

**Fitness testing, exercise intervention and  
health-related quality of life validation in  
Setswana speaking community dwelling  
Potchefstroom adults**

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Thesis submitted for the degree *Doctor Philosophiae* in Human  
Movement Sciences at the Potchefstroom Campus of the North-  
West University

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Co-Promoter: Prof MC Cameron

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# DEDICATION

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## TO MY FAMILY

The Lord my God is with me, the mighty warrior who saves. He will take great delight in me;  
in his love he will no longer rebuke me, but will rejoice over me with singing  
(Zephaniah 3:17)

---

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# AUTHORS' CONTRIBUTIONS

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The studies reported in this thesis were planned and executed by a team of researchers. The contribution of each of the researchers is depicted in the table hereafter. Also included in this section is a statement from the co-author confirming their roles in the study and giving their permission that the articles may be part of this thesis.

Article 1: Validity and reliability of the Setswana translation of SF-8 health related quality of life health survey in adults.

Article 2: Cardiorespiratory fitness testing in Setswana-speaking community-dwelling Potchefstroom adults.

Article 3: Preferred exercise intervention among Setswana-speaking community-dwelling Potchefstroom adults.

Article 4: Managing non-communicable diseases in an African community: Effects, compliance, and barriers to participation in a four-week exercise intervention.

NAME	ROLE IN THE STUDY
Mr SO ONAGBIYE (MA) (Physical Education) (Nigeria)	First author, responsible for the execution of the full thesis, data collection, management and statistical analyses. Main author of the thesis, and lead author of the manuscripts written under the guidance of Prof. SJ Moss and Prof. M Cameron
Prof. S.J. Moss (PhD) (Biokineticist) (South Africa)	Project supervisor, co-author and scientist; conceptualisation of the study, design and planning of the manuscript, analysis and interpretation of results, critical reading and finalisation of the manuscripts. Promotor of SO Onagbiye (NWU)
Prof. M. Cameron (PhD) (Accredited Exercise physiologist) (Australia)	Co-supervisor of the study. Significant contribution towards the writing of the thesis, critical reading and finalisation of the manuscripts. Co-promotor of SO Onagbiye.

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# DECLARATION

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I declare that I have approved the above mentioned articles and that my role in the study as indicated above is representative of my actual contribution and that I hereby give my consent that it may be published as part of the PhD thesis of SO Onagbiye.

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**Prof. S.J. Moss (PhD)**

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**Prof. M. Cameron (PhD)**

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# ABSTRACT

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## **FITNESS TESTING, EXERCISE INTERVENTION AND HEALTH-RELATED QUALITY OF LIFE VALIDATION IN SETSWANA SPEAKING COMMUNITY DWELLING POTCHEFSTROOM ADULTS**

This study was a series of linked investigations in which we explored self-reported health-related quality of life and fitness tests, as well as exercise preferences and effects among black South African adults. We (1) translated the SF-8 into Setswana, and determined face validity and reliability of this version of the questionnaire, (2 and 3) compared group and individual protocols, as well as metronome and musical accompaniment, for an 8-minute step test to determine cardiorespiratory fitness (CRF), (4) explored people's most preferred and enjoyed physical activities (PA), and (5) trialled the effects and acceptability of a 4-week exercise intervention for non-communicable diseases (NCDs) risks factors, CRF, and HRQoL among the same population.

All the participants were adults (male and female) aged 35-65 years, drawn from a low resourced area (LRA) of Kenneth Kaunda district in Ikakeng (study 1: n=60, study 2: n=52, study 3: n=52, study 4: n=130). A total of 76 adults participated at the baseline of the fifth objective of which only 54 completed. Study 1: Participants' completed both the English and Setswana versions of the SF-8 on separate occasions, and the correlation between responses compared using a Spearman's rank correlation co-efficient. Internal consistency of the Setswana questionnaire was calculated via Cronbach's alpha. Study two and three gathered information about CRF testing of an eight-minute graded step test of one protocol comparing individual and group, and whether metronome or culturally-specific music accompanied protocol increased the rate of completion. Simple percentages were used to determine the best adaptation while a one-way ANOVA was used to test the significant difference in participants' maximum oxygen consumption level. Study 4 gathered information on most preferred and enjoyed mode of physical activity and the reliability of the questionnaire was calculated with the Cronbach's alpha coefficients. Frequency analyses and chi-square tests were performed to determine the most preferred type and time of PA and association between preferred type of PA and demographic variables were performed using regression analyses. Study 5 gathered information on the compliance and acceptability alongside effects of a four-week aerobic physical activity intervention on NCD risk factors, cardiorespiratory fitness, and quality of life. Independent sample *t*-test was performed to determine the significance of

differences of the all variables. The exercise benefits and barriers scale (EBBS) reliability was calculated by Cronbach's alpha coefficient while mean and standard deviation were computed for each sub-scale of EBBS to allow straight forward comparisons between each sub-scale. ANCOVA with adjustment for pre-test was performed for all repeated variables. Qualitative data were analyzed using AtlasTi7. Normality for all variables was assessed using the Shapiro-Wilk test and the level of significance used was 5% level.

The Setswana SF-8 has good concurrent validity with the spearman correlation coefficients ranged from moderate ( $\rho = 0.72$ ,  $p < 0.001$ ) to excellent ( $\rho = 0.91$ ,  $p < 0.001$ ) relationship. Cronbach alpha coefficient for first and second measurement was 0.87 and 0.87 for the Setswana-translated SF-8 and for the original English SF-8 was 0.86 and 0.89 conferring to translated and original index a good internal consistency. Most participants (67.7%) completed the step-test individually, and accompanied by metronome. Walking (39.2%) was the most preferred and enjoyed type of physical activity, and most participants (70%) reported that they preferred to exercise in the morning. Four weeks of community exercise was acceptable for most participants (71% compliance, 29% drop out), and produced measurable improvements in NCD risk factors such as body mass ( $p=0.02$ ), RPE ( $p=0.03$ ) and MCS (0.003) in men, and body mass ( $p=0.00$ ), BMI ( $p=0.003$ ),  $\dot{V}O_{2\max}$  ( $p=0.003$ ), RPE ( $p=0.00$ ), glucose ( $p=0.04$ ), PCS ( $p=0.00$ ) and MCS (0.00) in women. The results of the ANCOVA evaluating the change from baseline to end of the exercise intervention shows that there was no statistically significant difference in all the variables between the groups when adjusted for the covariates (pre-test) ( $p < 0.05$ ). Covariates were height, weight, BMI, WHR, systolic BP, diastolic BP, RHR, glucose, cholesterol, predicted maximum oxygen consumption, RPE, PCS and MCS

In conclusion the SF-8 is brief, reliable, and internally consistent in Setswana when used among community dwelling South Africans. Individual, metronome accompanied step-test protocol appears to be acceptable and robust across culture. We recommend use of the standard protocol to obtain the largest possible completion rates for cardiorespiratory fitness testing. The drop-out rate of nearly 30% is a reality that should be factored in with exercise intervention studies. Although not the main purpose, as little as four weeks of regular exercise may improve the NCD risk profiles. Consideration of PA preference may increase motivation for future exercise intervention programs.

**Keywords:** quality of life, cardiorespiratory fitness testing, physical activity preference, physical activity intervention, Setswana, adults

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# ABSTRAK

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## **FIKSHEIDTOETSING, OEFENINTERVENSIE, EN EVALUERING VAN GESONDHEIDVERWANTE LEWENSKWALITEIT VAN VOLWASSENES IN 'n TSWANASPREKENDE GEMEENSKAP NABY POTCHEFSTROOM**

Hierdie studie bestaan uit 'n reeks gekoppelde ondersoeke waarin selfgerapporteerde gesondheidverwante lewenskwaliteit (GVL) nagevors is, fiksheid getoets is, en oefeningvoorkeure en effekte onder swart Suid-Afrikaanse volwassenes vasgestel is. Eerstens (1) is SF-8 vertaal na Tswana, en sigwaarde en betroubaarheid van hierdie weergawe van die vraelys is bepaal. Tweedens en derdens (2 en 3) is groep- en individuele protokolle vergelyk, sowel as begeleiding met 'n metronoom en met tradisionele musiek, vir 'n 8-minuut opstaptoets om kardiorespiratoriese fiksheid (KRF) te bepaal, (4) is gedoen om na voorkeur en genot volle fisieke aktiwiteite (FA), en (5) op die uitval syfer en aanvaarbaarheid van 'n vier-week oefening intervensie vir nie-ordraagbare siektes (NOS'e) se risiko faktore, KRF (kardiorespiratoriese fiksheid) en GVL (gesondheidverwante lewenskwaliteit) onder dieselfde bevolking, te bepaal.

