) were the greatest determinants of global daily adjusted life years (DALYs) (5).

Unhealthy diets, tobacco smoking, alcohol and insufficient physical activity contribute to four key metabolic changes: increased blood pressure, obesity, hyperglycaemia and hyperlipidaemia (1). Blood pressure is the leading metabolic risk factor to which 19% of deaths are attributed, followed by obesity and diabetes (1).

NCDs impact the lives of individuals, families, communities and health care systems through premature death, disability, impoverishment and discrimination (6). Cardiovascular diseases, cancer, respiratory diseases, diabetes and mental illness could result in the global financial loss of US\$ 47 trillion between 2010 and 2030 (6).

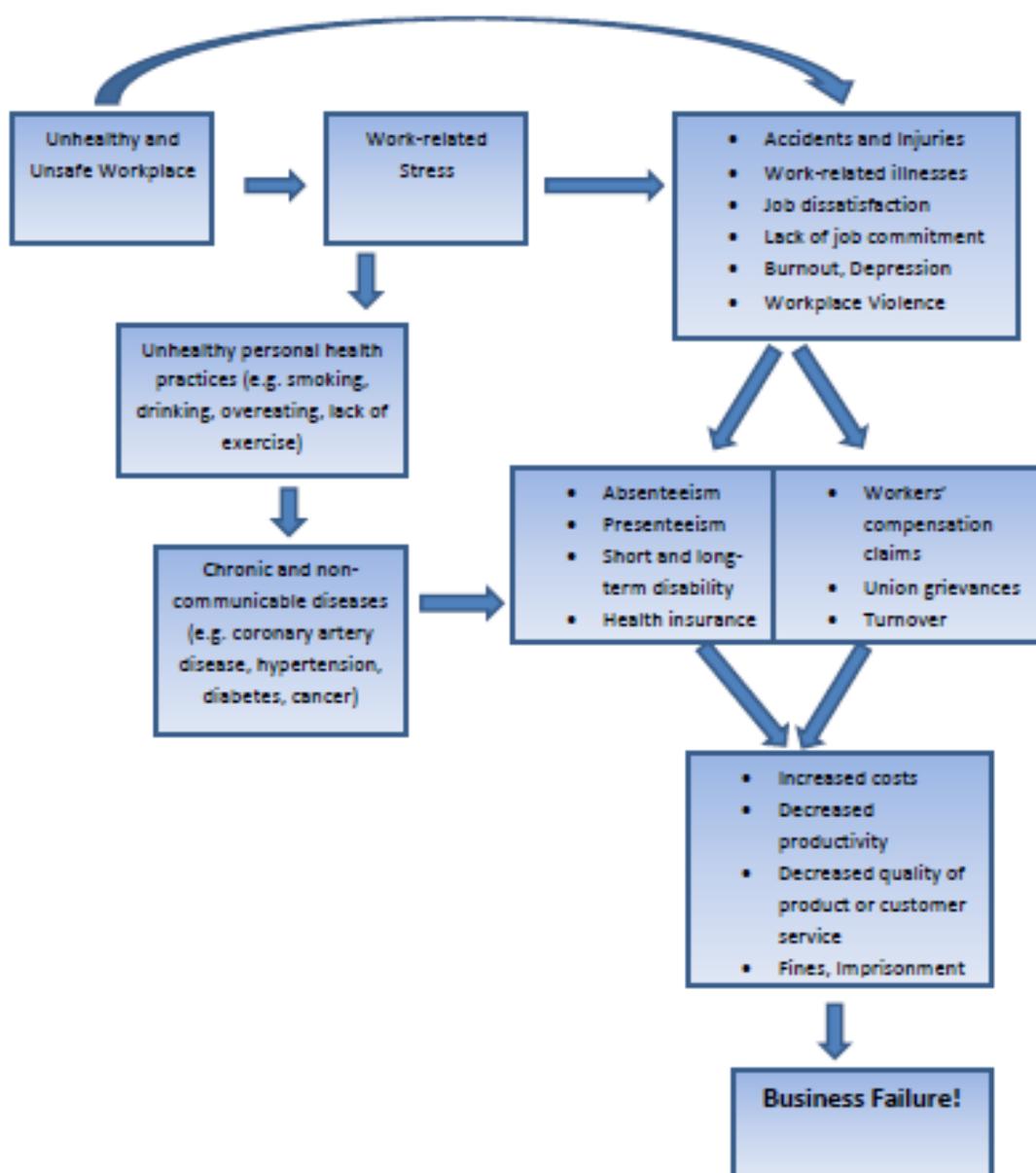
NCDs can be prevented by focusing on the reduction of risk factors associated with these diseases and implementing cost-effective interventions. The impact of NCDs can be reduced by adopting a comprehensive approach, which includes all sectors of government and industry in a collaborative commitment to risk reduction (3). The World Health Organization's (WHO) global plan of action for the prevention and control of NCDs emphasises multi-sectoral collaboration at national and global levels (7). Their goals include relative reductions in the prevalence of key risk factors: 10% for harmful alcohol use, 10% for insufficient physical activity,

30% for mean population salt intake, 30% for tobacco smoking, 25% for high blood pressure and a slowing down of the increase in diabetes (7). However progress has been slow and a call for concerted action in all sectors is needed to speed up progress on NCDs (6).

NCDs account for 51% of all deaths in South Africa with cardiovascular disease being the biggest contributor (19%), followed by cancer (10%), diabetes (7%) and chronic respiratory disease (4%) (8). The burden of NCDs in South Africa has highlighted key factors to consider when addressing the problem: a) NCDs inadvertently affect the poorest and challenge the capacity of the health system to care for chronic diseases; b) the high burden of NCDs is reflected in the increase in deaths due to diabetes, chronic kidney disease, cancer of the prostate and cervix, and depression; c) an integrated model of care and robust surveillance is needed for chronic care; d) national initiatives which include policy and legislation are an imperative for developing and implementing programmes in rural and urban settings for the prevention and control of NCDs (9).

NCDs not only contribute to prolonged illness, but also absence from work, which poses a problem in ensuring workers are economically active (10). Due to the daunting NCD trends, employers suffer financial loss as a result of illness. With the constant demand for increased productivity in the global marketplace, employers have realised that the existing occupational health services are insufficient (11). Sick leave utilisation is high and sickness can be attributed to unhealthy behaviours, an aging workforce and increased work-related stress (11). There are therefore also economic or business reasons to promote healthy lifestyles and prevent NCDs. The economic costs of NCDs, through loss of workers and reduced productivity, is substantial (12) and national economic growth is reduced by 0.5% for every 10% increase in NCDs (7). The annual loss to the South African economy of absenteeism is estimated at R2 billion and absenteeism is higher amongst those with NCD related risk factors such as obesity. Worksites and organisations are therefore directly affected by NCDs due to increased absenteeism, reduced work-related productivity and increased potential for disability (13). Research has also shown that a stressful work environment, with low levels of control and high levels of demand, exacerbates the NCD risk profile for employees.

There is a strong business case to ensure that workers are physically and mentally well through health promotion in the workplace. The business case for having a workplace health promotion program is illustrated in Figure 1.1. The illustration shows how accidents and acute injuries affect the organisation, how the physical and mental health of workers affect the organisation and depicts how an unsafe and unhealthy workplace can impact on stress and lead to increased NCDs and contribute to business failure (14). Organisations who have the best health and safety records, and have the most physically and mentally healthy workers, are most successful.



**Figure 1.1: Business case for workplace health promotion: Source: Joan Burton (14)**

The workplace is highlighted as an important setting for prevention of NCDs by the WHO and this is endorsed by the Sixtieth World Health Assembly (10). The workplace is ideally positioned to reach a great proportion of the adult population for health promotion and lifestyle behaviour change (15). The workplace setting can also facilitate co-worker support and provide opportunities for reinforcement of behaviour change within a supportive environment (16). The work environment directly shapes employee health, safety, and health behaviours, can act as an accelerator or preventer of chronic disease, and determines individual health behaviours through physical and psycho-social mechanisms (17). Risks posed by the work environment vary according to employee socioeconomic status; the impacts of work stressors and their relationship to health behaviours and chronic diseases (18). Evidence shows that job hazards (downsizing, restructuring, inadequate staffing, job strain/demands) and health behaviour are highly correlated (15)(19).

Workplace factors associated with risk of NCDs can be categorised into three groups; namely; the business environment (e.g. organisational practises and policies, downsizing, restructuring, inadequate staffing, work related rewards ); the psychosocial environment (e.g. job strain, low job control, long hours, shift work, relationships with colleagues, work norms and social support); and the physical environment ( access to opportunities for physical activity, healthy food or tobacco smoking) (20).

The thesis therefore focuses on how to prevent behavioural and metabolic risk factors for chronic diseases in the workplace by transforming the physical, business and psychosocial workplace environment. By addressing the burden of disease in the workplace, employees who make up a substantial proportion of the population can be reached through behaviour change interventions and environmental changes. This contributes to action being taken on social determinants of health in a cost effective manner to strengthen health systems.

## **STUDY SETTING OF THE THESIS**

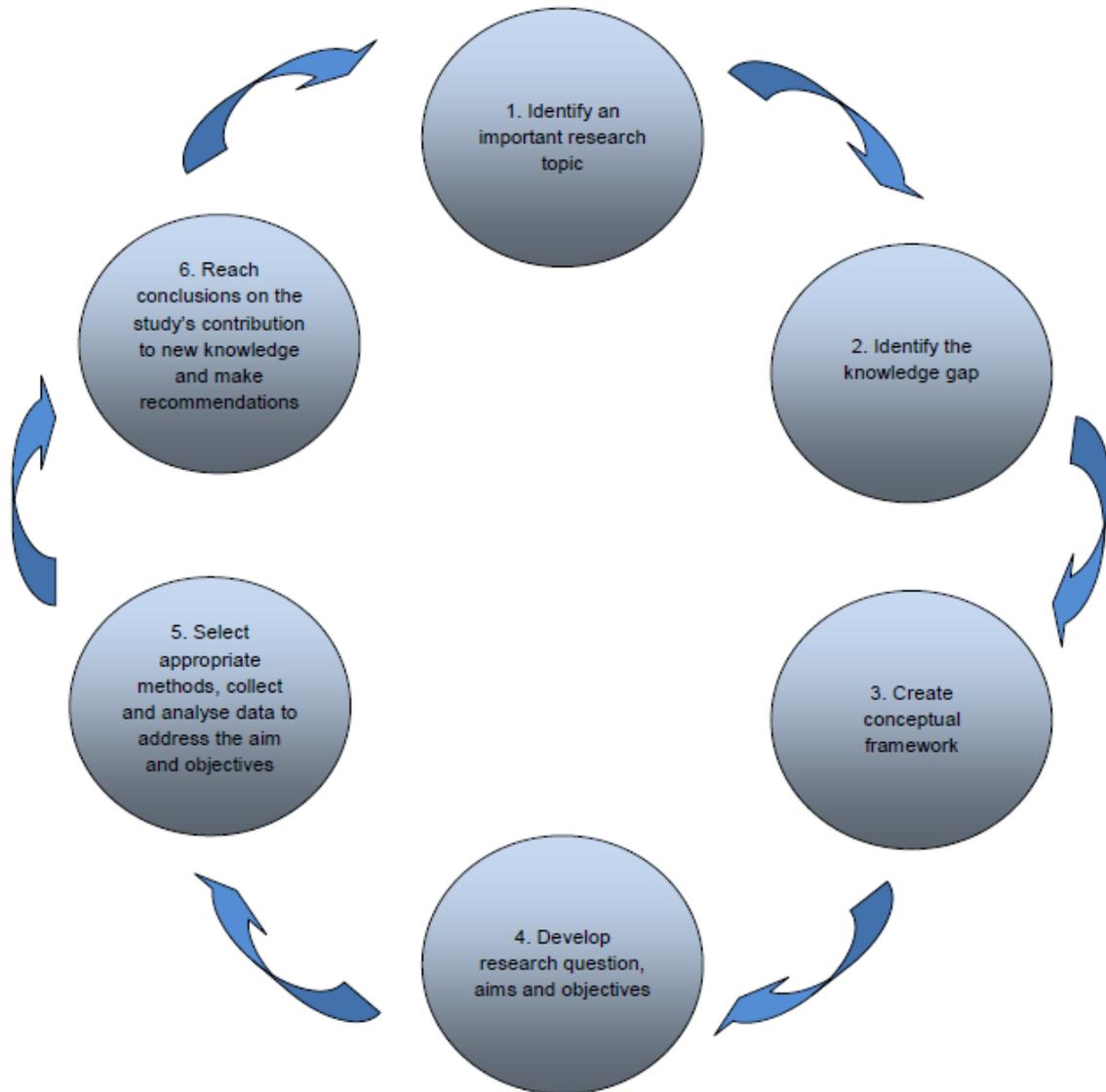
An industrial workplace in South Africa focussing on generating commercial energy was investigated to determine how to implement a workplace health promotion program to prevent NCDs using participatory action research. Baseline health risk assessments will identify employees at risk and an action research study will conceptualise the design of a cost effective workplace health promotion program.

### **1.3 KNOWLEDGE GAP AND SCIENTIFIC VALUE OF THE STUDY**

The next chapter makes an argument for the scientific value of this study and the knowledge gap to be addressed. Most of the evidence on workplace health promotion programs (WHPP) and transformation of the workplace environment are from high-income countries, with few effective interventions in LMIC (16). Most WHPPs focus on office-based settings, self-selected participants and targeted interventions by health professionals rather than the transformation of the whole workplace environment. More evidence was needed of the benefits of transforming the organisational environment as a whole through a multicomponent, multidisciplinary and collaborative approach to change behaviour and tackle NCDs in our context. This thesis examined whether the implementation of such a WHPP would result in significant reductions in behavioural, metabolic and psychosocial risk factors for NCDs and result in cost effective interventions, which could be replicated in similar settings.

### **1.4 OVERVIEW OF THE THESIS**

In order to envisage the thesis as a whole, the diagram in Figure 1.2 provides the reader with the step wise approach followed, from identifying the research topic and knowledge gap; developing a conceptual framework; defining the research question, aim and objectives; presenting the contribution to new knowledge; and making final conclusions and recommendations.



**Figure 1.2 Overview of the thesis (adapted from Lesham and Trafford 2007)(21)**

### **Step 1: Identify an important research topic**

Chapter 1 outlines the research topic and the social value of the study.

### **Step 2: Identify the knowledge gap**

Chapter 2 reviews the literature in order to establish what is already known about the topic “How to transform the workplace environment to prevent and control risk factors associated with NCDs’ and to identify the knowledge gap that the thesis will address.

### **Step 3: Create conceptual framework**

Chapter 2 also constructs a conceptual framework for the thesis that is derived from the literature and provides an overarching framework for the design, development and evaluation of a workplace health promotion programme.

#### **Step 4: Develop research question, aim and objectives**

The research question, aim and objectives related to the knowledge gap are also presented in Chapter 2.

#### **Step 5: Select appropriate methods, collect and analyse data to address the aim and objectives**

Chapter 3 includes four articles each of which provides information on the methods used to address the aim and objectives, the results and a discussion of the results. One article has been published, one articles accepted for publication and two articles are presented in a submission ready format.

Article 1: The article reports on a survey to measure the prevalence of reported NCDs, risk factors for NCDs, and 10-year cardiovascular risk amongst the workforce.

Article 2: The article presents the findings of participatory action research on how to transform the business, psychosocial and physical environments to help prevent and control NCDs.

Article 3: The article presents the results of a before-and-after study looking at changes in NCD risk factors associated with the implementation of the WHPP.

Article 4: The article analyses the incremental costs and consequences of the intervention in terms of changes in risk factors and sick leave.

#### **Step 6: Reach conclusions on the study's contribution to new knowledge and make recommendations**

The conclusions and recommendations of the thesis and its contribution to new knowledge is presented in chapter 4.

## **1.5 ETHICAL CONSIDERATIONS**

Ethics approval was obtained from the Health and Research Ethics Committee (HREC) of Stellenbosch University (S15/08/165) and permission obtained from the power plant to conduct the study. The risks to participants were minimal and the benefits/ risk ratio was favourable. All participants gave written informed consent and their confidentiality and privacy was respected in the reporting of findings.

## **1.6 CONCLUSION**

Chapter 1 presented the social value of the study and the importance of the research topic. It also included an overview of the setting and thesis as a whole. In the following Chapter, the scientific value of the study, conceptual framework, knowledge gap, aim and objectives of the study will be presented.

## **1.7 REFERENCES**

1. World Health Organization. Non-communicable diseases [Internet]. 2018 [cited 2018 Jul 11]. Available from: <http://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
2. World Health Organisation. Global Action Plan for the prevention and control of non-

- communicable diseases 2013 – 2020 [Internet]. 2013 [cited 2018 May 23]. Available from:  
[http://africahealthforum.afro.who.int/IMG/pdf/global\\_action\\_plan\\_for\\_the\\_prevention\\_and\\_control\\_of\\_ncds\\_2013-2020.pdf](http://africahealthforum.afro.who.int/IMG/pdf/global_action_plan_for_the_prevention_and_control_of_ncds_2013-2020.pdf)
3. World Health Organization. Global status report on non communicable diseases 2010 [Internet]. Alwan A, editor. World Health Organisation. 2010 [cited 2018 Jul 4]. Available from: [http://www.who.int/nmh/publications/ncd\\_report\\_full\\_en.pdf](http://www.who.int/nmh/publications/ncd_report_full_en.pdf)
  4. World Health Organization. South Africa, World Health Organization: Non Communicable Disease (NCD) Country Profiles [Internet]. 2014 [cited 2018 Feb 18]. p. 2014. Available from: [http://www.who.int/nmh/countries/zaf\\_en.pdf](http://www.who.int/nmh/countries/zaf_en.pdf)
  5. Forouzanfar MH, Afshin A, Alexander LT, Biryukov S, Brauer M, Cercy K, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* [Internet]. 2016 [cited 2018 Aug 18];388(10053):1659–724. Available from:  
[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(16\)31679-8/fulltext?code=lancet-site](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(16)31679-8/fulltext?code=lancet-site)
  6. NCD Alliance. Advocacy Agenda of People Living with NCDs [Internet]. 2017 [cited 2018 Jul 11]. Available from: <https://www.sancta.org.za/product/advocacy-agenda-of-people-living-with-ncds/>
  7. WHO. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. [Internet]. World Health Organization. 2013 [cited 2017 Feb 22]. 102 p. Available from:  
[http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf)
  8. World Health Organization (WHO). | South Africa [Internet]. WHO NCD Country Profiles. 2018 [cited 2018 Nov 2]. p. 2018–21. Available from:  
[http://www.who.int/nmh/countries/zaf\\_en.pdf](http://www.who.int/nmh/countries/zaf_en.pdf)
  9. Mayosi BM, Flisher AJ, Lalloo UG, Sitas F, Tollman SM, Bradshaw D. The burden of non-communicable diseases in South Africa. *Lancet* [Internet]. 2009 [cited 2017 Jul 29];374(9693):934–47. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/19709736>
  10. World Health Organization. WHO Global Plan of Action on Workers' Health (2008-2017): Baseline for Implementation. Global country survey 2008/2009. Executive summary and survey findings. [Internet]. Geneva; 2013. Available from:  
[http://www.who.int/occupational\\_health/who\\_workers\\_health\\_web.pdf](http://www.who.int/occupational_health/who_workers_health_web.pdf)
  11. Kirsten W. Making the Link between Health and Productivity at the Workplace — A Global Perspective. *Ind Health* [Internet]. 2010 [cited 2017 Mar 14];25(48):251–5. Available from: [https://www.jstage.jst.go.jp/article/indhealth/48/3/48\\_3\\_251/\\_pdf](https://www.jstage.jst.go.jp/article/indhealth/48/3/48_3_251/_pdf)
  12. Bloom DE, Cafiero E, Jané-Llopis E, Abrahams-Gessel S, Reddy Bloom L, Fathima S, et al. The Global Economic Burden of Non-communicable Diseases [Internet]. World Economic Forum. Geneva; 2011 [cited 2017 Apr 14]. Available from:  
<http://ideas.repec.org/p/gdm/wpaper/8712.html>

13. Jourbert J, Norman R, Lambert EV, Groenewaid P, Schneider M, Bull F, Bradshaw D et al. Initial burden of disease estimates for South Africa, 2000. Cape Town, South Africa Medical Research Council. South African Medi [Internet]. 2003 [cited 2016 Jun 12];93(9):2003. Available from:  
<http://www.samj.org.za/index.php/samj/article/view/2327/1595>
14. Burton J. WHO Health Workplace Framework and Model: Background and supporting literature and practise [Internet]. World Health Organisation. Geneva; 2009 [cited 2017 Nov 19]. Available from:  
[http://www.who.int/occupational\\_health/healthy\\_workplace\\_framework.pdf](http://www.who.int/occupational_health/healthy_workplace_framework.pdf)
15. Quintiliani L, Sattelmair J, Activity P, Sorensen G. The workplace as a setting for interventions to improve diet and promote physical activity [Internet]. World Health Organisation. 2007 [cited 2017 Jul 18]. Available from:  
<http://www.who.int/dietphysicalactivity/Quintiliani-workplace-as-setting.pdf>
16. Joan Burton. Healthy Workplace Framework and Model: Background and Supporting Literature and Practices [Internet]. World Health Organization. 2010 [cited 2017 Nov 19]. p. 1–131. Available from:  
[http://www.who.int/occupational\\_health/healthy\\_workplace\\_framework.pdf](http://www.who.int/occupational_health/healthy_workplace_framework.pdf)
17. Tryon K, Bolnick H, Pomeranz JL, Pronk N, Yach D. Making the workplace a more effective site for prevention of noncommunicable diseases in adults. J Occup Environ Med [Internet]. 2014 [cited 2017 Jun 18];56(11):1137–44. Available from:  
<https://pdfs.semanticscholar.org/99e4/8ba6fb113c79b3e0d90a19bd513859d94bc1.pdf>
18. Artinian, N. T., Fletcher, G. F., Mozaffarian, D., Kris-Etherton, P., Van Horn, L., Lichtenstein, A. H., ... & Burke LE. Interventions to promote physical activity and dietary lifestyle changes for cardiovascular risk factor reduction in adults a scientific statement from the American Heart Association. Circulation [Internet]. 2010 [cited 2018 Jul 4];122(4):406–41. Available from:  
<https://digitalcommons.wayne.edu/cgi/viewcontent.cgi?article=1002&context=nursingfrp>
19. Sorensen G, McLellan DL, Sabbath EL, Dennerlein JT, Nagler EM, Hurtado DA, et al. Integrating worksite health protection and health promotion: A conceptual model for intervention and research. Prev Med (Baltim) [Internet]. 2016 [cited 2015 May 12];91(August):188–96. Available from: <http://dx.doi.org/10.1016/j.ypmed.2016.08.005>
20. Sorensen G, Landsbergis P, Hammer L, Amick BC, Linnan L, Yancey A, et al. Preventing chronic disease in the workplace: A workshop report and recommendations. Am J Public Health [Internet]. 2011 [cited 2017 Jun 12];101(SUPPL. 1):196–207. Available from: <http://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.2010.300075>
21. Leshem S, Trafford V. Overlooking the conceptual framework. Innovations in education and teaching international. 2007. 93-105 p.

## CHAPTER 2

# SCIENTIFIC VALUE OF THE STUDY

### 2.1 INTRODUCTION

This Chapter makes an argument for the scientific value of the study by summarising what is already known about workplace-based health promotion programmes (WHPP) for the prevention of NCDs. In addition, the Chapter describes the conceptual framework that was used to guide the design and evaluation of the WHPP in this study. This leads on to a discussion of the knowledge gap, aim and objectives. Finally, the Chapter describes the South African workplace context and the specific setting of this study.

Relevant and appropriate studies were found in Google Scholar, PubMed, Cochrane Library, SCOPUS and EBSCO using the terms, 'workplace', 'non-communicable diseases', 'prevention' and 'health promotion' to search. In the search, I particularly looked at recent scoping and systematic review articles, which already summarized the research on the topic as well as local studies in the African context. A second strategy was to identify key scholars in the field of study and follow their citations. In addition, I identified key journals where studies on WHPP to prevent NCDs were published.

It is evident from the social argument for the study in Chapter 1 that much work is needed to avert the upward trend in NCDs. The WHO has identified advocacy, partnerships and leadership as instrumental strategies in the prevention of NCDs (1). There is sufficient evidence demonstrating that organized systems of prevention and care, not just individual health providers, are critical in producing positive outcomes (1).

South Africa is in the midst of a health transition characterized by a growing burden of NCDs (2). The behavioural risk factors such as insufficient physical activity, harmful alcohol use, tobacco smoking and unhealthy diet are modifiable and preventable. These diseases affect both rich and poor, but the greater effect is experienced by the poor (3)(4). This calls for preventive interventions, which are both cost effective and feasible across all settings in society. The workplace has been identified by various health authorities as strategic in reaching working adults of varying socio-economic backgrounds and cultures for the prevention of NCDs (5). The WHO has therefore called on organisations to strengthen WHPPs especially for the prevention and control of NCDs (6). Traditionally, WHPP were implemented by human resource departments who were responsible for employee wellbeing and mostly for office-based employees. Employees volunteered to participate in these programs and were often the "worried well" (people who have no need for medical treatment but visit the doctor or health professional for reassurance). A considerable number of studies have demonstrated the impact of workplace interventions on behavioural and metabolic risk factors, especially in high-income countries (7)(8)(9)(10). In some organisations, single component interventions have been used in WHPPs. However, several scientific reviews have shown the success of utilizing multi-component interventions to change behaviour (11). Effective WHPPs that target environmental and not just individual changes are also needed to enable and support healthy behaviour (12). At an individual level, small changes can influence one's NCD risks such as reducing the intake of salt, sugars, fats, alcohol, smoking and including physical activity as part of one's routine. Organisations can support the health of employees through WHPPs, which can complement

community or primary care based health promotion initiatives. Nationally, stakeholders (different tiers of government, health care providers, social sector, non-governmental and voluntary organisations and industry) can strengthen and support prevention initiatives to avoid NCDs and the associated costly health complications (13).

## **2.2 WHAT IS A WORKPLACE HEALTH PROMOTION PROGRAMME**

A healthy workplace as defined by the WHO includes the following :(1)

- Health and safety concerns in the physical work environment;
- Health, safety and well-being concerns in the psychosocial work environment including organisation of work and workplace culture;
- Health promotion opportunities in the workplace; and ways of participating in the community to improve the health of workers, their families and other members of the community.

Workplace health promotion embraces two important philosophies regarding the theory of change. Firstly, healthy lifestyle can be attributed to the individual's responsibility and behaviour and secondly to forces outside of the individual's control such as the organisational environment (14). Organisations that implement WHPPs usually subscribe to one or both philosophies, which were also promulgated by the 1997 Luxembourg Declaration on Workplace Health Promotion in Europe that promoted a blending of these philosophies (15). However, many organisations tend to implement WHPPs that focus only on the individual to the exclusion of the environment.

WHPPs are initiated by employers to improve the health and wellbeing of their staff. These organisations implement programs that either prevent or slow down the progression of diseases. WHPPs can support primary, secondary, and tertiary types of prevention in the organisation. Primary prevention is targeted at the healthy population and includes activities aimed at improving physical activity, healthy eating, overweight/obesity, mental health, sensible alcohol consumption, tobacco smoking cessation, use of seat belts in cars and safe sex. Secondary prevention is targeted at individuals who have asymptomatic NCDs (hypertension, diabetes, cancer). Tertiary prevention is aimed at individuals with established NCDs with the aim of preventing complications (16).

## **2.3 EFFECTIVENESS OF WORKPLACE HEALTH PROMOTION PROGRAMS – DO THEY WORK?**

### **Evidence regarding the effect of WHPPs on behavioural and metabolic risk factors**

Amongst the systematic reviews, the reviews from the Community Preventative Services Task Force Group usefully evaluate the effectiveness of WHPPs (17). The Task Force Group is regarded as a global authority on evidence for preventative activities and follows a rigorous process of collecting, appraising, and interpreting the strength of the key interventions globally.

There are several systematic reviews on the effectiveness of WHPPs. Table 2.1 provides a summary of these systematic reviews. Strong evidence of effectiveness was found for

improvement in physical activity. Moderate evidence of effectiveness was found for programs focusing on behavioural risk factors such as tobacco use, alcohol use, seatbelt non-use and dietary fat intake as listed in Table 2.1. Limited evidence was found on body composition as well as fruit and vegetable consumption.

Scientific evidence was inconclusive for improvement in metabolic risk factors for blood pressure, blood glucose, total cholesterol and body mass index in single component interventions found in Table 2.1. Evidence of effectiveness was also found for improving mental wellbeing.

**Table 2.1 Summary of systematic reviews on effectiveness of Workplace Health Promotion Programs**

Author, title and date published	Methods	Key results	Conclusions
Malik S et al. A systematic review of workplace health promotion interventions for increasing physical activity. 2014. (18).	<p>Systematic review of 58 workplace physical activity studies to identify types of interventions and their outcomes.</p> <p>6 studies on physical activity/exercise interventions (active travel, stair walking and exercise classes).</p> <p>13 studies on counselling/support interventions via telephone, individual motivational interviewing, groups and peers.</p> <p>39 health promotion interventions (health risk assessments, health promotion messages/information via email, posters, flyers, information classes, internet)</p>	32 of the 58 studies showed a statistically significant improvement in physical activity against a control group at follow up.	<p>The studies in the review show some evidence for physical activity interventions in the workplace being efficacious.</p> <p>The results are largely inconclusive and more work is needed to determine which aspects of physical activity interventions in the workplace can increase effectiveness in the workplace.</p>
Proper K et al. The Effectiveness of Worksite Physical Activity Programs on Physical Activity, Physical Fitness, and Health. 2003. (19)	15 randomised and 11 non-randomised controlled trials. Included WHPPs aimed at improving physical activity and or fitness (cardiorespiratory	Physical activity: two out of five studies showed strong evidence for increased exercise behaviour and a great increase in energy expenditure	Strong evidence was found for programs on physical activity and musculoskeletal disorders at the worksite.

	fitness, muscle flexibility, muscle strength, body weight and body composition) and health related outcomes (general health, fatigue, musculoskeletal disorders, blood pressure and blood serum lipids).	Musculoskeletal disorders: three out of seven studies showed strong evidence for effect of exercise on neck and back pain	Insufficient evidence for a positive effect on fatigue and no evidence for an effect on cardiorespiratory fitness, muscle flexibility, muscle strength, body weight, body composition, general health, general health, blood pressure and blood serum lipids
Groeneveld I et al. Lifestyle-focused interventions at the workplace to reduce the risk of cardiovascular disease - a systematic review.2010. (20)	<p>Systematic review of 31 randomised controlled trials which</p> <ul style="list-style-type: none"> <li>a) Focused on workers</li> <li>b) Aimed at improving diet and or increasing physical activity</li> <li>c) Measured blood pressure, blood lipids, blood glucose, body weight and body fat</li> </ul> <p>Diverse interventions included: Counselling (individual) Group education or self-help (diet and physical activity) Exercise (supervised)</p>	<p>18 out of 31 RCT were high quality studies. There was strong evidence for positive effect on body fat which is one of the strongest predictor for CVD risk according to the Framingham risk score. There was strong evidence for a positive effect on body weight for participants “at risk”.</p> <p>No evidence was found for effectiveness on other outcomes due to inconsistencies in results between studies</p>	<p>Strong evidence was found for effectiveness of workplace lifestyle-based interventions on body fat and specifically body weight for populations at risk for CVD.</p> <p>Participants at high risk for CVD appeared to benefit in terms of weight reduction from lifestyle interventions, whilst interventions involving supervised exercise appeared least effective.</p>
Kahn-Marshall J et al. Making Healthy Behaviors the Easy Choice for Employees: A Review of the Literature on Environmental and Policy Changes in Worksite Health Promotion. 2012. (21)	A review of 27 studies examining the effectiveness of WHPP utilising environmental and/or policy change on its own or in combination with individually focussed	Inconclusive evidence for the effectiveness of environmental and policy changes alone to improve workers physical activity and dietary behaviours.	Limited evidence on effectiveness of environmental and/or policy changes alone.as opposed to

	<p>behaviour change strategies to change employee behaviour.</p> <p>Environmental modifications or policy changes</p> <p>Physical activity and nutrition</p> <p>Interventions for change (catering, healthy options, nutrition information, motivational signage for health, indoor and outdoor walking routes)</p>	<p>Greatest evidence for multicomponent interventions which focussed on nutrition and physical activity.</p> <p>3/5 studies showed significant increases in fruit and vegetable intake</p> <p>3/4 studies showed a reduction in BMI</p> <p>2 multicomponent interventions aimed at increasing opportunities for participation in physical activity found that self-reported physical activity levels increased among employees.</p>	<p>environmental and/or policy changes with individual level strategies.</p> <p>Effective WHPPs increased fruit and vegetable intake, improved physical activity and reduced BMI)</p>
<p>Kuoppala J et al. Work Health Promotion, Job Well-Being, and Sickness Absences—A Systematic Review and Meta-Analysis. 2008. (22)</p>	<p>46 Studies ( 14 RCTs, 1 cluster randomised trial, 7 clinical trials, 22 cohort studies, and 2 cross-sectional studies) investigated the following aspects:</p> <p>Wellbeing</p> <p>Physical wellbeing (somatic symptoms, musculoskeletal discomfort or pain)</p> <p>Mental wellbeing (psychological symptoms, mood states, mental illness and depression)</p> <p>Job wellbeing (work related mental health and exhaustion).</p> <p>Workability (physical, psychological and social capacity to work).</p> <p>Work health promotion (exercise, lifestyle and ergonomics)</p>	<p>There was moderate evidence that WHPPs reduced sickness absenteeism and reduced work ability. WHPPs appeared to increase mental wellbeing, but no increase in physical wellbeing, Exercise appeared to improve overall wellbeing and work ability. Education and psychological methods did not appear to impact sickness absenteeism or wellbeing. Activities promoting healthy lifestyle appeared to reduce sickness absenteeism</p>	<p>WHPP increases mental well-being but not physical wellbeing and general well-being. WHPP appears to promote work ability, and decrease sickness absenteeism with activities involving exercise, lifestyle and. WHPP should target physical and psychosocial work environments.</p>

<p>Task Force on Community Preventive Services. A Systematic Review of Selected Interventions for Worksite Health Promotion. 2010. (17)</p>	<p>86 studies included health risk assessments alone and HRAs plus. Before and after studies, time series or retrospective cohort studies, prospective cohort, group and individual randomised trial, other and with feedback: three elements were included</p> <ol style="list-style-type: none"> <li>1. Information on two personal health behaviours or indicators</li> <li>2. Translation of the information into individual risk scores</li> <li>3. Feedback to participants regarding behavioural risks</li> </ol> <p>Interventions include:</p> <ul style="list-style-type: none"> <li>• Health education</li> <li>• Enhanced access</li> <li>• Policies and environmental change</li> <li>• Incentives</li> </ul>	<p>Effectiveness of HRA is strong when combined with health education, with or without intervention for physical activity, smoking, dietary habits and alcohol use. Alcohol: most studies reflected beneficial effects of HRA however they do not reflect the absolute reductions of harmful alcohol use</p> <p>Dietary behaviours: effect estimates were small and in the favourable direction</p> <p>Physical activity: favourable intervention effects, however threshold differences were too great for meaningful median effect estimates,</p> <p>Seatbelt use: favourable behaviour</p> <p>Tobacco use: studies providing before and after change, showed a reduction in tobacco use.</p> <p>Blood pressure: results were not favourable for intervention. Median changes were close to zero.</p> <p>Body composition: Little to no change in body weight or BMI</p> <p>Cholesterol: interventions resulted in moderate decreases in total cholesterol.</p> <p>Risk Status: moderate changes following the interventions.</p>	<p>Interventions with HRAs are effective for substantial change in tobacco use, non-use of seatbelt, dietary fat intake, blood pressure, cholesterol, certain health risks, worker absenteeism.</p> <p>Insufficient evidence for effectiveness for changes in body fat, physical activity, fruit and vegetable intake as a result of inconsistent effect estimates</p> <p>Health risk assessments is a gateway intervention for WHPPs which includes education of <math>\geq 1</math> hour or repeated multiple times during one year in addition to multicomponent interventions</p>

		Absenteeism: median effect is small	
Goldgruber J et al. Effectiveness of workplace health promotion and primary prevention interventions: a review. 2010. (23)	17 meta-analysis and systematic reviews examined the effectiveness of primary prevention interventions	Evidence for effectiveness was found for stress (91%), physical activity, nutrition (78%), organizational development (75%), smoking (69%), ergonomics (48%) and back pain (10%).	Greatest results are evident in comprehensive multimodal programs which include relational and behavioural elements
Anderson L et al. The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity. 2009. (24)	47 studies reviewed RCT and cohort designs and non-randomised weight-related outcomes. Before and after study. Indicators included weight, BMI and percentage body fat  Information and behaviour change strategies were used to influence physical activity and diet.	Workplace nutrition and physical activity programmes achieved modest improvements in employee weight status at 6–12-month follow-up. A pooled loss of 1.3kgs was found in 9 RCT's and a reduction of 0.5 in BMI was found in 6 RCTs.	There was strong evidence of consistent modest effects on overweight and obesity outcomes.  Few studies included environmental changes to promote healthy choices in the workplace

## 2.4 TRANSFORMING THE WORKPLACE ENVIRONMENT – HOW DO THEY WORK

The evidence presented in Table 1 suggests that HRAs should be followed by multicomponent interventions to reduce the risk of NCDs. This can mean targeting multiple risk factors (e.g. unhealthy eating, physical inactivity, psychosocial stress, tobacco smoking, alcohol use) as well as multiple parts of the system (the individual, their social network and the organisational environment). Behaviour change counselling can help when targeting the individual. Small or medium sized enterprises may have the ability to target all individuals and effect change more easily than large enterprises.

Organisations wanting to implement a WHPP should be cognisant that not all WHPP programs work (25). The success of the program depends on the goals, design, implementation and evaluation (25). Organisations that adopt a WHPP with the only intent to reduce health care costs may not commit to an effective comprehensive program as their goal is narrowly focussed on a return on investment. The program must fit into the culture of the organisation and be monitored over a span of years to observe the impact. Most organisations, however, measure

impact from one quarter to the next, which is too short a timeframe. To determine if a WHPP works, an evaluation framework should include three categories namely; a) the structure of the program and how it is delivered, b) the cost and c) productivity (26). The design elements of the program should include a checklist of the following: breakdown of the intervention, alignment to demographic and health profile of the employees and their families, detail of how program is delivered and incorporated into the operational work plans, relevant topics for the demographics of the employees, evidence for interventions, consistency; use of incentives, inclusion of adequate resources and staffing, linkage of program design with organisational plan, linkage to employee benefits, tailoring to the culture of the organisation, plan to evaluate program outcomes that includes both quantitative (HRAs, disability, sickness absenteeism, and epidemiology) and qualitative (observations and interviews) data. The evaluation process should be continuous to enable refinement of the program (25).

According to Healthy People 2010 (27), the following elements are components of an effective WHPP:

- Health education that builds awareness of the need to change disseminates information and supports skill development and lifestyle behaviour change.
- Supportive social and physical environments that reflect the organization's expectations and policy regarding healthy behaviours.
- Integration of the worksite program into the organization's employee benefits, human resources infrastructure, and environmental health and safety initiatives.
- Links between health promotion and related programs like employee assistance.
- Screenings followed by counselling and education on how to best use medical services for necessary follow-up.

In a study on the state of WHPPs in South Africa, it was found that there was a lack of research in this area. While programs were in place, they were not incorporated into organisational policies. In smaller organisations, health promotion only focussed on individual health behaviour and centred particularly on risk of HIV/AIDS rather than a more comprehensive approach for the prevention of all chronic diseases. Larger organisations followed a more comprehensive holistic approach for health promotion in the workplace (28).

The evidence in Table 2.1 suggests that single interventions that target individual behavioural risks have minimal impact. The solution for behaviour change and health promotion in the workplace is found in three core components; namely behaviour change approach, supportive environment anchored by strong policy (29).

Reviews showed that there was some evidence that current approaches to environmental changes do not work in the organisation, and as such, an improvement in the design of programs that focused on environmental and or policy changes is needed.

A study conducted in 2013 on South African WHPPs, identified leadership support as vital to their success, in order to ensure that the policies and procedures are acted upon. A model based on social exchange theory was developed and tested for improving leadership support using data from 71 South African organisations (30). The theory hypothesised that company's commitment to WHPPs facilitate a relationship between leadership, provision of resources and facilities and employee wellbeing (30).

## 2.5 THE CONCEPTUAL FRAMEWORK

The conceptual framework in Figure 2.1 describes the components that need to be addressed in order to transform the workplace environment to be a more supportive environment for healthy lifestyle choices (5)(9)(31). In this model, the workplace environment includes the business environment (e.g. policies on alcohol and smoking, human resource practises), the physical environment (e.g. ease of access to health and fitness facilities, physical activity or healthy food, ergonomics and places for smoking) and psychosocial environment (e.g. relationship with colleagues, supervisors, partner and family; finding resources to work; finding clarity concerning work outputs; finding recognition, personal health; job strain, job demands, shift work; finding meaningful work). At the core is the individual, where the aforementioned environments make an impact on their choice of risky or healthy behaviours (behavioural risk factors). Behavioural risk factors are linked to metabolic risk factors and development of NCDs. The links between the three work environments and the impact on the individual are shown by the arrows. By positively transforming the workplace environment, the individual can be supported to adopt a healthy lifestyle and reduce risk factors for NCDs.

The workplace is characteristically conceptualised and managed through a mechanistic process, where hierarchy, bureaucracy, and structure govern how activities are implemented. In this mechanistic world, if instructions and procedures are exactly followed, the cogs in the machine will move smoothly in a linear and predictable pattern. However, in the real world, business, health, economics, and environment cannot be understood or explained in isolation, as they are all interconnected and interdependent. In a complex adaptive living system, where all components and sub-systems are interrelated, our business and health leaders may need to engage in a different way in order to enable change. Looking at the business through the lens of the living system a bio-psycho-social-business perspective is needed to understand and make advances in preventing NCDs (32). This implies that change may come through leveraging the relationships, feedback and connectivity that cuts across the hierarchy as well as seeing the interconnectedness of the business and health issues.

Lifestyle behaviours are not just a matter of individual choice and control, but are also influenced by the environment in which individual decision-making is embedded. For example, does this environment make healthier choices and behaviour easier, affordable and more attractive? In the workplace the interconnectedness of the business, psychosocial and physical environments, individual risk factors and NCDs, are illustrated in the conceptual framework in Figure 2.1. Theories of behaviour change and organisational change that underpin the design of the conceptual framework, include theories of behaviour change counselling and motivational interviewing.

According to the U.S. Preventative Services (USPTF), behaviour has a critical impact on health and wellbeing and as such they made recommendations for 11 behavioural counselling interventions (BCI), which can be delivered in different settings with patients (33)(34). Despite the USPSTF recommendations, the BCI's are not always delivered effectively and may not result in meaningful behaviour change. Two of these BCIs were motivational interviewing and brief behaviour change counselling. As these BCIs had been developed and evaluated further in the local South African and Cape Town context and were appropriate for use in a WHPP, they are considered in more detail (35)(36).

Motivational interviewing (MI) is an approach to motivating change in behaviour in health care settings. The design of MI originated from developments in the field of addictions and was

developed simultaneously with the stages of change model that has often been used to make sense of the application of MI (37). MI was developed pragmatically from practice in the field of addictions and as a reaction to the directive and authoritarian approaches of the 1970s and was theorised later. Clear principles and skills were identified (38). Subsequently, self-determination theory has been used to make sense of why it works (39). MI is dually a treatment philosophy and a group of skills utilised to assist individuals to increase intrinsic motivation by exploring and resolving ambivalence (40).

Motivational interviewing is not a set of techniques that are “used” on people to get them to do something they do not want to do. It is an interpersonal style and is not restricted to formal counselling settings. The components are not directive, but guiding, although they are focused on helping someone change and have a broad series of phases. The essence of MI is lost if it becomes a manipulative technique (41). MI is a method of talking with people about change and has become the favoured approach for consulting with people in a variety of health care and other settings (41). The primary goals of MI are; to create and amplify, from the individuals’ perspective, a discrepancy between present behaviour and their broader goals and values; explore and resolve ambivalence, elicit “change talk”; and set in motion the individuals natural change potential (38).

A review of 4 meta-analyses demonstrated that MI can have a moderate effect on behaviour that leads to an improvement in diet, exercise and alcohol, while smoking cessation varies from a low to moderate effect (40). MI has also been shown to have a moderate effect on body mass index, total blood cholesterol, systolic blood pressure and blood alcohol concentrations.

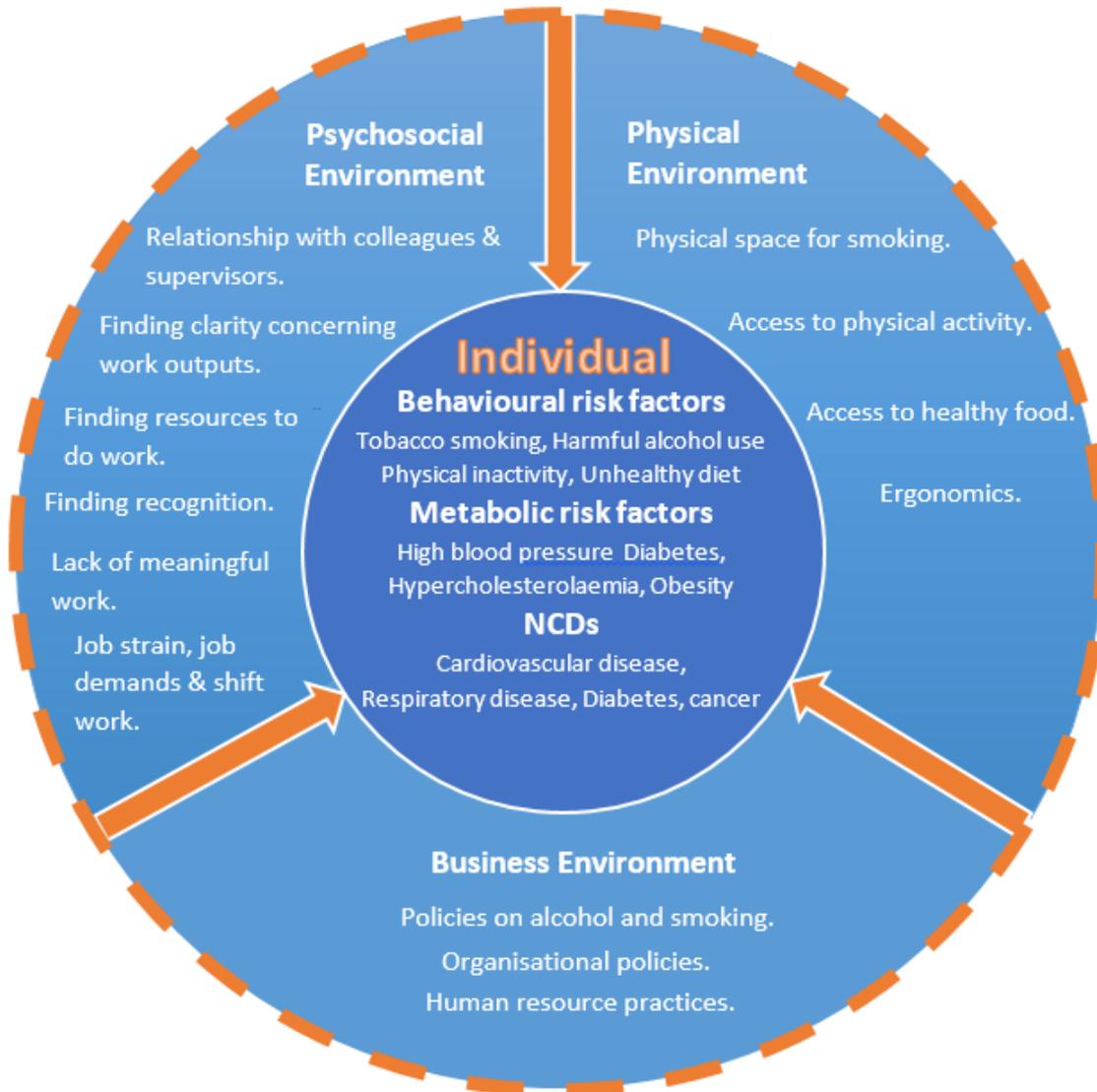
When utilising MI in quick encounters of 15 minutes, 64% of the studies showed an effect. MI outperforms traditional advice giving in the treatment of a wide range of diseases and behavioural problems (42). Large-scale studies are now needed to prove that MI can be implemented into daily clinical work in the workplace (42). MI requires less time than other cognitive-behavioural psychological treatments, and typically can be effective in four sessions (40).

The 5A’s approach has also been identified as a framework for structuring brief behaviour change counselling (BBCC)(43)(44) . BBCC is applicable in low resourced organisations and has the ability to enable behaviour change (45) . The 5As have been defined as: Ask patients about unhealthy behaviours, Advise patients to change, Assess readiness to change, Assist patients to make changes, and Arrange follow-up). Within the South African context a model of BBCC has been developed that integrates the 5As with a guiding style derived from motivational interviewing (46)(47).

In order to implement training of BBCC, a training program is essential. For competency in BBCC clinicians are required to undergo essential training that will equip them on:

- a) Using a guiding style of counselling (collaborative, evocative, empathic, respectful and focused on behaviour change)
- b) Using communication skills (reflective listening, recognising, eliciting and responding to change talk, exchanging information)
- c) Using the 5 A steps (Ask, Alert, Assess, Assist, Arrange).
- d) Counselling employees relating to the four risk factors for NCDs (48).

For this reason, brief behaviour change counselling which is based on the principles of MI has potential in the transformation of the workplace environment.



**Figure 2.1: Inter-relationship between the organisational environment and individual risk of NCDs.**

## 2.6 THE KNOWLEDGE GAP – WHAT IS IT WE DON'T KNOW AND NEED TO STUDY

Most of the evidence on WHPPs and transformation of the workplace environment are from high-income countries, with few studies from LMIC. Most WHPPs focus on office-based settings, self-selected participants and target interventions by health professionals rather than the transformation of the whole workplace environment. More evidence was needed of the benefits of transforming the organisational environment as a whole through a multicomponent approach that focused on multiple risk factors as well as the individual and their organisational environment. WHPP are also known as Workplace Wellness Programs (WWP) or Employee Wellness Programs (EWP) in South Africa.

The South African human resource body, the South African Board for People Practitioners (SABPP), developed an overview of the Employee Wellness Standards (49) for organisations

and identified two short comings: a) most wellness programs address physical and emotional wellness only as opposed to all the dimensions (spiritual, financial, social, occupational) b) most wellness efforts consist of ad hoc events such as once-off annual days for specific wellness issues e.g. fitness, blood donation. (49). The SABPP have listed the following objectives for wellness programs:

- To promote opportunities and guidance that enable employees to engage in effective management of their own physical, mental, spiritual, financial and social well-being.
- To enable the employer to manage all aspects of employee wellness that can have a negative impact on employees' ability to deliver on organisational objectives and to demonstrate the impact of wellness activities on the achievement of organisational objectives.
- To promote a safe and healthy working environment in pursuit of optimum productivity and preservation of human life and health.
- To reduce employee risk emanating from health and wellness issues.
- To contain health and wellness costs.
- To enhance the employment value proposition by means of promoting a culture of individual health and overall organizational wellness (49).

Different role players within organisations have different interests in terms of the effectiveness of WHPPs. Employers may focus on employee health, positive work influences and the dimensions of wellness; wellness departments may be concerned about the mutual benefits to employees and the organisation; whilst the unions may be interested in the legislation of health and safety of the workers (50). Evaluations however often fail to include baseline measures of health and risk factors and organisations may rely on proxy measures such as WHPP utilisation rates, reduction in absenteeism, employees with HIV returning to work, reporting on chronic diseases and employee buy-in on programs.

This thesis therefore attempted to address the need for more studies of WHPPs from LMIC and to evaluate a multicomponent design. The study intended to examine whether the implementation of such a WHPP would result in significant reductions in behavioural, metabolic and psychosocial risk factors for NCDs and result in cost effective interventions, which could be replicated in similar settings.

## **2.7 THE AIM AND OBJECTIVES**

### **2.7.1 AIM**

The aim was to design, implement and evaluate a WHPP to prevent or reduce the risk factors for NCDs amongst the workforce at a commercial power plant in South Africa.

### **2.7.2 OBJECTIVES**

The specific objectives related to the design and implementation of the WHPP were:

To explore how to transform the business, psychosocial and physical environments to reduce the risks and risk factors for NCDs.

To explore how to enable individual behaviour change within the workplace to help prevent and reduce risk factors for NCDs.

The specific objectives, which related to the evaluation of the WHPP, were:

To monitor changes in behavioural, metabolic and psychosocial risk factors in the workforce associated with the implementation of the WHPP.

To monitor changes in sick leave in the workforce associated with the WHPP.

To evaluate the costs and consequences of the intervention.

## **2.8 THE SOUTH AFRICAN WORKPLACE CONTEXT**

Health in the South African workplace is governed by the National Occupational Health and Safety Act of 2003 (51). The primary objective of this Act is to ensure the number of accidents and diseases in the workplace is kept to a minimum, whereby government, employers and employees adopt and implement a culture of safety and disease prevention. South African workplaces, that manage their employees' wellness using EWPs, define employee wellness differently and have little baseline data with which to measure the effectiveness of their EWPs (50).

The occupational health legislative framework in South Africa is complex and numerous government departments contribute to it. Occupational health (OH) activities for the mines and quarries is governed by the Department of Mineral Resources (DMR) through the Mine Health and Safety Act (MHSA)(52). The Department of Labour (DoL) through the Occupational Health and Safety Act (OHSA) administers OH in all other sectors (53). The governance of occupational health services is inadequate and is not prioritised within the health system (54). Occupational health services have been delivered in a fragmented manner within a complex legislative framework (54). Several government departments were assigned both conflicting and overlapping functions, which resulted in poor policy cohesion and ineffective service delivery. This has led to poor control of occupational health services and a lack of accountability (54). The South African labour law favours physical health, wherein employee wellness is not defined. Although the South African labour relations framework provides a mechanism for health interventions for workers, little is done in terms of risk analysis for physical and psychological risks (55). The National Department of Health's (NDoH) strategic objective is to reduce risk factors and improve management for NCDs by implementing the strategic plan for the prevention and control of non-communicable diseases 2013-17.

Organisations are categorised by The Companies Act of 2008 according to the type of business structure in South Africa. They can be listed as a private company, public company, sole proprietorship, partnership, personal liability company, state owned or parastatal companies, non-profit organization, foreign and external companies. The commercial power plant in this study was a parastatal, which is a public corporation allowed to raise money publically, whereas other state owned corporations depend on government funding for capital financing.

Employment in the formal business sector in 2017 are listed as follows

- mining and quarrying (452 862)
- manufacturing (1 172 060)
- electricity, gas and water supply (63 625)
- construction( 601 097)
- wholesale, retail and motor trade and restaurants (2 154 201)
- transport, storage and communication (467 818)

- finance, insurance, real estate and business services (2 240 144)
- community, social and personal services (2 626 447)

The commercial power plant in this study would be listed under electricity, gas and water supply with an employment base of 63 625 out of the 9 778 254 average total formal sector employment. The electricity industry is the smallest employing industry compared to the government who has 27% (2.58 million) of employed people in South Africa (56).

Small enterprises in South Africa are classified as companies employing 100 or less people, medium enterprises employ between 100-999 people and large employees have more than 1000 people. The power plant in this study is the fourth largest power utility in the world and is the largest and best performing of the South African government's assets across all sectors. Despite being the smallest formal business sector in South Africa, the findings will be important for industries who are similar in design, for example industrial sites and manufacturing plants as well as for government since its link as a government parastatal.

## 2.9 THE STUDY SETTING

The study took place in a commercial power plant on the west coast, near Cape Town, South Africa. The power plant's workforce was primarily made up of engineers, technicians, plant operators, chemists, electricians, artisans and support staff. The power plant supplied 5% of South Africa's total electricity needs and about 50% of the electricity demands of the Western Cape. The power plant was a critical part of the national electricity supply, but according to planned schedules, had to shut down for routine maintenance and refuelling. During these "outages", employees had to work shifts and extended hours in order to maximise the duration of the outage, which also impacted on their health and wellness. The organisation at the time of study was experiencing severe budget constraints, high turnover of staff and low morale.

Health in the workplace was managed by the health and wellness department, which was governed by policies and procedures for the energy sector. The purpose of the health and wellness department was to manage occupational health services and employee wellness, with two key focus areas: 1) Manage occupational health services (medical surveillance, sick absenteeism, incapacity due to illness or injuries, people with disability (PWD), occupational injuries and diseases; and 2) Manage employee wellness (office based primary care, promote wellness and chronic disease management). The onsite health and wellness department employed seven clinical staff: a medical practitioner, five occupational health nurses, a physical therapist (the researcher) and two administrators who were responsible for providing a service to 1743 permanent employees as well as contract staff.

The organisation hosted annual wellness days where healthy lifestyle was promoted to the staff, but these were often poorly attended and attracted those already committed to looking after their health. This is common in workplaces where health risk assessments are conducted. Within the organisation, employees were subsidised with private health insurance in addition to treatment received at the onsite medical centre. They were also offered subsidised meals from an external caterer contracted by the organisation. The power plant was located within a nature reserve, not utilised by the employees. There was a sport and recreation department, which was not functioning due to lack of funds. There were no recreational or physical activity facilities at the workplace. Previous health risk assessment results conducted at the wellness days were analysed, but not translated into meaningful policy and actions.

Health issues in the organisation were traditionally addressed by the health and wellness department and in a hierarchical “top down” approach. Programs were provided to the employees and developed by the organisation with no buy in from employees. Annual medicals performed on employees showed an increase in NCD risk factors in an aging population. In 2014, eight NCD-related mortalities were reported in eight consecutive months amongst the permanent employees. This was also part of the motivation for conducting this study.

## 2.10 CONCLUSION

In this chapter I argued for the scientific value of the study by providing an overview of what is known about the effectiveness of WHPPs as well as a conceptual framework that assisted with the design and implementation of the program evaluated in this thesis. The knowledge gap to be addressed was described along with the aim and objectives of the study to address this gap. Finally, an overview of South African workplaces and the specific workplace setting for the study was given.

## 2.11 REFERENCES

1. Tripathy J. Partnerships in noncommunicable disease prevention and control. *Int J Non Communicable Dis* [Internet]. 2017 [cited 2018 Oct 7];2:102–6. Available from: <http://www.ijnccd.org/text.asp?2017/2/4/102/225981>
2. Mayosi BM, Flisher AJ, Lalloo UG, Sitas F, Tollman SM, Bradshaw D. The burden of non-communicable diseases in South Africa. *Lancet* [Internet]. 2009 [cited 2017 Jul 29];374(9693):934–47. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/19709736>
3. World Health Organization. NCDs and Development [Internet]. World Health Organisation. 2007 [cited 2018 Aug 17]. Available from: [http://www.who.int/nmh/publications/ncd\\_report\\_chapter2.pdf](http://www.who.int/nmh/publications/ncd_report_chapter2.pdf)
4. World Health Organization. Global status report on non communicable diseases 2010 [Internet]. Alwan A, editor. World Health Organisation. 2010 [cited 2018 Jul 4]. Available from: [http://www.who.int/nmh/publications/ncd\\_report\\_full\\_en.pdf](http://www.who.int/nmh/publications/ncd_report_full_en.pdf)
5. Joan Burton. Healthy Workplace Framework and Model: Background and Supporting Literature and Practices [Internet]. World Health Organization. 2010 [cited 2017 Nov 19].p.1–131.Availablefrom: [http://www.who.int/occupational\\_health/healthy\\_workplace\\_framework.pdf](http://www.who.int/occupational_health/healthy_workplace_framework.pdf)
6. World Health Organization. WHO Global Plan of Action on Workers’ Health (2008-2017): Baseline for Implementation [Internet]. 2013 [cited 2017 Mar 3]. Available from: [http://www.who.int/occupational\\_health/who\\_workers\\_health\\_web.pdf](http://www.who.int/occupational_health/who_workers_health_web.pdf)
7. C3 Collaborating for health. Workplace health initiatives : evidence of effectiveness [Internet]. Vol. 44. 2011 [cited 2017 Nov 2]. Available from: <https://www.c3health.org/wp-content/uploads/2017/09/Workplace-health-initiatives-review-of-the-evidence-v-2-20140903-1.pdf>
8. Bellew B, St George A, King L. Workplace screening programs for chronic disease prevention : a rapid review [Internet]. 2012 [cited 2017 Aug 4]. Available from:

[https://www.saxinstitute.org.au/wp-content/uploads/04\\_Workplace-screening-programs-for-chronic-disease-preventi.pdf](https://www.saxinstitute.org.au/wp-content/uploads/04_Workplace-screening-programs-for-chronic-disease-preventi.pdf)

9. Sorensen G, Landsbergis P, Hammer L, Amick BC, Linnan L, Yancey A, et al. Preventing chronic disease in the workplace: A workshop report and recommendations. *Am J Public Health* [Internet]. 2011 [cited 2017 Jun 12];101(SUPPL. 1):196–207. Available from: <http://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.2010.300075>
10. Financial SL. CHRONIC DISEASE IN THE WORKPLACE : FOCUS ON PREVENTION [Internet]. 2016 [cited 2017 Apr 2]. Available from: <https://www.sunlife.ca/static/canada/Sponsor/About Group Benefits/Group benefits products and services/The Conversation/Bright Papers/files/GB10267-E.pdf>
11. Cantera CM, Puigdomènech E, Ballvé JL, Arias OL, Clemente L, Casas R, et al. Effectiveness of multicomponent interventions in primary healthcare settings to promote continuous smoking cessation in adults: A systematic review. *BMJ Open* [Internet]. 2015 [cited 2018 Aug 14];5(10). Available from: <https://bmjopen.bmj.com/content/bmjopen/5/10/e008807.full.pdf>
12. Prochaska J, Prochaska J. A Review of Multiple Health Behavior Change Interventions for Primary Prevention. *Am J Lifestyle Med* [Internet]. 2011 [cited 2017 Jun 11];5(3):1–21. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3865280/pdf/nihms340366.pdf>
13. Griffiths J, Griffiths J. ‘ Stakeholder Involvement . ’ 2007 [cited 2018 Oct 7];44(September):0–40. Available from: <http://www.who.int/dietphysicalactivity/griffiths-stakeholder-involvement.pdf>
14. Shain M, Kramer DM. Health promotion in the workplace: Framing the concept; reviewing the evidence. *Occup Environ Med* [Internet]. 2004 [cited 2018 Sep 17];61(7):643–8. Available from: <https://oem.bmj.com/content/oemed/61/7/643.full.pdf>
15. ENWHP. European Network for Workplace Health Promotion [Internet]. 2013 [cited 2018 Sep 23]. Available from: [http://www.enwhp.org/fileadmin/user\\_upload/pdf/ENWHP-image\\_brochure-final.pdf](http://www.enwhp.org/fileadmin/user_upload/pdf/ENWHP-image_brochure-final.pdf)
16. Goetzel RZ, Ozminkowski RJ. The Health and Cost Benefits of Work Site Programs. *Annu Rev Public Health*. 2008;29:303–23.
17. Soler RE, Leeks KD, Razi S, Hopkins DP, Griffith M, Aten A, et al. A Systematic Review of Selected Interventions for Worksite Health Promotion. The Assessment of Health Risks with Feedback. *Am J Prev Med* [Internet]. 2010 [cited 2018 Sep 22];38(2 SUPPL.). Available from: [https://www.thecommunityguide.org/sites/default/files/assets/Worksite2010AHRFSytematic\\_Soler.pdf](https://www.thecommunityguide.org/sites/default/files/assets/Worksite2010AHRFSytematic_Soler.pdf)
18. Malik, S. H., Blake, H., Suggs LS. A systematic review of workplace health promotion interventions for increasing physical activity. *Br J Health Psychol* [Internet]. 2014;19(1):149–80. Available from: <http://eprints.nottingham.ac.uk/38444/1/BJHP - Malik et al Final.pdf>  
<http://eprints.nottingham.ac.uk/38444/1/BJHP - Malik et al>

Final.pdf

19. Proper KI, Koning M, Beek AJ Van Der, Hildebrandt VH, Bosscher RJ, Mechelen W Van. The Effectiveness of Worksite Physical Activity Programs on Physical Activity , Physical Fitness , and Health. *Clin J Sport Med* [Internet]. 2003 [cited 2018 Sep 10];13:106–17. Available from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.456.5442&rep=rep1&type=pdf>
20. Groenewald I, Proper K, van der Beek A, Hildebrandt V, van Mechelen W. Lifestyle-focused interventions at the workplace to reduce the risk of cardiovascular disease--a systematic review. *Scand J Work Environ Heal* [Internet]. 2010 [cited 2018 Aug 12];36(3):202–15. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/20066386>
21. Kahn-Marshall JL, Gallant MP. Making Healthy Behaviors the Easy Choice for Employees: A Review of the Literature on Environmental and Policy Changes in Worksite Health Promotion. *Heal Educ Behav* [Internet]. 2012 [cited 2017 May 12];39(6):752–76. Available from: <https://doi.org/10.1177/1090198111434153>
22. Kuoppala J, Lamminpää A, Husman P. Work health promotion, job well-being, and sickness absences - A systematic review and meta-analysis. *J Occup Environ Med* [Internet]. 2008 [cited 2018 Sep 10];50(11):1216–27. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/19001948>
23. Goldgruber J, Ahrens D. Effectiveness of workplace health promotion and primary prevention interventions: a review. *J Public Health (Bangkok)* [Internet]. 2010 [cited 2018 Sep 9];18(1):75–88. Available from: <https://rd.springer.com/article/10.1007/s10389-009-0282-5>
24. Anderson LM, Quinn TA, Glanz K, Ramirez G, Kahwati LC, Johnson DB, et al. The Effectiveness of Worksite Nutrition and Physical Activity Interventions for Controlling Employee Overweight and Obesity. A Systematic Review. *Am J Prev Med* [Internet]. 2009 [cited 2018 Sep 9];37(4):340–57. Available from: <http://dx.doi.org/10.1016/j.amepre.2009.07.003>
25. Goetzel RZ, Henke RM, Tabrizi M, Pelletier KR, Loeppke R, Ballard DW, et al. Do workplace health promotion (wellness) programs work? *J Occup Environ Med* [Internet]. 2014 [cited 2017 Feb 17];56(9):927–34. Available from: <https://www.workhealthresearchnetwork.org/wp-content/uploads/2016/01/Do-Workplace-Health-Promotion-Wellness-Programs-Work.pdf>
26. Dunn RL. SAMHSA / Csap Workplace Managed Care Financial / Cost Research Evaluation Guide Ronald J . Ozminkowski , Ph . D . Senior Economist and Research Manager The MEDSTAT Group , Inc . Ann Arbor , Michigan Ron Z . Goetzel , Ph . D . Vice President , Consulting a [Internet]. 1999 [cited 2018 Oct 8]. Available from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.110.9489&rep=rep1&type=pdf>
27. Services UD of H and H. Healthy People 2010, 2nd ed. With understanding and improving health and objectives for improving health. *Orthop Nurs* [Internet]. 2000 [cited

- 2010 Oct 1];18:1–62. Available from:  
[http://www.cdc.gov/nchs/ppt/hp2010/focus\\_areas/fa21\\_2\\_ppt/fa21\\_oral2\\_ppt.htm](http://www.cdc.gov/nchs/ppt/hp2010/focus_areas/fa21_2_ppt/fa21_oral2_ppt.htm)
28. Mchunu G, Uys L. The state of workplace health promotion in South Africa: An exploratory study. *Occup Heal South Africa* [Internet]. 2008 [cited 2017 May 22];14(6):26–32. Available from:  
[https://scholar.google.co.za/scholar?hl=en&q=The+state+of+workplace+health+promotion+in+South+Africa&btnG=&as\\_sdt=1%2C5&as\\_sdtp=](https://scholar.google.co.za/scholar?hl=en&q=The+state+of+workplace+health+promotion+in+South+Africa&btnG=&as_sdt=1%2C5&as_sdtp=)
29. Laverack G. The Challenge of Behaviour Change and Health Promotion. *Challenges* [Internet]. 2017 [cited 2018 Nov 15];8(2):25. Available from: <http://www.mdpi.com/2078-1547/8/2/25>
30. Milner K, Greyling M, Goetzel RON, Silva RDA, Kolbe-alexander T, Patel D, et al. The relationship between leadership support , workplace health promotion and employee wellbeing in South Africa. *Health Promot Int* [Internet]. 2013 [cited 2018 Jul 22];30(3):514–22. Available from: <https://watermark.silverchair.com/dat064.pdf>
31. Villiers A De, Fourie J, Phil M. An ecological approach to non-communicable disease prevention in the workplace. *Occup Heal South Africa* [Internet]. 2011 [cited 2017 Nov 11]; Available from: [www.occhealth.co.za/?/...ecological+approach...non-communicable+disease+-prevention](http://www.occhealth.co.za/?/...ecological+approach...non-communicable+disease+-prevention)
32. Capra F, Luisi P. *The Systems View of Life. A Unifying Vision*. First edit. United States of America: Cambridge University Press; 2014. 144-180 p.
33. Krist AH, Baumann LJ, Holtrop JS, Wasserman MR, Stange KC, Woo M. Evaluating Feasible and Referable Behavioral Counseling Interventions. *Am J Prev Med* [Internet]. 2015 [cited 2018 Nov 15];49(3):S138–49. Available from:  
<http://dx.doi.org/10.1016/j.amepre.2015.05.009>
34. Grossman DC, Bibbins-Domingo K, Curry SJ, Barry MJ, Davidson KW, Doubeni CA, et al. Behavioral counseling to promote a healthful diet and physical activity for cardiovascular disease prevention in adults without cardiovascular risk factors: US preventive services task force recommendation statement. *JAMA - J Am Med Assoc* [Internet]. 2017 [cited 2018 Nov 7];318(2):167–74. Available from:  
<https://www.uspreventiveservicestaskforce.org/Home/.../health...recommendation.../pd..>
35. Malan Z, Mash B, Everett-Murphy K. A situational analysis of training for behaviour change counselling for primary care providers, South Africa : original research. *African Prim Heal Care Fam Med VO - 7* [Internet]. 2015 [cited 2017 Jun 12];7(1):1–10. Available from: <http://0-search.ebscohost.com/brum.beds.ac.uk/login.aspx?direct=true&db=edssas&AN=edssas.phcfm.v7.n1.a3&site=eds-live&scope=site>
36. Murphy K, Mash R, Malan Z. The case for behavioural change counselling for the prevention of NCDs and improvement of self-management of chronic conditions. *South African Fam Pract* [Internet]. 2016 [cited 2017 Apr 4];58(6):249–52. Available from:  
<https://www.tandfonline.com/doi/full/10.1080/20786190.2016.1187885>

37. Rockville M. Center for Substance Abuse Treatment. Enhancing Motivation for Change in Substance Abuse Treatment. In: 35th ed. US: Substance Abuse and Mental Health Services Administration; 1999 [cited 2018 Dec 2]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK64964/>
38. Rollnick S, Mason P, Butler C. Health Behaviour Change: A guide for practioners. China: Churhill Livingstone; 2003.
39. Markland D, Ryan RM. Interviewing Motivational Interviewing and Self – Determination Theory. J Soc Clin Psychol [Internet]. 2005 [cited 2018 Dec 2];24(6):811–31. Available from: [http://selfdeterminationtheory.org/SDT/documents/2005\\_MarklandRyanTobinRollnick\\_MotivationalInterviewing.pdf](http://selfdeterminationtheory.org/SDT/documents/2005_MarklandRyanTobinRollnick_MotivationalInterviewing.pdf)
40. Lundahl B, Burke B. The Effectiveness and Applicability of Motivational Interviewing: A Practice-Friendly Review of Four Meta-Analyses. J Clin Psychol [Internet]. 2009 [cited 2018 Oct 18];65(11):1232–45. Available from: [http://www.antonioacasella.eu/archila/lundahl\\_2009.pdf](http://www.antonioacasella.eu/archila/lundahl_2009.pdf)
41. Rollnick S, Muller W. What is Motivational Interviewing? Behav Cogn Psychother. 1995;23:325–34.
42. Rubak S, Sandbaek A, Christensen B. Motivational interviewing : a systematic review and meta-analysis. Br J Gen Pract [Internet]. 2005 [cited 2018 Oct 18];(April):305–12. Available from: [http://www.antonioacasella.eu/archila/lundahl\\_2009.pdf](http://www.antonioacasella.eu/archila/lundahl_2009.pdf)
43. Krist A, Baumann L, Summers Holtrop J. Evaluating Feasible and Referable Behavioural Counselling Interventions. Am J Prev Med. 2015;49:138–49.
44. Consortium L. Lifescripts practice manual: supporting lifestyle risk factor management in general practice [Internet]. 2nd editio. Canberra: Commonwealth of Australia; 2010. Available from: <http://www.health.gov.au/internet/main/publishing.nsf/Content/chronic-xref-pubs-lifeman>
45. Mozaffarian D, Kris-etheron P, Horn L Van, Lichtenstein AH, Kumanyika S, Kraus WE, et al. Interventions to Promote Physical Activity and Dietary Lifestyle Changes for Cardiovascular Risk Factor Reduction in Adults: A Scientific Statement From the American Heart Association. 2010 [cited 2018 Jul 4];circulatio:406–41. Available from: <https://digitalcommons.wayne.edu/cgi/viewcontent.cgi?article=1002&context=nursingfrp>
46. Malan Z, Mash B, Everett-Murphy K. Development of a training programme for primary care providers to counsel patients with risky lifestyle behaviours in South Africa. African J Prim Heal Care Fam Med [Internet]. 2015 [cited 2017 May 2];7(1):1–8. Available from: <http://www.scielo.org.za/pdf/phcfm/v7n1/24.pdf>
47. Everett-Murphy K, Mash R, Malan Z. Helping people change [Internet]. 2013 [cited 2017 Jan 8]. 1-68 p. Available from: <https://www.ichange4health.co.za/wp-content/uploads/2016/01/Helping-People-Change.pdf>
48. Co-supervisor RM. The development , implementation and evaluation of a training intervention for primary health care providers on brief behaviour change counselling ,

- and assessment of the provider ' s competency in delivering this counselling intervention . [Internet]. University of Stellenbosch; 2015 [cited 2018 Jun 10]. Available from: <http://scholar.sun.ac.za/handle/10019.1/98878>
49. Young M. Private vs . Public Healthcare in South Africa [Internet]. Western Michigaan University; 2016 [cited 2018 Sep 27]. Available from: [https://scholarworks.wmich.edu/cgi/viewcontent.cgi?article=3752&context=honors\\_theses](https://scholarworks.wmich.edu/cgi/viewcontent.cgi?article=3752&context=honors_theses)
  50. Sieberhagen C, Pienaar J, Els C. Management of employee wellness in South Africa : Employer , service provider and union perspectives. SA J Hum Resour Manag [Internet]. 2011 [cited 2018 Apr 12];9(1):1–14. Available from: <https://pdfs.semanticscholar.org/8c94/1451042047b046076fbaff31f3290de74f51.pdf>
  51. The National Occupational Health And Safety. 2003 [cited 2018 Sep 27];(July):1–59. Available from: <http://www.kznhealth.gov.za/occhealth/policy2.pdf>
  52. South Africa. Mine Health and Safety Act No. 29 of 1996. [Internet]. South Africa; 1996 p. 1–73. Available from: [http://www.dmr.gov.za/Portals/0/mhs\\_act\\_29\\_of\\_19960\\_1.pdf](http://www.dmr.gov.za/Portals/0/mhs_act_29_of_19960_1.pdf)
  53. Act SA, Act LR. Occupational Health & Safety Act ( 85 OF 1993 ) [Internet]. 1995 p. 1–13. Available from: <http://www.sun.ac.za/english/policy/Documents/Occupational Health and Safety Act.pdf>
  54. Michell K, Rispel LC. Governance of occupational healthcare services in South Africa : Cohesion or conflict ? Occup Heal South Africa [Internet]. 2017 [cited 2018 Sep 26];23(2):10–7. Available from: [www.occhealth.co.za/?/.../Governance...occupational++healthcare+services...South+Af..](http://www.occhealth.co.za/?/.../Governance...occupational++healthcare+services...South+Af..)
  55. Sieberhagen C, Rothmann S, Pienaar J. Employee Health and Wellness in South Africa: The role of legislation. SA J Hum Resour Manag [Internet]. 2009 [cited 2018 Nov 15];7(1):18–26. Available from: <https://sajhrm.co.za/index.php/sajhrm/article/view/144/172>
  56. Maynard J. South Africa's Formal Business Sector [Internet]. 2018 [cited 2018 Dec 7]. Available from: <https://www.southafricanmi.com/south-africas-formal-business-sector.html>

## CHAPTER 3

This chapter contains the four articles as follows:

**Article 1:** Risk factors for non-communicable diseases in the workforce at a commercial power plant in South Africa.

This article was published in Occupational Health Southern African Journal. Volume 24(5) September/October 2018. ISSN : 1024-6274 E-ISSN: 2226-6097.

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**Article 2:** Transforming the workplace environment to prevent non-communicable chronic diseases: participatory action research in a South African power plant

This article was published in Global Health Action 2018. 11:1, DOI: 10.1080/16549716.2018.1544336

**Article 3:** Changes in risk factors for non-communicable diseases associated with a Healthy Choices at Work program at a commercial power plant

This article will be submitted to PLOS one for publication

**Article 4:** Cost and consequence analysis of Healthy Choices at Work (HCW) program to prevent non communicable diseases in a commercial power plant, South Africa

This article will be submitted to the African Journal of Primary Health Care and Family Medicine for publication

## 3.1 Article 1:

# Risk factors for non-communicable diseases in the workforce at a commercial power plant in South Africa

### 3.1.1 INTRODUCTION

Approximately 45% of the burden of disease in South Africa is due to non-communicable diseases (NCDs).<sup>1</sup> Premature deaths in people of working age (36-64 years) are expected to increase by 41% from 2000 to 2030.<sup>2</sup> These deaths are attributed to a high prevalence of underlying risk factors.<sup>3</sup>

Deaths are attributable to four modifiable risky behaviours: tobacco smoking, unhealthy diet, physical inactivity and excessive alcohol use.<sup>1,3</sup> These behaviours contribute to several risk factors which include tobacco addiction, high cholesterol, diabetes, hypertension and obesity.<sup>4,5</sup> The risk factors are associated with NCDs such as ischaemic heart disease, cerebrovascular disease, cancers and chronic respiratory disorders.<sup>4</sup> This conceptual framework that links risky behaviours, risk factors and NCDs is derived from the South African Medical Research Council's (SAMRC) technical report on chronic diseases.<sup>4</sup> Psychosocial stress should also be considered as it increases susceptibility to mental disorders, respiratory problems and cardiovascular disease (CVD).<sup>6</sup> Work-related stress, caused by heavy workloads and strained interpersonal relationships, may thus be a risk factor for cardiovascular diseases.<sup>6</sup>

NCDs account for 40% of deaths in South Africa, with cardiovascular disease being the biggest contributor, followed by cancers, diabetes and respiratory diseases.<sup>7</sup> According to the World Health Organization (WHO), these diseases have resulted in the loss of 65 000 lives per year in South Africa.<sup>8</sup> The Western Cape province has the highest NCD risk profile of all the provinces in South Africa,<sup>7</sup> accounting for 61% of deaths compared to the national average of 38%.<sup>8</sup> The Western Cape province also has the highest tobacco smoking rates (32% of females and 46% of males smoked in 2012),<sup>9</sup> and the highest rates of overweight (27%) and obesity (16%) amongst males.<sup>8</sup> Men in the Western Cape province also have higher mean waist circumference and waist-to-hip ratios (which measures abdominal obesity) than those in other provinces.<sup>8</sup>

Occupational health is linked to public health.<sup>10</sup> The increase in the prevalence of NCDs in workers is due to a complex interaction between unhealthy lifestyles, global economic crisis, increased productivity demands, and an ageing workforce.<sup>11</sup> Job strain, stress, shift work and unhealthy food provision in canteens all contribute to increased risk for metabolic disorders, obesity and coronary artery disease.<sup>12,13</sup> These diseases result in decreased productivity, and increased absenteeism, presenteeism, disability and staff turnover in the workplace, and reduce available resources within families.<sup>14,15</sup> The work environment directly shapes employee health and health behaviours, and acts as an accelerator or preventer of chronic disease.<sup>15</sup> Effective interventions in the workplace range from individual- to corporate-level activities, and include offering healthy cooking demonstrations, health risk assessments and feedback, provision of exercise facilities, access to healthy catered food, and monitored health programmes.<sup>16</sup>

Workplace-based health risk assessments can usefully assess risk factors for NCDs.<sup>17</sup> Results of a survey of South African workplaces in 2014 showed that the three most prevalent health issues were stress, hypertension and high cholesterol.<sup>18</sup> In South Africa, 32% of businesses provide health promotion programmes, and 82% perform health risk assessments and biometric screenings.<sup>19</sup> Health promotion programmes may lack clear objectives, and may not be organised as policies that involve employees as stakeholders.<sup>20</sup> Workplace health promotion should focus on transforming the work environment (business, psychosocial and physical).