Al die deelnemers was volwassenes tussen die ouderdomme van 35 en 65 jaar, uit 'n area met beperkte hulpbronne in Ikageng naby Potchefstroom (Studie 1: n = 60, Studie 2: n = 52, Studie 3: n = 52, Studie 4: n = 130). 'n Totaal van 76 volwassenes het deelgeneem aan die basislyn van die oefenintervensie, waarvan slegs 54 dit voltooi het. Studie 1: Deelnemers het die Engelse en Tswana-weergawes van die SF-8 by afsonderlike geleenthede ingevul, en die korrelasie tussen antwoorde is ontleed met Spearman korrelasie koëffisiënt. Interne konsekwentheid van die Tswana vraelys is bereken via Cronbach alfa. Studies twee en drie het inligting versamel oor KRF d.m.v. 'n agt-minuut gegradeerde opstaptoets van vier protokolle wat individue en groepe vergelyk het en wat nagegaan het die verskil van metronoom en kultureel-spesifieke musiek wat die protokolle vergesel die tyd van voltooiing verleng. Die persentasie persone wat die onderskeie protokolle voltooi het is gebruik om die beste aanpassing te bepaal. 'n Eenrigting ANOVA is gebruik om die betekenisvolheid van die verskil te bepaal in die maksimale suurstofverbruik van deelnemers. Studie 5 het inligting versamel oor die fisieke aktiwiteit wat die deelnemers verkies het en die meeste geniet het. Die betroubaarheid van die vraelys is bereken d.m.v. Cronbach alfa-koëffisiënte. Frekwensie-

ontledings en chi-kwadraattoets is uitgevoer om die mees gewenste tipe en tyd vir FA asook die verwantskap tussen verkose tipe FA en demografiese veranderlikes te bepaal, met behulp van regressie-ontledings. Studie vyf het inligting versamel oor die nakoming en aanvaarbaarheid en nagevolge van 'n vier-week lange aërobiese fisieke aktiwiteit intervensie op NOS risikofaktore, kardiorespiratoriese fiksheid, en lewenskwaliteit. 'n Onafhanklike *t*-toets is uitgevoer om die betekenisvolle verskille van die veranderlikes te bepaal. Die betroubaarheid van die skaal van voordele en beperkings (SVB) is bereken met Cronbach alfa-koëffisiënt en gemiddelde en standaardafwyking is bereken vir elke sub-skaal van die SVB ten einde eenvoudige vergelykings tussen sub-skale toe te laat. ANCOVA is uitgevoer met aanpassing vir basislyn toetsing vir alle herhaalde veranderlikes. Kwalitatiewe data is ontleed met behulp AtlasTi7. Normaliteit vir alle veranderlikes is bepaal met die Shapiro-Wilk-toets en 'n beduidendheidsvlak van 5% is gebruik.

Die Tswana SF-8 is intern konsekwent bevind (Cronbach se alfa 0,87) en as betroubaar vir herhaalde metings (toets-hertoets-betroubaarheid: geestelike komponent  $r = 0,45$ , fisieke komponent  $r = 0,50$ ). Die meeste deelnemers (67,7%) het die opstapstaptoets individueel voltooi, begelei deur 'n metronoom. Stap (39,2%) is aangedui as die mees gewenste en genotvolste tipe fisieke aktiwiteit, en die meeste deelnemers (70%) het aangedui dat hulle verkies om soggens te oefen. Oefen intervensie van vier-weke het 'n 29% uitval syfer in deelnemers getoon (71% het studie voltooi). Meetbare verbetering in risikofaktore vir NOS'e (nie-oordraagbare siektes) is teweeggebring: in bv. liggaamsmassa ( $p = 0,02$ ), Skaal van Waargenome Inspanning (SWI) ( $p = 0,03$ ) en Telling vir Geestelike Komponent (TGK) ("MCS") ( $p = 0,003$ ) in mans, en liggaamsmassa ( $p = 0,00$ ), Liggaamsmassa-indeks (LMI) ( $p = 0,003$ ),  $VO_{2max}$  ( $p = 0,003$ ), Skaal van Waargenome Inspanning (SWI) ( $p = 0,00$ ), glukose ( $p = 0,04$ ), Telling vir Fisieke Komponent (**TFK**) ("PCS") ( $p = 0,00$ ) en Telling vir Geestelike Komponent (TGK) ("MCS") ( $p = 0,00$ ) in vrouens. Die resultate van die ANCOVA wat die verandering vanaf die basislyn tot die einde van die oefening-intervensie evalueer, toon aan dat daar geen statisties beduidende verskil is in al die veranderlikes tussen die groepe wanneer hulle aangepas word vir die ko-variate (voortoets) ( $p < 0,05$ ) nie. Ko-variate was lengte, gewig, LMI, MHR, sistoliese BD, diastoliese BD, RHT, glukose, cholesterol, voorspelde maksimum suurstofverbruik, RPE, PCS en MCS.

Die SF-8 is 'n kort, betroubare en intern geldige vraelys vir gebruik in Tswana. Individuele, metronoom begeleide opstaptoetsprotokol blyk aanvaarbaar en robuus te wees vir gebruik oor kultuurgrense heen. Die gebruik van die standaard protokol word aanbeveel om die beste moontlike voltooiingsresultate vir kardiopiratoriese fiksheidstoets te verkry. Die uitvalsifer van 30% tydens die intervensie moet in toekomstige intervensie studies ingereken word vir die steek proefgrootte. Alhoewel nie die fokus van die studie nie, het so min as vier weke gereelde oefening die risiko profiele vir nie-oordraagbare siekte (NOS'e) verbeter. Oorweging van FA voorkeur mag motivering vir toekomstige oefening intervensieprogramme verhoog.

**Sleutelwoorde:** lewenskwaliteit, kardiopiratoriese fiksheidstoets, fisieke-aktiwiteitvoorkeur, fisieke-aktiwiteit ingryping, Tswana, volwassenes

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# LIST OF ABBREVIATIONS

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<b>A</b>	ACSM	-American College of Sports Medicine
	A	-Agree
	AED	-Automated external defibrillator
	ANOVA	-Analysis of variance
	$A - \dot{V}O_2 \text{ diff.}$	-Arteriovenous oxygen difference
<b>B</b>	BP	-Body Pain
	BMI	-Body mass index
	BLS	-Basic life support
	BMRI	-Brunel Music Rating Inventory
<b>C</b>	CI	-Class interval
	CRF	-Cardiorespiratory fitness
	CDCP	-Centres for Disease Control and Prevention
	CVD	-Cardiovascular disease
	CHD	-Coronary heart disease
	CAD	-Coronary artery disease
<b>D</b>	DQoL	-Diabetes Quality of Life instrument
	DBP	-Diastolic blood pressure
	D	-Disagree
<b>E</b>	EBBS	-Exercise benefits/barriers scale
<b>F</b>	FBG	-Fasting blood glucose
	FTC	-Fasting total cholesterol
	FACIT	-Functional Assessment of Chronic Illness Therapy
	FLIC	-Functional Living Index – Cancer
<b>G</b>	GH	-General health
	GV	-Group variables
	GXT	-Graded Exercise Testing
<b>H</b>	HRQoL	-Health related quality of life
	HC	-Hip circumference
	HRR	-Heart rate reserve
	HR	-Heart rate

	HR max	-Heart rate maximum
	HDL-C	-High-density lipoprotein-cholesterol
<b>I</b>	ISAK	-International Society for the Advancement of Kin-anthropometry
	Kg/m <sup>2</sup>	-Kilograms per metre squared
<b>L</b>	LTPA	-Leisure time physical activity
<b>M</b>	MH	-Mental health
	Max HR	-Maximum heart rate
	MCS	-Mental component summary
	MTI	-Metronome individual
	MUI	-Music individual
	MTG	-Metronome group
	MUG	-Music group
	M	-Men
	METs	-Metabolic equivalents
	mmol/L	-millimole per litre
<b>N</b>	NCDs	-Non-communicable diseases
	N	-Number
	NHANES	-National Health and Nutrition Examination Survey
	NHP	-Nottingham Health Profile
<b>O</b>	O <sub>2</sub>	-Oxygen
<b>P</b>	PCS	-Physical component summary
	$\dot{V}O_{2\max}$	-Predicted Maximum Oxygen Consumption
	PF	-Physical functioning
	PA	-Physical activity
	PPA-Q	-Preferred physical activity questionnaire
	PAR-Q	-Physical activity readiness questionnaire
<b>Q</b>	QoL	-Quality of life
	Q	-Cardiac output
<b>R</b>	RF	-Role physical
	RE	-Role emotional
	RHR	-Resting heart rate
	RPE	-Rate of perceived exertion
	RCT	-Randomised control trial

<b>S</b>	SF	-Social functioning	
	SBP	-Systolic blood pressure	
	SD	-Standard deviation	
	STA	-Short test algorithm	
	SA	-strongly agree	
	SD	-strongly disagree	
	SIP	-Sickness Impact Profile	
	SF-36	-Short Form-36	
	SF-36v2	-Short Form 36-version 2	
	SF-12v2	-Short Form-12 version 2	
	SF-8	-Short Form-8	
	<b>U</b>	USDHHS	-United States Department of Health and Human Services
	<b>V</b>	V	-Vitality
$\dot{V}O_{2\max}$		-Maximum oxygen consumption	
$\dot{V}O_{2\text{Peak}}$		-Maximum oxygen uptake	
<b>W</b>	WC	-Waist circumference	
	WHR	-Waist-hip-ratio	
	W	-Women	
	WHO	-World Health Organisation	

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# CHAPTER 1: INTRODUCTION

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## 1.1 INTRODUCTION

Non-communicable diseases (NCDs) are chronic sicknesses which cannot be transferred from one person to another (Bradshaw *et al.*, 2011). Popular samples include stroke, heart attacks, diabetes, cancer, asthma and depression. Quite a lot of main NCDs come as a result of predated behaviours that are not healthy, which comes after the appearance of metabolic risk factors and disease (Bradshaw *et al.*, 2011:1). Non-communicable diseases (NCDs) has been understood as the paramount root of mortality globally, triggering more deaths than all other causes all together, and are afflicting many low and middle-income inhabitants (National Department of Health, 2012). The risk factors which have been known to be related to NCDs are overweight and obesity, high blood pressure, raised blood sugar and blood cholesterol levels (Bradshaw *et al.*, 2011:1). Some of these risk factors can be modified via changes in lifestyles and or treatments (Bradshaw *et al.*, 2011:1). There are four main behaviours by which the NCDs risks factors can be prevented or modified , namely: eating a healthy diet, participating in regular physical activity (PA), not using tobacco, and avoiding harmful use of alcohol (National Department of Health, 2012; Bradshaw *et al.*, 2011:1).

Globally, as the level of involvement in PA declines, people's health and well-being are diminishing. Sixty-three percent of all deaths worldwide are attributed to non-communicable diseases (NCDs) (Bloom *et al.*, 2011:6). Cardiovascular diseases (CVD) such as stroke, chronic respiratory diseases, and diabetes are important components of the broader group of NCDs (Bloom *et al.* 2011:6). Close to 80% of the deaths caused by NCDs occur in low- and middle-income countries (WHO, 2011:vii). NCDs reduce productivity and increase healthcare expenditure. The number of people affected by NCDs is expected to rise substantially in the coming decades (Bloom *et al.*, 2011:6), if the risk factors related to NCDs are not managed.

In South Africa, many deaths are attributed to lifestyle-related risk factors such as tobacco use, excess body weight, alcohol consumption, and physical inactivity (Derman *et al.*, 2008:6). These behaviours contribute to the development of chronic, non-communicable diseases and precursor conditions, including diabetes, high blood pressure, and abnormal cholesterol concentrations. In 1999 the United Nations (UN) predicted that CVD would be

the prime contributor to total disease and death in South Africa by the year 2030. Further, the UN projected that deaths among the 35-64 year age group would increase by over 40% by the year 2030 (Mandy *et al.*, 2011:48). In South Africa there is a decrease in the ratio of younger to older persons in the population due to the consistent high death rate among the younger generation resulting from HIV/AIDS (Joubert & Bradshaw, 2005:206). Having an older population increases the burden of disease and poses a threat due to the deterioration in the public health care facilities, lack of access to a medical aid funds and expensive private health care (Joubert & Bradshaw, 2005:216). Therefore a negative effect is anticipated on the nation's economy if chronic diseases of lifestyle are not controlled, which may then cause setback on persons quality of life.

Further, it has been argued that although physical health is important, overall quality of life is more significant (Gill *et al.*, 2013:S30). Quality of life (QoL) is defined as an individual's perception of their position in life in the context of the culture and value systems in which they live, as well as in relation to their goals, expectations, living standards and concerns (WHO, 1997). Health-related quality of life (HRQoL) and QoL are used somewhat interchangeably (Bakas *et al.*, 2012:134). Furthermore, the existence of NCDs in an adult population impacts on their health related quality of life (HRQoL) and independence (Sazlina *et al.*, 2012:498). Adults with NCDs report a decrease in HRQoL (Sazlina *et al.*, 2012:498; Bowling *et al.*, 2007:310). NCDs have also been seen as the underlying factor that can cause many difficulties in day-to-day activities of many people and therefore, lower their HRQoL (Sazlina *et al.*, 2012: 498). On the other hand, poor social support, women, and low level of education were related to reduce physical and mental health components of HRQoL (Gallicchio *et al.*, 2007:777). The measure of HR-QoL is determined by means of a reliable and valid survey instrument.

Reliability and validity is often a concern when data is collected by means of questionnaires since validation thereof is quite challenging. Validity is divided into three types:

- (i) content validity,
- (ii) criterion-related validity, and
- (iii) construct validity (DeVellis, 2003:49).

Validation procedures are undertaken to make sure that a questionnaire measures what it is intended to measure, regardless of the responder (Kazi & Khalid, 2012:514). Use of a valid questionnaire reduces the effort required for data collection and increases the credibility of

data. Typically, valid questionnaires are simple, acceptable, reliable, precise in wording, adequate for the problem intended to measure, reflect the underlying theory or concept to be measured, and be capable of measuring change (Kazi & Khalid, 2012:515).

The importance of PA as an intervention to combat and control chronic disease caused by an unhealthy lifestyle has been established (Kruk, 2007:325). Physical activity is defined as a bodily movement through skeletal muscle activations which results in energy expenditure in kilocalories and varies between low to high levels. Physical activity is also positively correlated with physical fitness (Caspersen *et al.*, 1985) and the general term for all structured (e.g. aerobic exercise, resistance training, or both) and unstructured (e.g. walking, for transport, domestic duties, or occupational PA) activities. Structured PA includes exercise which has been defined as a planned, structured, and repeatable bodily drive to improve and preserve physical fitness components (Caspersen *et al.*, 1985). Physical activity could serve as a protective factor for many NCDs risks factors (Moy *et al.*, 2010:21).