The economic costs of NCDs, such as loss of workers and reduced productivity, are high.<sup>14,21</sup> Globally, economic growth is reduced by 0.5% for every 10% increase in NCDs.<sup>22</sup> The loss to South Africa's gross domestic product from 2006 to 2015, due to stroke, coronary heart disease and diabetes, was estimated at US\$1.88 billion.<sup>23</sup> Workplace health promotion has been shown to reduce absenteeism and medical aid costs, and improve productivity, morale and risk profiles.<sup>24</sup> More evidence-based guidelines to address NCDs are needed to harness innovation and scientific knowledge and guide health promotion and disease prevention programmes.<sup>18,25,9</sup>

Studies in South Africa have investigated prevention of NCDs primarily from a community-based perspective, and those that have been conducted in workplace settings have often lacked a robust design.<sup>26</sup> Studies have also focussed on physical activity in employees and the association of high healthcare costs with risk factors. Research on health risk assessments has focussed on self-selected employees who may have been healthier than the target population.<sup>23,27,14,9</sup>

The objectives of this study were to assess risky behaviour and risk factors for NCDs, to estimate the prevalence of reported NCDs, and to calculate the 10-year risk for cardiovascular disease, amongst the workforce at a commercial power plant in the Western Cape province, South Africa.

### 3.1.2 METHODS

A cross-sectional survey was conducted, using a questionnaire and biometric testing, amongst a workforce in a commercial power plant in Cape Town in the Western Cape province of South Africa. The industry had a large workforce of engineers, plant operators, physicists, technicians, artisans and support staff. The power plant operated a Health and Wellness Department that was mandated to provide occupational health services, medical surveillance, fitness for duty assessments and health promotion. All employees received subsidised meals. There were no indoor exercise facilities. Compulsory breathalyser alcohol testing was performed on all employees every time they entered the plant.

A sample size of 156 employees was calculated, based on the 1 743 permanently employed workers in 2015 with a 95% confidence interval, an error of 7.5% and a percentage of 50%, to give the sample size required to measure a variety of unknown proportions. The equation used was:  $\text{sample size} = z^2 \times p(1-p) / e^2 / 1 + (z^2 \times p(1-p) / e^2 N)$  where  $z$  is the  $z$ -score for the desired confidence interval,  $p$  is the proportion,  $e$  is the margin of error, and  $N$  is the size of the study population.

A list of employees was obtained from the Human Resources Department. Workers were randomly selected for inclusion in the study based on random numbers generated by computer. Workers were invited to participate via e-mail, and received follow-up phone calls if they did not

respond. It was necessary to invite 395 people in total, using random sampling with replacement, as 220 did not respond to the e-mail or answer the telephone, and four declined to participate.

### 3.1.3 DATA COLLECTION

Three questionnaires and biometric health screening tools were used to collect data from the study participants. The first questionnaire elicited information on demographic characteristics (age, sex and job categories), self-reported medical history (diabetes, hypertension, hypercholesterolaemia, heart disease, lung disease, cancer and depression), and causes of psychosocial stress. All questions required a 'yes' or 'no' answer. Psychosocial stress was measured by asking respondents to indicate causes of stress from a list of 12 items. These items were previously identified by the company and incorporated in their annual health risk assessment. Respondents were also asked how well they coped with psychosocial stress.

Data on tobacco smoking and diet were elicited using the South African Demographic Health Survey Questionnaire.<sup>9</sup> Tobacco use included current and passive smoking. Questions on diet focussed on consumption of fruit and vegetables. Data on physical activity were collected using the validated Global Physical Activity Questionnaire (GPAQ).<sup>28</sup> Study participants were asked questions relating to usual levels of light, moderate and vigorous activity at work, during travel, and while performing recreational activities. Data on harmful alcohol use were collected using the validated Alcohol Use Disorders Identification Test (AUDIT) questionnaire;<sup>29</sup> questions were in a four-point Likert scale format, giving a possible total score of 41.<sup>2</sup> Systolic and diastolic blood pressures were calculated from the average of three readings, with the participant seated for five minutes and the elbow slightly flexed, using a digital sphygmomanometer (Microlife AG, 9943, Switzerland).<sup>30</sup> Point-of-care testing of random glucose and total cholesterol were conducted with a finger prick capillary blood sample, using a Cardio Chek (Polymer Technology Systems, USA).<sup>31,32</sup> Standing height was measured to the closest 0.1 cm, with a stadiometer. Weight was measured to the closest 0.1 kg, using a portable calibrated scale (Seca 813, United Kingdom). Waist circumference was measured with a stretch-resistant tape that provided a constant 100 g tension, at the narrowest point of the waist, with the subject in mid-expiration. Hip circumference was recorded at the widest point over the greater trochanters and maximal protruding part of the buttocks. Questionnaires were administered by trained health professionals from the Health and Wellness Department, at testing booths, in close proximity to employee's workstations, during both day and night shifts. All clinical measures were taken by trained health professionals. Data were collected from December 2015 to April 2016.

### 3.1.4 DATA MANAGEMENT AND ANALYSIS

Data were captured on an Excel spreadsheet and checked for errors or omissions before being analysed using IBM SPSS Statistics software Version 24.1.

Raw data from the GPAQ were analysed in terms of the metabolic equivalent of task (MET) minutes. The MET is a physiological measure that expresses the energy cost (or calories) of different levels of physical activities. One MET is the energy equivalent expended by an individual while seated at rest. MET minutes are a product of the intensity of physical activity and the duration. A minimum of 600 MET minutes per week is required for one to be considered physically active.<sup>28</sup> This translates to participating in a minimum of 150 minutes of moderate-intensity activity or 75 minutes of vigorous-intensity activity, per week. The raw data included the number of hours and minutes per week that individuals engaged with vigorous or moderate activity at work, and

during travel or recreation. The data were combined, according to the GPAQ manual, to give a total MET minutes per week.

Respondents with a score of seven or less on the AUDIT questionnaire were categorised as sensible drinkers; those with a score of 8-19 were considered to be potentially harmful drinkers, and those with a score of 20 or more, potentially dependent drinkers.

Body mass index (BMI)(kg/m<sup>2</sup>) was calculated, using height and weight (kg/m<sup>2</sup>). Participants were classified as normal (18.5-24.9 kg/m<sup>2</sup>), overweight (25-29.9 kg/m<sup>2</sup>) or obese ( $\geq 30$  kg/m<sup>2</sup>). Waist-to-hip ratio was calculated by dividing the waist circumference by the hip circumference; abdominal obesity was defined as  $> 0.95$  for males and  $> 0.86$  for females.<sup>33</sup> High (above threshold) random blood glucose was defined as  $> 11.1$  mmol/l, high total cholesterol as  $> 5.2$  mmol/l, high systolic blood pressure as  $> 140$  mmHg, and high diastolic blood pressure as  $> 90$  mmHg.<sup>34</sup>

The risk of suffering from CVD, such as a heart attack or stroke, over the next 10 years from the date of assessment was calculated for each employee, using a chart-based validated non-laboratory algorithm for South Africa, developed by Peer et al.<sup>35</sup> Factors included in the calculation of the CVD risk were sex, age ( $< 50$ , 50-60 and  $> 60$  years), systolic blood pressure, self-reported diabetes, BMI category, and reported current smoking status. The calculated risk was categorised as low ( $< 10\%$ ), moderate (10-20%) or high ( $> 20\%$ ).

Descriptive statistics were used to summarise findings. Normally distributed continuous data were reported as means ( $\pm$  standard deviation) or medians (range), and categorical data were reported as frequencies and percentages. Proportions for categorical data were compared between males and females, using the Pearson's Chi-Square Test, while medians were compared using the independent samples Mann-Whitney U Test.

Ethics approval was obtained from the Health and Research Ethics Committee (HREC) of Stellenbosch University (S15/08/165) and permission was obtained from the power plant to conduct the study.

### **3.1.5 RESULTS**

#### Demographic characteristics

A total of 156 employees participated in the survey; 102 (65.4%) males and 54 (34.6%) females. The mean age of the study participants was 42.8 ( $\pm 9.71$ ) years. Most (58.6%) were supervisors or professionals, 24.8% were general employees, 13.3% were middle managers, and 4.2% were senior managers.

#### **3.1.6 RISKY BEHAVIOURS FOR NCDs**

Table 1 presents key findings for tobacco smoking, alcohol use, fruit and vegetable intake and physical activity. Overall, 26.0% of the study participants smoked cigarettes; 44.6% of non-smokers reported passive smoking; and 29.4% were harmful or dependent drinkers. The majority (73.0%) had inadequate fruit and vegetable intake ( $< 5$  portions per day), and 64.1% were physically inactive ( $< 600$  MET min/week). The median for combined moderate and vigorous physical activity was 6.4 MET minutes per day (range: 0.0-473.6): 0.0 MET minutes per day at work (range: 0.0-252.9), 0.0 MET minutes per day during travel (range: 0.0-64.3), and 0.0 MET minutes per day during recreation (range: 0.0-195.0).



**Table 1. Prevalence of self-reported risky behaviours amongst the workforce**

Risky behaviours	Males		Females		Total		p value
	n	%	n	%	n	%	
<b>Smoking</b>							
Current tobacco smoker	21	25.0	13	27.7	34	26.0	0.739
Passive tobacco smoker	14	34.1	15	60.0	29	43.9	0.004
<b>Alcohol consumption</b>							
Sensible	55	62.5	43	82.7	96	70.6	
Harmful	31	35.2	8	15.4	37	27.2	0.038*
Dependent	2	2.3	1	1.9	3	2.2	
<b>Nutrition</b>							
Inadequate fruit and vegetable intake	61	70.9	39	76.5	100	73.0	0.480
<b>Physical activity</b>							
Inactive	61	59.8	39	72.2	100	64.1	0.124

Note: denominators differ between variables as not all respondents answered all questions

\*p value denotes difference between males and females for all categories of alcohol drinking

A higher proportion of men than women drank alcohol ( $p = 0.038$ ), while more women than men were exposed to passive smoking (60.0% vs. 34%,  $p = 0.004$ ). There were no statistically significant differences between men and women with regard to other risky behaviour factors. However, the median MET minutes per day for total physical activity were 1.79 MET minutes per day (0.0-137.1) for women and 7.86 minutes per day (0.0-473.6) for men ( $p = 0.075$ ), suggesting a tendency towards males being more physically active.

### 3.1.7 RISK FACTORS FOR CARDIOVASCULAR DISEASE

Table 2 presents objective CVD risk factors. Overall, a third exceeded the risk thresholds of 140 mmHg and 90 mmHg for systolic and diastolic blood pressure, respectively. More than 60.0% had raised total cholesterol ( $> 5.2$  mmol/l), 77.4% were overweight or obese as defined by BMI, and 27.1% had abdominal obesity.

**Table 2. Prevalence of cardiovascular risk factors amongst the power station employees**

Clinical measurement	Males n = 102		Females n = 54		Total n = 156		p value
	n	%	n	%	n	%	
Raised systolic blood pressure*	40	39.2	11	20.4	51	32.7	0.017
Raised diastolic blood pressure †	43	42.2	11	20.4	54	34.6	0.007
Hyper cholesterolaemia ‡	64	64.0	33	61.1	97	62.2	0.723
Suggested diabetes §	3	2.9	0	0.0	3	1.9	0.203
Overweight/obese¶	82	81.2	38	70.4	120	76.9	0.125
Large waist circumference, cm ¶	35	34.3	19	35.8	54	34.8	0.849
Waist-hip ratio**	35	33.7	13	13.7	42	27.1	0.009

\* $\geq 140$  mmHg; †  $\geq 90$  mmHg; ‡total cholesterol  $> 5.2$  mmol; §random glucose  $> 11.1$  mmol/l;

¶BMI  $\geq 25$  kg/m<sup>2</sup>; ¶¶  $> 102$  cm for men,  $> 88$  cm for women; \*\* $> 0.95$  for men,  $> 0.86$  for women

As shown in Table 2, significantly more men than women had elevated blood pressure but there were no differences, by sex, for total cholesterol, random glucose and body mass index. However, more men than women had abdominal obesity as measured by the waist-to-hip ratio, although not by waist circumference alone. Table 3 presents the self-reported stress-related risk factors experienced by the study participants in their homes and workplace. The three most

commonly reported risk factors were personal finances, a lack of resources to do work, and relationships with colleagues. There were no significant differences between males and females apart from stress due to one's own health or members' health (males 15.5% vs. females 30.8%,  $p = 0.028$ ). Overall, 101 (66.0%) said they coped well with stress, 45 (29.4%) sometimes struggled to cope, and 7 (4.6%) did not cope well with stress.

**Table 3. Sources of psychosocial stressors among study participants**

Stress factor	Male N = 102		Female N = 54		Total N = 156		p value
	n	%	n	%	n	%	
Personal finances	26	26.8	16	30.2	42	28.0	0.659
Lack of resources to do work	28	28.6	14	26.4	42	27.8	0.778
Relationship with colleagues	21	21.4	11	20.4	32	21.1	0.878
Own health or health of family member	15	15.5	16	30.8	31	20.8	0.028
Lack of clarity concerning work outputs	20	20.4	11	20.0	31	20.3	0.952
Lack of recognition	18	18.4	9	16.7	27	17.8	0.793
Relationship with family/children	12	12.4	12	22.6	24	16.0	0.101
Lack of meaningful work	15	15.3	8	14.8	23	15.1	0.936
Relationship with partner/spouse	16	16.5	4	7.5	20	13.3	0.123
Relationship with supervisor	8	8.2	8	14.8	16	10.5	0.201
Emotional/mental health concerns	7	7.3	6	11.5	13	8.8	0.384
Challenges with addictions	4	4.9	1	1.9	5	3.3	0.466

### 3.1.8 NON-COMMUNICABLE DISEASES

Table 4 presents self-reported and family NCDs, and use of medication for NCDs. The most common disorders were hypercholesterolaemia, hypertension and depression. The least common disorders reported were heart condition, lung condition, diabetes and cancer. Males and females did not significantly differ in the prevalence of disorders, apart from hypercholesterolaemia (males 23.1% vs females 7.5%,  $p = 0.018$ ).

Table 5 presents the estimated 10-year risk of developing a CVD for the study participants. Overall, 34.2% were at moderate- to-high risk. There was no significant difference between males and females ( $p = 0.289$ ), but the risk increased significantly with age ( $p < 0.001$ ).

**Table 4. Self-reported NCDs and use of medication**

NCD	Males		Females		Total		p value	Family history		On medication	
	n	%	n	%	n	%		n	%	n	%
Hypercholesterolemia	21	23.1	4	7.5	26	17.4	0.018	29	20.0	20	14.6
Hypertension	18	19.6	7	12.7	25	17.0	0.256	64	45.1	21	16.0
Depression	15	16.1	9	16.4	24	16.2	0.970	20	13.9	17	11.8
Diabetes	4	4.4	6	10.7	10	6.8	0.140	52	37.4	11	8.0
Heart Condition*	6	6.4	3	5.4	9	6.0	0.798	33	22.8	7	4.9
Lung condition <sup>†</sup>	5	5.3	3	5.4	8	5.3	0.992	21	14.3	6	4.0
Cancer	3	3.2	0	0.0	3	2.0	0.177	38	26.0	2	1.3

\*heart attack, stroke, angina; <sup>†</sup>asthma, COPD

Note: denominators differ between variables as not all respondents answered all questions

**Table 5. Prevalence of estimated 10-year risk of developing a cardiovascular disease**

Category	Low risk		Moderate risk risk		High	
	n	%	n	%	n	%
All (N = 152)	100	65.8	30	19.7	22	14.5
Females (n = 54)	39	72.2	7	13.0	8	14.8
Males (n = 98)	61	62.2	23	23.5	14	14.3
< 50 years (n = 108)	99	91.7	3	2.8	6	5.6
50-60 years (n = 37)	1	2.7	27	73.0	9	26.3
> 60 years (n = 7)	0	0.0	0	0.0	7	100.0

### 3.1.9 DISCUSSION

More than half of the study participants had an inadequate fruit and vegetable intake and were physically inactive, while at least a quarter were current smokers and consumed alcohol at a harmful level. Participants reported moderate levels of stress, particularly from a lack of resources to do their work and personal finances. More than half of the employees exceeded the risk thresholds for overweight/ obesity, blood pressure and total cholesterol. A substantial number were already taking medication for hypertension, hypercholesterolaemia, depression and diabetes. A third of the participants had a moderate-to-high risk of a cardiovascular event over the next 10 years. The findings demonstrate the huge opportunity for health promotion and disease prevention in the workplace setting.

A quarter of the participants smoked. The prevalence of smoking, in both men and women, was lower than in the Western Cape province general population (26.0% and 31.7%);<sup>7</sup> perhaps because our study only took into account cigarette smoking, whereas the national survey included all tobacco products. The power plant workforce had a high proportion of technicians and engineers from higher socio-economic classes, who are also known to have lower levels of tobacco smoking.<sup>36</sup> There was no difference in smoking between the sexes in our study, while men in the Western Cape province population smoked significantly more than women in 2012.<sup>7</sup> Nevertheless, significantly more women than men were exposed to passive smoking in our study.

Twenty-nine percent of the participants consumed alcohol at a harmful level. Nearly 4.5% of global NCDs are due to alcohol abuse.<sup>37</sup> South Africa has one of the highest risky drinking patterns in the world.<sup>38</sup> Risky behaviour with regard to dependant drinking in the male study participants was 2.0%; the same prevalence has been recorded for men in Africa.<sup>37</sup> In a study in the mining sector in South Africa 15.1% of employees were alcohol dependent.<sup>39,40</sup> The lower alcohol dependence prevalence of employees in the power plant can possibly be ascribed to the zero alcohol tolerance policy of the company, which has punitive consequences. Rates of harmful alcohol use amongst employees are high in the South African public, industrial and financial sectors.<sup>41</sup> According to the WHO, males in the African region, including South Africa, have higher levels of harmful drinking.<sup>38</sup> Harmful alcohol consumption amongst the employees in the study was 29.0%, compared to 25.0% in the South African mining industry in 2002<sup>40</sup> and 25.6% in Africa in 2010.<sup>37,42</sup> The prevalence of harmful drinking amongst the study participants was also higher than the rate found in the Western Cape province (16.0%).<sup>43</sup> This is of particular concern in a workplace environment that is potentially hazardous and has a zero-tolerance policy on alcohol use. Harmful alcohol consumption can be addressed in the workplace by offering behaviour-change counselling to employees.

As found elsewhere in South Africa<sup>44</sup> study participants had a diet low in fruits and vegetables, which may correlate with a higher risk for CVD, stroke, high blood pressure, cancer and obesity.<sup>7,12</sup> The finding is supported by the South African National Health and Nutrition Examination Survey,<sup>12</sup> which also found that unhealthy habits are promoted by an unhealthy eating environment and poor knowledge of the benefits of healthy food choices.<sup>45</sup>

Almost two thirds of the workforce was physically inactive, which supports data from other South African studies.<sup>12,24</sup> Meeting targets for physical activity can reduce the risk of coronary heart disease, type 2 diabetes, and certain cancers, by as much as 10%, and improve life expectancy.<sup>46</sup>

Blood pressure readings were similar to other community and workplace-based reports in South Africa.<sup>7</sup> In this study, twice as many men than women exceeded the recommended thresholds for blood pressure. Medical restrictions are placed on workers with uncontrolled hypertension in the commercial power plant, as this poses a health and safety risk to the employee and the plant.

More than three quarters of the workforce was overweight or obese; this has been ascribed to high calorie intake, poor dietary composition, low levels of physical activity and changes in the gut microbiome.<sup>13</sup> In certain South African communities, people do not necessarily perceive themselves to be overweight, and may associate this with health and wellbeing.<sup>21</sup> In most South African studies, significantly more women than men have been reported to be obese (68.0% and 20.0%, respectively), when comparing BMI.<sup>8</sup> The opposite was seen in this workforce. Obesity in the workforce is also associated with difficulty performing work in confined spaces, decreased productivity, greater absenteeism, higher turnover and cost to company.<sup>9</sup>

More employees reported medication use for diabetes than reported having diabetes. Participants may have been unaware of their status, but complied with the prescribed medication.

Employees reported moderate levels of stress, particularly from a lack of resources to do their work and personal finances. A high proportion (16.2%) of the participants reported that they had a history of depression, and 11.8% were taking medication for it. The South African stress and health survey of 2004 indicated that, on average, 10% of South Africans suffer from major depression, with females having the highest rates.<sup>47</sup> These findings warrant further research to identify triggers of depression that might be particular to this workforce.

The study participants had a higher prevalence of self-reported NCDs than expected in the South African population. The higher prevalence may be due to the older mean age of the workforce when compared to the general population. In addition, stress and the impact of shift work on circadian rhythms could contribute to the higher prevalence.

### **3.1.10 LIMITATIONS**

More than 200 of the employees initially invited did not respond. This might be ascribed to a culture of prioritising job demands over 'other' activities, although there might have been some selection bias if response was associated with one's perceived health risk. Many of the findings were self-reported conditions which could lead to further bias; participants might have under-reported alcohol consumption, tobacco use and depression. The denominators varied for some

of the questions, particularly those related to risky behaviour, where participants who were more at risk may have avoided answering, which could have led to an under-estimation of prevalence.

### **3.1.11 RECOMMENDATIONS**

A third of the sample had a moderate-to-high risk of a cardiovascular event over the next 10 years and this demonstrates the opportunity for targeted health promotion and disease prevention in the workplace. The Health and Wellness Department at the company plans to use these findings as the basis for designing a series of interventions aimed to improve the organisational environment and to promote personal behaviour change. Potential under-reporting may bias the study; therefore future studies should use objective measures of NCDs. As there was a high non-response rate to the initial request to participate, the company needs to develop easily accessible health interventions that appeal to workers. Strengthening of routine annual health risk assessments is advocated in order to monitor changes in the worker's health status more effectively.

### **3.1.12 CONCLUSION**

A third of the sample had a moderate-to-high risk of a cardiovascular event over the next 10 years. More than half of the employees exceeded the risk thresholds for overweight/obesity, raised blood pressure and total cholesterol. More than half had an unhealthy diet and were physically inactive. Employees reported moderate levels of stress, particularly from a lack of resources to do their work and personal finances.

#### **LESSONS LEARNED**

- The high prevalence of NCDs and underlying risk factors in this workforce could result in long-term illness and absenteeism.
- The workplace may be a missed opportunity to engage with health promotion and NCD prevention programmes.
- The company could benefit in terms of productivity and staff engagement from a healthier workforce if psychosocial stress and unhealthy behaviours are addressed.

### **3.1.13 ACKNOWLEDGEMENTS**

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### **3.1.14 DECLARATION**

The authors declare no conflicts of interest.

### 3.1.15 REFERENCES

1. Bradshaw D, Norman R, Lewin S, Joubert J, Schneider M, Nannan N, et al. Strengthening public health in South Africa: building a stronger evidence base for improving the health of the nation. *S Afr Med J* 2007; 97(8Pt2):643-649. Available from: [https://open.uct.ac.za/bitstream/handle/11427/22573/Steyn\\_Article\\_2007.pdf?sequence=1](https://open.uct.ac.za/bitstream/handle/11427/22573/Steyn_Article_2007.pdf?sequence=1) (accessed 12 Jun 2017).
2. J. 2007; 97(8Pt2):643-649. Available from: [https://open.uct.ac.za/bitstream/handle/11427/22573/Steyn\\_Article\\_2007.pdf?sequence=1](https://open.uct.ac.za/bitstream/handle/11427/22573/Steyn_Article_2007.pdf?sequence=1) (accessed 12 Jun 2017).
3. Harikrishnan S, Leeder S, Huffman M, Panniyammakal J, Prabhakaran D. A race against time: the challenge of cardiovascular diseases in developing economies. Centre for chronic disease control. New Delhi: India; 2014. Available from: [https://www.researchgate.net/publication/277279425\\_A\\_race\\_against\\_time\\_The\\_Challenge\\_of\\_Cardiovascular\\_Diseases\\_in\\_Developing\\_Economies](https://www.researchgate.net/publication/277279425_A_race_against_time_The_Challenge_of_Cardiovascular_Diseases_in_Developing_Economies) (accessed 5 Dec 2017).
4. World Health Organization. The global burden of disease: 2004 update. WHO; 2008. Available from: [http://www.who.int/healthinfo/global\\_burden\\_disease/2004\\_report\\_update/en/index.html](http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html) (accessed 5 Dec 2017).
5. Chronic diseases of lifestyle in South Africa: 1995-2005. Steyn K, Fourie S, Temple N (eds). MRC; 2006. Available from: <http://www.mrc.ac.za/sites/default/files/files/2016-07-14/cdl1995-2005.pdf> (accessed 8 Sep 2018).
6. Ndinda C, Chilwane D, Mokomane Z. Civil society activism in accessing healthcare in South Africa. HSRC; 2013. Available from: [www.hsrc.ac.za/en/research-data/mtree-doc/13805](http://www.hsrc.ac.za/en/research-data/mtree-doc/13805) (accessed 4 Jul 2018).
7. Gomes CM, Capellari C, Pereira DSG, Volkart PR, Moraes AP, Jardim V, et al. Stress and cardiovascular risk: multi-professional intervention in health education. *Rev Bras Enferm*. 2016; 69(2):329-336. Available from: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0034-71672016000200351&lng=en](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-71672016000200351&lng=en). <http://dx.doi.org/10.1590/0034-7167.2016690219i> (accessed 29 June 2017).
8. Shisana O, Labadarios D, Rehle T, Simbayi L, Zuma K, Dhansay A, et al. National health and nutrition examination survey (SANHANES-1). Cape Town: HSRC; 2013. p. 1-5. Available from: [http://www.hsrc.ac.za/uploads/pageNews/72/SANHANES-launch edition \(online version\).pdf](http://www.hsrc.ac.za/uploads/pageNews/72/SANHANES-launch%20edition%20(online%20version).pdf) (accessed 4 Apr 2017).
9. Sheik S, Evans J, Morden E, Coetzee D. Non-communicable diseases in the Western Cape. Western Cape Government: Health. 2016. Available from: [https://www.westerncape.gov.za/assets/departments/health/burden\\_of\\_disease\\_update\\_ncds\\_.pdf](https://www.westerncape.gov.za/assets/departments/health/burden_of_disease_update_ncds_.pdf) (accessed 4 Apr 2017).
10. South Africa. Department of Health, Medical Research Council, OrcMacro. South Africa demographic and health survey 2003. Pretoria: Department of Health; 2007. Available from: <https://dhsprogram.com/pubs/pdf/FR206/FR206.pdf> (accessed 14 Aug 2017).
11. World Health Organization. WHO global plan of action on workers' health (2008-2017): baseline for implementation. Geneva: WHO; 2013. p. 1-46. Available from: [http://www.who.int/occupational\\_health/who\\_workers\\_health\\_web.pdf](http://www.who.int/occupational_health/who_workers_health_web.pdf) (accessed 3 Mar 2017).
12. Kirsten W. Making the link between health and productivity at the workplace - a global perspective. *Ind Health*. 2010; 25(48):251-255.
13. Rodriguez-Fernandez R, Rahajeng E, Viliiani F, Kushadiwijaya H, Amiya RM, Bangs MJ. Non-communicable disease risk factor patterns among mining industry workers in Papua, Indonesia. Longitudinal findings from the cardiovascular outcomes in a Papuan population and estimation of risk (COPPER) Study. *Occup Environ Med*. 2015; 72(10):728-735.
14. Stadler K. Dietary intake: physical activity and risk for chronic diseases of lifestyle among employees at a South African open-cast diamond mine. Master of Nutrition. University of Stellenbosch; 2006. Available from: [https://scholar.sun.ac.za/bitstream/handle/10019.1/2000/stadler\\_dietary\\_2006.pdf?...1](https://scholar.sun.ac.za/bitstream/handle/10019.1/2000/stadler_dietary_2006.pdf?...1) (accessed 14 Apr 2017).
15. Bloom DE, Cafiero E, Jané-Llopis E, Abrahams-Gessel S, Reddy Bloom L, Fathima S, et al. The global economic burden of non-communicable diseases. Geneva: World Economic Forum; 2011. Available from: <http://ideas.repec.org/p/gdm/wpaper/8712.html> (accessed 14 Apr 2017).
16. Sorensen G, Landsbergis P, Hammer L, Amick BC, Linnan L, Yancey A, et al. Preventing chronic disease in the workplace: a workshop report and recommendations. *Am J Public Health*. 2011; 101(Suppl 1):196-207.

18. Quintiliani L, Sattelmair J, Activity P, Sorensen G. The workplace as a setting for interventions to improve diet and promote physical activity. Geneva: WHO; 2007. Available from: <http://www.who.int/dietphysicalactiv-ity/Quintiliani-workplace-as-setting.pdf> (accessed 18 Jul 2017).
19. Elloker S, Olckers P, Gilson L, Lehmann U. Crises, routines and innovations: the complexities and possibilities of sub-district management. *South African Health Review* 2012/13. Health Systems Trust; 2012. p. 161-176. Available from: [https://www.health-e.org.za/wp-content/uploads/2013/04/SAHR2012\\_13\\_lowres\\_1.pdf](https://www.health-e.org.za/wp-content/uploads/2013/04/SAHR2012_13_lowres_1.pdf) (accessed 14 Apr 2017).
20. Patel D, Goetzel RZ, Beckowski M, Milner K, Greyling M, Silva R, et al. The healthiest company index: a campaign to promote worksite wellness in South Africa. *J Occup Environ Med*. 2013; 55:172-178.
21. Working well: a global survey of health promotion and workplace well-ness strategies: executive summary. Buck Consultants; 2009. Available from: [http://www.acsm-iawhp.org/files/DOCUMENTLIBRARY/Global%20Wellness%202009\\_ExecSumm\\_English-1.pdf](http://www.acsm-iawhp.org/files/DOCUMENTLIBRARY/Global%20Wellness%202009_ExecSumm_English-1.pdf) (accessed 9 Sep 2018).
22. Mchunu G, Uys L. The state of workplace health promotion in South Africa: an exploratory study. *Occup Health Southern Afr*. 2008; 14(6):26-32.
23. Chopra M, Steyn N, Lambert V. Decreasing the burden of cardiovascular disease. Vol 6. Western Cape Burden of Disease Reduction Project. Cape Town: Dept of Health; 2007. Available from: [http://www.westerncape.gov.za/text/2007/6/cd\\_volume\\_6\\_cardiovascular\\_diseases.pdf](http://www.westerncape.gov.za/text/2007/6/cd_volume_6_cardiovascular_diseases.pdf) (accessed 3 Mar 2017).
24. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. Geneva: WHO; 2013. p. 102. Available from: [http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf) (accessed 22 Feb 2017).
25. Kreis J, Bödeker W. Health-related and economic benefits of workplace health promotion and prevention. Summary of the scientific evidence. Essen: BKK Bundesverband; 2004. Available from: [http://www.enwhp.org/fileadmin/downloads/IGA-Report\\_3\\_English.pdf](http://www.enwhp.org/fileadmin/downloads/IGA-Report_3_English.pdf) (accessed 15 May 2017).
26. NCD Alliance. Realising the potential of workplaces to prevent and control NCDs. Geneva: NCD Alliance; 2016. Available from: [https://ncdalliance.org/sites/default/files/NCDs\\_%26\\_WorkplaceWellness\\_web.pdf](https://ncdalliance.org/sites/default/files/NCDs_%26_WorkplaceWellness_web.pdf) (accessed 14 May 2017).
27. Titler MG. The evidence for evidence-based practice implementation. Patient safety and quality: an evidence-based handbook for nurses: Vol New York: The Free Press; 2008. p. 113-132. Available from: [https://www.ncbi.nlm.nih.gov/books/NBK2659/pdf/Bookshelf\\_NBK2659.pdf](https://www.ncbi.nlm.nih.gov/books/NBK2659/pdf/Bookshelf_NBK2659.pdf) (accessed 12 Jun 2017).
28. 26. Nojilana B, Bradshaw D, Pillay-van Wyk V, Msemburi W, Laubscher R, Somdya NIM, et al. Emerging trends in non-communicable disease mortality in South Africa, 1997-2010. *S Afr Med J*. 2016; 106(5):477-484. Available from: <http://www.samj.org.za/index.php/samj/article/view/10674> (accessed 14 Jul 2017).
30. Verweij LM, Coffeng J, Van Mechelen W, Proper K. Meta-Analysis of workplace physical activity and dietary behaviour interventions on weight outcomes. *Obes Rev*. 2011;12:406-429.
31. World Health Organization. Global physical activity questionnaire (GPAQ). WHO stepwise approach to NCD risk factor surveillance. Surveillance and population-based prevention. Prevention of Non-communicable Diseases Department. Geneva: WHO; 2008. p. 1-3. Available from: [http://www.who.int/chp/steps/GPAQ\\_EN.pdf](http://www.who.int/chp/steps/GPAQ_EN.pdf) (accessed 6 Mar 2016).
32. Saunders JB, Aasland OG, Babor TF, De la Fuente JR, Grant M. Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption – II. *Addiction* 1993; 88, 791-804.
33. National High Blood Pressure Education Program. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. Bethesda: National Heart, Lung, and Blood Institute; 2004. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK9630/> (accessed 9 Sep 2018).
34. American Diabetes Association. 2. Classification and diagnosis of diabetes. *Diabetes Care*. 2015; 38 (Suppl 1):S8-S16.
35. Klug EQ, Raal FJ, Marais AD, Taskinen M-R, Dalby AJ, Schamroth C, et al. South African dyslipidaemia guideline consensus statement. *S African Fam Pract*. 2015; 57(2):22-31.

36. World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation. Geneva: WHO; 2008. Available from: [http://apps.who.int/iris/bitstream/10665/44583/1/9789241501491\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/44583/1/9789241501491_eng.pdf) (accessed 1 Jul 2018).
37. Risk factors assessment and screening procedures. Philippines: WHO Press; 2009. Available from: <http://www.wpro.who.int/philippines/publications/module2.pdf> (accessed 1 Jul 2018).
38. Peer N, Lombard C, Steyn K, Gaziano T, Levitt N. Comparability of total cardiovascular disease risk estimates using laboratory and non-laboratory based assessments in urban-dwelling South Africans: the CRIBSA study. *S Afr Med J*. 2014; 104(10):691-696.
39. Meijer E, Gebhardt W, Van Laar C, Kawous R, S B. Socio-economic status in relation to smoking: the role of (expected and desired) social support and quitter identity. *Soc Sci Med*. 2016; 162:41-49.
40. World Health Organization. Global status report on alcohol and health. Geneva: WHO Press; 2011. Available from: [http://www.who.int/substance\\_abuse/publications/global\\_alcohol\\_report/msbgsru-profiles.pdf](http://www.who.int/substance_abuse/publications/global_alcohol_report/msbgsru-profiles.pdf) (accessed 3 Jan 2017).
41. Fieldgate IB, Jeffrey R, Madinane M, Ebrahim Y, Soobyah L, Jordaan J. Economic impact of an advertising ban on alcoholic beverages. Johannesburg: Econometrix (Pty) Ltd; 2013. p. 24-36. Available from: [http://5737034557ef5b8c02c0e46513b98f90.cdn.ilink247.com/ClientFiles/econometrix/Econometrix/Company/Documents/Economic\\_Impact\\_of\\_an\\_Ad\\_Ban\\_Econometrix.pdf](http://5737034557ef5b8c02c0e46513b98f90.cdn.ilink247.com/ClientFiles/econometrix/Econometrix/Company/Documents/Economic_Impact_of_an_Ad_Ban_Econometrix.pdf) (accessed 9 Sep 2017).
42. Pick W, Naidoo S, Ajani F, Onwukwe V, Hansia R, Bielu O. Prevalence of alcohol and cannabis use and reported knowledge, attitudes and practice regarding its relationship with health and safety on mines in South Africa. Health 712 Final Report. Johannesburg: Mine Health and Safety Council. Available from: <https://research-space.csir.co.za/dspace/handle/10204/1277> (accessed 9 Sep 2018).
43. Wilson D. Routine screening tests for alcoholism. *S Afr Med J*. 1999; 89(9):949-951.
44. Harker Burnhams N, Dada S, Linda B, Myers B, Parry C. The extent of problematic alcohol and other drug use within selected South African workplaces. *S Afr Med J*. 2013; 103(11):845-847.
45. World Health Organization. Country Profiles: global status report on alcohol and health 2014. Geneva: WHO; 2014. Available from: <https://www.afro.who.int/publications/global-status-report-alcohol-and-health-2014> (accessed 4 Sep 2017).
46. Strategic plan for the prevention and control of non-communicable diseases 2013-17. Pretoria: Department of Health; 2013. Available from: [http://www.hsrc.ac.za/uploads/pageContent/3893/NCDs\\_Strat\\_Plan\\_Content\\_8\\_April\\_proof.pdf](http://www.hsrc.ac.za/uploads/pageContent/3893/NCDs_Strat_Plan_Content_8_April_proof.pdf) (accessed 11 Feb 2017).
47. Peltzer K, Phaswana-Mafuya N. Fruit and vegetable intake and associated factors in older adults in South Africa. *Glob Health Action* 2012; 5(2):1-9.
48. Charlton K, Kowal P, Soriano MM, Banks E, Byles J. Fruit and vegetable intake and body mass index in a large sample of middle-aged Australian men and women. *Nutrients*. 2014; 6:2305-2319. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/24941447> (accessed 17 Jun 2017).
49. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet* 2012; 380(9838):219-229.
50. Tomlinson M, Grimsrud A, Stein D, Williams D, Myer L. The epidemiology of major depression in South Africa: results from the South African stress and health study. *S Afr Med J*. 2011; 118(11):1492-1501.

## 3.2 Article 2:

# Transforming the workplace environment to prevent non-communicable chronic diseases: participatory action research in a South African power plant

### 3.2.1 BACKGROUND

Non-communicable diseases (NCDs), are the leading cause of death globally, accounting for 71% of deaths and 85% of premature deaths (< 70 years) in low- and middle-income countries (LMIC) [1–3]. The NCDs include cardiovascular disease, cancer, diabetes and chronic obstructive pulmonary disease, which poses a substantial public health challenge in South Africa [4]. NCDs are responsible for 43% of deaths per year in South Africa, and this is particularly crucial for employers as most of the deaths occur before the age of 65 years [3,5–8]. Since the determinants for NCDs include behavioural, environmental and socio- economic factors, a shift towards a ‘whole of government’ and a ‘whole of society’ approach is needed [9,10].