Belza *et al.*, (2004:1) stated that physical activity preference based on peoples' culture should be considered when planning PA intervention programmes to reduce NCD risk factors, improve cardiorespiratory fitness and HRQoL. This could play an important role in addressing the rate of adherence and or dropout during interventions. Lubrano *et al.* (2012:1677) established that a reduced physical activity could aggravate a low level of cardiorespiratory fitness and HRQoL. Increase in PA participation could lead to increase in CRF which helps in promoting HRQoL and reduction in NCDs. This can be achieved by moderate exercise intensity sufficient to improve CRF. The rate at which an individual is able to consume oxygen can be considered as the gold standard for measuring cardiorespiratory fitness (Ruiz, 2007:14). Maximum oxygen consumption can be determined or estimated using different equations from the performance attained in maximal or sub-maximal tests (Ruiz, 2007:14) which are performed to improve CRF. Physical exercise conducted 3-5 times or 150 minutes per week might significantly lower the NCDs risks factors in adults who are at risk (Gill & Malkova, 2006:421).

This thesis provides information on the validity of short form eight (SF-8) health-related quality of life, the best modality for the completion of cardiorespiratory fitness testing, the most preferred modality of physical activity involvement, and the compliance and acceptability of a four-week exercise intervention for NCD risk factors among Setswana

speaking community-dwelling Potchefstroom adults. This introductory chapter in particular, serves to identify the problem statement, present the research question, objectives and hypotheses to be tested. The conceptual framework and structure of the thesis will also be presented.

## **1.2 PROBLEM STATEMENT**

Chronic diseases of lifestyle affect both young and older adults, but particularly when the age of 40 years is reached (Joubert & Bradshaw, 2005:206), which is also known as the clinical horizon for disease development. Many of these chronic diseases of lifestyle are preventable (Hoosain *et al.*, 2013) with physical activity and/or exercise interventions which protect against diseases and increase longevity (Paffenbarger *et al.*, 2001:1190). The most cost-effective interventions to reduce CVD are those that target many people, including education through mass media, promotion of healthy diets, and regular physical activity (Steyn, 2007:28). Cost-effective treatment means that a treatment is not only effective in removing or reducing a disease, but at a lower cost for society (Steyn, 2007:27). Physical activity could serve as one such intervention to reduce chronic diseases of lifestyle, and thus improve quality of life.

Regular physical activity and exercise are highly beneficial for physical health and psychological well-being (Physical Activity Guidelines Advisory Committee, 2008). Cultural differences play an important role in increasing physical activity and cardiorespiratory fitness levels. Culture is seen as a characteristic of a particular group of people defined by everything from language, religion, cuisine, social habits, to music and arts (Zimmermann, 2012). Belza *et al.* (2004:1) stated that physical activity programmes to enhance participation among ethnically diverse minority older adults include the provision of culture-specific exercise among others. Generally, exercise programmes in line with cultural preferences create interest and increase adherence (Astle, 2005:1). Having knowledge about what already is a popular form of exercise within an ethnic group may be effective and acceptable to increase adherence to physical activity (Astle, 2005:1). Culturally tailored aerobic exercise intervention programmes can increase activity intensity and cardiorespiratory fitness (Halvorson, 2008:1). Knowledge on the cultural preferences would guide the compilation of culture specific exercise interventions that are known to improve health outcomes.

Psychological factors, such as enjoyment (Hardy & Rejeski, 1989:308), self-efficacy (McAuley & Courneya, 1993), and social influence (Carron *et al.*, 1996:7) have been seen as an inspiration during exercise. Dishman and Buckworth (1996) pronounced that group exercise programmes could increase exercise adherence compared to those based on individual participation. People who perceive that they may be negatively judged might not be willing to participate in group exercise programmes (Bain *et al.*, 1989). According to Bain and colleagues (1989), this judgement may include negative assessment of another's physique, equipment or materials for exercise, or time available to exercise. Irwin *et al.* (2012:158) stated that working as a group compared to working individually both motivates and influences performance. Bood *et al.* (2013:1) stated that performance or movement tied with external sound such as metronomes or music harmonisation could lead to a higher performance. Based on the previous studies, cardiorespiratory fitness testing performance may be influenced when manipulating the grouping of participants and adding music. Meanwhile, movement to music involves the synchronized movement of the whole body based on the rhythm of the beat (Bood *et al.*, 2013:1). This could be followed by finger-tapping, clapping hands, or jamming feet together while listening to the beat (Bood *et al.*, 2013:1). Szabo *et al.* (2009:1) ascertained that music can lower fatigue, increase the levels of arousal and pace of the movement, as well as bring about neuromuscular relaxation and steadiness. Using music while exercising increases individual motivation and makes the activity more enjoyable, which might result in people exercising more frequently (Polasek & Hendrick, 2011:438).

Evaluating the exercise working capacity is important in determining the fitness levels of an individual. Cardiorespiratory fitness could be achieved either by stepping, cycling or running (Watkins, 1984:84). Step tests are frequently used for the assessment of exercise working capacity (de Andrade *et al.*, 2012:116) because they can be administered to a large group in a field situation. Furthermore, step tests do not require expensive equipment or highly trained personnel (Heyward, 2006:84). A great level of motivation is required however in order to ensure a reliable and valid measurement. Using a reliable test to measure or determine the level of cardiorespiratory fitness is a necessity (Watkins, 1984:84).

There are various studies on graded step tests to determine cardiorespiratory fitness with (Chatterjee *et al.*, 2013:10; Takayama *et al.*, 2012:200). In a study conducted in India to determine the effects of step height on cardiorespiratory responses during aerobic step tests in

young women, of which the participants maintained cardiorespiratory fitness test at a cadence of 120 beats per minute, reported that aerobic stepping based on cadence is a useful exercise mode to develop, improve and maintain cardiorespiratory fitness (Chatterjee *et al.*, 2013:10). A pilot study of the feasibility and benefits of a 24-week step test and home-based exercise intervention was conducted and revealed that home-based exercise interventions, coupled with cognitive behavioural intervention therapy sessions, indicate a significant improvement in relative VO<sub>2</sub> peak over time from baseline to six months. Furthermore, the patient health-related quality of life (HRQOL) factors improved from baseline to six months ( $F_{(2, 14)} = 6.905$ ,  $p = .008$ , partial  $\eta^2 = 0.497$ ). This study provided evidence that a home-based exercise intervention focusing on improving cardiorespiratory fitness is possible, beneficial, feasible and effective (Moonsammy *et al.*, 2013:8).

The health of the South African population has been studied thoroughly, but information on the health-related quality of life and exercise intervention of adults in low socio-economic environments is lacking. South Africa, also called a rainbow nation is a culturally complex country, with 11 official languages, for which Setswana language speaks mostly by Setswana people is one of them. Setswana group formed one of the major ethnic groups among black South Africans and account for the largest percentage of total black population, with 3 million people for which the majority lives in the province of North-West and Northern Cape ([www.sahistory.org.za/people-south-africa/tswana](http://www.sahistory.org.za/people-south-africa/tswana)). Meanwhile, the adoption of western lifestyle by Setswana people based on technology advancement has overshadowed part of their cultural lifestyle especially their feeding patterns and physical activity levels. Valid and reliable instruments in indigenous languages are required in South Africa to accurately measure and assess the well-being of the adult population.

There do not appear to have information on what exercise interventions are likely to be suitable in this cultural context. The lack of exercise interventions in low resourced communities contributes to the lack of information with regard to the most appropriate interventions strategy to follow in the specific cultures of ethnic groups in South Africa. The research questions considered in this thesis might be broadly phrased as: “What are the reliable and valid measure instruments to determine the effect, compliance and barriers of an exercise intervention on quality of life and fitness in community dwellers in South Africa?”

Results obtained from this study will indicate the appropriateness of using the Setswana translation of the SF-8 quality of life questionnaire in an exercise intervention study. Answers to research questions posed will provide information on the key variables to be used in future exercise and quality of life based exercise interventions of community-dwelling South Africans, and make it possible to understand the perceived quality of life in South African communities in order to improve the quality of their lives. Information gathered with the step test and intervention programme will provide information on the appropriateness of the step test for determining cardiorespiratory fitness. The preferred modalities that would be appropriate to implement as an intervention programme with the purpose of reducing NCDs in South African rural and urban populations can improve adherence to future exercise intervention programmes. The findings of this study will form the basis of a multi-centre exercise intervention study to promote physical activity in curbing the increase of NCDs in South African public health settings.