The workplace has been identified by numerous health authorities as strategic in reaching working adults, as a substantial proportion of the population can be reached from a wide variety of socio- economic and cultural backgrounds. The workplace influences employees’ health, safety and risk behaviour, and can act as an accelerator or preventer of chronic diseases [11]. The workplace affects individual health behaviours through both physical and psycho-social mechanisms [12]. According to the World Health Organization (WHO), a healthy workplace is one where employees and managers collaborate to continually improve the health, safety and well-being of all employees, and by doing this also sustains the productivity of the business [13,14].

There is a growing body of evidence on the success of using health promotion programmes by health professionals in the workplace [15]. Most of these programmes, however, exclude the environmental changes that help to make healthy choices easy and sustainable [16]. Work environments in South Africa are governed by legislation and policies to protect employees from occupational health hazards [17]. However, these policies have focused more on ‘what’ to do and less on ‘how’ to do [18]. Implementation of these policies in organizations is typically the responsibility of the health and wellness departments [19], which are often embedded in human resource management units within the organizational structure. Leaders of occupational health and safety are unlikely to receive training in the principles of behaviour and environmental change [19]. Stronger leadership and processes that reach beyond the confines of health and wellness services may be needed [20].

Innovative actions in the workplace are needed to tackle the predicted increase of NCDs over the next two decades in South Africa [18]. While there are multiple workplace wellness programmes, there is no South African guideline on preventing NCDs in the workplace and there may be a need for such a guideline to be informed by local evidence. Single-component interventions have minimal impact on the risk of NCDs [21]. Focused attention should be given to multi-component interventions that make healthy eating and physical activity part of employees’ daily schedules [22–

25] Programmes also succeed where employees are involved in the planning and implementation [11,26]. There is therefore a need to be innovative in designing, implementing and evaluating interventions to prevent NCDs in the workplace. The need for such an intervention was also evident in the annual health risk assessments performed by the commercial power plant that is the focus of this study.

This study aimed to explore how to transform the workplace environment at a commercial power plant in South Africa in order to prevent and manage the risk factors for NCDs amongst the workforce.

## **3.2.2 METHODS**

### **Study design**

Participatory action research (PAR) [27] in the format of a cooperative inquiry group (CIG) followed a cyclical process of planning, action, observation and reflection over a two-year period (November 2015– December 2017).

### **The setting**

This study was conducted at a commercial industrial power plant in the Western Cape, South Africa. The industry's focus was technical, with 1,743 employees that included engineers, plant operators, physicists, technicians, artisans and support staff. The organization was governed by strict policies and standardized operating procedures, although it also experienced severe budget constraints, and was headed by a general manager with an executive committee.

Health in the South African workplace is governed by the National Occupational Health and Safety Act of 2003 [28]. The plant included a health and wellness department whose mandate was to provide occupational health services and medical surveillance, assess fitness to work and promote wellness. The staff included a medical practitioner, seven occupational health nurses, a wellness manager, a senior adviser for physical wellness (the first author) and two administrators.

The plant was a critical part of the national electricity supply, but also had to close down generation on a regular basis for maintenance. During these 'outages', employees had to work shifts and extended hours in order to minimize the duration of the outage, which also impacted their health and wellness.

All employees received subsidized meals from an external caterer contracted to the organization. The power plant was located within a nature reserve, but there were no recreational or physical activity facilities at the workplace. A previous survey of employees' health risks found that they had multiple risk factors for NCDs and underlying risky behaviours such as harmful or dependent alcohol use (29%), tobacco smoking (26%), inadequate fruit and vegetable intake (73%) and physical inactivity (64%) [29]. These four risk factors became the target for the design of the intervention.

### **Forming the co-operative inquiry group**

Eleven employees in managerial positions were purposefully invited to join the CIG based on their influence over decision making, as well as their track record of successful action and openness to change. Of those invited, two declined as they felt overcommitted. Participants attended an onsite presentation on NCDs, the purpose of the inquiry and the

process of the CIG. All participants consented to take part for two years. The CIG was facilitated by Darcelle Schouw (DS) and co-facilitated by Bob Mash (BM). CIG members were comprised of one financial manager, one wellness manager, one senior occupational health nurse, three engineering managers, two project management advisors, one industrial relations manager and one human resources manager, one quality control officer, and a manager from the organization's training department.

## **Initiating the inquiry**

The CIG aligned itself with the main research question, 'How can the workplace environment be transformed in order to prevent and control the risk factors for NCDs amongst the workforce?' Ownership of the inquiry by the whole group, as well as democratic and collaborative group dynamics, was encouraged (see Table 4, Supplementary file on quality criteria for the functioning of the CIG). Group members were trained in reflectivity as they were both the researchers and the researched during this process and needed to document their observations and reflections. At the same time, group members were encouraged to engage with practical action and transformation of practice at the plant.

The CIG used outcome mapping (OM) to identify the intended outcomes, plan initial activities and subsequently monitor progress during the inquiry [30]. OM involved three phases: the intentional design, outcome and performance monitoring, and evaluation (Figure 1). The intentional design phase answered four questions: What is the vision and mission of the project? Who are the boundary partners? What are the changes (the outcomes) being sought? How will the project enable these changes (the activities)? This design also provided a framework for the monitoring of outcomes and activities. During the evaluation phase at the end of the CIG, a consensus was built regarding the key learning from CIG members over the two years.

Boundary partners were people or groups that the CIG needed to influence in order to achieve its mission. The four boundary partners were: The contracted caterer and food supplier; external support services such as the surrounding nature reserve, sport clubs and health services; the health and wellness department; the management and decision makers.

The CIG agreed on outcome challenges for each boundary partner, which described the desired changes in behaviour. Each outcome challenge was then broken down into a series of progress markers, which reflected increasing complexity and depth of change and were categorized into what the CIG would like to see, expect to see and love to see [27,30]. The full intentional design using OM is given in a supplementary file.

## **Action and observation**

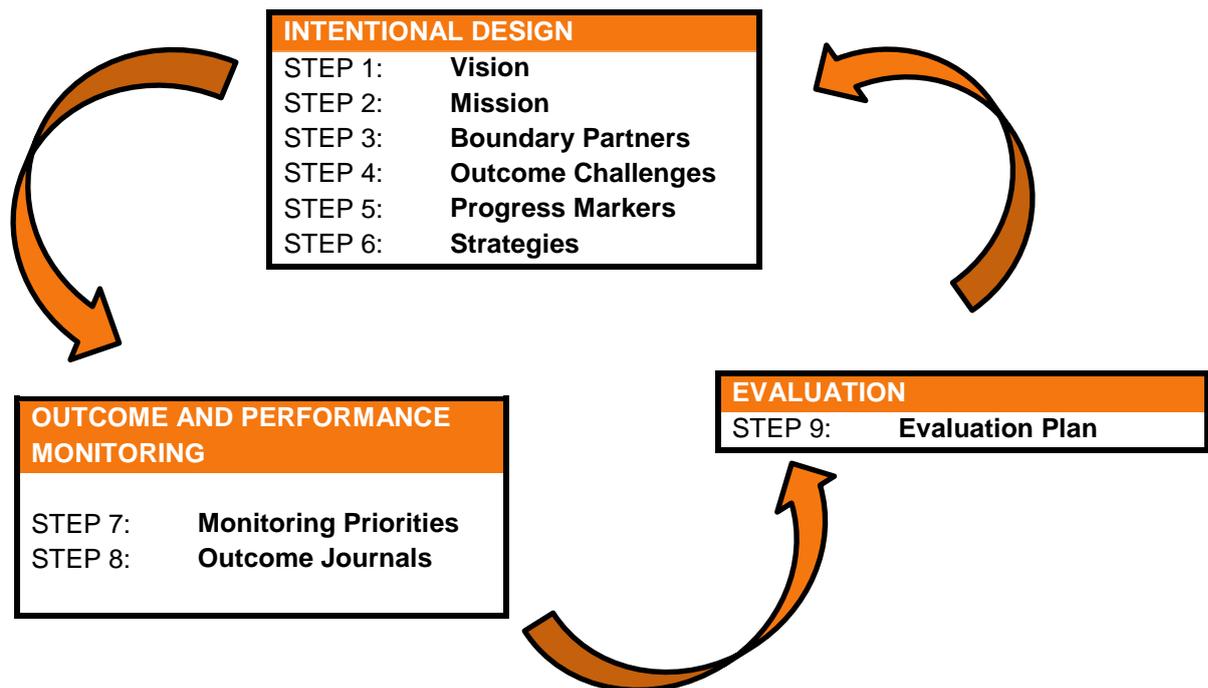
After the initial planning using OM, the CIG engaged with the activities that were identified for each boundary partner. The principal researcher also shared relevant evidence from the literature on activities that had worked elsewhere. The CIG divided itself into a number of smaller sub-groups who each focused on a different boundary partner and met more often than the CIG as a whole. The whole CIG met monthly for two to four hours at the workplace over this period, equating to 22 meetings.

## Reflection and planning

Each CIG meeting started with a report back from members on what they had done and observed. The CIG then reflected on what had happened in order to learn how to transform the organization and to inform planning for further action. A set of structured questions was used to guide reflection. These included: What did I do? What happened? What was different to what I expected? What did I not do? What did I do instead? What have I learnt from this? What action can I take in future? The meeting ended with planning new or adjusting existing actions for implementation in the sub-groups.

## Documentation of research

Each member of the CIG kept a journal of their observations and reflections. All the CIG meetings were documented by means of audio recordings, materials from small-group work, such as key points on newsprint or drawings, and notes taken during the meetings by the facilitator. These various data sources were used to summarize the observations, reflections and plans from each meeting. The researcher made a summary of each meeting and distributed it to the team for validation.



**Figure 1** Phases and steps of outcome mapping. Source (Earl et al, 2001)[30]

## Building of final consensus

The CIG concluded by building a final consensus of what was learnt over the two years. A member of the CIG delivered a presentation on what had happened with each boundary partner in relation to the progress markers and outcome challenge. The whole group then reflected on the extent of change and individually scored each progress marker from 0 (no change) to 3 (fully achieved). The amount of change achieved was evaluated as a percentage of the total possible score that could be achieved for that boundary partner if all members of the CIG scored every progress marker as fully achieved. The CIG then reviewed the strategies that had been attempted to achieve these changes and reflected

on which strategies had worked and which had not. Finally, the CIG engaged with a nominal group technique to identify the key lessons learnt and to rank them from most to least important [31,32]. In the nominal group technique each person scored their top five lessons from most important (score = 5) to least important (score = 1). The sum of the scores from all participants was then used to rank the items. The summary of the final consensus meeting was validated by the whole group.

### **3.2.3. RESULTS**

The scoring of the progress markers in the four boundary partners is indicated in Figure 2. Change was seen in all boundary partners, although score were highest in catering and external support and lowest in health and wellness, as well as management.

The following sections describe the changes seen in each boundary partner and the activities that enabled these changes. Illustrative quotations from the CIG that support the key findings are given in the supplementary file

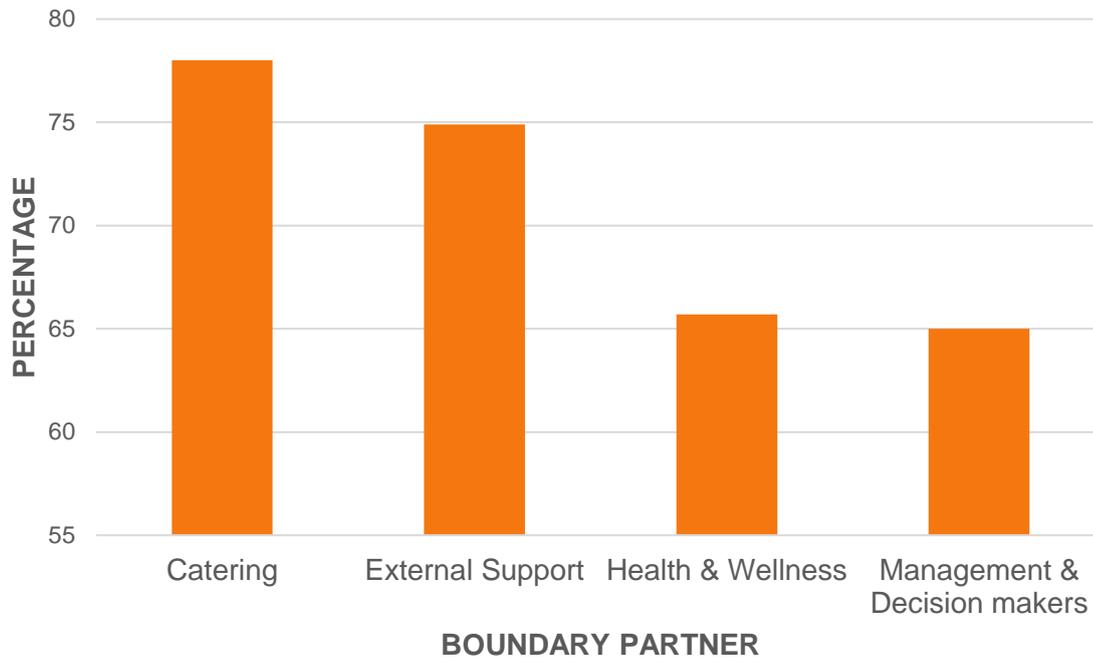
#### **Caterer and food supplier**

The CIG informed their planning and actions by benchmarking with five similar industries to understand how they were incorporating healthy meals into their catering. Strategic meetings were held between the finance manager (a member of the CIG), contract manager and external catering manager. Despite initial resistance the team was able to negotiate the inclusion of a 'wellness' meal at no additional cost.

The new wellness meal was planned with the dietician and the catering company provided colourful posters on healthy food choices and the wellness meal. The wellness meal was positioned at the top of the computer touch screen as the first option to consider, with healthy foods coded in green and gold. The launch of the wellness meal was celebrated with a Valentine's Day picnic for all employees, with 'healthy heart' messages. Within three months the wellness meal, which was initially offered once a week, was offered every day.

The catering staff were trained in the preparation of wellness meals and consulted on all changes to ensure collaboration and buy-in. When the wellness meal became somewhat monotonous the chef prepared a 'taste off' for employees to give feedback on a variety of other meal options.

Live demonstrations on how to prepare healthy food at home were broadcast on the plasma screens to all employees at their workstations. The health and wellness department also promoted healthy eating and provided health education to employees, with relevant materials [33].

**Figure 2.** Percentage of change in each boundary partner.

Note: Percentage of all progress markers achieved for each boundary partner. Each progress marker was scored 0 (no change), 2 (partially achieved) or 3 (fully achieved). Percentage is calculated as the score/total possible score x 100.

## External service providers

The CIG members presented a strategy for promoting physical wellness in the employees to the general manager, who subsequently acted as sponsor for the implementation of the program.

Areas were identified within the surrounding nature reserve for walking, running and cycling. Management provided support for extended lunches on Wednesdays to encourage employees to participate in physical activity and a monthly Friday sport day. The 'First Friday' sports day, with innovative themes, was incorporated into the organization's official calendar and staff received time off from work to participate. Private health insurers provided medals for the monthly sports day and marketed their own wellness programmes to employees. Functional exercise equipment was purchased for the staff to utilize during their lunch- times under supervision. The CIG also linked employees and their families with weekend park runs organized in local communities. A weight loss challenge, based on the television series *The Biggest Loser*, was launched throughout the organization, with 18 interdepartmental teams participating. The CIG group began the process for a new gym facility; however, this was not implemented during the study period.

The interventions resulted in team building and improved morale, as reported by employees and management. A significant shift, according to reflections of the CIG, was evident in the volume of employees exercising before and after work, walking during their lunchtimes, and ordering from the wellness menu.

The communications department promoted physical activities and sport events using innovative signage and marketing. The CIG also collaborated with the Western Cape government's Working on Wellness programme for employees to access activities such as Pilates, spinning, yoga and kickboxing outside of the work environment. All

employees, who were screened for health risks received weekly text messages with health tips and motivation for behaviour change throughout the study period.

## **Health and wellness**

The CIG planned activities in collaboration with health and wellness staff, local hospitals, clinics, and private health insurers. Initially, the support from the health and wellness department was minimal as they were uncomfortable with the CIG implementing strategies to prevent NCDs, because they perceived this as their role.

In order to effectively educate employees on the benefits/importance of healthy eating and physical activity in promoting a healthy lifestyle, CIG members collaborated with the Information Technology and Communication Departments to educate employees on healthy living. A dedicated newsletter was distributed to all employees on a quarterly basis; this focused on healthy eating and physical activity. In addition, private health insurers conducted health risk assessments and provided feedback to employees, specifically those identified at high risk for NCDs to identify employees at high risk, and referred them to the health and wellness department. Clinical staff participated in a three-day training course on brief behaviour change counselling to improve their capability to support individual lifestyle change.

Visibility and greater uptake of the health services was achieved by taking the annual health risk assessment to the employees and providing them with feedback and counselling at their workstations, rather than expecting them to come to the department.

## **Managers and decision makers**

In 2016, three months after the CIG was formed, two presentations were made at executive level to inform management on the organizational impact of NCDs and how transformation of the environment could improve productivity and well-being of staff. The meeting was experiential because managers were also medically assessed and informed of their personal health risk profiles. Managers approved all strategies presented, although the CIG had to be creative in planning low-cost initiatives as there was no substantial budget allocation.

Healthy lifestyle was promoted in meetings and work team sessions. Managers led by example in choosing wellness meals, marketing activities, participating in physical activities and promoting health by broadcasting discussions of their own behaviour change on plasma screens throughout the plant. Health and wellness also became a permanent agenda item for the monthly employee meetings hosted by the general manager.

The capacity-building programme for supervisors was also revised to include a wellness segment that featured personal risk assessment, education on healthy eating, physical activity and coping with stress. The physical activities were also included in the business plan as they were seen to uplift staff morale and team building.

A 'winning outage well' campaign was initiated to improve employees' health during scheduled maintenance of the plant, which occurred twice during the study period for three months each time. The CIG was included in the outage planning meetings to monitor and give feedback on employees' wellbeing and make recommendations.

Healthy food was provided weekly during the outages to employees by senior management promoting health in sporting attire.

## **Consensus of CIG**

Consensus of key lessons learnt by the CIG are shown in Table 1. The key lessons learnt emphasized the importance of the CIG itself in enabling change. The CIG was unlike other project groups in that it was highly diverse in terms of its members' educational, departmental and cultural backgrounds. Change was enabled by harnessing this diverse set of ideas, competencies and circles of influence, which went far beyond the health and wellness department. The group dynamics were also high

lighted in terms of the lack of hierarchy, mutual respect, collaboration, open communication, alignment with purpose and shared values. The leadership of the group was also critical in connecting, motivating and encouraging creativity and innovation. Members of the CIG took ownership of the project and felt passionate about facilitating change. The CIG also enabled the informal identification of wellness champions in each department.

The OM process enabled the CIG to have clear goals and strategies, and to conceptualize the whole project as a group, particularly at the beginning. Subsequently, the OM enabled the CIG to check on progress and to revise goals or strategies.

Management buy-in enabled change to happen with all the other boundary partners. It was important for them to engage at both a personal and organizational level. Creating practical, fun and easily accessible activities or healthy lifestyle options was also critical to enabling change.

**Table 1.** Consensus of key learning from CIG members on transforming the workplace environment.

Key learning of the CIG	Score
Dynamic passionate leadership of CIG, collaborative, focused, supportive	35
Composition, network and diversity of CIG, Multiple foci/sub groups (not necessarily in expert field but interest - creativity, access points to organization.	24
Having a clear set of outcomes/goals in outcome mapping.	24
Creating tangible opportunities to take action and environment that stimulates participation by the workforce.	17
Finding a way to personally engage and motivate management	13
Functioning of CIG is different to other groups. CIG is organic, creative, more personal engagement, less rules/procedures.	8
CIG takes positive, energetic, innovative approach "out of the box". Making change with minimal resources.	8
Included key people linked to the boundary partners as partners in the process/activities.	8
Good functioning of CIG. Participation, integration, execution	7
Having a wellness champion in each department who wants to see the change not necessarily management.	6
Have a specific separate group of people committed to the issue.	6
Having a health risk profile assessment at baseline for individuals to change focus on what to do.	4
People selected had sufficient autonomy, dedication, capability and confidence, over their work to participate in CIG.	3
People are valued in CIG not just the task.	2
Problem solving between boundary partner groups was focused yet took responsibility for bigger "vision" picture. Took ownership of the group	2

CIG = Cooperative inquiry group. Ranked according to the score derived from the nominal group technique.

### 3.2.4 DISCUSSION

Transformation of the workplace environment was achieved using a PAR approach. The fundamental enablers were functioning of the CIG; value of outcome mapping; management support; and making the healthy choice the easy choice. The intervention as a whole was subsequently named the 'Healthy Choices at Work' programme by the organization.

Transformation was enabled by team diversity and authentic leadership [34]. The team was diverse in terms of age, gender, professional and cultural background, as well as position within the organization. Health programmes that are driven by a diverse set of experts rather than only health professionals may be more effective at solving complex problems because they engage multiple disciplines [35,36]. The CIG, therefore, worked in a transdisciplinary approach, which is defined 'as research efforts conducted by investigators from different disciplines working jointly to create new conceptual, theoretical, methodological, and translational innovations that integrate and move beyond discipline-specific approaches to address a common problem' [37]. The CIG can be seen as exemplifying a transdisciplinary approach as it integrated people from health, physical therapy, engineering, finances and human resource management into one team that addressed the research question collectively and collaboratively [37].

The CIG identified a style of leadership that was congruent with the theory of authentic leadership [36]. This could be understood in terms of an emphasis on enhancing trust, collaboration and acceptance of others' differences, as well as meaningful recognition, effective communication and appreciation of others' contributions [19,24,34]. In addition, authentic leadership enhances commitment and engagement of group members, which leads to better performance and achievement of outcomes [35,36,38]. The functioning of the CIG was congruent with John Maxwell's 4Cs of effective teamwork: the importance of group chemistry, character that makes trust possible, belief in the capacity to make a difference, and members contributing beyond their job responsibilities [39].

The outcome mapping approach was particularly congruent with the CIG because it defined outcomes as 'changes in the behaviour, relationships, activities, or actions of the people, groups, and organizations with whom a program works directly', rather than changes in biological or health indicators [30]. OM focuses on measuring the contribution of programmes to complex outcomes, rather than trying to attribute change to specific interventions. OM therefore was well aligned with planning transformation in a complex organizational environment with a focus on changing risk behaviour.

Management endorsed the initiative at the highest level, which enabled change to occur at all other levels in the organization. Managerial support was also important because it went beyond this traditional approach to change through the setting of policy or issuing of directives. The modelling of personal commitment to behaviour change and visible demonstration of managerial support was important [40].

Many of the strategies related to healthy eating and physical activity involved making the healthy choice an easy choice. Social economists have described how changing the choice architecture or environmental design, rather than a person's motivation, can 'nudge' people in the desired direction. Examples of small changes to the choice architecture at the power plant included placing the wellness meal at the top of the computer screen, giving permission for employees to engage with physical activity during working hours and providing them with a range of options in the immediate vicinity [41].

Current thinking on organizational change highlights the need to see the organization as a complex adaptive or living system, as well as in terms of the more traditional hierarchical and mechanistic structure [42]. The successful approach to transformation in this study was more congruent with the former viewpoint as it emphasized networking and relationships, and feedback loops, and allowed change to emerge from the creation of a non-hierarchical community of practice. For transformation to take place leaders must become less hierarchical and shift their thinking from control to connectivity [42].

The behaviour change wheel is another conceptual framework that helps to make sense of the interventions used by the CIG [43]. The framework provides a typology of different types of interventions and policy changes that can support behaviour change. In this study, the activities developed by the CIG can be allocated across all the different types of interventions and policy categories, as shown in Table 2 [43]. This speaks to a multifaceted approach and resonates with evidence that organizations will benefit more from multi-component programmes to change behaviour [40,44].

## Strengths and limitations

Reflecting on the eight quality criteria for cooperative inquiry by the facilitators DS and BM [27], the CIG members were well aligned with the purpose of the inquiry and took ownership of the process. The facilitator ensured a collaborative and democratic group process by valuing each person's contribution, openness and being truthful without judgement. The CIG members were more committed to practical action than in-depth reflection and needed assistance to document their actions and structure reflection. The groups' findings are clearly described so that other organizations can transfer ideas and learning to their own contexts. New knowledge was created from the experience of the CIG members during the inquiry, and more particularly through a formal consensus-building process. Although CIG members were employees, their reflections and findings were not influenced by the organization and were not part of the appraisal of their key performance areas. The nature of PAR is that participants are engaged in changing their own practice, and therefore it was essential that CIG members were integral to the environment being transformed.

The learning from this study may be replicable in other business settings, particularly large enterprises that have the ability to engage with all the activities. Nevertheless, many of the activities would be possible for medium-sized enterprises, such as the provision of healthy food, opportunities for physical activity and engagement with management.

**Table 2** Definitions of interventions and policies

INTERVENTION	DEFINITION	EXAMPLES
Education	Increasing knowledge or understanding	Information was provided to staff to promote healthy living
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Live demonstrations of exercise and healthy eating were done on plasma screens broadcasted to all employees. Live interviews with managers were aired on screens about their healthy lifestyles.
Incentivization	Creating expectation of reward	Using prizes for biggest loser competitions, and monthly walks, runs, cycling in the nature reserve to improve physical fitness and reduce weight
Training	Imparting skills	Brief behavior change training done with all health and wellness staff
Restriction	Using rules to reduce the opportunity to engage in the target behavior (or to increase the target behavior by reducing the opportunity to engage in competing behaviors)	Prohibiting the use of salt in the preparation of food.
Environmental restructuring	Changing the physical or social context	Providing employees with 3 text messages per week to improve their lifestyles
Modelling	Providing an example for people to aspire to or imitate	Management and CIG models healthy lifestyles by participating and leading in the planned activities

Enablement	Increasing means/reducing barriers to increase capability or opportunity	Behavioral support to reduce NCDs by the health and wellness team, regular exercise classes, weight loss and fitness challenges
<b>POLICIES</b>		
Communication/marketing	Using print, electronic, telephonic or broadcast media	Quarterly Wellness newsletter, on site billboard advertising, emails, plasma screens, meetings
Guidelines	Create documents that recommend or mandate practice. This includes all changes to service provision.	Produce directive for catering wellness meals. No meals and snacks to be issued to staff without wellness approval.
Regulation	Establishing rules or principles of behavior or practice	Time is given off once a month for all employees to participate in 3 hour sports sessions
Environmental/social planning	Designing and/or controlling the physical or social environment	The gym was planned using project managers, design and structural engineers.
Service provision	Delivering a service	Support services was established by the medical aids, health and wellness team, sport and recreation, and catering department

## Recommendations

The study findings point to the following recommendations:

- Create a diverse, multi-professional, transdisciplinary team to lead the transformation process.
- Lead in a style congruent with authentic leadership that encourages collaborative teamwork.
- Ensure that management is actively involved in both a personal and a professional capacity.
- Plan and monitor transformation with tools that are consistent with the behavioural goals and complexity of change; for example, outcome mapping.
- Take a systematic approach to change that works through communities of practice, as well as traditional hierarchies.
- Design multifaceted interventions and policy changes.
- Design interventions that make the healthy choice the easy choice within the organizational environment.

The intervention focused primarily on cardio-metabolic risk factors for NCDs, and in the future it may be important to focus more directly on mental health, particularly as the industry considered here is working under considerable political, economic and psychosocial pressures.

- These findings may be useful to the development of policies or guidelines by the Department of Health on the prevention of NCDs in the workplace in South Africa.
- Transformation is an ongoing process and the CIG has continued to work together even though the formal research phase has been completed.
- Further research will be published on evaluating change in risk factors for NCDs within the workforce, and quantifying the incremental costs and other organizational consequences of the intervention.

### 3.2.4 CONCLUSION

Transformation of the workplace environment was documented through changes in catering, opportunities for physical activity, management, as well as the health and wellness department. Key factors in enabling transformation were the functioning of the CIG, value of outcome mapping, personal and professional managerial support, as well as making the healthy choice the easy choice in the organizational environment. Planning multifaceted interventions, as well as engaging the organization as both a living system and a hierarchy, were thought to be important. Further research should measure actual change in risk behaviour, risk factors, and the costs and consequences for the organization.

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## Author contributions

DS conducted the study for a doctoral degree under the supervision of RM and TKA. DS conceptualized the study. DS and RM facilitated the inquiry group. All data were collected and analysed by DS. The manuscript was written by DS and revisions were made by RM and TKA. All authors approved the final version.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## Ethics and consent

Ethics approval was obtained from the Health and Research Ethics Committee © of Stellenbosch University (S15/08/165) and permission was obtained from the power plant to conduct the study. Written consent was obtained from each participant in the study

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## Paper context

Transformation of the workplace to prevent non-communicable diseases is usually associated with single-component interventions by trained health professionals. This paper reports that through a participatory process incorporating diversity, workplace transformation can be achieved using multi-component interventions. In addition, transformation was made possible using limited resources and innovative strategies.

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## 3.2.6 REFERENCES

1. World Health Organization. Non-communicable diseases [Internet]; 2018 [cited 2018 Jul 11]. Available from: <http://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
2. World Health Organisation. Global Action Plan for the prevention and control of non-communicable diseases 2013 – 2020 [Internet]; 2013 [cited 2018 May 23]. Available from: [http://africahealthforum.afro.who.int/IMG/pdf/global\\_action\\_plan\\_for\\_the\\_prevention\\_and\\_control\\_of\\_ncds\\_2013-2020.pdf](http://africahealthforum.afro.who.int/IMG/pdf/global_action_plan_for_the_prevention_and_control_of_ncds_2013-2020.pdf)
3. World Health Organization. Global status report on non communicable diseases 2010 [Internet]. Alwan A, editor. World Heal. Organ; 2010 [cited 2018 Jul 4]. Available from: [http://www.who.int/nmh/publications/ncd\\_report\\_full\\_en.pdf](http://www.who.int/nmh/publications/ncd_report_full_en.pdf)
4. Steyn K, Fourie S, Temple N Chronic diseases of life-style in South Africa: 1995-2005 [Internet]; 2005 [cited 2017 Nov 10]. Available from: <http://www.mrc.ac.za/chronic/cdl1995-2005.pdf>
5. StatsSA. Mortality and causes of death in South Africa, 2010: findings from death notification. Stat. release [Internet]; 2013 [cited 2017 Jul 12];1–127. Available from:

- <http://www.statssa.gov.za/Publications/P03093/P030932010.pdf%5Cnhttp://www.statssa.gov.za/Publications/P03093/P030932009.pdf>
6. Ndinda C, Chilwane D, Mokomane Z Civil society activism in accessing healthcare in South Africa [Internet]; 2013 [cited 2018 Jul 4]. Available from: [www.hsrc.ac.za/en/research-data/ktree-doc/13805](http://www.hsrc.ac.za/en/research-data/ktree-doc/13805)
  7. Hari Krishnan S, Stephen Leeder MH, Panniyammakal Jeemon DP A race against time: the challenge of cardiovascular diseases in developing economies. Centre for chronic disease control [Internet]. New Delhi; 2014 [cited 2017 Dec 5]. Available from: [https://www.researchgate.net/publication/277279425\\_A\\_race\\_against\\_time\\_The\\_Challenge\\_of\\_Cardiovascular\\_Diseases\\_in\\_Developing\\_Economies](https://www.researchgate.net/publication/277279425_A_race_against_time_The_Challenge_of_Cardiovascular_Diseases_in_Developing_Economies)
  8. World Health Organization. South Africa, World Health Organization: non Communicable Disease (NCD) Country Profiles [Internet]; 2014 [cited 2018 Feb 18]. p. 2014. Available from: [http://www.who.int/nmh/countries/zaf\\_en.pdf](http://www.who.int/nmh/countries/zaf_en.pdf).
  9. Diem G, Brownson RC, Grabauskas V, et al. Prevention and control of noncommunicable diseases through evidence-based public health: implementing the NCD 2020 action plan. *Glob. Health Promot* [Internet]; 2015 [cited 2017 Dec 12];1–9. Available from: <http://ped.sagepub.com/cgi/content/abstract/1757975914567513v1>
  10. National Department of Health. National Department of Health: South Africa - Annual Report 2012/2013 [Internet]. 2013 [cited 2018 Jan 12]. Available from: <https://africacheck.org/wp-content/uploads/2014/02/131016dohrreport.pdf>
  11. De Villiers A, Fourie J, Phil M An ecological approach to non-communicable disease prevention in the workplace. *Occup Heal South Africa* [Internet]; 2011 [cited 2017 Nov 11]; Available from: [www.occhealth.co.za/?/...ecological+approach...non-communicable+disease+prevention](http://www.occhealth.co.za/?/...ecological+approach...non-communicable+disease+prevention)
  12. Sorensen G, Landsbergis P, Hammer L, et al. Preventing chronic disease in the workplace: A workshop report and recommendations. *Am J Public Health* [Internet]. 2011 [cited 2017 Jun 12];101:196–207. Available from: <http://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.2010.300075>
  13. World Health Organization (WHO). Promoting and creating an enabling environment for healthy behaviours among workers [Internet]; 2014 [cited 2017 Feb 3]. Available from: [www.who.int/nmh/ncd-coordination-mechanism/Policybrief33.pdf](http://www.who.int/nmh/ncd-coordination-mechanism/Policybrief33.pdf)
  14. Mozaffarian D, Kris-Etherton P, Van Horn L, et al. Interventions to promote physical activity and dietary lifestyle changes for cardiovascular risk factor reduction in adults a scientific statement from the American Heart Association; 2010 [cited 2018 Jul 4];406–441. Available from: <https://digitalcommons.wayne.edu/cgi/viewcontent.cgi?article=1002&context=nursingfrp>
  15. Quintiliani L, Sattelmair J, Activity P, et al. The workplace as a setting for interventions to improve diet and promote physical activity [Internet]. *World Heal. Organ*; 2007 [cited 2017 Jul 18]. Available from: <http://www.who.int/dietphysicalactivity/Quintiliani-workplace-as-setting.pdf>
  16. Strategy M, Guide C. Recommendations for Worksite- Based Interventions to Improve Workers' Health. *Am J Prev Med* [Internet]. 2010 [cited 2018 Apr 14];38:232–236. Available from: [https://www.ajpmonline.org/article/S0749-3797\(09\)00755-7/pdf](https://www.ajpmonline.org/article/S0749-3797(09)00755-7/pdf)
  17. National Department of Health. Occupational Health and Safety Policy for the National department of health [Internet]. The National Department of Health; 1993. p. 1–14. Available from: <https://www.acts.co.za/occupational-health-and-safety-act-1993>
  18. National Department of Health. Strategic plan for the prevention and control of non-communicable diseases 2013-2017 [Internet]. *Dep Heal*. 2013 [cited 2017 Feb 11]. Available from: <http://www.hsrc.ac.za/uploads/pageContent/3893/NCDsStratPlanContent8aprilproof.pdf>
  19. Tryon K, Bolnick H, Pomeranz JL, et al. Making the workplace a more effective site for prevention of non-communicable diseases in adults. *J Occup Environ Med* [Internet]. 2014 [cited 2017 Jun 18];56:1137–1144. Available from: <https://pdfs.semanticscholar.org/99e4/8ba6fb113c79b3e0d90a19bd513859d94bc1.pdf>
  20. Public Health Agency of Canada, World Health Organization. Health equity through intersectoral action: an analysis of 18 country case studies [Internet]. *Health Equity through Intersectoral Action*

- an Analysis 18 Country Case Studies; 2008 [cited 2017 May 6]. Available from: [http://www.who.int/social\\_determinants/resources/health\\_equity\\_isa\\_2008\\_en.pdf](http://www.who.int/social_determinants/resources/health_equity_isa_2008_en.pdf)
21. Schröer S, Haupt J, Pieper C. Evidence-based lifestyle interventions in the workplace-an overview. *Occup Med (Chic Ill)* [Internet]. 2014 [cited 2017 May 11];64:8–12. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/24280187>
  22. Bradshaw D, Steyn K, Levitt N, et al. Non- Communicable Diseases – A race against time [Internet]. Chronic Disease initiative Africa, Department of Medicine at University of Cape Town; 2011 [cited 2017 Oct 10]. Available from: [http://www.health.uct.ac.za/usr/health/research/groupings/cdia/downloads/MRC\\_policy\\_brief.pdf](http://www.health.uct.ac.za/usr/health/research/groupings/cdia/downloads/MRC_policy_brief.pdf)
  23. NCD Alliance. Realising the potential of workplaces to prevent and control NCDs [Internet]; 2016 [cited 2017 May 14]. Available from: [https://ncdalliance.org/sites/default/files/NCDs\\_%26\\_WorkplaceWellness\\_web.pdf](https://ncdalliance.org/sites/default/files/NCDs_%26_WorkplaceWellness_web.pdf)
  24. Everette-Murphy K, Mash B, Malan Z Helping people change [Internet]. Chronic Disease initiative Africa, Department of Medicine at University of Cape Town; 2013 [cited 2017 Nov 22]. p. 1–68. Available from: <http://www.emeraldinsight.com/doi/10.1108/00197850310463797>
  25. Onufrak S, Zaganjor H, Moore L, et al. Nutrition standards for food service guidelines for foods served or sold in municipal government buildings or worksites. *Centers Dis Control Prev* [Internet]. 2016 [cited 2018 Jun 4];13:1–10. Available from: [https://www.cdc.gov/pcd/issues/2016/16\\_0364.htm](https://www.cdc.gov/pcd/issues/2016/16_0364.htm)
  26. Centers for Disease Control and Prevention. The CDC Worksite Health ScoreCard: an assessment tool for employers to prevent heart disease, stroke, and related health conditions. *US Dep Heal Hum Serv* [Internet]. 2014 [cited 2018 Jun 3]; Available from: [https://www.cdc.gov/dhdsp/pubs/docs/HSC\\_Manual.pdf](https://www.cdc.gov/dhdsp/pubs/docs/HSC_Manual.pdf)
  27. Mash B. African Primary Care Research : participatory action research. *African J Prim Heal Care Fam Med* [Internet]. 2014 [cited 2017 Feb 12];6:1–5. Available from: <https://phcfm.org/index.php/phcfm/article/view/585>
  28. The National Occupational Health and Safety. 2003 [cited 2018 Sep 27];1–59. Available from: <http://www.kznhealth.gov.za/occhealth/policy2.pdf>
  29. Schouw D, Mash B, Kolbe-Alexander T. Assessing risk factors for non-communicable diseases in the work- force at a commercial power plant, South Africa. *Occup Heal South Africa*. 2018;24(5):145–152.
  30. Sarah E, Carden Fred ST Outcome mapping [Internet]. Canada: International Development Research Centre; 2001 [cited 2017 Jul 14]. Available from: [https://www.outcomemapping.ca/download/OM\\_English\\_final.pdf](https://www.outcomemapping.ca/download/OM_English_final.pdf)
  31. McMillan SS, Kelly F, Sav A, et al. Using the Nominal Group Technique: how to analyse across multiple groups. *Heal Serv Outcomes Res Methodol* [Internet]. 2014 [cited 2018 Jul 4];14:92–108. Available from: [https://www.researchgate.net/publication/266588426\\_Using\\_the\\_Nominal\\_Group\\_Technique\\_How\\_to\\_analyse\\_across\\_multiple\\_groups](https://www.researchgate.net/publication/266588426_Using_the_Nominal_Group_Technique_How_to_analyse_across_multiple_groups)
  32. Prevention C for DC and. Gaining Consensus Among Stakeholders Through the Nominal Group Technique. *Centers Disease Control Prevention* [Internet]; 2006 [cited 2018 Jul 4]:1–2. Available from: <http://www.cdc.gov/healthyouth/evaluation/index.htm>
  33. Everett-Murphy K, Mash B, Malan Z Helping people change [Internet]; 2013 [cited 2017 Jan 8]. Available from: <https://www.ichange4health.co.za/wpcontent/uploads/2016/01/HELPING-PEOPLE-CHANGE.pdf>
  34. Titler MG. The evidence for evidence-based practice implementation [Internet]. *Patient Saf Qual Evidence Handb Nurses*. 2008 [cited 2017 Jun 12]:1. Available from: [https://www.ncbi.nlm.nih.gov/books/NBK2659/pdf/Bookshelf\\_NBK2659.pdf](https://www.ncbi.nlm.nih.gov/books/NBK2659/pdf/Bookshelf_NBK2659.pdf)
  35. Avolio BJ, Gardner WL. Authentic leadership development: getting to the root of positive forms of leadership. *Leadersh Q* [Internet]. 2005 [cited 2018 Apr 4];16:315–338. Available from: <https://www.sciencedirect.com/science/article/pii/S1048984305000263>

36. Avolio BJ, Gardner WL, Walumbwa FO, et al. Unlocking the mask : A look at the process by which authentic leaders impact follower attitudes and behaviors. *Leadersh Quarterley* [Internet]. 2004 [cited 2018 Jun 4];15:801–823. Available from: <http://www.ipcrc.net/LDI/pdfs/sdarticle-unlocking-the-mask.pdf>
37. Todorova P. The contemporary transdisciplinary approach as a methodology to aid students of humanities and social sciences. *Bulg Comp Educ Soc* [Internet]. 2013 [cited 2018 Oct 28];187–191. Available from: <http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED567177&site=ehost-live>
38. Shirey M. Authentic Leaders Creating Healthy Work Environments for nursing practice. *Am J Crit Care* [Internet]. 2006 [cited 2018 Jun 3]:15. Available from: <http://ajcc.aacnjournals.org/content/15/3/256.full.pdf+html>
39. Maxwell J. *The 5 Levels of leadership*. 1st ed. New York, (NY): Hachette Book Group; 2011.
40. Totterdill P, Dhondt S, Boermans S. Your guide to workplace innovation [Internet]. *Eur Work Innov Netw*. [cited 2018 Mar 3]:1–20. Available from: <https://repository.tudelft.nl/view/tno/uuid:59b50a07-5286-42e2-921b-a34ec56cb86f/>
41. Thaler R, Sunstein C. *Nudge: improving decisions about health, wealth, and happiness*. New Haven: Yale University Press; 2008.
42. Capra F. Life and leadership in organizations. *Hidden Connect Sci Sustain Living* [Internet]. 2004 [cited 2018 May 7];1–29. Available from: <http://beahrselfp.berkeley.edu/wp-content/uploads/2010/06/Capra-Hidden-Connections-Ch-4.pdf>
43. Michie S, Van Stralen MM, West R. The behaviour change wheel : A new method for characterising and designing behaviour change interventions. *Implement Sci* [Internet]. 2011 [cited 2018 Jun 6];42:12. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/21513547>
44. Capra F, Luisi P. *The systems view of life. A unifying vision*. 1st ed. USA: Cambridge University Press; 2014.