### **1.3 OBJECTIVES**

The objectives for this study are to:

- 1) Assess the face validity of the Setswana translation of SF-8 health-related quality of life health survey in community-dwelling Potchefstroom adults.
- 2) Determine if either individual fitness testing or group fitness testing increases the rate of completion of an 8-minute graded step test in Setswana-speaking community-dwelling Potchefstroom adults
- 3) Determine if a metronome accompanying or cultural-specific music increase the rate of completion of an 8-minute graded step test in Setswana-speaking community dwelling Potchefstroom adults.
- 4) Determine the most preferred modality of physical activity in Setswana speaking community-dwelling Potchefstroom adults.
- 5) Determine the compliance and barriers of a four-week exercise intervention for reducing risk factors of NCDs and improving HRQoL among Setswana speaking community-dwelling Potchefstroom adults.

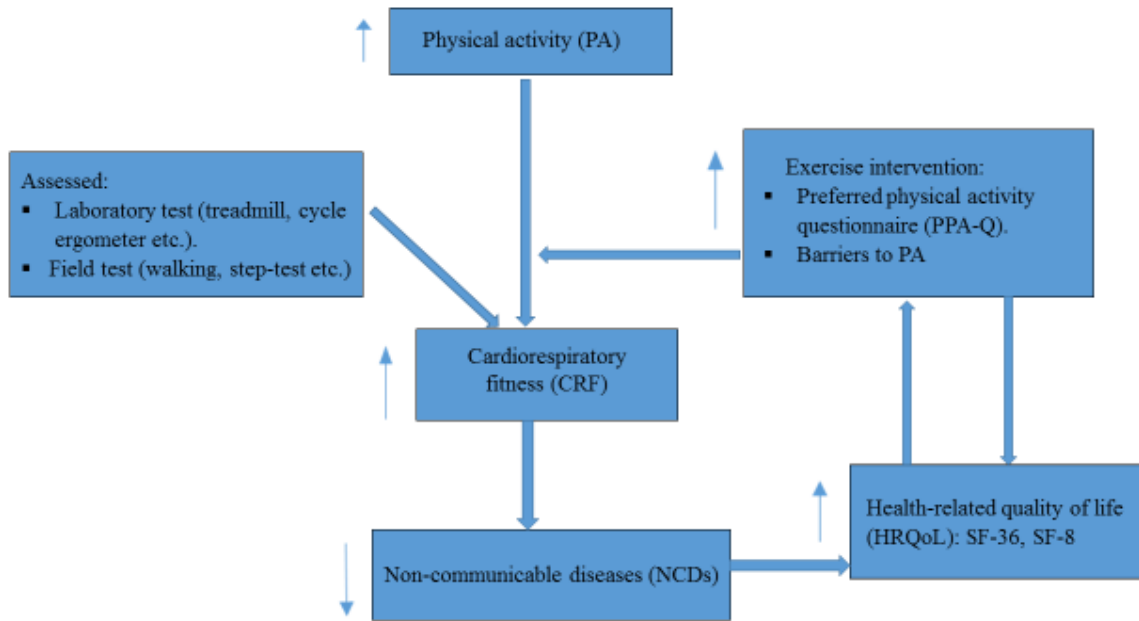
## **1.4 HYPOTHESES**

This study is based on the following hypotheses:

- 1) The Setswana translation of the SF-8 HRQL health survey is a valid assessment for determining health-related quality of life in community-dwelling Potchefstroom adults.
- 2) Group fitness testing will increase the rate of completion compared to individual testing of an 8-minute graded step test in Setswana-speaking community-dwelling Potchefstroom adults
- 3) Cultural specific music will increase the rate of completion compared to metronome accompanying testing of an 8-minute graded step test in Setswana-speaking community-dwelling Potchefstroom adults.
- 4) There will be no one specific preferred modality of exercise intervention for men and women in Setswana-speaking community-dwelling Potchefstroom adults.
- 5) A compliance rate above 80% and minimal barriers will be experienced for a four-week exercise intervention on reducing risk factors for NCDs and improving HRQoL among Setswana speaking-community-dwelling Potchefstroom adults.

## **1.5 CONCEPTUAL FRAMEWORK OF THE STUDY**

This study is therefore based on the conceptual framework presented in Figure 1, where the reduction in risk factors for NCDs is associated with increased cardiorespiratory fitness due to increased physical activity in a structured approach. This decrease in risk factors for NCDs, contribute to an increase in HR QoL. However, in order to determine the magnitude of the effect of exercise on risk factors for NCDs, assessments used in the algorithm should be standard, valid and acceptable measurements.



**Figure 1.1: Conceptual framework of the thesis**

## 1.6 STRUCTURE OF THE THESIS

This thesis will be presented in an article format and structured as indicated in Table 1.1. It will comprise of seven chapters, namely; an introduction (Chapter 1) which states the general field of interest presents the problem and leads into the objectives and hypotheses. In the literature review (Chapter 2), the evaluation and integration of the literature that is known on the topic will be discussed. Four research manuscripts (Chapters 3-6) will then follow. Chapter 7 will present the summary, conclusion, limitations and recommendations to assist with future research on the topic. Chapters 1, 2 and 7 are written in accordance to the North-West University regulations and guidelines. Referencing style of these chapters will be according to the NWU Harvard style. Chapters 3, 4, 5 and 6 are written according to the journal's guidelines for authors.

**Table 1.1: The structure of the article format thesis**

Chapter 1	Introduction
Chapter 2	Literature review: Health-related quality of life, cardiorespiratory fitness testing, and the effects of exercise
Chapter 3	Article 1: Validity and reliability of the Setswana translation of SF-8 quality of life health survey in adults ( <i>BMC Research Notes</i> ).
Chapter 4	Article 2: Cardiorespiratory fitness testing in Setswana-speaking adults in Potchefstroom, South Africa ( <i>AJPHRD</i> ).
Chapter 5	Article 3: Preferred modality of physical activity among Setswana-speaking community-dwelling Potchefstroom adults ( <i>South African Journal for Research in Sport, Physical Education and Recreation</i> ).
Chapter 6	Article 4: Managing non-communicable diseases in an African community: Effects, compliance, and barriers to participation in a four-week exercise intervention ( <i>International Quarterly of Community Health Education</i> ).
Chapter 7	Summary, conclusions, limitations and recommendations.

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## **CHAPTER 2: LITERATURE REVIEW: HEALTH-RELATED QUALITY OF LIFE, CARDIORESPIRATORY FITNESS TESTING, AND THE EFFECTS OF EXERCISE**

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### **2.1 Introduction**

Substantial evidence is available on the multiple health advantages of regular physical activity (PA) on health later in life (Durstine *et al.*, 2013:3; Loucaides *et al.*, 2004:138; Kesaniemi *et al.*, 2001:S351 & Cavill *et al.*, 2001:18). Researchers are in agreement that increased PA is related to a decrease in all causes of non-communicable disease risk factors in populations, independent of other factors such as race or environment (Durstine *et al.*, 2013:3; Loucaides *et al.*, 2004:138 & Kesaniemi *et al.*, 2001:S351). Various critical appraisals of the literature have shown that throughout their entire lives PA could increase its positive effects on people's psychological well-being and self-esteem, as well as reduce the risk of overweight, obesity and other chronic disease risk factors.

Several studies have shown that higher levels of PA or exercise and cardiorespiratory fitness (CRF) bring fortification to help avoid all manner of heart diseases (Swift *et al.*, 2013:281; Li & Segrist, 2012:391; Sofi *et al.*, 2008:247 & Lee *et al.*, 2001:1447). It stands to reason that a low level of PA results in low levels of CRF, and is therefore a risk factor for deaths related to cardiovascular disease (CVD) and coronary heart disease (CHD) (Swift *et al.*, 2013:282) most especially in later life. A decrease in CRF in turn negatively affects adults' health-related quality of life (HRQoL) and total well-being due to reduced functional capacity. Exercise intervention programmes to improve CRF and quality of life for adults are known low-cost approaches to reducing non-communicable diseases (NCDs). The purpose of this literature review chapter is to critically review the current knowledge on HRQoL and CRF, as well as the effect of exercise on outcomes of cardiorespiratory fitness and risk factors for NCDs. This critical appraisal will also address standard, valid, and reliable tests available for determining HRQoL, cardiorespiratory fitness, as well as the factors influencing motivation for participation, and preferred type of physical activities.