### **3.3 Article 3:**

## **Changes in risk factors for non-communicable diseases associated with a Healthy Choices at Work program at a commercial power plant.**

### **3.3.1 INTRODUCTION**

Globally, 71% of deaths are attributed to non-communicable diseases (NCDs), with over 85% of premature deaths occurring in low- and middle-income countries (1)(2). In 2014, these diseases accounted for 43% of all deaths in South Africa (3)(4). Premature deaths from NCDs in people of working age (36-64 years) are expected to increase by 41% in developing economies between 2000 and 2030 (5), which has implications for employers and the health of their workforce.

The increased prevalence in NCDs is associated with unhealthy lifestyles, an ageing workforce and changing socio economic determinants (6)(7)(8)(9). NCDs are ascribable to four behavioural risk factors: excessive alcohol use, tobacco smoking, unhealthy diet and inadequate physical activity (10). Behavioural, metabolic (blood pressure, cholesterol, diabetes, body mass index, waist circumference and waist-to-hip ratio) and psychosocial risk factors (causes of stress at home and in the workplace) lead to NCDs such as cardiovascular disease, cancers, diabetes and chronic lung disorders (10).

The World Health Organization's (WHO) Global Plan of Action on Worker's Health 2008-2017 highlights the importance of the workplace as a setting for the prevention of NCDs (10). A substantial proportion of the adult population can be reached in the workplace (11) and this setting can provide a supportive environment for behaviour change with the possibility of co-worker support (12). The workplace environment shapes employees' health and safety, influences their health behaviours through physical and psycho-social mechanisms and acts as an accelerator or preventer of the risk of developing NCD (12). This risk varies according to employees' socioeconomic status, the impact of work stressors and their personal health risk profile (13)(14).

In South Africa, the industrial workforce has a high prevalence of NCD risk factors. For example in the mining and energy industries there is a 25-27% prevalence of harmful alcohol use, which is amongst the highest in the world (15)(16). Alcohol accounted for 7% of all deaths in South Africa in 2000 (15). In the South African adult population, heavy episodic drinking was reported in 45%, which is much higher than the global estimate of 12% (17). The effects of harmful alcohol such as high blood pressure and hepatic cirrhosis far outweigh the potential benefits of sensible alcohol use on coronary heart disease (15). Adequate fruit and vegetable consumption ensures the necessary provision of vitamins, minerals, fibre and antioxidants (18). Diets low in fruit and vegetable intake correlate with a high risk for cardiovascular disease, stroke, high blood pressure, cancer and obesity (19)(20). Unhealthy diets are promoted by an unhealthy eating environment and poor knowledge on the benefits of healthy food choices (21)(22).

Insufficient physical activity in employees also contributes to the burden of disease (23). Strategies to increase physical activity can therefore assist in reducing the risk of coronary heart disease, type 2 diabetes, certain cancers and improve life expectancy (24). Tobacco use is a risk factor for cardiovascular disease, cancer, diabetes and chronic lung disease, as well as for tuberculosis and lower respiratory infections (18). Tobacco smoking related deaths and disease rates in South Africa are amongst the highest in Africa with 24% of cancer mortalities attributed to tobacco in men and 11% in women. However, due to legislation on tobacco in South Africa, smoking rates are declining (25).

Occupational psychosocial stress factors such as high workload, psychological demands, loss of autonomy, poor recognition, lack of social support and rewards, are all related to employee health and psychological wellbeing (26). Mental and emotional stress contributes to NCDs with occupational stress identified as a global workplace challenge. Changing the psychosocial work environment can contribute to enhanced wellbeing, work-life balance and job security (27).

NCDs impact the workplace through stigmatisation, decreased productivity, increased absenteeism, disability and premature death (7)(13)(28). The burden of NCDs also negatively affects the economy and could contribute a cumulative global loss of US\$47 trillion over the next 20-years (28). Workplace health promotion programs (HCW) have been effective in reducing absenteeism, improving productivity, improving morale and reducing behavioural, metabolic and psychosocial risk factors for NCDs (12)(29). Programs also reduce co-morbidity in people with existing NCDs (28). Despite this, most HCWs focus on conducting health risk assessments in office-based settings and among self-selected participants. Some HCWs tend to focus on targeted interventions by health professionals within the workplace rather than the transformation of the whole workplace environment. More evidence is needed of the benefits of transforming the organisational environment as a whole(30)(31). Addressing the risk factors for NCDs can be achieved by adopting healthy lifestyles, however extensive innovation is needed to change behaviour in the workplace and on a global level (32). A study conducted by WHO in 2015 to assess HCW in low- and middle-income countries found that only 34% of African countries had an operational integrated multisectoral plan for the four main behaviour risk factors and NCDs (33). To achieve change, new methodologies and approaches are needed that go beyond the traditional health care model (32). The American Heart Association, European Association for Cardiovascular Prevention and Rehabilitation as well as the American College of Preventative Medicine have developed policies to define targeted interventions to equip the workplace with HCW (32). The WHO recommends a number of interventions in the workplace such as reducing exposure to second-hand tobacco, providing low sodium food options and education on increased fruit and vegetable intake as well as multicomponent physical activity programs (33). Moving forward, the workplace should encourage employees to make the healthy choice, the easy choice (e.g. healthy subsidised food in the cafeteria, onsite exercise facilities and walking routes, active management support) (32).

Previous studies in South Africa have investigated the prevention of NCDs from a public health perspective through legislation and the healthcare sector. Recommendations for improved health outcomes in public health settings, include using the socio-ecological model that describes the relationship of the person to their environment, community and policy (34). However, theory, research and training, requires refining to foster successful efforts to transform the business, physical and psychosocial environments to reduce NCDs (34). Priority

should be given toward improving HCW infrastructure, employee participation in WHHPs and research on HCWs to establish best practice standards (32).

Participatory action research (PAR) has rarely been used in the African context to transform the workplace environment, although it is well suited to the primary care context and to close the gap between evidence and practice (35, 36). This study was conducted at a commercial power plant in South Africa and used PAR to design the HCW. A baseline survey showed that employees had multiple risk factors for NCDs and a third of the workforce had a moderate-high risk of a cardiovascular event in the next 10-years (16). The survey report recommended that a HCW be implemented to reduce this risk. The aim of this study was to evaluate changes in risk factors for NCDs associated with the implementation of the HCW.

### **3.3.2 METHODS**

#### **Study design**

This was a before-and-after study that evaluated changes in risk factors for NCDs, which were associated with a HCW at a commercial power plant in the Western Cape, South Africa.

#### **Setting**

This commercial power plant, in the energy sector, had 1743 permanent employees. The general employees had a wide range of occupations, which included engineers, plant operators, physicists, technicians, artisans and support staff working shifts. The power plant was situated close to the city of Cape Town in a nature reserve. The power plant included a health and wellness department that conducted annual health risk assessments on self-selected employees and provided occupational health services. Food was subsidised and provided by an external company who were contracted to run the canteen and vending machines. The management team consisted of an executive committee with 10-12 senior managers led by a general manager. The power plant operated in a highly pressurised environment due to the lack of generation capacity in South Africa relative to the increased demand for electricity and the dissatisfaction of the population with regular load shedding. Employees worked very intensively during outages when generation was halted for routine maintenance.

#### **Study population and sample size calculation**

The study population included all permanent employees working at the power plant and there were no specific exclusion criteria. A previous cross-sectional survey had identified a representative sample of 156 employees prior to the introduction of the HCW (16). Sample size calculations were performed to evaluate the power of this sample to detect meaningful changes in risk factors for NCDs over time. Assuming an alpha error of 5% this sample size gave 98% power to detect a mean 5mmhg decrease in diastolic blood pressure, 95% power to detect a reduction from 50% to 30% prevalence of insufficiently active employees (threshold of 600 met minutes / week) and a 95% power to detect an increase in prevalence of adequate consumption of fruit and vegetables (5 or more portions per day) from 30% to 50%.

#### **Recruitment**

The list of employees (n= 1743) was reorganised according to random numbers generated by computer. People were then consecutively invited to participate in the study, according to the

randomised list, initially by email and then with a follow up phone call if they did not respond. It was necessary to invite 395 people to obtain the sample size of 156 as many people did not respond to their email or answer the telephone, although only four refused to participate. Data on non-responders indicated that they did not differ from the responders with  $p=0.351$ . Data on the various business units reflect the percentages with nuclear unit (22% in study vs 26% non-responders), the operating unit (72% in study vs 71% non-responders) and business support unit (6% in study vs 3.5% non-responders).

## Intervention

The intervention took place during 2016-2017 using participatory action research with a co-operative inquiry group (CIG) and is more fully described in a separate publication (35). The intervention focused on four key areas:

- **Catering and the provision of food:** The CIG negotiated with the catering contract manager to offer and promote a subsidised 'wellness meal' (a low fat, low salt option with additional vegetables and fruit) for all employees on all shifts. In addition, they sold affordable healthy snacks at the cafeterias and make fruit available as snacks throughout all shifts. Healthier snacks, such as fruit, were provided during power outages when the power plant was taken out of production for maintenance and when staff worked longer hours in shifts.
- **Opportunities for physical activity:** Areas were identified within the surrounding nature reserve for walking, running and cycling. A "First Friday" sports day, occurring once a month, was rostered on the organizational plan as a regular activity that encouraged employees to participate in physical activity. In addition, functional exercise classes were conducted four times per week during the intervention. Employees were also encouraged to attend "park run" events in their local communities.
- **Provision of health and wellness services:** CIG members collaborated with the information technology and the communications department to educate employees on healthy living using a dedicated wellness newsletter and live broadcasting on plasma screens throughout the plant. Annual health risk assessments for employees (two during the intervention) provided feedback on risk and offered counselling on behaviour change. Clinical staff participated in a three-day training course on brief behaviour change counselling that was based on the 5 A model (Ask, Alert, Assess, Assist, Arrange) and a guiding style derived from motivational interviewing to improve their capability to support individual lifestyle change (33). Private health insurers also offered health assessments and follow up of risk factors.
- **Managerial buy-in and participation:** Results of the employees' health risk assessments (HRA) and the design of workplace health promotion program (HCW) were presented to the managerial team at the beginning of the intervention. The managers' own health profiles were also assessed during the presentation. Managers approved the prevention program and led by example in choosing wellness meals, marketing activities, participating in physical activities and promoting health by broadcasting discussions of their own behaviour change.

## Data collection

All the questionnaires and clinical tests were administered by trained health professionals from the health and wellness department at testing booths in close proximity to employee's workstations during both day and night shifts. Information was collected at baseline and at 24 months.

### *Questionnaires*

Questionnaires included data on demographic information, medical and family history, medication use, diet, alcohol consumption and psychosocial stress factors (36). Psychosocial stress was measured by asking respondents to tick the biggest causes of stress from a list of 12 items at work or at home. These items were obtained from the organisation's in-house HRA questionnaire (home-related stress: personal finances, own health or health of family members, relationship with family or children, relationship with partner or spouse, emotional or mental health concerns, challenges with addictions; work-related stress: lack of resources to do work, relationship with colleagues, lack of clarity concerning work outputs, lack of recognition, lack of meaningful work, relationship with supervisor). The Global Physical Activity Questionnaire (GPAQ) was used to quantify levels of physical activity (37). The employees answered questions relating to usual levels of moderate and vigorous activity at work, during travel and leisure activities as well as sedentary behaviour (38). Data on alcohol use was collected using the validated Alcohol Use Disorders Identification Test (AUDIT) questionnaire (39). Questions on tobacco smoking as well as fruit and vegetable intake were extracted from the South African Demographic Health Survey Questionnaire. At follow up, an additional questionnaire assessed participation in the various components of the HCW.

### *Clinical measurements*

Systolic and diastolic blood pressure was recorded as the average of three readings. The participant was seated for 5 minutes with the elbow slightly flexed using an automated sphygmomanometer (Microlife AG, 9943, Switzerland) (40). Random blood glucose and total cholesterol testing was conducted with a finger prick capillary blood sample using a Cardio Chek (Polymer Technology Systems, USA) (41).

Standing height (cm) was measured to the closest 0.1cm with a stadiometer. Body mass was recorded to the closest 0.1kg using a portable calibrated scale (Seca 813, United Kingdom). Body mass index was calculated by using the following calculation:  $\text{weight (kg)}/[\text{height (m)}]^2$ . From the calculation, participant's BMIs were classified as either, normal (18.5-24.9  $\text{kg}\cdot\text{m}^{-2}$ ), overweight (25-29.9  $\text{kg}\cdot\text{m}^{-2}$ ) or obese ( $\geq 30 \text{ kg}\cdot\text{m}^{-2}$ ) (42).

Waist circumference was measured using a stretch resistant tape that provided a constant 100g tension, at the narrowest point of the waist, with the subject in mid-expiration. Hip circumference was recorded at the widest point over the greater trochanters and the waist-to-hip ratio was calculated. Waist to hip ratio (WHR) was calculated by dividing the waist circumference with the hip circumference (43).

The risk of developing a cardiovascular disease (CVD) such as heart attack or stroke over the next 10-years from the date of assessment for each employee was assessed using a validated non-laboratory algorithm for South Africa (41). Risk factors used to compute the CVD risk included gender, age, systolic blood pressure, diagnosis of diabetes, BMI and smoking history. Age categories used in the chart were < 50 years, 50-60 years and >60 years (44). The

estimated risk expressed as a percentage was categorised into low risk (<10%), moderate risk (10-20%) and high risk (>20%).

## Data analysis

Data were captured in Excel and checked for errors or omissions. Data were then analysed using the Statistical Package for the Social Sciences Version 24.1.

MET minutes were calculated from the GPAQ data. The MET (metabolic equivalents) is a physiological measure that expresses the energy cost (or calories) of different levels of physical activities. METs is the ratio of the individuals working metabolic rate proportional to the resting metabolic rate. One MET is the energy equivalent expended by an individual while seated at rest and is equivalent to a caloric consumption of 1 kcal/kg/hour. Moderate physical activity gives a metabolic rate four times that of resting (METx4) and vigorous physical activity a rate eight times resting (METx8) (38). A MET minute score was calculated by multiplying the MET value for the type of activity by the time in minutes that the activity was performed. A minimum of 600 MET minutes per week was required to be considered physically active. This translates to participating in a minimum of 150 minutes of moderate-intensity activity per week or 75 minutes of vigorous intensity activity per week.

The AUDIT questionnaire included 10-questions with a 4-point Likert scale that gave a possible total score of 41. Respondents with a score of 7 or less were categorised as sensible drinkers, those with a score of 8-19 as potentially harmful drinkers and those with a score of 20 or more as potentially dependent drinkers.

Descriptive analysis was used to calculate the mean and standard deviation or frequency and percentage of all variables at baseline and follow up. Paired t-tests were used to compare the mean differences for normally distributed numerical data (e.g. blood pressure, blood glucose, total cholesterol, BMI, waist circumference, WHR) from baseline to follow up at two years. McNemar's Chi-square test was used to compare paired binary categorical data from before to after (e.g. psychosocial stress, smoking, fruit and vegetables). Statistical significance was set at  $p < 0.05$ .

## Ethical considerations

Ethical approval was obtained from the Health and Research Ethics Committee (HREC) of Stellenbosch University (S15/08/165) and permission was obtained from the general manager of the power plant to conduct the study.

### 3.3.3 RESULTS

Paired data was obtained for 137 participants (73% of sample) who completed all the questionnaires and assessments. The mean age of the participants was 42.7 years (SD 9.7) and 64% were male. Overall, 4% were senior managers, 13% were middle managers, 58% were supervisors or professionals and 24% were general employees.

## Participation in wellness activities

Table 1 shows the proportion of participants that engaged in the various HCW activities. All the employees received feedback on their health risk assessment and the majority received behaviour change counselling and consumed healthier snacks during outages. A substantial

proportion purchased the wellness meals regularly and participated in the monthly sport events, lunchtime walks or park runs. Very few participated in physical activity during outages, functional exercise classes, lunchtime runs or cycles and the biggest loser competition.

**Table 1 Participation in HCW over two years (N=137)**

HCW activities	%
Ate wellness meal > 1/week	44.5
Often/always ate fruit provided during outage	62.0
Often/always participated in physical activity during outage	5.1
Often/always participated in monthly First Friday sport	27.7
Often/always attended weekly functional exercise session	2.2
Often/always participated in weekly lunchtime walks	32.8
Often/always participated in weekly lunchtime runs	7.3
Often/always participated in weekly lunchtime cycles	4.4
Ever attended community park run events (yes/no)	24.1
Participated in biggest loser competition (yes/no)	8.8
Obtained health risk assessment feedback (yes/no)	100.0
Received behaviour change counselling (yes/no)	80.3

## Change in psychosocial stress factors

Table 2 presents results for self-reported stressors at work and home for all participants. Participants reported significantly less stress from personal finances, relationships with colleagues as well as from their own health or that of a family member at follow up.

**Table 2: Change in psychosocial factors causing stress (N=137)**

Stress factors	Baseline %	Follow up %	p value
<b>WORK</b>			
Relationship with colleagues	21.1	11.3	0.015
Lack of recognition	18.8	18.8	1.000
Lack of resources to do my work	29.5	30.3	1.000
Lack of meaningful work	15.1	13.5	0.664
Relationship with my supervisor	9.8	12.0	0.664
Lack of clarity concerning work outputs	20.9	15.7	0.265
<b>PERSONAL</b>			
Personal finances	29.8	18.3	0.008
My health or family member's health	22.3	10.8	0.006
Relationship with family/children	16.0	13.7	0.690
Relationship with my partner/spouse	13.3	9.2	0.210
Emotional/mental health concerns	8.8	4.7	0.227
I have challenges with addictions	3.3	0.8	0.250

## Behavioural risk factors

Table 3 reports on the changes in behavioural risk factors. The intervention resulted in significantly fewer employees engaging in harmful alcohol consumption. Other lifestyle behaviours that improved significantly were fruit and vegetable consumption and habitual levels of physical activity. There was no significant reduction in smoking.

**Table 3: Change in behavioural risk factors (N=137)**

	Baseline %	Follow up %	p value
Sensible alcohol drinker (AUDIT score < 8)	78.2	93.5	0.001
Harmful alcohol drinker (AUDIT score 8-19)	21.0	4.8	
Dependent alcohol drinker (AUDIT score $\geq$ 20)	0.8	1.6	
Tobacco smoking	25.0	21.8	0.344
Inadequate fruit & vegetable intake (< 5 portions / day)	73.2	35.8	<0.001
Insufficiently active (<600 MET minutes/week)	55.9	34.7	<0.001

## Metabolic risk factors

Table 4 shows the changes in metabolic risk factors. There was a significant improvement in systolic and diastolic blood pressure. There was also a significant decrease in cholesterol levels, but not in random blood glucose. Weight, BMI and waist circumference were unchanged.

**Table 4: Change in metabolic risk factors (N=137)**

Risk factors	Baseline Mean (SD)	Follow up Mean (SD)	Mean of the difference (95% CI)	p value
Systolic blood pressure (mmHg)	131.6 (18.5)	121.4 (14.6)	-10.2 (-7.3 : -13.2)	<0.001
Diastolic blood pressure (mmHg)	83.4 (13.7)	79.5 (8.8)	-3.87 (-1.8 : -5.8)	<0.001
Total cholesterol (mmol/l)	5.6 (1.1)	5.1 (1.1)	-0.45 (-0.3 : -0.6)	<0.001
Random glucose (mmol/l)	5.7 (1.5)	6.0 (2.0)	0.31 (-0.6 : 0.2)	0.069
Body mass index (kg/m <sup>2</sup> )	29.0 (5.5)	29.0 (5.7)	-0.05 (-0.4 : 0.3)	0.760
Waist circumference (cm)	92.1 (14.3)	92.2 (14.4)	0.05 (-1.1 : 1.0)	0.926
Waist to hip ratio (cm)	0.86 (0.1)	0.87 (0.1)	-0.00 (-0.0 : 0.0)	0.484

## Non-communicable diseases

Prevalence for self-reported NCDs and the use of medication indicated that changes were not significant from pre to post for diabetes, hypertension, high cholesterol, heart and lung condition, cancer and depression (Table 5).

**Table 5: Prevalence of self-reported non-communicable disorders and medication use**

	Diagnosis of NCD			Medication for NCD		
	Baseline %	Follow up %	p value	Baseline %	Follow up %	p value
Diabetes	6.0	9.0	0.317	7.0	8.6	0.625
Hypertension	15.9	18.9	0.311	14.0	18.6	0.146
High Cholesterol	16.4	14.9	0.303	13.0	13.7	1.000
Heart Condition	6.0	4.5	0.687	4.5	3.8	1.000
Lung Condition	5.3	6.1	1.000	3.7	3.0	1.000
Cancer	2.3	3.0	1.000	1.5	0.7	1.000
Depression	15.0	13.5	0.250	11.2	10.4	1.000

## Cardiovascular risk

Table 6 presents the 10-year cardiovascular disease risk profile for participants. There were no significant risk reductions from pre to post measures. However, there was a 4.5% risk reduction for employees who were categorised as high risk, suggesting some improvement.

**Table 6: 10-year cardiovascular disease risk (N=137)**

Variable	Baseline %	Follow Up %	p value
Low risk	66.2	67.7	<b>0.155</b>
Moderate risk	18.0	21.1	
High risk	15.8	11.3	

## 3.3.4 DISCUSSION

The HCW was associated with significant improvements in risk factors for NCDs. Significant changes in behavioural risk factors included a reduction in harmful alcohol use, increase in fruit and vegetable intake and improvement in physical activity. Employees reduced their systolic and diastolic blood pressure as well as serum cholesterol concentration. Employees reported less stress from relationships at work and their own health. There was no change in tobacco smoking and the levels of overweight and obesity. There was a non-significant reduction in the proportion of employees at high cardiovascular risk. The proportion of employees diagnosed with NCDs and on medication did not change.

There was a high prevalence of harmful alcohol use at baseline, which was similar to levels found elsewhere in South Africa, despite the company having a zero alcohol tolerance and performing routine breathalyser tests on employees (45)(46)(47)(48). An analysis of systematic reviews and meta-analysis (2006-2016) on the effectiveness of alcohol interventions found brief interventions followed by longer psychosocial and psychological interventions to be effective (49). However, South Africa lacks a comprehensive national strategy to reduce harmful alcohol

use (49). This workplace initiative has demonstrated that substantial reductions can be achieved, which can most likely be attributed to the annual screening, feedback and behaviour change counselling offered to employees.

Fruit and vegetable intake was low at baseline (27%), and was similar to the South African population, although values better than reported (14%) in other workplace studies in South Africa (50). Fruit and vegetable intake improved significantly with 64% of the participants consuming the recommended portions at follow up as more fruit and vegetables were introduced into the wellness meals. A recent meta-analysis found a relationship between increased fruit and vegetable intake in reducing the risk of developing type 2 diabetes (51). This correlation was not found in this study, as glucose levels remained unchanged despite the increased fruit and vegetable intake. Other studies have also shown a significant improvement in fruit and vegetable intake as a result of education, cooking demonstrations and improved access, as utilised in this study (55, 56, 57).

The baseline prevalence of insufficiently active employees (56%) was higher than the global South African population (45%)(52), although lower than figures reported for other South African workplaces (53). The beneficial effect of this HCW may partly be due to the longer duration of the intervention (24 months) as studies with shorter interventions (3 months) may be less effective (54). A systematic review on workplace-based interventions for improving physical activity also supported the need to target change in the environmental aspects of the organisation (55). An improvement in physical activity should lead to lowering the risk of all-cause mortality as well as the risk of ischaemic heart disease, diabetes, stroke, hypertension and depression (56). The improvement in physical activity can be attributed to individual behaviour change counselling, first Friday sports, lunchtime walks and park runs. The opportunities for physical activity during working hours may have been critical as behaviour change counselling alone may not be sufficient in the workplace (57).

Of the four major behaviour risk factors for NCDs, tobacco smoking was not significantly reduced. The prevalence was lower than found in other workplaces (52), and lower than the Western Cape (33%) but higher than the total South African population (18%)(58). There was, however, a non-significant reduction in smoking of 3.2%, which was similar to the reduction reported in a systematic review of totally smoke free workplaces (51). The power plant was not totally smoke free and actually provided many facilities where people could smoke. The brief behaviour change counselling and feedback on individual risk profiles possibly accounted for the reduction. Many participants indicated a willingness to stop smoking, but needed help. Smoking cessation programs were only available through the private health insurers, which had not been integrated into the HCW.

The change in blood pressure is likely to be clinically significant as a 10 mmHg reduction in systolic blood pressure translates to a 22% reduction in coronary heart disease and 41% reduction in stroke (59)(48, 63).The workplace may be particularly suited to interventions that reduce blood pressure as even much shorter interventions can have a significant, albeit smaller, effect (54).This change in blood pressure appears to be more associated with behaviour change than changes in prescription of medication. It is possible that reductions in blood pressure were related to increased levels of physical activity, reduced alcohol intake and changes in diet as well as greater awareness of the need to control hypertension with feedback from the HRA and behaviour change counselling (60)(61)(62). Behaviour change counselling has a 55%

increased chance of instilling positive outcomes compare to routine medical advice in reducing blood pressure, cholesterol levels, BMI, harmful drinking and smoking (63)(64).

The change in total cholesterol was also likely to be clinically significant (54)(20) as a decrease of 0.6 mmol/l is associated with a 50% reduced risk for ischaemic heart disease at age 40 (65). The reduction in cholesterol may be attributed to increased physical activity and possibly changes in diet (62). The study found similar rates of overweight and obesity compared to studies from other international workplaces(66)(67)(68)(69) as well as the South African population (74). Employees may not be aware of the health risks of obesity and the adoption of regular surveillance, interventions and education may be needed to address increasing obesity in Africa (69). BMI did not improve despite the improvements in physical activity and fruit and vegetable intake (69)(68)(20)(67). The fat content in food was not measured nor was a record kept of food consumed by the participants outside the workplace and it is possible that despite the improvement in physical activity the diet did not change sufficiently to enable weight loss.

The reduction in stress from personal finance can be linked to weekly financial wellness workshops and one-on-one consultations conducted in the organisation, which were not part of the HCW. The improvement in relationship with colleagues could be associated with the various sports activities, which also facilitated team building. Improved perceptions of personal health are congruent with the HCW and its effects on physical activity, diet, alcohol and metabolic risk factors. Other psychosocial risk factors did not change and this is also congruent with the loss of skilled employees abroad and an organisational culture characterised by cost-cutting and financial restraints during the same period as the study.

This study met the two criteria for offering comprehensive and effective HCW for NCDs as defined by Healthy People 2010: health education which includes a behaviour change component as well as a supportive social and physical environment. In HCW in high income countries, where more than 750 people were employed, only 7% met these criteria (70). The design of the intervention itself was an important factor in the success of our HCW and this was evaluated in a previous study (32). Key features of the intervention included an annual HRA with feedback and behaviour change counselling, changes in the catering, opportunities for physical activity and explicit support and personal engagement from management. The use of a diverse cooperative inquiry group that was not just made up of the health and wellness department, an intentional design and monitoring process, use of social engineering to make the healthy choice the easy choice and working with the organization as a living system as well as a hierarchy were all important. The HCW met the two criteria suggested by the Healthy People 2010 report.

### **3.3.5 LIMITATIONS**

Three key limitations are noted in this study 1) the absence of a control group 2) the number of non-responders to the study invitation and 3) the loss to follow up.

A control group was not included in the study as the intervention targeted the whole organisation and therefore all employees were potentially affected by the HCW. It would have been practically difficult to enrol a similar workforce from another company to act as a control. Prior to the HCW, annual HRAs showed a steady increase in cardiovascular risk profile. Indeed, the study was prompted by eight deaths from NCDs within the company in 2014. The reductions in risk factors for NCDs associated with the HCW are therefore unlikely to be due to trends in the study population that were not controlled for. In addition, there were no other known

interventions targeting the workforce during this period. Nevertheless, the reductions in risk factors should be seen as associated with the HCW and the study cannot prove cause-and-effect.

Many people (61%) did not respond to the invitation via email or telephone and this was most likely due to them being unaware of the invitation rather than deciding not to participate. We believe that many of the non-responders were away on training in partner commercial plants outside of South Africa, working in other regions, working shifts, pregnant or on extended sick leave. Only four employees that were invited declined to participate. Although we had limited data on the non-responders, we were able to show that they did not differ significantly from those that did respond in terms of their role within the company.

Reasons for loss to follow up (n=19) included employee resignations (to a new recruiting commercial power plant), retirements, death, relocation (to other business units) and five withdrawals from the study. However, there were no significant differences ( $p>0.05$ ) between those that were lost to follow up and those that remained in the study in terms of key baseline characteristics such as age, gender, fruit and vegetable intake, physical activity, smoking, systolic blood pressure, diastolic blood pressure and cholesterol.

### **3.3.6 RECOMMENDATIONS**

This study adds to the body of evidence supporting the value of HCW as a means to prevent NCDs and reduce risk factors. This study suggests that more attention should be given to the workplace as a setting for effective disease prevention in order to meet national targets for the prevention of NCDs (71). The study should be of interest to similar organisations and companies, governmental departments such as health and labour as well as occupational health services.

It may be possible in other workplace settings to test the intervention further using stronger study designs such as randomised controlled trials. The intervention in future could include a robust smoking cessation program offered at individual levels and priority given to target obesity through holistic dietary intervention. Further work on this HCW will evaluate the cost-effectiveness and consequences for employee engagement and work-related performance.

### **3.3.7 CONCLUSION**

This HCW intervention was associated with clinically significant improvements in behavioural, metabolic and psychosocial risk factors for NCDs. The study shows the potential of health promotion in the workplace to complement interventions in the health services and community. Workplace-based interventions could make a substantial contribution to preventing the burden of disease from NCDs in South Africa. This study showed reductions in alcohol use, improvements in fruit and vegetable intake, increase in physical activity levels, as well as improving metabolic risk factors for blood pressure and cholesterol over two years. This study contributes to research from low- and middle-income countries on the effectiveness of HCW for reducing risk factors for NCDs.

### **3.3.8 ACKNOWLEDGMENTS**

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intervention. The authors would like to thank the Harry Crossley Foundation at Stellenbosch University (S15/08/165) and the Chronic Disease Initiative of Africa (CDIA) for the funding of the study.

### 3.3.9 COMPETING INTERESTS

The authors declare that they do not have conflicts of interest.

### 3.3.10 AUTHORS' CONTRIBUTIONS

DS conducted the study for a doctoral degree under the supervision of RM and TKA. DS, conceptualized the study. All data was collected by DS and analyzed by DS and RM. The manuscript was written by DS and revisions made by RM and TKA. All authors approved the final version.

### 3.3.11 REFERENCES

1. World Health Organization. WHO Global Plan of Action on Workers' Health (2008-2017): Baseline for Implementation. Global country survey 2008/2009. Executive summary and survey findings. [Internet]. Geneva; 2013. Available from: [http://www.who.int/occupational\\_health/who\\_workers\\_health\\_web.pdf](http://www.who.int/occupational_health/who_workers_health_web.pdf)
2. World Health Organization. Non-communicable diseases [Internet]. 2018 [cited 2018 Jul 11]. Available from: <http://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
3. World Health Organization. South Africa, World Health Organization: Non Communicable Disease (NCD) Country Profiles [Internet]. 2014 [cited 2018 Feb 18]. p. 2014. Available from: [http://www.who.int/nmh/countries/zaf\\_en.pdf](http://www.who.int/nmh/countries/zaf_en.pdf)
4. StatsSA. Mortality and causes of death in South Africa, 2010: Findings from death notification. Stat release [Internet]. 2013 [cited 2017 Jul 12];(November 2015):1–127. Available from: <http://www.statssa.gov.za/Publications/P03093/P030932010.pdf>  
<http://www.statssa.gov.za/Publications/P03093/P030932009.pdf>
5. Sivadasanpillai Harikrishnan, Stephen Leeder MH, Panniyammakal Jeemon DP. A race against time: The challenge of cardiovascular diseases in developing economies. Centre for chronic disease control. [Internet]. New Delhi, India; 2014 [cited 2017 Dec 5]. 75 p. Available from: [https://www.researchgate.net/publication/277279425\\_A\\_race\\_against\\_time\\_The\\_Challenge\\_of\\_Cardiovascular\\_Diseases\\_in\\_Developing\\_Economies](https://www.researchgate.net/publication/277279425_A_race_against_time_The_Challenge_of_Cardiovascular_Diseases_in_Developing_Economies)
6. Bradshaw D, Norman R, Lewin S, Joubert J, Schneider M, Nannan N, et al. O VERVIEWS Strengthening public health in South Africa : Building a stronger evidence base for improving the health of the nation. 2007;97(8):643–9.
7. Bloom DE, Cafiero E, Jané-Llopis E, Abrahams-Gessel S, Reddy Bloom L, Fathima S, et al. The Global Economic Burden of Non-communicable Diseases [Internet]. World Economic Forum. Geneva; 2011 [cited 2017 Apr 14]. Available from: <http://ideas.repec.org/p/gdm/wpaper/8712.html>
8. Villiers A De, Fourie J, Phil M. An ecological approach to non-communicable disease prevention in the workplace. Occup Heal South Africa [Internet]. 2011 [cited 2017 Oct 13];(July/August):6–11. Available from: <http://www.occhealth.co.za/?/viewArticle/1245>

9. Wyk VP, Msemburi W, Laubscher R, Dorrington RE, Groenewald P, Glass T, et al. Mortality trends and differentials in South Africa from 1997 to 2012 : second National Burden of Disease Study. *Lancet Glob Heal* [Internet]. 2012 [cited 2018 Jul 11];4(9):e642–53. Available from: [http://dx.doi.org/10.1016/S2214-109X\(16\)30113-9](http://dx.doi.org/10.1016/S2214-109X(16)30113-9)
10. World Health Organization. Global status report on non communicable diseases 2010 [Internet]. Alwan A, editor. World Health Organisation. 2010 [cited 2018 Jul 4]. Available from: [http://www.who.int/nmh/publications/ncd\\_report\\_full\\_en.pdf](http://www.who.int/nmh/publications/ncd_report_full_en.pdf)
11. Bellew B, St George A, King L. Workplace screening programs for chronic disease prevention : a rapid review. 2012 [cited 2017 Aug 4];(May):1–94. Available from: [https://www.saxinstitute.org.au/wp-content/uploads/04\\_Workplace-screening-programs-for-chronic-disease-preventi.pdf](https://www.saxinstitute.org.au/wp-content/uploads/04_Workplace-screening-programs-for-chronic-disease-preventi.pdf)
12. Quintiliani L, Sattelmair J, Activity P, Sorensen G. The workplace as a setting for interventions to improve diet and promote physical activity. *World Heal Organ*. 2007;1–36.
13. Sorensen G, Landsbergis P, Hammer L, Amick BC, Linnan L, Yancey A, et al. Preventing chronic disease in the workplace: A workshop report and recommendations. *Am J Public Health* [Internet]. 2011 [cited 2017 Jun 12];101(SUPPL. 1):196–207. Available from: <http://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.2010.300075>
14. Joan Burton. Healthy Workplace Framework and Model: Background and Supporting Literature and Practices [Internet]. World Health Organization. 2010 [cited 2017 Nov 19]. p. 1–131. Available from: [http://www.who.int/occupational\\_health/healthy\\_workplace\\_framework.pdf](http://www.who.int/occupational_health/healthy_workplace_framework.pdf)
15. Schneider M, Norman R, Parry C, Bradshaw D, Pluddeman A, Group SACRAC. Estimating the burden of disease attributable to alcohol use in South Africa in 2000. *South African Med J*. 2007;97:664–72.
16. Schouw D, Mash B, Kolbe-Alexander T. Assessing risk factors for non-communicable diseases in the workforce at a commercial power plant, South Africa. *Occup Heal South Africa*. 2018;In Publica:1–20.
17. Fieldgate I. Alcohol demand / consumption patterns in South Africa. In: *Economic Impact of An Advertising Ban on Alcoholic Beverages* [Internet]. 2011 [cited 2017 May 14]. p. 24–36. Available from: [https://www.thedti.gov.za/business\\_regulation/docs/nla/economic-impact-of-an-adban.pdf](https://www.thedti.gov.za/business_regulation/docs/nla/economic-impact-of-an-adban.pdf)
18. World Health Organization. Increasing fruit and vegetable consumption to reduce the risk of noncommunicable diseases [Internet]. 2018 [cited 2018 Jul 22]. p. 1. Available from: [http://www.who.int/elena/titles/fruit\\_vegetables\\_ncds/en/](http://www.who.int/elena/titles/fruit_vegetables_ncds/en/)
19. Shisana O, Labadarios D, Rehle T, Simbayi L, Zuma K, Dhansay A, et al. South African National Health and Nutrition Examination Survey (SANHANES-1) [Internet]. Igarss 2014. 2013 [cited 2017 Apr 4]. 1-5 p. Available from: [http://www.hsrc.ac.za/uploads/pageNews/72/SANHANES-launch edition \(online version\).pdf](http://www.hsrc.ac.za/uploads/pageNews/72/SANHANES-launch%20edition%20(online%20version).pdf)
20. Rodriguez-fernandez R, Rahajeng E, Villiani F, Kushadiwijaya H, Amiya RM, Bangs MJ. Non-communicable disease risk factor patterns among mining industry workers in Papua , Indonesia : longitudinal findings from the Cardiovascular Outcomes in a Papuan Population and Estimation of Risk (COPPER) Study. 2015 [cited 2017 Dec 8];1–8. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/26231573>
21. Puoane Thandi, David Sanders, Spires Mark, Hoelzel Philipp, Delobelle Peter SR. Diet-