## **2.2 Non-communicable diseases and quality of life**

### **2.2.1 Risk factors for non-communicable diseases**

Physical activity is body movement, created by muscle contraction, which can significantly boost energy disbursement to bring about improved health (Kesaniemi *et al.*, 2001:351). Worldwide contemporary technological innovation has reduced the volume of physical activity reported by adults (Walter *et al.*, 2011:1), and this change is not limited to advanced economies. Globally, statistics show that physical inactivity increases the risk of many adverse health conditions emanating from NCDs such as CHD, Type 2 diabetes, and breast and colon cancers, and shortens life expectancy (Lee *et al.*, 2012:219). The World Health Organization (2015) identifies low levels of physical activity as one of the 10 leading risk factors for global mortality. People who are insufficiently physically active have a 20-30% increased risk of all-cause mortality, compared to those who participate in at least 150 minutes of moderate intensity physical activity per week, as recommended by WHO (WHO, 2015). In 2010, 23% of adults aged 18 and above were insufficiently active (men 20% and women 27%) worldwide of which in general, older adults were less active than younger adults. In the youngest age group which comprises of both men and women, 19% did not meet the recommended level of physical activity, compared to 55% of the oldest age group, however, young women were slightly less active than middle-aged women (WHO, 2015).

The WHO Eastern Mediterranean Region (31%) and the Region of the Americas (32%) had the highest prevalence of insufficient physical activity, while the prevalence was lowest in the South-East Asia (15%) and Africa (21%) regions. In all regions, women were less physically active than their male counterparts, with a 10% difference in prevalence between men and women in most regions, and even greater disparity in the Eastern Mediterranean and the Americas. According to WHO (2015), the prevalence of insufficient physical activity is somewhat related to income levels; countries with higher earnings appear to have more than double the prevalence compared to countries with low income, for both men and women (41% of men and 48% of women in high income countries and 18% of men and 21% of women in low income countries). These statistics may be described by increased work and transport-related physical activity in the low and lower-middle income countries (WHO, 2015). Lee *et al.* (2012:219) suggested that even if physical inactivity was decreased by only 10-25%, more than a million deaths could be prevented each year. Therefore, by eliminating physical inactivity, the life expectancy of the world's population is estimated to increase by 0.68 years (WHO, 2015).

In South Africa, the rates of diseases associated with sedentary lifestyles are now at the same levels observed in industrialized countries (Walter *et al.*, 2011:1). According to Bradshaw *et al.* (2003:682), almost forty percent of adult deaths in South Africa in year 2000 were due to NCDs. Women are mostly affected and the increase in the incidence is reportedly due to growth in cities, industries and the adoption of a western lifestyle, often referred to as urbanization. Data on the cause of death related to risk factors for NCDs, shows that overall mortality from NCDs has barely changed in the past decade (Mayosi *et al.*, 2012:2029).

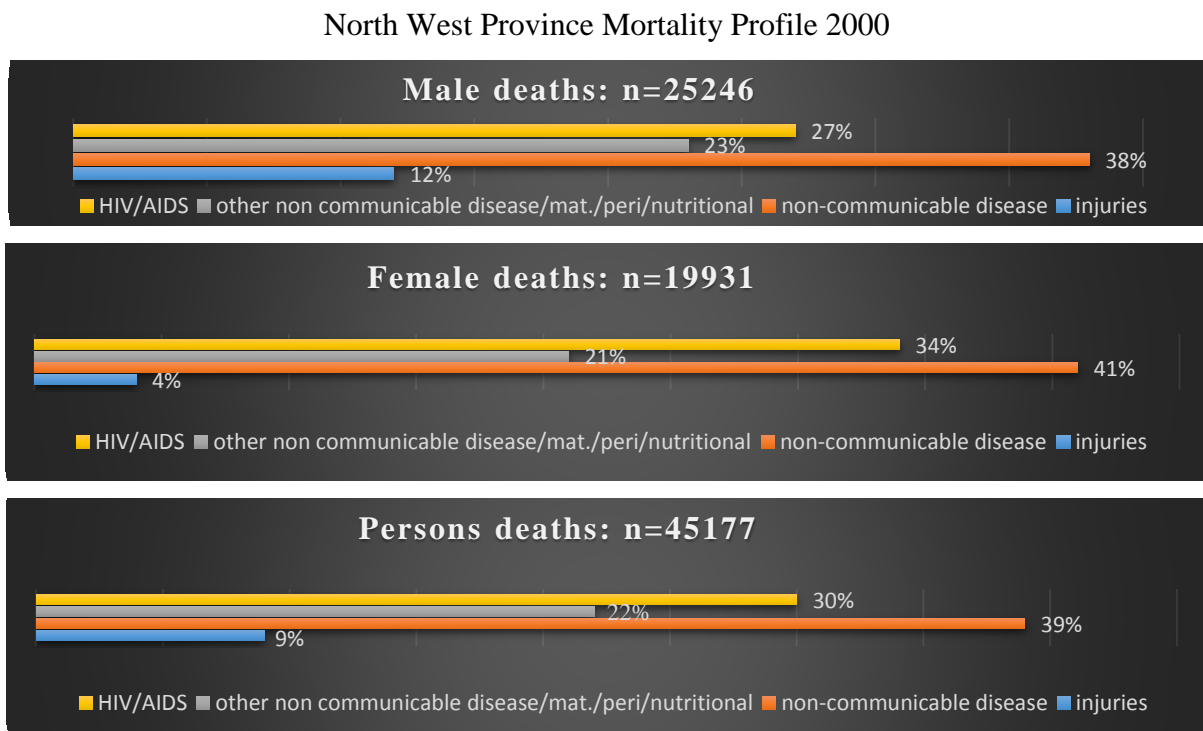
Statistically, in South Africa, physical inactivity has been regarded as a major contributing factor to increasing prevalence of overweight and obesity. South Africa has the highest overweight and obesity rates in sub-Saharan Africa. Seventy percent (70%) of women and a third of men are classified as overweight or obese while a shocking 40% of women are obese, which means that they have a body mass index higher than 30 kg/m<sup>2</sup> (The Heart and Stroke Foundation South Africa, 2014). The problem is no longer only an adult problem as one out of four girls, and one out of five boys between the ages of 2-14 years are overweight or obese (The Heart and Stroke Foundation South Africa, 2014).

Physical inactivity, which is slightly different to insufficient physical activity, is defined as “doing no or very little physical activity at work, at home, for transport or during discretionary time.” In 2014, physical inactivity was estimated at 43-49% in South Africans aged 15 years and older (Micklesfield *et al.*, 2014:40). According to the national cause-of-death statistics released by Statistics South Africa in 2005, 20% of deaths in the 35-64 year age group were as a result of chronic diseases of lifestyle (van Zyl *et al.*, 2012:1). The physical inactivity of South Africans appears to start during childhood and continues into adulthood - fewer than two-thirds of South African children participate in regular weekly physical activity such as sport or planned exercise. Among adults, half of males and almost two-thirds of females are physically inactive (The Heart and Stroke Foundation of South Africa, 2014).

In South Africa, the cross-sectional statistics that were collected for close to 20 years on the frequency of PA for health promotion and the reduction in risk factors for NCDs, report low levels of regular PA, in particular in women (Jane *et al.*, 2007:726). Steyn *et al.* (2004:235) conducted a study in a sample of people from a small urban area in the Western Cape of South Africa and found that close to fifty percent (49.7%) of participants did not meet public

health advice of 150 minutes (at least 30 minutes per day) or more of health-promoting PA per week. Jane *et al.* (2007:726) stated that 40% of young adults were insufficiently active.

In a study conducted in North West Province, it was revealed that the principal cause of death was burden of disease related to NCDs (Figure 2.1), with women reporting higher frequencies (41%) compared to men (38%) (Bradshaw *et al.*, 2000:5). There was a drift in CVD risk factors from higher socio-economic status groups to lower socio-economic status groups among black South Africans living in North West Province (Pita *et al.*, 2012:371).



**Figure 2.1: Estimated deaths by groups for the North West Province in 2000. Adapted from Bradshaw *et al.* (2000:5)**

Fletcher *et al.* (1996:857) stated that healthy people and anyone with heart and blood vessel disease can increase their cardiovascular capacity and reduce myocardial oxygen demanded with regular PA. Regular PA participation can improve physical strength, cardiorespiratory fitness, the ability to remain active for a long period of time (endurance), and improve flexibility. An improvement of these components of functional capacity also contributes to well-being and HRQoL. Beside the improvement on functional capacity, structured PA, or exercise, also improves a range of physical and physiological outcomes including body composition, haemoglobin concentration, immune function, tiredness, insulin sensitivity,

psychosomatic well-being, physiological performance and HRQoL (Cramp & Byron-Daniel, 2012:3; Knols *et al.*, 2010:1; Speed-Andrews & Courneya, 2009:179; Knols *et al.*, 2005:3841).

### **2.3 Cardiorespiratory fitness, physical activity, and health-related quality of life**

Berryman (2010:195) stated that exercise can be prescribed as a medicine to promote mental and overall health. Myers (2003:e2) stated that regular physical exercise has a positive effect on many of the well-known risk factors that cause cardiovascular diseases. Activity similar in intensity to brisk walking at a pace of approximately 5-6 kilometres per hour can create many health benefits. Furthermore, a work-related or leisure activity at appropriate intensity and frequency as seen in cycling, gardening and swimming can be advantageous for health (USDHHS, 1996).

Myers (2003) specified that 150 minutes of exercise per week of 3-6 METs, or approximately 600-1,200 calories expended per week, could enhance total health. Health benefits could also be achieved through physical activity performed for shorter bouts of 10 minutes to accumulate 30 minutes of exercise each day based on the prescription of mode, intensity, duration, and frequency. The benefits of exercise are typically transferred through exercise programmes of 30-60 minutes of continuous exercise, three days per week at an intensity corresponding to between 60-75% of an individual's heart rate reserve (HRR) (Myers, 2003:e2). Individuals who meet the recommendation proposed in the guideline can increase or sustain the benefits of increase in cardiorespiratory fitness through regular aerobic exercise (Myers, 2003:e2).

Cardiorespiratory fitness (CRF) is a health-related component of physical fitness, defined as the ability of the circulatory, respiratory, and muscular systems to supply oxygen during sustained physical activity (Lee *et al.*, 2010:27). Ruiz (2007:14) stated that cardiorespiratory fitness, cardiovascular fitness, cardiorespiratory endurance, aerobic fitness, aerobic capacity, aerobic power, maximal aerobic power, aerobic work capacity, physical work capacity, and maximal oxygen uptake ( $\dot{V}O_2 \text{max}$ ), all refer to the same concept, and these terms are used interchangeably in the literature.

## **2.4 Influence of physical activity on cardiorespiratory fitness**

The influence that physical activity has on cardiorespiratory fitness cannot be underestimated (Ruiz, 2007:14). It has been established that a decrease in physical activity could lead to a low level of cardiorespiratory fitness which increases the morbidity and mortality rate associated with both CVD (Lubrano *et al.*, 2012:1677) and coronary heart diseases (CHD) (LaMonte *et al.*, 2000:1627). The rate at which an individual is able to consume oxygen can be considered as the gold standard for measuring cardiorespiratory fitness (Ruiz, 2007:14). Maximum oxygen consumption can be determined or estimated using different equations from the performance attained in maximal or sub-maximal tests (Ruiz, 2007:14) which are performed to improve CRF.

Improvement in CRF is related to the performance of other health-related fitness parameters in adults (Ruiz, 2007:14). A cross-sectional study of 2,859 young people showed that the performance of several health-related fitness tests was higher in young people with high levels of CRF compared to those with lower levels of CRF (Ortega *et al.*, 2005:905). From observation, regarding PA and CRF, it seems neither can work in isolation. Involvement in PA brings about improvement in CRF which helps in promoting HRQoL. This can be achieved by moderate exercise intensity sufficient to improve CRF.

Gill and Malkova (2006:421) argued via a systematic review of physical activity, fitness and cardiovascular disease risk factors in adults: interaction with insulin resistance and obesity, that, there is widespread proof that bodily movement produced by skeletal muscles and aerobic capacity can prevent cardiovascular diseases and improve HRQoL in adults. Physical exercise conducted routinely at a reasonable amount of 150 minutes as recommended per week, might significantly lower the CVD risks factors for those who are at risk (Gill & Malkova, 2006:421) most especially adults. Furthermore, adequate CRF levels have proved beneficial in improving the HRQoL and decreasing the risks for CVD and injuries (Lubrano *et al.*, 2012:1680). Therefore, both aerobic exercise and aerobic fitness are self-reliantly linked with a reduction in CVD risks factors and should be considered during the assessment of risk factors (Ekblom-Bak *et al.*, 2010:179) for health improvement.

## **2.5 Cardiorespiratory fitness testing**

The objective evaluation of cardiorespiratory fitness is an important outcome in several clinical and research settings (Jones *et al.*, 2008:757). Cardiorespiratory fitness is based on

the capacity of the body to transport oxygen ( $O_2$ ) to working muscles for the formation of adenosine triphosphate to produce energy for the contraction of muscles (Jones *et al.*, 2008:757). Jones *et al.* (2008:757) put it clearly: “the maximum volume of oxygen ( $\dot{V}O_{2\max}$ ) that an individual can use at maximum levels of intense aerobic exercise is the outcome of the volume of blood pumped per minute by each ventricle of the heart and the difference in the oxygen content of the blood between arterial blood and venous blood”. Physiological adaptation in oxygen transport can bring about improvements in the capacity of the body to utilise oxygen (Jones *et al.*, 2008:757). This can be achieved due to changes in any step of  $O_2$  transport which can cause predictable changes in the body’s ability to consume and use  $O_2$  (Jones *et al.*, 2008:757).

The term “ $\dot{V}O_2$ ” is derived from V-volume of  $O_2$ -oxygen. Maximum oxygen consumption is the maximum volume of oxygen that the body can consume during intense, whole-body exercise.  $\dot{V}O_{2\max}$  is seen, therefore, as a concrete measure of cardiorespiratory fitness which varies from individual to individual (Jones *et al.*, 2008:757).  $\dot{V}O_{2\max}$  may be determined during a maximal exertion cardiopulmonary exercise test to exhaustion, but this type of exercise testing to exhaustion is demanding and costly, both to the individual and to the tester.

The terms “peak” and “max”  $\dot{V}O_2$  are sometimes used interchangeably, but they are not actually the same parameters. Peak  $\dot{V}O_2$  is the highest value of  $\dot{V}O_2$  attained on an aerobic exercise test (Howley *et al.*, 1995: 1292). On the other hand, “max” or maximum  $\dot{V}O_2$  refers to the highest value of  $\dot{V}O_2$  that is attainable by an individual. Further, peak  $\dot{V}O_2$  identified in a submaximal test may be used to estimate maximal  $\dot{V}O_2$  in an individual according to established algorithms, but it would be erroneous to refer to an estimate as “max  $\dot{V}O_2$ ” because the individual’s actual maximal capacity was not determined. An important weakness of submaximal peak  $\dot{V}O_2$ - testing is that it does not show the level of performance an individual is capable of reaching. Maximum oxygen consumption is therefore considered the best indicator of a person's cardiorespiratory fitness.

There are four main criteria used during maximal cardiorespiratory fitness tests to determine whether  $\dot{V}O_{2\max}$ , has been reached. These are:

- (i) plateau in oxygen consumption as workload increases
- (ii) a respiratory exchange ratio (RER) between 1.05 and 1.15
- (iii) a blood lactate level from 8 to 10 mmol.L, and
- (iv) a heart rate that is within 10 to 12 beats of the age predicted maximum heart rate (Howley *et al.*, 1995: 1292).