- related non-communicable diseases in South Africa: determinants and policy responses. 2016.
22. Kahn-Marshall JL, Gallant MP. Making Healthy Behaviors the Easy Choice for Employees: A Review of the Literature on Environmental and Policy Changes in Worksite Health Promotion. *Heal Educ Behav* [Internet]. 2012 [cited 2017 May 12];39(6):752–76. Available from: <https://doi.org/10.1177/1090198111434153>
  23. Deci EL, Ryan R m., Hamer M, Lavoie KL, Bacon SL, Reiner M, et al. Long-term health benefits of physical activity--a systematic review of longitudinal studies. *Br J Sports Med* [Internet]. 1995;XXXIII(2):239–43. Available from: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3847225&tool=pmcentrez&rendertype=abstract%5Cnhttp://bjsm.bmj.com/content/early/2013/10/28/bjsports-2013-092993>
  24. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT, et al. Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *Lancet* [Internet]. 2012 [cited 2017 Jun 25];380(9838):219–29. Available from: [http://dx.doi.org/10.1016/S0140-6736\(12\)61031-9](http://dx.doi.org/10.1016/S0140-6736(12)61031-9)
  25. Chopra M, Steyn N, Lambert V. Decreasing the Burden of Cardiovascular Disease Final Report 2007. Western Cape Burden of Disease Reduction Project [Internet]. Vol. 6. 2007 [cited 2017 Mar 3]. Available from: [http://www.westerncape.gov.za/text/2007/6/cd\\_volume\\_6\\_cardiovascular\\_diseases.pdf](http://www.westerncape.gov.za/text/2007/6/cd_volume_6_cardiovascular_diseases.pdf)
  26. Anderzén I, Arnetz BB. The impact of a prospective survey-based workplace intervention program on employee health, biologic stress markers, and organizational productivity. *J Occup Environ Med*. 2005;47(7):671–82.
  27. WHO. Policy Brief : Promoting and Creating an Enabling Environment for Healthy Behaviours Among Workers [Internet]. Vol. 44. 2014 [cited 2018 Jul 25]. Available from: <http://www.who.int/nmh/ncd-coordination-mechanism/Policybrief33.pdf>
  28. NCD Alliance. Advocacy Agenda of People Living with NCDs [Internet]. 2017 [cited 2018 Jul 11]. Available from: <https://www.sancta.org.za/product/advocacy-agenda-of-people-living-with-ncds/>
  29. NCD Alliance. Realising the potential of workplaces to prevent and control NCDs [Internet]. 2016 [cited 2017 May 14]. Available from: [https://ncdalliance.org/sites/default/files/NCDs\\_%26\\_WorkplaceWellness\\_web.pdf](https://ncdalliance.org/sites/default/files/NCDs_%26_WorkplaceWellness_web.pdf)
  30. Parmelli E, Flodgren G, Beyer F, Baillie N, Schaafsma ME, Eccles MP. The effectiveness of strategies to change organisational culture to improve healthcare performance : a systematic review. *Implement Sci* [Internet]. 2011;6(1):33. Available from: <http://www.implementationscience.com/content/6/1/33>
  31. Egan M, Bambra C, Thomas S, Petticrew M, Whitehead M, Thomson H. The psychosocial and health effects of workplace reorganisation. 1. A systematic review of organisational-level interventions that aim to increase employee control. *J Epidemiol Community Health* [Internet]. 2007 [cited 2015 Mar 5];61(11):945–54. Available from: <https://jech.bmj.com/content/61/11/945>
  32. Arena R, Berra K, Kaminsky L, Hivert MF, Cherie Franklin N, Myers J, et al. Healthy lifestyle interventions to combat noncommunicable disease-a novel nonhierarchical connectivity model for key stakeholders: A policy statement from the American Heart Association, European Society of Cardiology, European Association for Cardiovascu. *Eur Heart J* [Internet]. 2015 [cited 2018 Sep 9];36(31):2097–109. Available from:

- <http://eurheartj.oxfordjournals.org/>  
<http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=emed13&AN=2015311538>  
<http://sfxhosted.exlibrisgroup.com/cmc?sid=OVID:embase&id=pmid:&id=doi:10.1093%2Feurheartj%2Fehv207&issn=0195-668X&isbn=&volume=>
33. Eng JY, Moy FM, Bulgiba A. Impact of a workplace health promotion program on employees' blood pressure in a public university. *PLoS One* [Internet]. 2016 [cited 2018 Sep 9];11(2):1–14. Available from: <https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0148307&type=printable>
  34. Golden SD, Earp JAL. Social Ecological Approaches to Individuals and Their Contexts. *Heal Educ Behav* [Internet]. 2012;39(3):364–72. Available from: <http://journals.sagepub.com/doi/10.1177/1090198111418634>
  35. Schouw D, Mash R, Kolbe-Alexander TL. Transforming the workplace environment to prevent non-communicable chronic diseases: Participatory action research in a South African power plant. *Glob Health Action* [Internet]. 2018 [cited 2018 Jul 10];under review. Available from: under review
  36. Department of Health, Medical Research Council, OrcMacro. South Africa Demographic and Health Survey 2003 [Internet]. Pretoria: Department of Health. 2007 [cited 2017 Aug 14]. Available from: <https://dhsprogram.com/pubs/pdf/FR206/FR206.pdf>
  37. World Health Organisation. Global Physical Activity Questionnaire (GPAQ) WHO stepwise approach to NCD risk factor surveillance [Internet]. Surveillance and Population-Based Prevention, Prevention of Noncommunicable Diseases Department. 2008 [cited 2016 Mar 6]. p. 1–3. Available from: [http://www.who.int/chp/steps/GPAQ\\_EN.pdf](http://www.who.int/chp/steps/GPAQ_EN.pdf)
  38. World Health Organization. Global Physical Activity Questionnaire. 2010;380(9838):282–93. Available from: [http://www.who.int/chp/steps/resources/GPAQ\\_Analysis\\_Guide.pdf](http://www.who.int/chp/steps/resources/GPAQ_Analysis_Guide.pdf)
  39. Saunders J, Aasland O, Babor T, De la Fuente J, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption [Internet]. Vol. 88, *Addiction*. 1993 [cited 2016 Apr 19]. Available from: <http://www.automasure.com/library/pdf/8329970.pdf>
  40. Report TS. Prevention, Detection, Evaluation, and Treatment of blood pressure. [cited 2018 Jun 28]; Available from: <https://www.nhlbi.nih.gov/files/docs/guidelines/jnc7full.pdf>
  41. Pract SAF. South African Dyslipidaemia Guideline Consensus Statement. 2015;57(2).
  42. Nishida C, Ko G, Kumanyika S. Body fat distribution and noncommunicable diseases in populations: overview of the 2008 WHO Expert Consultation on Waist Circumference and Waist-Hip Ratio. *Eur J Clin Nutr* [Internet]. 2010 [cited 2018 Jun 11];64(11):205. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/19935820>
  43. WHO. Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation [Internet]. World Health Organization. 2008 [cited 2018 Jul 1]. Available from: [http://apps.who.int/iris/bitstream/10665/44583/1/9789241501491\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/44583/1/9789241501491_eng.pdf)
  44. Gaziano TA, Pandya A, Steyn K, Levitt N, Mollentze W, Joubert G, et al. Comparative assessment of absolute cardiovascular disease risk characterization from non-laboratory-based risk assessment in South African populations. *BMC Med* [Internet]. 2013 [cited 2017 May 18];11(1):170. Available from: <http://bmcmmedicine.biomedcentral.com/articles/10.1186/1741-7015-11-170>

45. Maimela E, Alberts M, Modjadji SEP, Choma SSR, Dikotope SA, Ntuli TS, et al. The Prevalence and Determinants of Chronic Non-Communicable Disease Risk Factors amongst Adults in the Dikgale Health Demographic and Surveillance System (HDSS) Site, Limpopo Province of South Africa. *PLoS One* [Internet]. 2016 [cited 2018 Jul 30];11(2):e0147926. Available from: <http://dx.plos.org/10.1371/journal.pone.0147926>
46. Program W, Health S, Assessment R, Care H, Comparisons C, Reduces P, et al. 1 . Impact of StayWell Programs on Chrysler Health Care Costs , Increased Health Care Costs Associated with Health Risks [Internet]. 1999 [cited 2017 Apr 14]. Available from: [http://thehealthproject.com/wp-content/uploads/2015/02/DaimlerChrysler\\_UAW.pdf](http://thehealthproject.com/wp-content/uploads/2015/02/DaimlerChrysler_UAW.pdf)
47. Ajani F. Safety In Mines Research Advisory Committee ( SIMRAC ) Final Report SIM 020103 ‘ Alcohol and cannabis use among South [Internet]. [cited 2017 Dec 3]. Available from: [https://researchspace.csir.co.za/dspace/bitstream/handle/10204/1277/Health\\_712final\\_cover.pdf?sequence=1&isAllowed=y](https://researchspace.csir.co.za/dspace/bitstream/handle/10204/1277/Health_712final_cover.pdf?sequence=1&isAllowed=y)
48. Schneider M, Norman R, Parry C, Bradshaw D, Plüddemann A. Estimating the burden of alcohol abuse in South Africa in 2000 [Internet]. Medical Research Council. 2007 [cited 2017 Dec 2]. Available from: <http://www.samrc.ac.za/sites/default/files/files/2017-07-03/Alcoholburdentechinical.pdf>
49. Du Plessis U, Young C, Macleod CI. Harm reduction strategies in alcohol use and abuse : A critical review of interventions [Internet]. Grahamstown; 2017 [cited 2010 Sep 10]. Available from: [https://www.ru.ac.za/media/rhodesuniversity/content/criticalstudiesinsexualitiesandreproduction/documents/20170602\\_2\\_FASReport\\_web.pdf](https://www.ru.ac.za/media/rhodesuniversity/content/criticalstudiesinsexualitiesandreproduction/documents/20170602_2_FASReport_web.pdf)
50. Kolbe-Alexander TL, Buckmaster C, Nossel C, Dreyer L, Bull F, Noakes TD, et al. Chronic disease risk factors, healthy days and medical claims in South African employees presenting for health risk screening. *BMC Public Health* [Internet]. 2008 [cited 2017 Jul 11];8:228. Available from: <https://doi.org/10.1186/1471-2458-8-228><https://bmcpublihealth.biomedcentral.com/articles/10.1186/1471-2458-8-228>
51. Wang P-Y, Fang J-C, Gao Z-H, Zhang C, Xie S-Y. Higher intake of fruits, vegetables or their fiber reduces the risk of type 2 diabetes: A meta-analysis. *J Diabetes Investig* [Internet]. 2016 [cited 2018 Sep 10];7(1):56–69. Available from: <http://doi.wiley.com/10.1111/jdi.12376>
52. Guthold R, Louazani S, Riley L, Cowan M, Bovet P, Damasceno A, et al. Physical Activity in 22 African Countries: Results from the World Health Organization STEPwise Approach to Chronic Disease Risk Factor Surveillance. *Am J Prev Med* [Internet]. 2011 [cited 2018 Sep 2];41(1):52–60. Available from: <https://www.sciencedirect.com/science/article/pii/S0749379711002017>
53. Patel D, Goetzel RZ, Beckowski M, Milner K, Greyling M, Silva R, et al. The Healthiest Company Index. *J Occup Environ Med* [Internet]. 2013 [cited 2017 Mar 12];00(00):1–7. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/23287724>
54. Mceachan RRC, Lawton RJ, Jackson C, Conner M, Meads DM, West RM. Testing a workplace physical activity intervention : a cluster randomized controlled trial. 2011;1–12.
55. Quyen G, Chen T, Magnussen C, Kien G. Workplace Physical Activity Interventions: A Systematic Review. *SAGE* [Internet]. 2013 [cited 2018 Sep 10];27(6):113–23. Available from: <http://journals.sagepub.com/doi/10.4278/ajhp.120425-LIT-222>
56. World Health Organisation. Prevalence of insufficient physical activity [Internet]. Global

- Health Observatory Data. 2018 [cited 2017 Jul 21]. Available from: [http://www.who.int/gho/ncd/risk\\_factors/physical\\_activity\\_text/en/](http://www.who.int/gho/ncd/risk_factors/physical_activity_text/en/)
57. Groeneveld IF, Proper KI, Van Der Beek AJ, Hildebrandt VH, Van Mechelen W. Short and long term effects of a lifestyle intervention for construction workers at risk for cardiovascular disease: A randomized controlled trial. *BMC Public Health* [Internet]. 2011 [cited 2018 Aug 11];11. Available from: <https://bmcpublichealth.biomedcentral.com/track/pdf/10.1186/1471-2458-11-836>
  58. Reddy P, Zuma K, Shisana O, Kim J, Sewpaul R. Prevalence of tobacco use among adults in South Africa: Results from the first South African National Health and Nutrition Examination Survey. *South African Med J* [Internet]. 2015 [cited 2018 Aug 16];105(8):648. Available from: <http://www.samj.org.za/index.php/samj/article/view/9424>
  59. Law MR, Morris JK, Wald NJ. Use of blood pressure lowering drugs in the prevention of cardiovascular disease: Meta-analysis of 147 randomised trials in the context of expectations from prospective epidemiological studies. *BMJ* [Internet]. 2009 [cited 2018 Jul 21];338(7705):1245. Available from: <https://www.bmj.com/content/bmj/338/bmj.b1665.full.pdf>
  60. Engbers L, van Poppel M, van Mechelen W. Modest effects of a controlled worksite environmental intervention on cardiovascular risk in office workers. *Prev Med (Baltim)* [Internet]. 2007 [cited 2017 Aug 14];44(4):356–62. Available from: <https://www.sciencedirect.com/science/article/pii/S0091743506004658>
  61. Prior J, van Melle G, Crisinel A, Burnard B, Cornuz J, Darioli R. Evaluation of a multicomponent worksite health promotion program for cardiovascular risk factors—correcting for the regression towards the mean effect. *Prev Med (Baltim)* [Internet]. 2005 [cited 2017 Jun 12];40(3):259–67. Available from: <https://www.sciencedirect.com/science/article/pii/S0091743504003007>
  62. Skogstad M, Lunde L, Skare Ø, Mamen A, Alfonso JH, Øvstebø R. Physical activity initiated by employer and its health effects ; an eight week follow-up study. *BMC Public Health* [Internet]. 2016 [cited 2018 Aug 11];1–11. Available from: <https://academic.oup.com/ajph/article/17/S3/49S/130351>
  63. Lundahl B, Moleni T, Burke L. Motivational interviewing in medical settings: A systematic review and meta analysis of randomised controlled trials. *Patient Educ Couns*. 2013;93:157–68.
  64. Artinian, N. T., Fletcher, G. F., Mozaffarian, D., Kris-Etherton, P., Van Horn, L., Lichtenstein, A. H., ... & Burke LE. Interventions to promote physical activity and dietary lifestyle changes for cardiovascular risk factor reduction in adults a scientific statement from the American Heart Association. *Circulation* [Internet]. 2010 [cited 2018 Jul 4];122(4):406–41. Available from: <https://digitalcommons.wayne.edu/cgi/viewcontent.cgi?article=1002&context=nursingfrp>
  65. Law MR, Wald NJ, Thompson SG. By how much and how quickly does reduction in serum cholesterol concentration lower risk of ischaemic heart disease? *Bmj* [Internet]. 1994 [cited 2018 Aug 16];308(6925):367. Available from: <https://doi.org/10.1136/bmj.308.6925.367>
  66. Rodriguez-Fernandez R, Rahajeng E, Viliiani F, Kushadiwijaya H, Amiya RM, Bangs MJ. Non-communicable disease risk factor patterns among Mining industry workers in Papua, Indonesia: Longitudinal findings from the Cardiovascular Outcomes in a Papuan Population and Estimation of Risk (COPPER) Study. *Occup Environ Med* [Internet]. 2015 [cited 2017 Dec 8];72(10):728–35. Available from:

- <https://www.ncbi.nlm.nih.gov/pubmed/26231573>
67. Mehan MB. Profile of non communicable disease risk factors in an industrial setting. 2006 [cited 2018 Mar 14];52(3):167–73. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/16855315>
  68. Senekal M, Seme Z, Villiers A De, Steyn NP. Health status of primary school educators in low socio-economic areas in South Africa. 2015 [cited 2017 May 20];1–10. Available from: <https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-015-1531-x>
  69. Aidoo H, Essuman A, Aidoo P, Yawson AO, Yawson AE. Health of the corporate worker : health risk assessment among staff of a corporate organization in Ghana. *J Occup Med Toxicol* [Internet]. 2015 [cited 2017 Feb 2];1–6. Available from: <http://dx.doi.org/10.1186/s12995-015-0072-7>
  70. Linnan L, Bowling M, Childress J, Lindsay G, Blakey C, Pronk S, et al. Results of the 2004 National Worksite Health Promotion Survey. *Am J Public Health* [Internet]. 2008 [cited 2018 Sep 10];98(8):1503–9. Available from: <https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.2006.100313>
  71. Steyn, K. Fourie S. Temple N. Chronic diseases of lifestyle in South Africa: 1995-2005 [Internet]. 2005 [cited 2017 Nov 10]. Available from: <http://www.mrc.ac.za/chronic/cdl1995-2005.pdf>

## 3.4 Article 4:

# Cost and consequence analysis of Healthy Choices at Work (HCW) program to prevent non communicable diseases in a commercial power plant, South Africa

### 3.4.1 INTRODUCTION

NCDs, such as cardiovascular disease, cancer, chronic respiratory disease and diabetes were responsible for 70% of global deaths in 2015 with over three quarters of these deaths occurring in low- and middle-income countries (LMIC).<sup>1,2</sup> Risk factors for NCDs are greatly interconnected with environmental factors and increased urbanization.<sup>3</sup> Eighty percent of the gross burden of chronic disease mortality is found in developing countries. In a study on 23 selected LMIC's, chronic NCD's accounted for 50% of the gross burden of disease.<sup>4</sup> The global increase of NCDs is of both epidemiological and economic concern as NCDs have substantial impact on health, health services and organisational productivity.<sup>4,5</sup> The World Economic Forum has identified chronic diseases as one of the most significant threats to global economic growth and estimated a cumulative loss to the global economy of US\$7 trillion between 2011-2025.<sup>5,6</sup>

In South Africa (SA) the burden of NCDs contributes to 57% of all deaths and is accompanied by significant impairments such as amputations, blindness, hemiparesis and speech problems.<sup>7</sup> There is a substantial impact on the quality of life of individuals and families.<sup>8,9</sup> The impact of NCDs is predicted to increase further in SA over the next decade.<sup>10</sup> In SA, between 2006 and 2015, diabetes, stroke and coronary heart disease caused an estimated loss of US\$1.88 billion to the gross domestic product.<sup>11</sup> Organisations are impacted by direct and indirect costs of high absenteeism and staff turnover as these diseases lead to morbidity in the working age population, with obese workers costing organizations in the United States of America, 49% more than their non-obese colleagues in terms of leave with pay.<sup>12</sup> The direct costs include sick leave days, medical referrals and costs related to replacing absent employees; while indirect costs include losses from reduced productivity.<sup>13</sup> Many of the deaths caused by NCDs are premature and occur in people of working age (36-64 years).<sup>10</sup>

Underlying these diseases are a number of behavioural risk factors such as tobacco smoking, harmful alcohol use, physical inactivity and an unhealthy diet.<sup>14</sup> Interventions therefore to prevent NCDs focus on reducing harmful alcohol levels and tobacco smoking as well as improving physical activity and a healthy diet.<sup>5</sup> Lifestyle behaviours are not just a matter of individual choice and control, but are also influenced by the environment in which individual decision making is embedded.<sup>15</sup>

The WHO has identified the "best buys" for LMIC countries to prevent and control NCDs.<sup>16</sup> A 'best buy' is an intervention that is very cost-effective, feasible, culturally acceptable and add on average an additional year of healthy life.<sup>17</sup> According to WHO the following should be considered when selecting such interventions: effectiveness, cost-effectiveness, affordability, capacity to implement, feasibility according to national circumstances, impact on health equity, and its place within a menu of population-wide and individual interventions.<sup>16</sup> Despite numerous

interventions for the prevention and control of NCDs, choices regarding which interventions should be prioritised are critical, as resources in most countries are limited.

The SA National Department of Health (NDoH) in its “Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-2017”, promulgates a balance between individual level and population based strategies to prevent NCDs. Prevention and postponement of NCDs is more effective and less costly than treating those who become ill.<sup>18</sup> NCDs in SA pose a challenge to economic development and there is a need for a priority setting agency that assesses cost effectiveness, accessibility and feasibility of diverse interventions.<sup>19</sup> The national health budget does not include funding for robust health and costing data for NCDs to enable planning, budgeting and evaluation of activities.<sup>19</sup>

The workplace is an important setting for the prevention and control of NCDs.<sup>20</sup> Workplace health promotion programmes (WHPP) adopt a twofold approach that attribute a healthy lifestyle to both the individual’s responsibility and behaviour as well as to the influence of the environment that is outside the individual’s control.<sup>21</sup> Organisations that implement WHPPs may subscribe to one or both approaches. The WHO’s ‘best buys’ found no conclusive cost-effectiveness analysis for interventions in the workplace, but nevertheless made some recommendations based on the available evidence. These recommendations include: a) implementing nutrition education and counselling to increase fruit and vegetable uptake, and b) implementing multi-component workplace physical activity programs.<sup>22</sup> In a systematic review, aligned to the WHO ‘best buys’ approach, no studies on ‘best buys’ in 89% of LLMICs were found. More than half of the studies reported effectiveness for group interventions in reducing tobacco, but found weaker evidence for interventions aimed at individuals. Since most of the LLMICs have not conducted research on WHO ‘best buys’, consideration should be paid to implement and evaluate effectiveness in the national context, focusing on national priorities and interventions with the strongest evidence base.<sup>23</sup> According to ‘best buy’ interventions for risk factors for NCDs in LMICs, interventions for tobacco use in the workplace include smoke-free indoor workplaces with health information and warnings, recommendations for a healthy diet include reduced salt intake in food and interventions to improve physical inactivity; include evidence informed mass media campaigns on activity.<sup>24</sup>

There are relatively few studies showing the cost effectiveness of WHPPs in Africa. Studies in Africa have shown that the NCD burden has increased as it occurs concurrently with HIV/AIDS, with workplace wellness programs showing promise. However, the urban poor and unemployed have little access to these programs. The families of the deceased carry the biggest brunt with two thirds of poor households having no insurance for funeral costs and succumb to a loss of income from the deceased grant recipients or wage earners.<sup>25</sup> In the USA, a cost effectiveness analysis concluded that a wellness fitness program prevented 10% of cardiovascular events for an event rate of 0.9% at \$1440 over 10years or an incremental cost-effectiveness ratio, of \$1.44 million per CVE prevented when compared to no program.<sup>13</sup> A study evaluating the cost effectiveness of a workplace dietary intervention in Ireland, concluded that a system-level dietary intervention (restrictions of salt, sugar and fat; increase in fibre, fruits discounts, portion size monitoring and strategic positioning of healthy food alternatives) was most cost effective in reducing absenteeism, showing the highest net benefits of \$64.59 per employee.<sup>26</sup> In a study determining the economic impact of worksite interventions to promote healthy diet and physical activity, cost savings from absenteeism varied from 2.5% to 4.9% for every dollar spent on the intervention. This resulted in a 25-30% reduction in absenteeism and health care costs over 4 years.<sup>27</sup>

In a study on 44 UK worksites, exploring the impact and cost effectiveness of a workplace physical activity designed to reduce physical inactivity, there was no significant effect on improvement in physical activity from baseline to follow up, nor was the intervention cost-effective.<sup>28</sup>

In certain countries, including SA, policy focuses on occupational health and safety rather than disease prevention in the workplace. There is a lack of empirical evidence to support the cost-effectiveness of policy implementation in the workplace.<sup>29</sup>

The literature on WHPPs in Africa has focused on short term feasibility or pilot studies and has not evaluated the cost-effectiveness of interventions.<sup>30,31</sup> Therefore further research on the cost-effectiveness of interventions for the prevention of NCDs in the SA workplace is needed. The cost effectiveness of WHPPs to prevent and control NCDs has been studied in high income countries, but few studies have looked at this in low- and middle-income settings, such as SA.

The aim of this study therefore was to determine the incremental costs and consequences of the Healthy Choices at Work program (HCW) in terms of improvement in risk factors for NCDs and sick leave absenteeism.

## **3.4.2 METHODS**

### **Study design**

This study was an incremental cost and consequence analysis of the HCW program at a commercial power plant in the Western Cape, SA. An incremental cost analysis was done for additional costs incurred to the organisation resulting from actions of the HCW. The study compared the incremental costs of implementing the HCW program over 2-years compared to the consequences in terms of changes in risk factors for NCDs and sick leave.

### **Setting**

The study was conducted at a commercial power plant within a nature reserve close to Cape Town, South Africa. The 1743 permanent employees had a wide range of occupations, which included engineers, plant operators, physicists, technicians, artisans and support staff working shifts. The power plant included a health and wellness department that conducted annual health risk assessments on self-selected employees and provided occupational health services. All staff in the organisation were entitled to 180 days of sick leave over a 3-year cycle and were insured for medical care. The onsite health and wellness department conducted routine medical surveillance and registered employees with NCDs on their database for chronic care. Food was subsidised and provided by an external company who were contracted to operate the canteen and vending machines.

The management team consisted of an executive committee with 10-12 senior managers led by a general manager. The power plant operated in a highly pressurised environment due to the lack of generation capacity in SA relative to the increased demand for electricity. Employees worked very intensively during outages when generation was halted for routine maintenance.

### **The health choices at work program**

The HCW intervention, which took place over two years, used participatory action research with a co-operative inquiry group (CIG) and is more fully described in a separate publication.<sup>32</sup> A

diverse CIG made up of 11 key decision makers across the organisation (one financial manager, one wellness manager, one senior occupational health nurse, three engineering managers, two project management advisors, one industrial relations manager, one human resources manager, one quality control officer and a manager from the organisation's training department) led the intervention. The intervention focused on four key areas:

1) **Catering and the provision of food:** A new wellness meal was made available to employees on all shifts at no additional cost and was actively promoted. Healthy affordable snacks were also sold at the cafeterias and fruit was provided as a healthy snack to employees working extended shifts.

2) **Opportunities for physical activity:** Areas were identified within the surrounding nature reserve for walking, running and cycling, and functional exercise classes were held 4 times a week. First Friday sports took place once a month and staff were released from their duties to participate in 2.5km/5km walks, a 10km run or a 25km cycle. Employees were also encouraged to participate with their families in weekend park runs within their own communities.

3) **Provision of health and wellness services:** The HCW included two annual health risk assessments (HRAs) during the intervention. The HRAs provided feedback on NCD risk and offered counselling to employees on behavior change. Staff at the Health and Wellness department participated in a three-day training course on brief behavior change counselling using the 5 As (Ask, Alert, Assess, Assist, Arrange) approach in a guiding style to assist employees in making healthy lifestyle decisions.<sup>33</sup>

4) **Managerial buy-in and participation:** Managers approved the prevention program and led by example in choosing wellness meals, marketing activities, participating in physical activities and promoting health by broadcasting discussions of their own behaviour change.

## Evaluation of incremental costs

Incremental costs to the organisation that were associated with implementing the HCW were calculated for the two year period. Incremental costs were defined as additional costs that were incurred on top of existing expenditure. For example, allowing employees to participate in first Friday sports did not alter the cost of salaries and therefore these costs were not included, while the purchasing of additional exercise equipment was included. Research related costs were excluded.

Activities that led to incremental costs were identified by the CIG for the four key areas of the intervention (catering, physical activity, health and wellness, management support). The information on cost was sourced from the organisation's financial system by the finance manager and entered into an Excel spreadsheet.

These costs are reported in the results according to the four main areas of intervention and were further analysed in terms of the cost per capita and cost per annum.

## Evaluation of changes in risk factors for NCDs

A before-and-after study evaluated changes in risk factors for NCDs and the methods are fully reported elsewhere.<sup>34</sup> the study population was all permanent employees working at the power plant and there were no specific exclusion criteria. A sample of 156 employees was randomly selected. Sample size calculations confirmed the power of this sample to detect meaningful changes in risk factors for NCDs over time.

Participants were assessed at baseline and 24 months by means of questionnaires and clinical tests administered by trained health professionals from the health and wellness department. The questionnaires included data on demographic information, medical and family history, medication use, diet, physical activity, alcohol consumption and psychosocial stress factors. The Global Physical Activity Questionnaire (GPAQ) was used to quantify levels of physical activity.<sup>35</sup> Data on alcohol use was collected using the validated Alcohol Use Disorders Identification Test (AUDIT) questionnaire.<sup>36</sup> Questions on tobacco smoking, fruit and vegetable intake was extracted from the South African Demographic Health Survey Questionnaire.<sup>37</sup> Questions on psychosocial stress at work or at home were obtained from the organisation's in-house HRA questionnaire.

Clinical tests were measured using standardised procedures for systolic and diastolic blood pressure. Point of care testing for random blood glucose and total cholesterol utilised a finger prick capillary blood sample. Standing height, weight, waist and hip circumference were measured, Body mass index and waist to hip ratio were calculated. A 10-year cardiovascular risk was assessed for each participant.<sup>38</sup>

Data was captured in an Excel spreadsheet and checked for errors or omissions. Data was then analysed using the Statistical Package for the Social Sciences Version 24.1.

MET minutes were calculated from the GPAQ data. A minimum of 600 MET minutes per week was required to be considered physically active. The AUDIT questionnaire included 10-questions with a 4-point Likert scale that gave a possible total score of 41. Respondents with a score of 7 or less were categorised as sensible drinkers, those with a score of 8-19 as potentially harmful drinkers and those with a score of 20 or more as potentially dependent drinkers. Descriptive analysis was used to calculate the mean and standard deviation or frequency and percentage of all variables at baseline and follow up.

Paired t-tests were used to compare the mean differences for normally distributed numerical data (e.g. blood pressure, blood glucose, total cholesterol, BMI, waist circumference, WHR) from baseline to follow up at two years. McNemar's Chi-square test was used to compare paired binary categorical data from before to after (e.g. psychosocial stress, smoking, fruit and vegetables). Statistical significance was set at  $p < 0.05$ .

## **Evaluation of changes in sick leave**

Changes in sick leave related to NCDs were evaluated on the same sample of 156 employees as described above in the before-and-after study. Employee data on sick leave was collected on an annual basis by the Human Resources Information System. For this study, data was extracted on the study sample at baseline for the year prior to the study and at 2-year follow up for the second year of the study intervention.

Sick leave was measured in the following ways:

- The Gross Sickness Absentee Rate (GSAR) measured person days lost due to sick leave as a percentage of the total potential working days. The GSAR is always expressed as a percentage and is the international standard used for comparison of sickness absenteeism between companies, other work forces and countries.<sup>39</sup> The ideal GSAR to aim for in SA is between 2% and 5%.<sup>40</sup>
- The Absentee Frequency Rate (AFR) is the number of absence incidents per person for a given period and is calculated as the total number of absence incidents over a 12 month

period divided by the number of employees over a 12 month period. Only the number of incidents and not the duration is calculated and a favourable AFR is less than 0.5.<sup>40</sup>

All data was captured on an excel spreadsheet and checked for errors or omissions before analysis using IBM SPSS software version 25.1. Descriptive analysis was used to calculate the mean and standard deviation of GSAR and AFR before and after the intervention. Pearson's correlation coefficient (r) investigated the relationship between GSAR and AFR for systolic blood pressure, diastolic blood pressure and total cholesterol assuming they were normally distributed. A one-way between subjects ANOVA was conducted to compare the effect of fruit and vegetable intake and psychosocial stress on GSAR and AFR.

### **Ethical considerations**

Ethics approval was obtained from the Health and Research Ethics Committee (HREC) of Stellenbosch University (S15/08/165) and permission obtained from the power plant to conduct the study.

### **3.4.3 RESULTS**

#### **Incremental costs**

Table 1 shows the incremental costs for the four key areas targeted in the intervention. The total incremental cost to the company was R54 683, which equated to an average of R27 341 per annum. The average incremental cost per employee for implementing the HCW was estimated as R31.37 (\$2.19) over two years or R15.67 (\$1.09) per annum.

**Table 1: Incremental costs for activities**

<b>Intervention</b>	<b>Cost for activities 2016-2017 Rand</b>	<b>Cost for activities 2016-2017 US\$</b>
Opportunities for physical activity	31,583	2162,91
Catering and the provision of food	11,400	780,71
Provision of health and wellness services	16,200	1109,43
Managerial buy-in and participation	0	0
<b>TOTAL</b>	<b>54,683</b>	<b>3744,87</b>

For physical activity the incremental costs included the costs of equipment for functional exercise activities (e.g. mats, balls, skipping ropes) and the first Friday sports (e.g. colour powder). For catering activities additional fruit was provided during outages. For health and wellness services the costs included the training of nine health professionals in brief behaviour change counselling. There were no incremental costs for the managers.

#### **Changes in risk factors**

The mean age of the participants was 42.7 years (SD 9.7) and 64% were male. Table 2 presents the changes in behavioural and psychosocial risk factors for NCDs that were associated with the intervention. There were significant reductions in (Table 2) harmful alcohol use, physical inactivity and improved fruit and vegetable intake. There was no change in

tobacco smoking. Participants reported significantly improved relationships with colleagues and self-perceived health that could possibly be attributed to the intervention. There were also significant improvements (Table 3) in mean systolic blood pressure (-10.2mmHg), diastolic blood pressure (-3.87mmHg) and total cholesterol (-0.45mmol), There was no change in overweight, obesity or random glucose.

**Table 2: Change in behavioural and psychosocial risk factors (N=137)**

<b>Risk factors</b>	<b>Baseline %</b>	<b>Follow up %</b>	<b>p value</b>
<b>Behavioural risk factors</b>			
Sensible alcohol drinker (AUDIT score < 8)	78.2	93.5	0.001
Harmful alcohol drinker (AUDIT score 8-19)	21.0	4.8	
Dependent alcohol drinker (AUDIT score $\geq$ 20)	0.8	1.6	
Tobacco smoking	25.0	21.8	0.344
Inadequate fruit & vegetable intake (< 5 portions / day)	73.2	35.8	<0.001
Insufficiently active (<600 MET minutes/week)	55.9	34.7	<0.001
<b>Psychosocial factors</b>			
Relationship with colleagues	21.1	11.3	0.015
Lack of recognition	18.8	18.8	1.000
Lack of resources to do my work	29.5	30.3	1.000
Lack of meaningful work	15.1	13.5	0.664
Relationship with my supervisor	9.8	12.0	0.664
Lack of clarity concerning work outputs	20.9	15.7	0.265
Personal finances	29.8	18.3	0.008
My health or family member's health	22.3	10.8	0.006
Relationship with family/children	16.0	13.7	0.690
Relationship with my partner/spouse	13.3	9.2	0.210
Emotional/mental health concerns	8.8	4.7	0.227
I have challenges with addictions	3.3	0.8	0.250

**Table 3: Change in metabolic risk factors (N=137)**

Risk factors	Baseline Mean (SD)	Follow up Mean (SD)	Mean of the difference (95% CI)	p value
Systolic blood pressure (mmHg)	131.6 (18.5)	121.4 (14.6)	-10.2 (-7.3 : -13.2)	<0.001
Diastolic blood pressure (mmHg)	83.4 (13.7)	79.5 (8.8)	-3.87 (-1.8 : -5.8)	<0.001
Total cholesterol (mmol/l)	5.6 (1.1)	5.1 (1.1)	-0.45 (-0.3 : -0.6)	<0.001
Random glucose (mmol/l)	5.7 (1.5)	6.0 (2.0)	0.31 (-0.6 : 0.2)	0.069
Body mass index (kg/m <sup>2</sup> )	29.0 (5.5)	29.0 (5.7)	-0.05 (-0.4 : 0.3)	0.760
Waist circumference (cm)	92.1 (14.3)	92.2 (14.4)	0.05 (-1.1 : 1.0)	0.926
Waist to hip ratio (cm)	0.86 (0.1)	0.87 (0.1)	-0.00 (-0.0 : 0.0)	0.484

## Changes in sick leave

Tables 4 and 5 looks at the relationship between changes in sick leave and changes in risk factors. Overall there was no meaningful correlation between sick leave and risk factors, although a decrease in alcohol intake was weakly associated with an increase in sick leave.

**Table 4: Relationship of sick leave and categorical risk factors**

Risk factors	Mean change in GSAR (SD)	p value	Mean change in AFR (SD)	p value
<b>Change in fruit and vegetable intake</b>				
Increase in intake (n=29)	-0.67 (2.9)	0.017	-0.52 (1.9)	0.892
No change in intake (n=55)	0.51 (4.4)		-0.25 (3.0)	
Decrease in intake (n=9)	-1.0 (3.1)		-0.56 (2.8)	
<b>Change in perceived personal and family health</b>				
Increase in stress (n=4)	0.95 (0.8)	0.918	-1.75 (2.9)	0.087
No change in stress (n=73)	-0.16 (4.8)		-0.23 (2.8)	
Decrease in stress (n=16)	-0.86 (3.4)		-0.37 (2.3)	
<b>Change in relationship with colleagues</b>				
Increase in stress (n=4)	-1.99 (3.1)	0.711	0.50 (1.7)	0.552
No change in stress (n=68)	-0.10 (3.7)		-0.03 (2.6)	
Decrease in stress (n=19)	-2.13 (7.1)		-1.53 (3.0)	

**Table 5 Correlation of sick leave with numerical risk factors**

Correlation	Pearson correlation (r)	p value
GSAR vs systolic blood pressure	0.171	0.096
GSAR vs diastolic blood pressure	- 0.102	0.325
GSAR vs total cholesterol	-0.168	0.101
GSAR vs AUDIT	-0.258	0.011
GSAR vs METS	-0.048	0.642
AFR vs systolic blood pressure	-0.087	0.399
AFR vs diastolic blood pressure	-0.160	0.118
AFR vs total cholesterol	-0.154	0.135
AFR vs AUDIT	-0.259	0.011
AFR vs METS	-0.002	0.981

### 3.4.4 DISCUSSION

The HCW demonstrated effectiveness through the significant improvements in risk factors for NCDs. The study also suggests that the HCW is a highly affordable intervention. Significant improvement in risk factors for NCDs was seen with minimal incremental costs to the company. The cost to implement the intervention was approximately \$1 per individual, which is important for LMIC where resources are constrained.

#### Affordability

The implementation of HCW was very affordable when compared to other types of interventions. For example, using the internet as a vehicle for health promotion to impact physical activity as well as fruit and vegetable intake was more costly (\$425 per person) and not effective.<sup>41</sup> The cost to implement a system level dietary modification intervention to reduce absenteeism in the workplace was \$55.58 per employee per annum which delivered greater benefits (QALYs) at lower costs than interventions aimed at nutrition education and combined interventions.<sup>26</sup>

Programs, such as HCW, that focus primarily on environmental modification rather than education from health professionals in the workplace are more likely to be affordable.<sup>23</sup> The HCW program also appears more affordable than some community-based interventions for reduction in systolic blood pressure (\$62 per person for a 1mmHg decrease vs \$1 per person for a 10mmHg decrease), especially as the HCW cost was not limited to an effect on blood pressure alone.<sup>42</sup>

#### Capacity to implement

Sufficient and trained capacity was provided in the form of a dedicated team of professionals from the organisational health and wellness department as well as from the operational sectors in the organisation and CIG. The alcohol policy and subsidised policy on providing wellness meals was encapsulated in the organisational regulations. Future capacity can be increased by incorporating a train-the trainer program whereby volunteers within the organisation are invited as health and wellness champions and trained on how to implement WHPP. An example of such a program is the Work@Health T3 Program, an evidence based curriculum whereby employees and contract staff are trained in health promotion to train other employees. The

Work@Health program is effective in that the curriculum can be adapted to the context and culture of the organisation and therefore build on the internal capacity to sustain health promotion in the workplace.<sup>43</sup>

### **Feasibility according to national circumstances**

The study demonstrates the feasibility of utilising currently available resources to relieve the burden of NCDs amongst employees. However, the HCW relied on significant indirect costs (extended time given off for participation in sport, staff within the organisation rendering the necessary services, clinical testing, media and advertising and occupational health services) made possible by the commitment of the senior management team of the organisation.

### **Impact on health equity of interventions**

Inequalities in health status were indirectly addressed as the whole organisation was open to participate in the activities and enjoyed the benefits of HCW. In broader terms, the HCW contributed to improving health equity for permanent and contract staff by partnering with community and government organisations to access participation in health activities and receive education on NCDs. Health Equity was a leader driven priority, whereby all staff were encouraged to participate in activities irrespective of their employment status within the organisation. However full equity was not afforded to contract workers as they were not have the same advantages of permanent employees (access to private medical insurers, time off incentives and access to health care facilities on the commercial plant).

### **The need to implement a combination of population-wide policy interventions and individual interventions**

The implementation of the multicomponent HCW by the CIG at the commercial power plant included modest investment, which was supported by organisational policies for alcohol and healthy food subsidies, as well as time off for participation included in the organisations operational plan.

Although we were unable to calculate an incremental cost effectiveness ratio for the HCW we believe that given the very low cost it is likely to meet the WHO best buy criteria of <\$100/DALY for LMIC.<sup>16</sup> If additional funding can be obtained, such a calculation will be possible.<sup>43</sup>

There was no relationship between the effect of HCW on risk factors and reduced sick leave. Absenteeism due to illness may have been influenced by many different factors, which could mask any impact of the HCW on sickness from NCDs. The timeframe may be too short to determine the impact of the HCW on improving risk factors for NCDs, as improvement differs for individuals and may manifest positively in subsequent years. As the impact of the HCW will only be felt years later, the HCW needs further evaluation to determine effectiveness on absenteeism. The correlation between a reduction in harmful alcohol use and increase in sick leave was unexpected. The reduction in alcohol use was attributed to the HCW intervention and it is difficult to explain why this would lead to an increase in sick leave. Elsewhere a similar phenomenon has been noted, but attributed to a link between reduction in alcohol intake and the development of other illnesses.<sup>44</sup> Other studies found a u-shaped relationship between alcohol consumption and sickness absenteeism such that people who abstained from alcohol had higher sickness absenteeism than people who consumed alcohol moderately.<sup>45</sup>

### **3.4.5 LIMITATIONS**

Although the incremental costs and consequences have been compared in this study it would have been helpful to calculate an incremental cost effectiveness ratio. A mini Markov model has been developed for the South African context to assess the ICER for interventions on risk factors for NCDs. Unfortunately the model is only available in the USA and additional funds would be needed to analyse the data.

This study did not measure indirect costs (salaries, treatment, clinical tests, travelling, reimbursements, catering, devices, etc.) already paid for by the organisation or costs associated with NCDs borne by the employee.

The before and after study design cannot prove the effectiveness of the HCW per se, but has allowed the researcher to measure changes in risk factors associated with the intervention. The whole organisation was exposed to the intervention, which made the selection of a control group difficult. Improvements in risk factors could be due to other confounding factors, although prior to the intervention the annual health risk assessments suggested a progressive increase in risk as retrieved from employee medical records.

Productivity was not evaluated and can best be evaluated using rigorous quantitative measurements for analyzing productivity (such as the Productivity Assessment Tool which is an analysis model for assessing the economic impact of occupational health and safety) and performance of employees following a HCW program.

### **3.4.6 RECOMMENDATIONS**

- As the HCW appears to be cost effective, the program could be implemented in other medium and large enterprises, which have similar organisational settings to potentially deliver the program.
- Further evidence of cost-effectiveness should be obtained from experimental study designs that include full cost-effectiveness analysis and measurement of the impact on productivity.
- The low cost and beneficial consequences of the HCW support the inclusion of such WHPPs in the National Department of Health's policy on NCD prevention and control.

### **3.4.7 CONCLUSION**

This study has demonstrated low incremental costs and substantial beneficial consequences in terms of risk factors for NCDs in the HCW program. Despite reductions in risk factors there was no reduction in sick leave. The study supports the value of WHPPs in the SA policy context for similar large and moderate enterprises to reduce the risk of NCDs. Future studies should formally measure the ICER and also assess the effect on productivity.

### **3.4.8 ACKNOWLEDGMENTS**

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### 3.4.9 COMPETING INTERESTS

The authors declare that they do not have conflicts of interest.

### 3.4.10 AUTHORS' CONTRIBUTIONS

DS conducted the study for a doctoral degree under the supervision of RM and TKA. DS, conceptualized the study. All data was collected by DS and analyzed by DS and RM. The manuscript was written by DS and revisions made by RM and TKA. All authors approved the final version.

### 3.3.11 REFERENCES

1. World Health Organization. NCD mortality and morbidity [Internet]. Global Health Observatory (GHO) data. 2018 [cited 2018 Aug 4]. p. 1. Available from: [http://www.who.int/gho/ncd/mortality\\_morbidity/en/](http://www.who.int/gho/ncd/mortality_morbidity/en/)
2. WHO. Action Plan for the Global Strategy for the Prevention and Control of Noncommunicable Diseases 2008-2013. Geneva World Heal Organ [Internet]. 2008;35. <http://www.who.int/nmh/Actionplan-PC-NCD-2008.pdf>  
<http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:2008-2013+Action+Plan+for+the+global+strategy+for+the+prevention+and+control+of+Noncommunicable+Diseases#0%5Cnhttp://scholar.google.com/scho>
3. Tryon K, Bolnick H, Pomeranz JL, Pronk N, Yach D. Making the workplace a more effective site for prevention of noncommunicable diseases in adults. *J Occup Environ Med* [Internet]. 2014 [cited 2017 Jun 18];56(11):1137–44. Available from: <https://pdfs.semanticscholar.org/99e4/8ba6fb113c79b3e0d90a19bd513859d94bc1.pdf>
4. Abefgunde D, Mathers C, Adam C, ADAM T, Strong K. The Burden and Costs of Chronic Diseases in Low-Income and Middle-Income Countries. *Lancet* [Internet]. 2008 [cited 2018 Sep 4];370(9603):192935. Available from: [https://www.researchgate.net/publication/5785309\\_The\\_Burden\\_and\\_Costs\\_of\\_Chronic\\_Diseases\\_in\\_Low-Income\\_and\\_Middle-Income\\_Countries](https://www.researchgate.net/publication/5785309_The_Burden_and_Costs_of_Chronic_Diseases_in_Low-Income_and_Middle-Income_Countries)
5. World Health Organization [WHO]. From Burden to “Best Buys”: Reducing the Economic Impact of Non-Communicable Diseases in Low- and Middle-Income Countries [Internet]. World Economic Forum. 2011 [cited 2018 Apr 2]. Available from: [https://www.who.int/nmh/publications/best\\_buys\\_summary/en/](https://www.who.int/nmh/publications/best_buys_summary/en/)
6. World Economic Forum, Companies M& M, Swiss Reinsurance Company, Wharton Center for Risk Management U of P, Services ZF. Global Risks [Internet]. Landscape. 2011 [cited 2018 Nov 4]. Available from: [http://www3.weforum.org/docs/WEF\\_Global\\_Risks\\_Report\\_2011.pdf](http://www3.weforum.org/docs/WEF_Global_Risks_Report_2011.pdf)
7. Richards NC, Gouda HN, Durham J, Rampatige R, Rodney A, Whittaker M. Disability, noncommunicable disease and health information. *Bull World Health Organ* [Internet]. 2016 [cited 2018 Nov 4];94(3):230–332. Available from: <http://www.who.int/bulletin/volumes/94/3/15-156869.pdf>
8. P0309. Statistical Release Mortality and causes of death in South Africa, 2016: Findings

- from death notification [Internet]. 2017. Report No.: P0309.3. Available from: [www.statssa.gov.za/info@statssa.gov.za](http://www.statssa.gov.za/info@statssa.gov.za)
9. World Health Organization. a Vital Investment. World Health [Internet]. 2005 [cited 2018 Aug 4];202. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Preventing+Chronic+Diseases:+A+Vital+Investment#3>
  10. Sivadasanpillai Harikrishnan, Stephen Leeder MH, Panniyammakal Jeemon DP. A race against time: The challenge of cardiovascular diseases in developing economies. Centre for chronic disease control. [Internet]. New Delhi, India; 2014 [cited 2017 Dec 5]. 75 p. Available from: [https://www.researchgate.net/publication/277279425\\_A\\_race\\_against\\_time\\_The\\_Challenge\\_of\\_Cardiovascular\\_Diseases\\_in\\_Developing\\_Economies](https://www.researchgate.net/publication/277279425_A_race_against_time_The_Challenge_of_Cardiovascular_Diseases_in_Developing_Economies)
  11. Abegunde DO, Mathers CD, Adam T, Ortegón M, Strong K. The burden and costs of chronic diseases in low-income and middle-income countries. *Lancet*. 2007;370(9603):1929–38.
  12. Nuys K, Globe D, Ng-Mak D, Cheung H, Sullivan J, Goldman D. The Association between Employee Obesity and Employer Costs: Evidence from a Panel of U.S. Employers. *Am J Heal Promot* [Internet]. 2014 [cited 2018 Nov 4];28(5):277–85. Available from: <http://journals.sagepub.com/doi/10.4278/ajhp.120905-QUAN-428>
  13. Patterson PD, Smith KJ, Hostler D. Cost-effectiveness of workplace wellness to prevent cardiovascular events among U . S . firefighters. *BMC Cardiovasc Disord* [Internet]. 2016 [cited 2018 Nov 10];1–7. Available from: <http://dx.doi.org/10.1186/s12872-016-0414-0>
  14. WHO. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. [Internet]. World Health Organization. 2013 [cited 2017 Feb 22]. 102 p. [http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/94384/1/9789241506236_eng.pdf)
  15. Quintiliani L, Sattelmair J, Activity P, Sorensen G. The workplace as a setting for interventions to improve diet and promote physical activity [Internet]. World Health Organisation. 2007 [cited 2017 Jul 18]. Available from: <http://www.who.int/dietphysicalactivity/Quintiliani-workplace-as-setting.pdf>
  16. World Health Organization (WHO). ‘Best buys’ and other recommended interventions for the prevention and control of noncommunicable diseases [Internet]. 2017 [cited 2018 Aug 18]. Available from: <http://www.who.int/ncds/management/best-buys/en/>
  17. Europe E, Commission WHO, Convention WHOF, Control T, Fctc WHO, Fctc TWHO, et al. Reducing risks and preventing disease: population-wide interventions [Internet]. Global status report on noncommunicable diseases 2010. 2011 [cited 2018 Nov 8]. Available from: [http://www.who.int/nmh/publications/ncd\\_report\\_chapter4.pdf](http://www.who.int/nmh/publications/ncd_report_chapter4.pdf)
  18. National Department of Health. Strategic Plan for the Prevention and Control of Non-Communicable Diseases 2013-2017 [Internet]. Department of Health. 2013 [cited 2017 Feb 11]. 1-80 p. Available from: <http://www.hsrb.ac.za/uploads/pageContent/3893/NCDs Strat Plan Content 8 april>

proof.pdf

19. Hofman K. Non-communicable diseases in South Africa: A challenge to economic development. *South African Med J* [Internet]. 2014 [cited 2018 Nov 5];104(10):647. Available from: <http://www.samj.org.za/index.php/samj/article/view/8727>
20. World Health Organization. WHO Global Plan of Action on Workers' Health (2008-2017): Baseline for Implementation [Internet]. 2013 [cited 2017 Mar 3]. Available from: [http://www.who.int/occupational\\_health/who\\_workers\\_health\\_web.pdf](http://www.who.int/occupational_health/who_workers_health_web.pdf)
21. Shain M, Kramer DM. Health promotion in the workplace: Framing the concept; reviewing the evidence. *Occup Environ Med* [Internet]. 2004 [cited 2018 Sep 17];61(7):643–8. Available from: <https://oem.bmj.com/content/oemed/61/7/643.full.pdf>
22. World Health Organization. "Best buys" and other recommended interventions for the prevention and control of noncommunicable diseases. Updated (2017) Appendix 3 of the Global action plan for the prevention and control of noncommunicable diseases 2013-2020 [Internet]. 2017 [cited 2018 Jul 10]. Available from: [http://who.int/ncds/management/WHO\\_Appendix\\_BestBuys.pdf?ua=1](http://who.int/ncds/management/WHO_Appendix_BestBuys.pdf?ua=1)
23. Allen LN, Pullar J, Wickramasinghe KK, Williams J, Roberts N, Mikkelsen B, et al. Evaluation of research on interventions aligned to WHO 'Best Buys' for NCDs in low-income and lower-middle-income countries: a systematic review from 1990 to 2015. *BMJ Glob Heal* [Internet]. 2018 [cited 2018 Nov 6];3(1):e000535. Available from: <http://gh.bmj.com/lookup/doi/10.1136/bmjgh-2017-000535>
24. World Health Organization (WHO). Scaling up action against noncommunicable diseases : How much will it cost ? [Internet]. 2011 [cited 2018 Apr 4]. Available from: <http://apps.who.int/medicinedocs/documents/s18805en/s18805en.pdf>
25. Collins D, Leibbrandt M. The financial impact of HIV/AIDS on poor households in South Africa. *AIDS* [Internet]. 2007 [cited 2018 Nov 18];21(Supplementary 7):S75-81. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/18040168>
26. Fitzgerald S, Murphy A, Kirby A, Geaney F, Perry IJ, Murphy A, et al. Cost-effectiveness of a complex workplace dietary intervention : an economic evaluation of the Food Choice at Work study. 2018 [cited 2018 Aug 6];1–9. Available from: <https://bmjopen.bmj.com/content/bmjopen/8/3/e019182.full.pdf>
27. Proper K, Mechelen W Van. Effectiveness and economic impact of worksite interventions to promote physical activity and healthy diet. Background paper prepared for the WHO / WEF Joint Event [Internet]. World Health Organization. 2008. Available from: [http://www.who.int/dietphysicalactivity/Proper\\_K.pdf](http://www.who.int/dietphysicalactivity/Proper_K.pdf)
28. Mceachan RRC, Lawton RJ, Jackson C, Conner M, Meads DM, West RM. Testing a workplace physical activity intervention : a cluster randomized controlled trial. *Int J Behav Nutr Phys Act* [Internet]. 2011 [cited 2018 Aug 3];8(29):1–12. Available from: [https://app.dimensions.ai/details/publication/pub.1020580334?and\\_facet\\_journal=jour.1093437](https://app.dimensions.ai/details/publication/pub.1020580334?and_facet_journal=jour.1093437)
29. Jager P, Rees D, Kisting S, Kgalamono S, Ndaba M, Stacey N, et al. Nudging for

- Prevention in Occupational Health and Safety in South Africa Using Fiscal Policies. *A J Environ Occup Heal Policy* [Internet]. 2017 [cited 2018 Nov 6];27(2):176–88. Available from: <https://doi.org/10.1177/1048291117710782>
30. Kolbe-Alexander TL, Proper KI, Lambert E V, van Wier MF, Pillay JD, Nossel C, et al. Working on wellness (WOW): A worksite health promotion intervention programme. *BMC Public Health* [Internet]. 2012 [cited 2015 Apr 4];12(1):372. Available from: <http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-12-372>
  31. CDIA. Chronic Disease Initiative for Africa [Internet]. 2015 [cited 2017 Aug 2]. Available from: [www.cdia.uct.ac.za/cdia/newsletters](http://www.cdia.uct.ac.za/cdia/newsletters)
  32. Schouw D, Mash R, Kolbe-Alexander TL. Transforming the workplace environment to prevent non-communicable chronic diseases: Participatory action research in a South African power plant. *Glob Health Action* [Internet]. 2018; Available from: in publication
  33. Everett-Murphy K, Mash R, Malan Z. Helping people change [Internet]. 2013 [cited 2017 Jan 8]. 1-68 p. Available from: <https://www.ichange4health.co.za/wp-content/uploads/2016/01/Helping-People-Change.pdf>
  34. Schouw D, Mash R, Kolbe-Alexander T. Changes in risk factors for non-communicable diseases associated with a Healthy Choices at Work program at a commercial power plant: Publ. 2018;1–21.
  35. World Health Organization. Global Physical Activity Questionnaire. 2010 [cited 2015 Apr 4];380(9838):282–93. Available from: [http://www.who.int/chp/steps/resources/GPAQ\\_Analysis\\_Guide.pdf](http://www.who.int/chp/steps/resources/GPAQ_Analysis_Guide.pdf)
  36. Saunders J, Aasland O, Babor T, De la Fuente J, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption [Internet]. Vol. 88, *Addiction*. 1993 [cited 2016 Apr 19]. Available from: <http://www.automesure.com/library/pdf/8329970.pdf>
  37. Department of Health, Medical Research Council, OrcMacro. South Africa Demographic and Health Survey 2003 [Internet]. Pretoria: Department of Health. 2007 [cited 2017 Aug 14]. Available from: <https://dhsprogram.com/pubs/pdf/FR206/FR206.pdf>
  38. Peer N, Lombard C, Steyn K, Gaziano T, Levitt N. Comparability of total cardiovascular disease risk estimates using laboratory and non-laboratory based assessments in urban-dwelling South Africans: the CRIBSA study. *South African Med J*. 2014;104(10):691–6.
  39. Mogabe T. Guidelines For Developing An Absenteeism Management [Internet]. University of Pretoria; 2011 [cited 2018 Nov 2]. Available from: <https://repository.up.ac.za/bitstream/handle/2263/29783/dissertation.pdf;sequence=1>
  40. Munro L, Rad ND, Unisa MA, Dip PG, Admin P, Unisa T. Absenteeism and presenteeism : possible causes and solutions . *South African Radiogr*. 2007;45(1):21–3.
  41. Robroek SJW, Polinder S, Bredt FJ, Burdorf A. Cost-effectiveness of a long-term Internet-delivered worksite health promotion programme on physical activity and nutrition: A cluster randomized controlled trial. *Health Educ Res*. 2012;27(3):399–410.

42. Zhang D, Wang G, Joo H. A Systematic Review of Economic Evidence on Community Hypertension Interventions. *Am J Prev Med* [Internet]. 2017;53(6):S121–30. Available from: <http://dx.doi.org/10.1016/j.amepre.2017.05.008>
43. Lang J, Cluff L, Rineer J, Brown D, N J-J. Building Capacity for Workplace Health Promotion: Findings From the Work@Health® Train-the-Trainer Program Jason. *Heal Promot Pract* [Internet]. 2017 [cited 2018 Nov 19];18(6):902–11. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5735412/pdf/nihms904141.pdf>
44. Uutela A, Johansson E, Bo P. Alcohol consumption and sickness absence : evidence from microdata. *Eur J Public Health* [Internet]. 2008 [cited 2018 Oct 31];19(1):19–22. Available from: <https://watermark.silverchair.com/ckn116.pdf?>
45. Ervasti J, Kivimäki M, Head J, Goldberg M, Airagnes G, Pentti J, et al. Sickness absence diagnoses among abstainers , low-risk drinkers and at-risk drinkers : consideration of the U-shaped association between alcohol use and sickness absence in four cohort studies. *Addiction* [Internet]. 2018 [cited 2018 Oct 31];113(October 2017):1633–42. Available from: <https://onlinelibrary.wiley.com/doi/pdf/10.1111/add.14249>

## CHAPTER 4

# CONCLUSIONS AND RECOMMENDATIONS

### 4.1 INTRODUCTION

In this chapter, I discuss the conclusions of the thesis in relation to the initial objectives and the conceptual framework that led to the development and implementation of the HCW program. I also discuss some of the methodological insights and lessons learnt, and make recommendations.

### 4.2 CONCLUSIONS RELATED TO THE OBJECTIVES

The aim of the research was to transform the workplace environment in order to prevent and control the risk factors for NCDs amongst the workforce. In this section, I will conclude on the findings in relation to each of the original objectives.

#### 4.2.1 Objectives 1 and 2

#### **How to transform the business, psychosocial and physical environments to help prevent and control NCDs.**

The CIG itself was seen as vital to the successful leadership and implementation of the HCW program. The characteristics of the CIG in terms of creativity and innovation, diversity, networking, mutual respect, alignment with purpose and shared values were seen as critical to the process. Transformation was particularly enabled by team diversity. The HCW program was driven by a diverse set of experts rather than only health professionals, and may have been more effective at solving complex problems because they engaged with multiple perspectives that gave a more accurate picture of reality at the plant and a wider range of ideas and approached to enabling change (1)(2).

The use of outcome mapping to define the vision, mission, boundary partners, outcome challenges and strategies required was also seen as appropriate to the complexity of the process and vital to the success.

Tangible opportunities were created for easily accessible healthy lifestyle options. Nudging or “choice architecture”, in the availability of subsidised wellness meals, fruit snacks, access to physical activity and sport during working hours were important in changing employees’ behaviours.

Management buy-in, enabled change to happen with all the boundary partners since managers were engaged in the process at both a personal and organisational level. All of these components worked together to result in workplace transformation.

In addition the behaviour change wheel (BCW) can be used to make sense of the range of interventions and policy changes utilised by the CIG (3)(4). Ideally the BCW should have formed part of the literature review, but I only discovered it after the conceptual framework had been developed. The BCW forms the basis for a systematic analysis of the selection of the HCW interventions and policies. The intervention was compromised of the following elements: education, persuasion, incentivisation, training, restriction, environmental restructuring,

modelling and enablement. Definitions according to the BCW are given to all of the above mentioned elements. Examples used in HCW program are listed for the elements of the intervention as seen in Table 4.1.

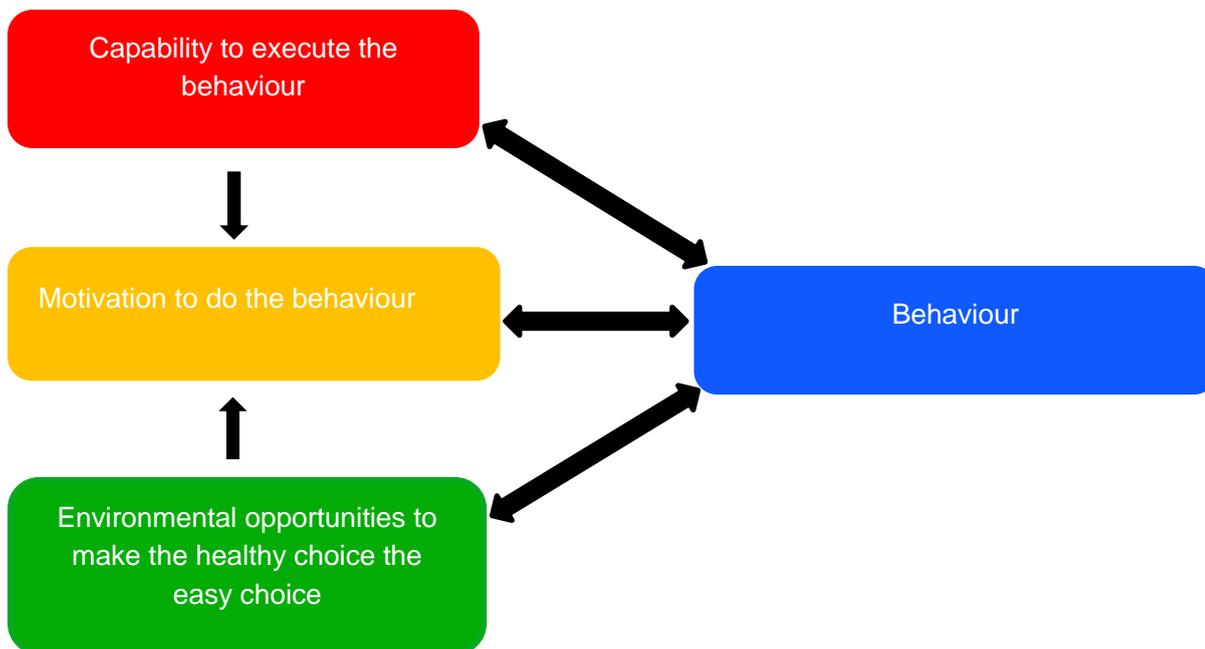
**Table 4.1 Definitions of interventions and policies**

<b>INTERVENTION</b>	<b>DEFINITION</b>	<b>EXAMPLES</b>
Education	Increasing knowledge or understanding	Information was provided to staff to promote healthy living
Persuasion	Using communication to induce positive or negative feelings or stimulate action	Live demonstrations of exercise and healthy eating were done on plasma screens broadcasted to all employees. Live interviews with managers were aired on screens about their healthy lifestyles.
Incentivisation	Creating expectation of reward	Using prizes for biggest loser competitions, and monthly walks, runs, cycling in the nature reserve to improve physical fitness and reduce weight
Training	Imparting skills	Brief behavior change training done with all health and wellness staff
Restriction	Using rules to reduce the opportunity to engage in the target behavior (or to increase the target behavior by reducing the opportunity to engage in competing behaviors)	Prohibiting the use of salt in the preparation of food.
Environmental restructuring	Changing the physical or social context	Providing subsidised healthy meals as easy access to healthy eating in the cafeterias Provide walking routes, as well as running and cycling trails on site. Providing employees with 3 text messages per week to improve their lifestyles
Modelling	Providing an example for people to aspire to or imitate	Management and CIG models healthy lifestyles by participating and leading in the planned activities
Enablement	Increasing means/reducing barriers to increase capability or opportunity	Behavioral support to reduce NCDs by the health and wellness team, regular exercise classes, weight loss and fitness challenges
<b>POLICIES</b>		
Communication/marketing	Using print, electronic, telephonic or broadcast media	Quarterly Wellness newsletter, on site billboard advertising, emails, plasma screens, meetings
Guidelines	Create documents that recommend or mandate practice. This includes all changes to service provision.	Produce directive for catering wellness meals. No meals and snacks to be issued to staff without wellness approval.
Regulation	Establishing rules or principles of behavior or practice	Time is given off once a month for all employees to participate in 3 hour sports sessions

Environmental/social planning	Designing and/or controlling the physical or social environment	The gym was planned using project managers, design and structural engineers.
Service provision	Delivering a service	Support services was established by the medical aids, health and wellness team, sport and recreation, and catering department

Transformation of the workplace environment was complemented by interventions aimed at individuals. HRAs were conducted annually as part of the ongoing monitoring of all participants. Employees received feedback on their health risks and were offered brief behaviour change counselling from trained health professionals to assist in changing risky behaviour.

The interventions can also be understood in terms of the adapted COM-B model (Capability, Opportunity, Motivation – Behaviour) as shown in Figure 4.1 In this model behaviour is predicted by an interaction between the individual's capability (knowledge and skills), motivation and the environmental opportunities or barriers. The HCW focused primarily on changing the opportunities for healthy behaviour, while also assisting the individual's capability and motivation through the HRAs and BBCC.



**Figure 4.1 Adapted COM-B System: A framework for understanding behaviour (4)**

The site appointed medical practitioner and clinical nurse practitioners from the health and wellness team underwent a three-day brief behaviour change counselling training course and used these skills when conducting health risk assessments, annual or follow up medicals. The team was trained in the use of the 5A's (Ask, Alert, Assess, Assist and Arrange) in a guiding style, which targeted all four risk factors.

All of the employees in the study received feedback on their health risk assessments, 80% of the employees received behaviour change counselling and 62% consumed healthier snacks

during outages. Approximately 45% regularly ate the wellness meals, and a substantial number of employees participated in monthly sport, lunchtime walks or park runs. Very few employees participated in physical activity during outages, functional exercise classes, lunchtime runs or cycles and the biggest loser competition.

### **4.2.3 Objective 3: To evaluate changes in behavioural and metabolic risk factors in the workforce.**

Changes in behavioural risk factors were noted as significantly fewer employees engaged in harmful alcohol consumption. Other lifestyle behaviours that improved significantly were fruit and vegetable consumption and habitual levels of physical activity. There was no significant reduction in smoking. However acknowledgment is made to self-reported variables that have the potential to change significantly and have potential for reporting bias.

The employees reported significantly less stress in some of the psychosocial work-related and personal factors, specifically for relationships with colleagues as well as their own health.

There was a significant improvement in metabolic risk factors for systolic (-10.2mmHG) and diastolic blood pressure (-3.87mmHG). There was also a significant decrease in cholesterol levels (-0.45mmol/l), but not in random blood glucose. Weight, BMI and waist circumference were unchanged.

According to the 10-year cardiovascular disease risk profile for participants, there were no significant risk reductions from pre to post measures. However, there was a non-significant 4.5% reduction in employees who were categorised as high risk, suggesting some improvement.

### **4.2.4 Objective 4: To monitor changes in sick leave in the workforce**

Sick leave absence is affected by many factors which could mask any impact of the HCW. Apart from a weakly associated increase in sick leave associated with decreased alcohol use, there was no relationship between improvements in risk factors for NCDs and changes in sick leave absence.

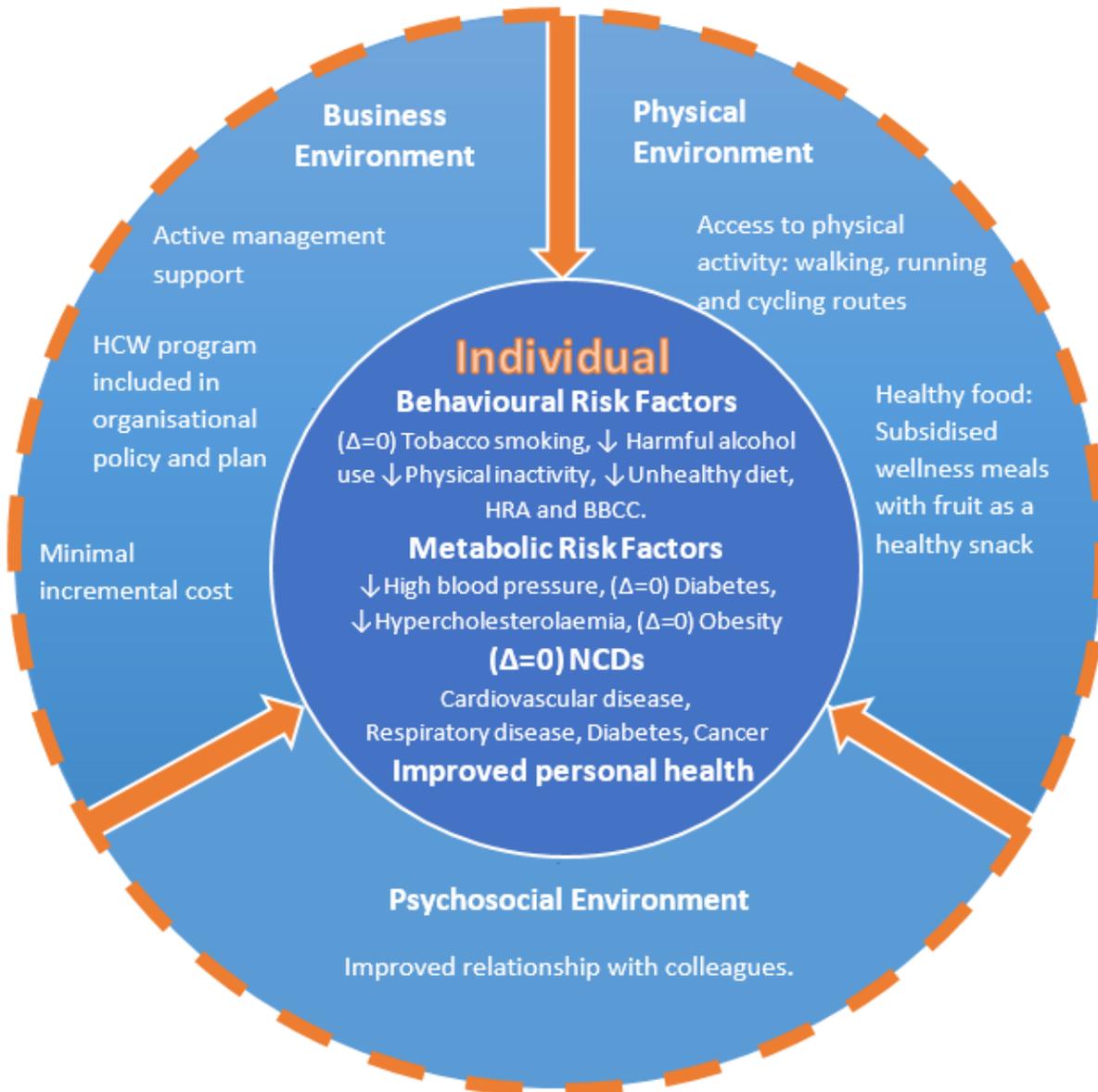
### **4.2.5 Objective 5: To evaluate the costs and consequences of the intervention**

The incremental costs for the four key areas targeted in the intervention included the following: opportunities for physical activity, catering and the provision of food, provision of health and wellness services, and managerial buy-in and participation. The total incremental cost to the company was R54683 which equated to an average of R27341 per annum. The average incremental cost per employee for implementing the HCW was estimated as R31.37 (\$2.19) over two years or R15.67 (\$1.09) per annum. The costs were therefore seen as minimal relative to important beneficial consequences for employee health.

## **4.3 CONCLUSIONS RELATED TO CONCEPTUAL FRAMEWORK**

The conceptual framework on which this study was based focused on transforming the business, physical and psychosocial environment in order to enable change in the individual.

The conclusions of the study that are presented in the previous section in relation to the objectives are also mapped onto the conceptual framework as shown in Figure 4.3.2.



**Figure 4.3.2 Conclusions mapped onto the conceptual framework.**

$\downarrow$  = reduction, ( $\Delta=0$ ) = no change

By making changes in the physical environment to provide easy access to walking, running and cycling trails on the nature reserve at the power plant, workers were provided with increased opportunity to increase their physical inactivity. The daily physical exercise classes and once a month 2.5km walk, 5km walk/run, 10km run and 25km cycle, allowed the workers the opportunity to enter as individuals or teams. The monthly activities were linked to a theme which allowed for creativity and fun, thereby contributing to increased morale and teambuilding. The provision and promotion of the subsidised wellness meal and fruit, contributed to making the healthy choice the easy choice for the employees, as workers had access to healthy meals at no additional cost. In addition, fruit snacks were made available at no cost to employees working long shifts.

The psychosocial environment was significantly affected through improved relationships amongst colleagues and reduced stress from personal health.

In the business environment, transformation occurred through significant management support at the highest level in the organisation. Management was provided with an experiential presentation on the status of NCDs in the organisation, the rationale for workplace transformation and an exploration of their own risk factor status. Management support was visible through their active participation, provision of resources and organisational support as the HCW was adopted into the organisational operation plan.

At the core is the individual where transformation of the physical, business and psychosocial environment, contributed to significant reductions in three behavioural risk factors, namely harmful alcohol use, physical inactivity and inadequate fruit and vegetable intake. BBCC following feedback on individual HRAs also motivated lifestyle change at the individual level. Metabolic risk factors were impacted and resulted in significant improvements for high blood pressure and hypercholesterolemia. The prevalence of self-reported NCDs did not change over the 2-year timeframe.

## **4.4 CONTRIBUTION TO METHODOLOGY**

### **4.4.1 Participatory action research**

The value of PAR as a methodology in transforming the workplace was evident in how it enabled an innovative approach to the design, implementation and evaluation of the HCW program.

The PAR research paradigm encouraged a style of authentic leadership (2) that was characterised by enhanced trust, collaboration, acceptance of others differences, meaningful recognition, effective communication and valuing of others contributions.(5)(6) Health promotion in the workplace is traditionally delivered through a more hierarchical and authoritarian approach, while collaboration and enhanced communication by all stakeholders is more likely to foster healthy lifestyles that prevent NCDs (7).

The functioning of the CIG can be understood in terms of key criteria previously suggested to judge the quality of the research process (8). The first was alignment of purpose where the CIG members were aligned with inquiry into a central research question. CIG members also took ownership of the inquiry process once the lead researcher (DS) had transferred power and knowledge of the research methodology. The members developed a reflective stance in witnessing their actions and fostered an open minded approach using critical questioning and open dialogue amongst each other. The facilitator (DS) was cognisant of ensuring a democratic and collaborative process amongst the members that broke down power barriers or hierarchy. There was a high level of trust and commitment to each other in achieving the results agreed upon for the process. The team was very effective in engaging with action, but required support to adequately reflect on their learning. The process was well documented in terms of the individual CIG members' experience and action, the group process as well as the development of reflections, learning and final consensus. The findings of the CIG were clearly described in an article on how to transform the workplace environment to enable readers to understand what aspects of the process can be utilised in their context. The CIG was also able to demonstrate the practical usefulness of the new knowledge constructed through the description of activities that were implemented and documented in the article (9).

The criteria as discussed above that were suggested by Buskens and Mash (8) were useful in assessing the quality of the PAR process. There remains, however, a methodological discourse on what criteria to use to judge the quality of PAR. There is less certainty regarding this than for other research paradigms, such as the empirical-analytical and interpretative-hermeneutic paradigms. Other researchers have suggested the following categories to assess the quality of PAR: adequate description; participatory process, relational, ethical, community orientated, power shifting, involves capacity building and co-learning, is action orientated, is intentional, has scientific rigor, requires certain skills and resources, has the potential of producing rich and meaningful data, addresses health issues and achieves social change, is mediated by contextual challenges and requires reflexive adaptation (10). Table 4.2 compares these criteria with those used in the study and demonstrate considerable overlap. PAR has three broad and different traditions within it. Empowering PAR has the aim to liberate, emancipate and empower communities. Organisational PAR is developed to solve organisational problems in a participatory way in the context of the corporate, business and industry sector. Professional PAR have been embraced by health and education sectors. The criteria used in the study were more tailor-made for the specific method of the CIG and in a more professional context where people were trying to change their practice. The only criteria not included in the suggested list from the other researchers was transferability, which implies a sufficient description of the context and learning to enable others to judge whether the findings can be transferred to their setting. The criteria identified in the literature were similar, but emphasised a more emancipatory and community-based approach to PAR. The criteria adopted for the CIG assumed that these would define scientific rigor for this method, while the list adopted from the literature saw scientific rigor as one of the criteria. This was probably intended to refer to how the actions and learning were documented. Overall therefore the criteria used to judge the CIG in a professional PAR context were practically useful and resonate with the literature.

**Table 4.2: Criteria used to judge the quality of PAR**

<b>Quality criteria used in the study (8)</b>	<b>Quality criteria from other researchers (10)</b>
Alignment with purpose	Intentional
Ownership of the inquiry process	Power shifting
Development of reflectivity	Co-learning and reflexive adaption
Democratic and collaborative group dynamics and facilitation	Participatory process, relational, ethical
Commitment to practical action and experience	Capacity-building and action orientated
Documentation of the process	Adequate description
Transferability	
Construction of new knowledge	Produces rich and meaningful data
	Community orientated, has scientific rigor, requires certain skills and resources,

	addresses health issues and achieves social change
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The CIG used outcome mapping as a methodology to identify the intended outcomes, plan initial activities, monitor progress during the inquiry and evaluate outcomes (11). The outcome mapping process was congruent with the CIG because outcomes were defined as “changes in behaviour, relationships, activities, or actions of individuals, groups and organisations with whom a program works directly” instead of changes in health or biological indicators (11). Outcome mapping was used to answer four questions for the program; namely 1) what is the vision? 2) who are the boundary partners? 3) what changes in behaviour are being sought? and 4) what can the program best contribute to these changes. Outcome mapping, which was developed by the international development research centre (IDRC) for complex interventions, appears to fit well with the PAR paradigm in process management and capacity building. The value of combining outcome mapping and PAR was key to the methodology of developing the HCW. Outcome mapping and PAR are grounded in a learning cycle where the CIG members are engaged in a process of observing and reflecting on their own experience, agreeing on what was learnt through the construction of new knowledge and abstract concepts and planning to actively implement the new knowledge in a follow up cycle of action and reflection. Outcome mapping was useful in monitoring behaviour changes of the four boundary partners (catering, external support, health and wellness as well as management and decision makers); the strategies used by the HCW program to encourage change in the boundary partners and how the program performs as an organisational unit (10).

#### 4.4.2 Systems thinking

The transformation of the workplace environment was also influenced by systems thinking which implies a shift of perspective from the parts to the whole. Living systems are mutually dependant wholes wherein their properties cannot be dissected into smaller parts as this will cause destruction in the system either physically or conceptually (12). In transforming the workplace, the boundary partners and CIG were mutually dependant to bring about the changes. One of the main stumbling blocks in transforming the workplace environment in the commercial plant is that the organisation is typically seen as a machine with a clear hierarchy and as a set of objects, where relationships are secondary (13)(14). A power plant is fundamentally a machine that creates energy and it is not surprising that such a mechanistic viewpoint would dominate the understanding of the organisation.

In the systems view, relationships are primary, and “objects” are secondary, as the focus for the systems thinker is networks of relationships rooted in larger networks. The change in perspective from objects to relationships in designing the HCW, at first did not happen easily, but evolved as this was counter to the traditional approach in the organisation. In the organisation everything of value is usually measured and weighed, but relationships are not measured so easily. The CIG required a perceptual change that went with the choice of methodology from focusing on hierarchy, authority and instructions to focusing on connection, collaboration and participatory action (12). When the CIG networked relationships using a style of authentic leadership, characterised by trust and mutual respect of differences, innovation emerged repeatedly in the design process of the HCW which resulted in a pattern of success. Cycles, boundaries and networks are examples of the characteristics of living systems, which

were central to the way in which the CIG engaged with the organisation. According to Wheatley and Kellner-Rogers: (6)

*“We have no choice but to invite people into the process of rethinking, redesigning, restructuring the organization. We ignore people's need to participate at our own peril. If they're involved, they will create a future that already has them in it. We won't have to engage in the impossible and exhausting tasks of 'selling' them the solution, getting them 'to enroll,' or figuring out the incentives that might bribe them into compliant behaviors.... In our experience, enormous struggles with implementation are created every time we deliver changes to the organization rather than figuring out how to involve people in their creation.... [On the other hand,] we have seen implementation move with dramatic speed among people who have been engaged in the design of those changes.”*

Engaging people with systems thinking within the PAR approach and CIG was a useful methodological approach to transform the workplace.

## **4.5 RECOMMENDATIONS**

This section presents recommendations for the design of WHPPs, for revision of the HCW, for the health sector and for future research.

### **4.5.1 Recommendations for the design of WHPPs**

Recommendations for the design of WHPPs are made using the framework of the behaviour change wheel. The wheel recognises the importance of both interventions and policies as shown in Figure 4.4.1. Interventions in the WHPP need to be supported by appropriate changes to policy in terms of communication, guidelines, regulations, planning and service provision. Interventions illustrated by and supported by the findings from this study are outlined below. Programs should be aligned to the demographic and health profile of the employees

#### **Education**

It is clear from the HCW program that despite employees being knowledgeable about certain aspects of health, education and information was needed to promote healthy living to the employees. Recommendations to improve health education:

- Occupational health professionals should be trained in BBCC, which includes skills in exchange of information.
- Use a variety of media, particularly video or live streaming if available
- Resources such as information leaflets should be made available to employees
- The catering and food services departments as well as managers should be educated on the impact of salt, sugar and high fat foods and health of workers.

#### **Persuasion**

The findings in this study found that employees needed persuasion or enhanced motivation to live and eat healthy. We note that the concept of “persuasion” is not wholly coherent with a guiding style, but is derived from the behaviour change wheel model. Recommendations on how to improve motivation:

- Share stories from employees and managers that demonstrate change as well as giving information.
- Employees will benefit from BBCC as it aims to enhance motivation to change.
- Provide personal feedback on health risks from the HRAs

## **Incentivisation**

Employees who were incentivised through rewards or recognition, for example a certificate or organisational newsflash, were motivated to improve their lifestyles and participate in weight loss and fitness challenges. Rewards do not have to be financial. Recommendations for incentivisation include:

- Ensure that policies and or organisational procedures include incentives or recognition through certificates, time off or vouchers that are of value to the employees in the specific organisation
- Involve the communications departments to advertise and “brag” about the rewards or recognition on a regular basis

## **Training**

Recommendations for training include:

- Train occupational health practitioners in BBCC and ensure they remain competent.

## **Restriction**

Recommendations for restrictions or rules that might encourage healthy behaviour or restrict unhealthy behaviour include:

- Prohibiting the use of salt and sugar in the preparation of foods
- Making fruit available at costs lower than sugary snacks

## **Environmental restructuring**

This refers to nudging or “architectural choices” whereby healthy choices are easily accessible to employees. Recommendations include:

- Providing walking, running, and cycling routes on sites at organisations where possible or collaborate with a nearby local government facility such as parks within the Sport and Recreation department.
- Make healthy foods available and affordable at cafeterias with informational signage and active promotion.

## **Modelling**

Recommendations for modelling in the organisation or workplace include:

- Executives in the organisation lead in the planned activities by participating as front runners
- Occupational health workers model healthy living by eating well and participating in the activities rather than only referring employees to the events

- When advertising activities, the endorsement should be from senior and middle managers and encourage employee engagement and participation.

## Enablement

Recommendations for enablement include:

- Ensure that adequate time during working hours is granted for employees to participate in physical activities and that this is included in the organizational operational plan.
- Discourage risky behaviour (e.g. remove smoking booths and high sugar/high fat content vending machines)
- Ensure that access to healthy food is available to all staff on all shifts

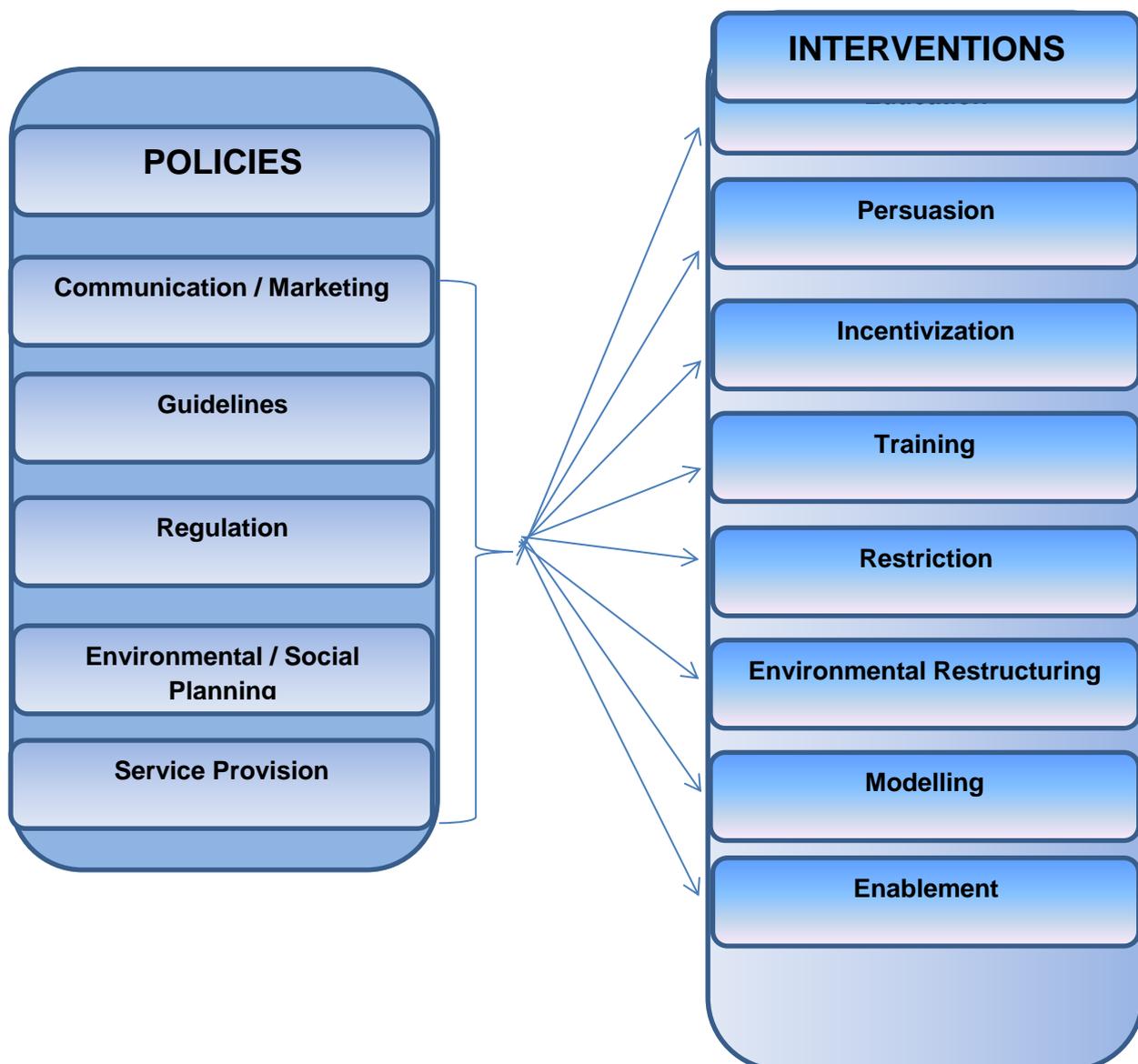


Figure 4.4.1 Adapted Behaviour Change Wheel Model

## 4.5.2 Recommendations for future design and development of HCW program

The following are recommendations for the future design and development of the HCW program. Some ideas originating from the CIG were not implemented in the study program and are included in the recommendations:

- The CIG hope to complete the development of a gym on site to further enable physical activity amongst employees. This was planned for during the CIG but not implemented.
- Explore ways to improve smoking reduction by removing the erected smoking shelters
- The CIG identified a need for an organisational based training program to certify interested employees as champions for WHPP which prioritises the reduction of NCD risk factors, improves productivity and reduces sickness absenteeism.
- Develop the program further for risk factors that did not yet improve in the HCW. A broader approach to health eating at home and the workplace as well as a broader evaluation of eating habits may be needed to enable weight loss. More visible and active support for smoking cessation may be needed.
- The program should be more strongly linked to employee benefits
- Include a plan to evaluate program outcomes that includes quantitative data on productivity and sickness absenteeism as well as qualitative data (interviews and observations).

## 4.5.3 Recommendations for the health sector

According to the annual report for the National Department of Health (NDOH) 2017/2018, the strategic objective is to reduce the risk factors and improve management of NCDs by implementing the strategic plan for NCDs 2012-2017.

Recommendations include:

- The health department as a workplace should also implement a WHPP and enable other government departments to do the same. The NDOH has made a start on implementing the guide to healthy eating at 43 national departments.
- The health department should include WHPPs in their policy on NCDs and actively promote such programs using lessons learnt from the HCW. The health department may need to collaborate with businesses and the department of labour in doing this, as the workplace is a neglected area to complement their traditional focus on interventions through primary health care and legislation.

## 4.5.4 Future research

Future research should consider the following:

- Evaluate how the HCW program evolves over time and what the longer term impact is on risk factors that did not change in this study e.g. tobacco smoking, obesity.
- Evaluate the sustainability of the HCW program and longer term impact on incidence of NCDs

- Evaluate the impact of the HCW program on productivity and the consequences for the business
- Look at ways of using more experimental study designs with control groups to evaluate the effect of the HCW program.

## 4.6 IMPACT OF THE FINDINGS

The research was presented in the form of a poster and an oral presentation at the 62<sup>nd</sup> Annual Academic Day on 29 August 2018 at the Faculty of Medicine and Health Sciences, Stellenbosch University.

The results of the study will be presented at upcoming national and international conferences with an interest in preventing NCDs such as for family medicine, primary care, occupational health and at the South African Board for People Practitioners (SABPP) which is a human resources forum for 465 organisations in South Africa,

The researcher has been invited by the NDOH to present the results of the study to Parliament in South Africa. The recommendation will be for the development of a national policy to reduce NCDs through WHPPs, using appropriate evidence from this and other studies. The results of the study will be presented orally as well as in a brief video on the HCW program as a low cost effective program for inclusion in the policy. The study aims to inform policy makers and organisations through the creation of a policy brief about the value of transforming the workplace environment to prevent disease and promote health.

The findings of the HCW have been presented in August 2018 to the EXCO of the commercial plant and incorporated into the organisation's operational and leadership plan. The research (CIG) team was nominated and came 2<sup>nd</sup> for the innovation award in the annual energy sectors' managers' awards during 2017, competing with the more traditional engineering sector for the prize.

Of the articles included in chapter 3, one article has been published in the Occupational Health Journal of South Africa, and the other has been published online in Global Health Action. An article on the before and after study will be submitted to PLOS one. The study on the cost and consequence analysis will be submitted to the African Journal of Primary Health Care and Family Medicine.

## 4.7 CONCLUSION

I have concluded the thesis and summarised the new knowledge obtained to address the research question, as well as presented recommendations and described the initial impact of the work. The journey to discover interventions that prevent NCDs in the workplace engages a living system made up of individuals (physiology, metabolism, capability, motivation), interacting within a dynamic environment (physical, psychosocial, business), where "relationships" are valued above "objects", and that causes us to act and behave in a certain way. A new paradigm is needed, a new way of thinking that can solve complex problems with solutions derived from systems thinking. This I believe will assist in identifying solutions to prevent NCDs in the workplace, which will contribute to the NDOH's and WHO's aim of reducing the impact of NCDs on the health of communities and populations.

## 4.8 REFERENCES

1. Avolio BJ, Gardner WL. Authentic leadership development: Getting to the root of positive forms of leadership. *Leadersh Q* [Internet]. 2005 [cited 2018 Apr 4];16(3):315–38. Available from: <https://www.sciencedirect.com/science/article/pii/S1048984305000263>
2. Avolio BJ, Gardner WL, Walumbwa FO, Luthans F, May DR. Unlocking the mask : A look at the process by which authentic leaders impact follower attitudes and behaviors. *Leadersh Quarterly* [Internet]. 2004 [cited 2018 Jun 4];15:801–23. Available from: <http://www.ipcrc.net/LDI/pdfs/sdarticle-unlocking-the-mask.pdf>
3. Michie S, Stralen MM Van, West R. The behaviour change wheel : A new method for characterising and designing behaviour change interventions. *Implement Sci* [Internet]. 2011 [cited 2018 Jun 6];42(April):12. Available from: <https://www.ncbi.nlm.nih.gov/pubmed/21513547>
4. Michie S, West R. Behaviour change theory and evidence: A presentation to Government. *Health Psychol Rev* [Internet]. 2013 [cited 2018 Sep 30];7(1):1–22. Available from: <https://www.tandfonline.com/doi/full/10.1080/17437199.2011.649445?scroll=top&needAccess=true>
5. Titler MG. The evidence for evidence-based practice implementation [Internet]. *Patient Safety and Quality: An Evidence-Based Handbook for Nurses: Vol. 1*. 2008 [cited 2017 Jun 12]. 113-132 p. Available from: [https://www.ncbi.nlm.nih.gov/books/NBK2659/pdf/Bookshelf\\_NBK2659.pdf](https://www.ncbi.nlm.nih.gov/books/NBK2659/pdf/Bookshelf_NBK2659.pdf)
6. Tryon K, Bolnick H, Pomeranz JL, Pronk N, Yach D. Making the workplace a more effective site for prevention of noncommunicable diseases in adults. *J Occup Environ Med* [Internet]. 2014 [cited 2017 Jun 18];56(11):1137–44. Available from: <https://pdfs.semanticscholar.org/99e4/8ba6fb113c79b3e0d90a19bd513859d94bc1.pdf>
7. Arena R, Guazzi M, Lianov L, Whitsel L, Berra K, Lavie CJ, et al. Healthy lifestyle interventions to combat noncommunicable disease—a novel nonhierarchical connectivity model for key stakeholders: a policy statement from the American Heart Association, European Society of Cardiology, European Association for Cardiovascu. *Eur Heart J* [Internet]. 2015 [cited 2018 Apr 12];36(31):2097–109. Available from: <https://academic.oup.com/eurheartj/article-lookup/doi/10.1093/eurheartj/ehv207>
8. Mash B, Meulenbergh-Buskens I. “Holding it lightly”: the co-operative inquiry group: a method for developing educational materials. *Med Educ* [Internet]. 2001 [cited 2018 Dec 5];35(12):1108–14. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/11895234>
9. Schouw D, Mash R, Kolbe-Alexander TL. Transforming the workplace environment to prevent non-communicable chronic diseases: Participatory action research in a South African power plant. *Glob Health Action* [Internet]. 2018;11(1). Available from: <https://www.tandfonline.com/doi/full/10.1080/16549716.2018.1544336>

10. Springett J, Atkey K, Kongats K, Zulla R, Wilkins E. Conceptualizing Quality in Participatory Health Research: A Phenomenographic Inquiry. *Qual Soc Res* [Internet]. 2016 [cited 2018 Dec 5];17(2). Available from: <http://www.qualitative-research.net/index.php/fqs/article/view/2568/3994>
11. Earl Sarah, Carden Fred ST. Outcome mapping [Internet]. Canada: International Development Research Centre; 2001 [cited 2017 Jul 14]. 1-155 p. Available from: [https://www.outcomemapping.ca/download/OM\\_English\\_final.pdf](https://www.outcomemapping.ca/download/OM_English_final.pdf)
12. Capra F, Luisi P. *The Systems View of Life. A Unifying Vision*. First edit. United States of America: Cambridge University Press; 2014. 144-180 p.
13. Capra F. Life and Leadership in Organizations. In: *The Hidden Connections: A Science for Sustainable Living* [Internet]. 2004 [cited 2018 May 7]. p. 1–29. Available from: <http://beahrsefp.berkeley.edu/wp-content/uploads/2010/06/Capra-Hidden-Connections-Ch-4.pdf>
14. Vargo SL, Koskela-Huotari K, Baron S, Edvardsson B, Reynoso J, Colurcio M. A systems perspective on markets – Toward a research agenda. *J Bus Res* [Internet]. 2017;79:260–8. Available from: <http://dx.doi.org/10.1016/j.jbusres.2017.03.011>

# ADDENDUMS

## A. ETHICS APPROVAL LETTER



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### Approval Notice

#### New Application

11-Sep-2015

Schouw, Darcelle DD

**Ethics Reference#: S15/08/165**

**Title: How to transform the workplace environment to prevent and control risk factors associated with non-communicable chronic diseases.**

Dear Miss Darcelle Schouw,

The New Application received on 17-Aug-2015, was reviewed by Health Research Ethics Committee I via Committee Review procedures on 02-Sep-2015 and has been approved.

Please note the following information about your approved research protocol: Protocol Approval Period: 11-Sep-2015 -01-Sep-2016

Present Committee Members:

Weber, Franklin CFS

Unger, Marianne M

Els, Petrus PJJS

Potgieter, Sunita S

Hendricks, Melany

ML Ferris, William

WF Welzel, Tyson T

Barsdorf, Nicola N

Botha, Paul JP

Rohland, Elvira EL

Hoek, Kim KGP

Glashoff, Richard RH

Philander, Cynthia C

Werely, Cedric CJ

Dosi, Alswald A

Lachman, Anusha A

Please remember to use your protocol number (S15/08/165) on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

#### After Ethical Review:

Please note a template of the progress report is obtainable on [www.sun.ac.za/rds](http://www.sun.ac.za/rds) and should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.

Translation of the consent document to the language applicable to the study participants should be submitted.

Federal Wide Assurance Number: 00001372

Institutional Review Board (IRB) Number: IRB0005239

The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

## Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Contact persons are Ms Claudette Abrahams at Western Cape Department of Health (healthres@pgwc.gov.za Tel: +27 21 483 9907) and Dr Helene Visser at City Health (Helene.Visser@capetown.gov.za Tel: +27 21 400 398!). Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.

For standard HREC forms and documents please visit: [WWW.sun.ac.za/rds](http://WWW.sun.ac.za/rds)

If you have any questions or need further assistance, please contact the HREC office at 0219399657. Included Documents:

Checklist

Amended consent CIG CV

B Mash

Declaration T Kolbe-Alexander

Amended protocol

Consent CIG

CV T Kolbe-Alexander

Declaration D Schouw

Declaration Bob Mash

Letter to PhD committee from ProfChikte

Permission to conduct study at Koeberg CV

D Schouw

Checklist - PhD Evaluation committee

Final report of the PhD committee

Delegation of authority Eskom Application form

Consent Employee

Supervisors report

Amended consent Employee

Protocol Synopsis

Protocol

Letter to PhD Committee Bob Mash

Sincerely,

Franklin Weber            •HREC  
Coordinator  
Health Research Ethics Committee I

## Investigator Responsibilities

### Protection of Human Research Participants

Some of the responsibilities investigators have when conducting research involving human participants are listed below:

1. Conducting the Research. You are responsible for making sure that the research is conducted according to the I-IREC approved research protocol. You are also responsible for the actions of all your co-investigators and research staff involved with this research.
2. Participant Enrolment. You may not recruit or enrol participants prior to the HREC approval date or after the expiration date of HREC approval. All recruitment materials for any form of media must be approved by the HREC prior to their use. If you need to recruit more participants than was noted in your HREC approval letter, you must submit an amendment requesting an increase in the number of participants.
3. Informed Consent. You are responsible for obtaining and documenting effective informed consent using only the HREC-approved consent documents, and for ensuring that no human participants are involved in research prior to obtaining their informed consent. Please give all participants copies of the signed informed consent documents. Keep the originals in your secured research files for at least fifteen (15) years.
4. Continuing Review. The HREC must review and approve all HREC-approved research protocols at intervals appropriate to the degree of risk but not less than once per year. There is no grace period. Prior to the date on which the HREC approval of the research expires, it is your responsibility to submit the continuing review report in a timely fashion to ensure a lapse in HREC approval does not occur. If HREC approval of your research lapses, you must stop new participant enrolment, and contact the HREC office immediately.
5. Amendments and Changes. If you wish to amend or change any aspect of your research (such as research design, interventions or procedures, number of participants, participant population, informed consent document, instruments, surveys or recruiting material), you must submit the amendment to the HREC for review using the current Amendment Form. You may not initiate any amendments or changes to your research without first obtaining written HREC review and approval. The only exception is when it is necessary to eliminate apparent immediate hazards to participants and the HREC should be immediately informed of this necessity.
6. Adverse or Unanticipated Events. Any serious adverse events, participant complaints, and all unanticipated problems that involve risks to participants or others, as well as any research-related injuries, occurring at this institution or at other performance sites must be reported to the HREC within five (5) days of discovery of the incident. You must also report any instances of serious or continuing problems, or non-compliance with the I-IRECs requirements for protecting human research participants. The only exception to this policy is that the death of a research participant must be reported in accordance with the Stellenbosch University Health Research Ethics Committee Standard Operating Procedures [www.sun025.sun.ac.za/portal/page/portal/Health\\_Sciences/English/Centres%20and%20Institutions/Research\\_Development\\_Support/Ethics/Application\\_package](http://www.sun025.sun.ac.za/portal/page/portal/Health_Sciences/English/Centres%20and%20Institutions/Research_Development_Support/Ethics/Application_package). All reportable events should be submitted to the HREC using the Serious Adverse Event Report Form.
7. Research Record Keeping. You must keep the following research-related records, at a minimum, in a secure location for a minimum of fifteen years: the HREC approved research protocol and all amendments; all informed consent documents; recruiting materials; continuing review reports; adverse or unanticipated events; and all correspondence from the HREC.
8. Reports to the MCC and Sponsor. When you submit the required annual report to the MCC or you submit required reports to your sponsor, you must provide a copy of that report to the HREC. You may submit the report at the time of continuing HREC review.
9. Provision of Emergency Medical Care. When a physician provides emergency medical care to a participant without prior HREC review and approval, to the extent permitted by law, such activities will not be recognised as research nor will the data obtained by any such activities should it be used in support of research.
10. Final reports. When you have completed (no further participant enrolment, interactions, interventions or data analysis) or stopped work on your research, you must submit a Final Report to the HREC.
11. On-Site Evaluations, MCC Inspections, or Audits. If you are notified that your research will be reviewed or audited by the MCC, the sponsor, any other external agency or any internal group, you must inform the HREC immediately of the impending audit/evaluation.

## B. PERMISSION TO CONDUCT STUDY



Permission to conduct Study for PhD at Koeberg Operating Unit:

**TITLE:**

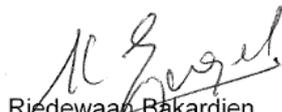
How to transform the workplace environment to prevent and control risk factors associated with non-communicable chronic diseases.

The study is self-funded and will not require funds from Koeberg for testing or training of staff and employees.

**Synopsis**

See attached.

Permission is **granted/rejected** for Darcelle Schouw, Senior Advisor (1148349) to conduct an intervention/study at the KOU.

  
Rjedewaan Bakardien  
Power Station Manager

..... Date 2015-03-26 .....

## C. CIG INFORMED CONSENT FORM



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jou kennisvenoot • your knowledge partner

### STELLENBOSCH UNIVERSITY CONSENT TO PARTICIPATE IN RESEARCH

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#### **How to transform the workplace environment to prevent and control risk factors associated with non-communicable chronic diseases.**

You are asked to participate in a research study conducted by Darcelle Schouw, from the department of Family Medicine at Stellenbosch University and Health and Wellness Department at Eskom, Koeberg. The results of the study will be publicized and contribute to research papers. You were selected as a possible participant in this study because you have been screened for two or more modifiable risk factors associated with non-communicable chronic diseases.

#### **1. PURPOSE OF THE STUDY**

The purpose of the study is to transform the workplace environment in order to prevent and control the risk factors for non-communicable disease amongst the workforce. The purpose of transformation is to develop a model for behavior change counseling within the workplace. The specific objectives which relate to the monitoring and evaluation of this transformation are

- a) To monitor changes in the NCD risk factors and behavior in the workforce
- b) To monitor changes in sick leave in the workforce
- c) To evaluate the costs and consequences of the intervention

The main study design will be participatory action research (PAR). PAR is a research paradigm in which the researcher and participants form a group to create and accrue new knowledge. This knowledge is then put into action and reflected upon again in order to create and accrue further knowledge. This is a cyclical process of observing and reflecting on one's own experiences, and experimenting actively with the new knowledge in continuous cycles of action and reflection. PAR will be used to explore how to transform the business, physical and psycho-social aspects of the workplace and how to introduce behaviour change counselling.

#### **2. PROCEDURES**

If you volunteer to participate in this study, we would ask you to do the following things:

You will be invited to be one of 12 people to form a co-operative inquiry group (CIG) to conducting Participatory Action Research (PAR) in a professional context. The principles of this process have been defined in the CRASP model namely: Critical collaborative enquiry by Reflective practitioners being Accountable and making the results of their enquiry public, Self-evaluating their practice and engaging in Participatory problem solving and continuing professional development.. The CIG will align itself with addressing the main research question "How to transform the workplace environment in order to prevent and control the risk factors for NCDs amongst the workforce?" Together you will work in a cyclical process of action, planning, reflection and observation over a period of 2-years. The CIG will meet monthly in order to engage with this process, which is described more fully below.

CIG members will be purposively drawn from the Health and Wellness team; senior managers involved in organisational change and selected union representatives. The inquiry group will consist of 10-12 people and participants will give

informed consent after the researcher has explained the purpose of the inquiry and the PAR process. The CIG will be facilitated by the researcher, who is also a key member of the Health and Wellness unit.

### **3. POTENTIAL RISKS AND DISCOMFORTS**

There are no risks involved during the tests.

### **4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

The study will monitor and evaluate the risk factors and implement behaviour change counselling to reduce your risk factors.

With each cycle of the CIG the actions will evolve to focus on the business, physical and psycho-social work environments as well as the provision of services such as behaviour change counselling. The CIG will come up with propositional knowledge on how to transform the workplace.

The study will benefit the organization to implement similar transformation to reduce the disease risk profile of their employees.

### **5. PAYMENT FOR PARTICIPATION**

There will be no payment for participation. Participation is voluntary.

### **6. CONFIDENTIALITY**

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of coding procedures using only unique numbers. Data will analyzed and interpreted by a statistician who is blind to the identity of the participants. Where data will be published, the participant will remain anonymous. The researcher and health professional are bound to a code of conduct and ethics as prescribed by the Health Profession's Council of South Africa (HPCSA).

### **7. PARTICIPATION AND WITHDRAWAL**

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

### **8. IDENTIFICATION OF INVESTIGATORS**

If you have any questions or concerns about the research, please feel free to contact Proff. Bob Mash at 021 9389170, Division of Family Medicine and Primary Care, Tygerberg Campus, Stellenbosch University .

### **9. RIGHTS OF RESEARCH SUBJECTS**

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.

**SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE**

The information above was described to..... by..... in [Afrikaans/English/Xhosa/other] and I am in command of this language. [I/the participant/the subject] was given the opportunity to ask questions and these questions were answered to [my/his/her] satisfaction.

*I hereby consent voluntarily to participate in this study. I have been given a copy of this form.*

\_\_\_\_\_  
**Name of Subject/Participant**

\_\_\_\_\_  
**Signature of Subject**

\_\_\_\_\_  
**Date**

**SIGNATURE OF INVESTIGATOR**

I declare that I explained the information given in this document to \_\_\_\_\_.  
[He/she] was encouraged and given ample time to ask me any questions. This conversation was conducted in  
[Afrikaans/\*English/\*Xhosa/\*Other] and *no translator was used*.

\_\_\_\_\_  
**Signature of Investigator**

\_\_\_\_\_  
**Date**

## D. PARTICIPANT INFORMED CONSENT FORM



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jou kennisvenoot • your knowledge partner

### STELLENBOSCH UNIVERSITY CONSENT TO PARTICIPATE IN RESEARCH

---

How to transform the workplace environment to prevent and control risk factors associated with non-communicable chronic diseases.

You are asked to participate in a research study conducted by Darcelle Schouw, from the department of Family Medicine at Stellenbosch University and Health and Wellness Department at Eskom, Koeberg. *The results of the study will be publicized and contribute to research papers.* You were selected as a possible participant in this study because you have been screened for two or more modifiable risk factors associated with non-communicable chronic diseases.

#### 10. PURPOSE OF THE STUDY

The purpose of the study is to transform the workplace environment in order to prevent and control the risk factors for non-communicable disease amongst the workforce. The purpose of transformation is to develop a model for behavior change counseling within the workplace. The specific objectives which relate to the monitoring and evaluation of this transformation are

- d) To monitor changes in the NCD risk factors and behavior in the workforce
- e) To monitor changes in sick leave in the workforce
- f) To evaluate the costs and consequences of the intervention

#### 11. PROCEDURES

If you volunteer to participate in this study, we would ask you to do the following things:

Questionnaires:

You will be asked to complete a Health Risk Assessment (HRA) questionnaire on demographic characteristics (e.g. age, gender), medical and family history (e.g. hypertension, diabetes). Data on physical activity will be collected using a Global Physical Activity Questionnaire (GPAQ). Data on harmful alcohol use will be collected using the Alcohol Use Disorders Identification Test (AUDIT).

Clinical tests:

You will be tested by trained health professionals using standard operating procedures. The following will be tested and measured (blood pressure, random glucose, waist and hip circumference, height and weight; and body mass index,

These tests will be conducted at baseline, 12months and 24months.

The assessment will take 45minutes which will include testing and feedback.

The assessments will be done in close proximity to your workstation.

#### 12. POTENTIAL RISKS AND DISCOMFORTS

There are no risks involved during the tests. The clinical tests and measurements will be done discreetly and privacy is ensured.

**13. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

The testing and measurements will help identify your risk factors associated with non-communicable chronic diseases. The study will monitor and evaluate the risk factors and implement behavior change counseling to reduce your risk factors.

The study will benefit the organization to implement similar transformation to reduce the disease risk profile of their employees.

**14. PAYMENT FOR PARTICIPATION**

There will be no payment for participation. Participation is voluntary.

**15. CONFIDENTIALITY**

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of coding procedures using only unique numbers. Data will analyzed and interpreted by a statistician who is blind to the identity of the participants. Where data will be published, the participant will remain anonymous. The researcher and health professional are bound to a code of conduct and ethics as prescribed by the Health Profession's Council of South Africa (HPCSA).

**16. PARTICIPATION AND WITHDRAWAL**

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

**17. IDENTIFICATION OF INVESTIGATORS**

If you have any questions or concerns about the research, please feel free to contact Proff. Bob Mash at 021 9389170, Division of Family Medicine and Primary Care, Tygerberg Campus, Stellenbosch University .

**18. RIGHTS OF RESEARCH SUBJECTS**

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.

**SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE**

The information above was described to..... by..... in [Afrikaans/English/Xhosa/other] and I am in command of this language. [I/the participant/the subject] was given the opportunity to ask questions and these questions were answered to [my/his/her] satisfaction.

*I hereby consent voluntarily to participate in this study. I have been given a copy of this form.*

\_\_\_\_\_  
**Name of Subject/Participant**

\_\_\_\_\_  
**Signature of Subject**

\_\_\_\_\_  
**Date**

**SIGNATURE OF INVESTIGATOR**

I declare that I explained the information given in this document to \_\_\_\_\_.  
[He/she] was encouraged and given ample time to ask me any questions. This conversation was conducted in  
[Afrikaans/\*English/\*Xhosa/\*Other] and *no translator was used.*

\_\_\_\_\_  
**Signature of Investigator**

\_\_\_\_\_  
**Date**

# E. WELLNESS SCREENING FORM

## Wellness Screening

Have you got your finger on the pulse?

Unique Identifier  
 Document Type Form  
 Revision 0  
 Effective Date  
 Revision Date

Date:

Practitioner:

### Demographic information

Name: Province:  
 Unique No: Department:  
 Age: Subsection:  
 Gender: Workplace:  
 Job Title: Cell Number\*:

### For Office Use:

HGT: mmol/dl  
 BP: / mmHg  
 Cholest.: mmol/dl  
 Height: cm  
 Weight: kg  
 Waist Circ: cm  
 Hip Circ: cm

\* From time to time, the H&W team may share some information with you regarding health and lifestyle trends via your mobile telephone, if you do not wish to be a part of this list, then please do not record your cell number.

### Medical History Do you have a personal or family history of any of the following medical conditions:

	Personal History			Medication?	Family History		
	Yes	No	Unsure		Yes	No	Unsure
Diabetes (Sugar):							
High Blood Pressure:							
High Cholesterol:							
Heart Condition:							
Lung Condition:							
Cancer:							
Depression/Anxiety:							

Other (Please specify):

Do you know your HIV Status?

How often do you test for HIV/Aids:

### Tell us about your lifestyle

Number of fruit/ day	1-3	4-5	>5
Number of vegetables/day	1-3	4-5	>5
Do you smoke?	No	Yes	Number of cigarettes
Do you smoke passively?	No	Yes	

### On Stress

Do you deal with your stress?

What are the biggest causes of stress to you at home and in the workplace: (you may choose more than one)

Relationship with colleagues		Personal Finances	
Relationship with my supervisor		Relationship with my partner/spouse	
Lack of clarity concerning work outputs		My health or health of family member	
Lack of resources to do my work		Relationship with children/family	
Lack of recognition		I have challenges with addiction	
Lack of meaningful work		Emotional/mental health concerns	

### Other factors

Are you or is there a possibility that you may be pregnant?

Yes	No	N/A
Yes	No	IDNK

Is your workstation appropriately set up for your body?

### Declaration:

I the undersigned, hereby declare that all the above information supplied by me is correct and true to the best of my knowledge:

Please sign here

## F. GPAQ FORM

### Global Physical Activity Questionnaire

I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.



Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.

Questions	Response	Code	
<b>Activity at work</b>			
1	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like [carrying or lifting heavy loads, digging or construction work] for at least 10 minutes continuously?	Yes 1 No 2 If No, go to P 4	P1
2	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days <input type="text"/>	P2
3	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours : minutes <input type="text"/> : <input type="text"/> hrs mins	P3 (a-b)
4	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking [or carrying light loads] for at least 10 minutes continuously?	Yes 1 No 2 If No, go to P 7	P4
5	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days <input type="text"/>	P5
6	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours : minutes <input type="text"/> : <input type="text"/> hrs mins	P6 (a-b)
<b>Travel to and from places</b>			
The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, to market, to place of worship.			
7	Do you walk or use a bicycle (pedal cycle) for at least 10 minutes continuously to get to and from places?	Yes 1 No 2 If No, go to P 10	P7
8	In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	Number of days <input type="text"/>	P8
9	How much time do you spend walking or bicycling for travel on a typical day?	Hours : minutes <input type="text"/> : <input type="text"/> hrs mins	P9 (a-b)
<b>Recreational activities</b>			
The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure).			
10	Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate like [running or football] for at least 10 minutes continuously?	Yes 1 No 2 If No, go to P 13	P10
11	In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational (leisure) activities?	Number of days <input type="text"/>	P11
12	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hours : minutes <input type="text"/> : <input type="text"/> hrs mins	P12 (a-b)

Continued on next page

Physical Activity (recreational activities) contd.		
Questions	Response	Code
13	Do you do any moderate-intensity sports, fitness or recreational (leisure) activities that causes a small increase in breathing or heart rate such as brisk walking, cycling, swimming, volleyball for at least 10 minutes continuously?  Yes 1  No 2 If No, go to P16	P13
14	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?  Number of days <input type="text"/>	P14
15	How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?  Hours : minutes <input type="text"/> : <input type="text"/> hrs mins	P15 (a-b)
<b>Sedentary behaviour</b>		
The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent [sitting at a desk, sitting with friends, travelling in car, bus, train, reading, playing cards or watching television], but do not include time spent sleeping.		
16	How much time do you usually spend sitting or reclining on a typical day?  Hours : minutes <input type="text"/> : <input type="text"/> hrs mins	P16 (a-b)

# G. AUDIT – ALCOHOL SCREENING FORM

## Audit Screening Tool: Alcohol

Unique Number: \_\_\_\_\_

This questionnaire is designed to indicate whether your drinking is harmful, hazardous or dependent.

These ten questions are about your use of alcohol during the past 12 months.



1. How often do you have a drink containing alcohol\*?

Never	
Monthly or less	
2 to 4 times a month	
2 or 3 times a week	
4 or more times a week	

2. How many alcohol units do you have on a typical day when you are drinking\*?

None	
1 or 2½	
3 or 4	
5 or 6	
7 to 9	
10 or more	

3. How often do you have seven or more units on one occasion\*?

Never	
Less than monthly	
Monthly	
Weekly	
Daily or almost daily	

4. How often have you found that you were unable to stop drinking once you had started?

Never	
Less than monthly	
Monthly	
Weekly	
Daily or almost daily	

5. How often have you failed to do what was normally expected from you because of drinking?

Never	
Less than monthly	
Monthly	
Weekly	
Daily or almost daily	

6. How often have you needed a first drink in the morning to get yourself going after a heavy drinking session?

Never	
Less than monthly	
Monthly	
Weekly	
Daily or almost daily	

7. How often have you had a feeling of guilt or remorse after drinking?

Never	
Less than monthly	
Monthly	
Weekly	
Daily or almost daily	

8. How often have you been unable to remember what happened the night before because you had been drinking?

Never	
Less than monthly	
Monthly	
Weekly	
Daily or almost daily	

9. Have you or someone else been injured as the result of your drinking?

Never	
Yes, but not in the last year	
Yes, during the last year	

10. Has a relative, friend, or a doctor or other health worker been concerned about your drinking or suggested you cut down?

Never	
Yes, but not in the last year	
Yes, during the last year	

\*A unit of alcohol means 10 grams of alcohol.

E.g.: 1 x bottle of 12% wine = 9 units; 1 x pint 5% beer = 3 units;  
 1 x can of 5% beer, large, cider = 2 units; 4 cans = 8 units  
 1 x can of 9% beer, large, cider = 4 units; 4 cans = 16 units  
 1 x 75cl bottle of 40% spirits = 30 units

Total Score