A plateau in oxygen consumption as the workload increases helps to confirm that the individual has pushed themselves to their actual maximum. This first criterion is debated because not everyone reaches a plateau (Howley *et al.*, 1995: 1292) which may be due to the limitations of the circulatory and respiratory system (Noakes, 2008:574).

Respiratory exchange ratio is the ratio between the amounts of oxygen ( $O_2$ ) consumed and carbon dioxide ( $CO_2$ ) produced in one breath. In this case, a person inhales more molecules of oxygen than they exhale of carbon dioxide. Achieving a RER between 1.05 and 1.15 signifies that the person's  $CO_2$  production is increasing over their  $O_2$  production because their aerobic metabolism has reached a maximum, and the buffering system starts to produce  $CO_2$  to compensate (Howley *et al.*, 1995: 1292). Achieving a blood lactate level from 8 to 10 mmol/L represents a level that is 8 to 10 times the resting blood lactate level. This extreme increase in blood lactate occurs due to the level of intensity and ATP production, which relies on the lactic acid system (Howley *et al.*, 1995: 1292). The lactic acid system is a system that does not require the presence of oxygen to resynthesize ATP in muscles, which is also known as anaerobic glycolysis. Furthermore, lactic acid system is regarded as the alternative fuel source after which the ATP-PC system consists of adenosine triphosphate (ATP) and phosphocreatine (PC) are depleted. Finally, achieving a heart rate within 10 to 12 beats of the age predicted maximum heart rate is based on the linear relationship between heartrate and oxygen consumption. Therefore as  $\dot{V}O_{2\max}$  is reached, the maximum heart rate should also be reached (Howley *et al.*, 1995: 1292).

Cardiorespiratory fitness measures can also be used to assemble information on:

- (i) the patient's existing fitness status in terms of  $\dot{V}O_{2\max}$ ,

- (ii) how to generate an individualised workout programme based on the extent of utmost tolerance,
- (iii) patients' improvement throughout an intervention programme,
- (iv) what is required to teach and encourage patients,
- (v) identifying the setbacks that can influence exercise programme plans, and
- (vi) identifying CVD risks (Janot, 2004:1).

Determining cardiorespiratory fitness status in humans is important because of its clinical application which includes diagnosis, evaluation of therapy, risk stratification, and to guide physical activity. Accurate and appropriate testing of CRF is important so that objective measures of cardiorespiratory fitness can be reported.

### **2.5.1 Determining cardiorespiratory fitness**

Cardiorespiratory fitness determined as relative  $\dot{V}O_{2\max}$  can be determined in two ways: direct measurement, or indirect measurement. Maximal aerobic testing in people with low functional capacity may be limited in the presence of ill-health. Further, maximal exercise tests are unpleasant to conduct, require extensive equipment including kit for gas collection and analysis, and are associated with risk of adverse events (e.g.: fall from the treadmill in the terminal (exhaustion) stage of the test). Alternative sub-maximal exercise testing (or  $\dot{V}O_{2\text{peak}}$ ) is preferable for some people – the selection of maximal or peak testing depends on individuals' choices, the individual state of health (Noonan & Dean, 2000:783), and the purpose of the CRF test. The relative  $\dot{V}O_{2\text{peak}}$  measurement has been found to be valid and reliable measured directly or indirectly (Jaguaribe de Lima *et al.*, 2005:159e).

#### **2.5.1.1 Direct $\dot{V}O_2$ measurements**

Direct (maximal) measurement of the body's maximal oxygen consumption during an increase in exercise to exhaustion is considered the gold standard for cardiorespiratory fitness testing. The relative  $\dot{V}O_{2\max}$  result is an important marker of both health and performance (Langeskov-Christensen *et al.*, 2014:79; Noonan & Dean, 2000:783). There are four main assumptions that can be made in relative  $\dot{V}O_{2\max}$  predictions:

- 1) Linearity of the heart rate-oxygen consumption (exercise intensity) relationship.
- 2) Similar maximum heart rates for all subjects.

- 3) Assumed constant economy or mechanical efficiency.
- 4) Day-to-day variation in heart rate (How-To Predict  $\dot{V}O_{2\max}$  using a Walking Test, 2005:1).

Maximum oxygen consumption is measured directly by respiratory gas exchange [oxygen (O<sub>2</sub>) uptake by body vs carbon dioxide (CO<sub>2</sub>) exhaled by body] measurements during an increase in exercise intensity (Langeskov-Christensen *et al.*, 2014:79). Direct relative  $\dot{V}O_{2\max}$  fitness testing requires highly specialised equipment, and highly trained individuals to perform the tests, which are more time consuming since a longer period of time is needed to achieve maximal exhaustion compared to field testing. (Noonan & Dean, 2000:783).

### 2.5.1.2 Indirect $\dot{V}O_2$ measurements

Due to expensive requirements for determining direct cardiorespiratory fitness by means of relative  $\dot{V}O_{2\max}$ , the indirect measure of relative  $\dot{V}O_{2\text{peak}}$  (also known as the field test) can be used (Noonan & Dean, 2000:783). This gives a researcher an opportunity to assess many people at once with a much lower cost (Jaguaribe de Lima *et al.*, 2005:159e). The main goal of indirect fitness testing is to estimate participants' relative  $\dot{V}O_{2\max}$  by the verification of heart rate response based on the amount of work to be done during the test (Janot, 2004:1). It was assumed that:

- 1) a firm condition of heart rate should be attained for the amount of work to be done during the test,
- 2) there must be an association between the number of heartbeats per unit of time and the rate at which work is done,
- 3) the heart rate maximum for a particular age must be the same, and
- 4) effective measure of relative  $\dot{V}O_{2\max}$  at a particular level of work done must be the same for everyone.

Furthermore, the acceptance of relative  $\dot{V}O_{2\max}$  assessed using indirect or field method based on this postulation is a logical assessment of fitness status for many participants (Janot, 2004:1).

### 2.5.1.3 Field test

The field test (regarded as the indirect measurement of relative  $\dot{V}O_{2\max}$ ) was designed to emulate the direct measurement (Jaguaribe de Lima *et al.*, 2005:159e). However, research shows that some of the field test measurements are fairly accurate and can be compared to the gold standard. Jaguaribe de Lima *et al.* (2005:159e) verified the correlation between the direct and indirect relative  $\dot{V}O_{2\max}$  measurement tests in 13 indoor soccer players aged  $18.6 \pm 1.9$  years. For the direct relative  $\dot{V}O_{2\max}$  measurement, the computerized ergo-Spirometric system was used (VO- 2000, Aerosport, Medgraphics, St. Paul, Minnesota), and for the indirect  $\dot{V}O_{2\max}$  measurement, the 3,200 m field test was performed. The relative  $\dot{V}O_{2\max}$  values obtained in the direct measurement test ( $62.8 \pm 10.1$  ml/kg/min) showed no significant differences in relation to the indirect measurement ( $58.5 \pm 8.5$  ml/kg/min). When the relative  $\dot{V}O_{2\max}$  values obtained in both tests were correlated, a strong correlation of  $r = 0.72$  was observed. Although there are a variety of field tests available for CRF testing, the level of motivation will influence the true value determined. Familiar field tests that have been validated against the criterion-test are the Cooper 12-minute run test (Penry, 2008:1), the 6-minute walk test (American College of Rheumatology, 2015), the Chester step test (Buckely *et al.*, 2004), the multi-stage step test (Watkins, 1984:84), the Harvard step test (Sekeljic *et al.*, 2012:183), and the Queens College step test (McArdle *et al.*, 1972). Many of these field tests could be suitable for assessing many participants simultaneously with simplified methodologies.

#### 2.5.1.3.1 Cooper 12-minute run

The Cooper 12-minute run is a popular maximal running test of aerobic fitness, in which participants try to cover as much distance as they can in 12 minutes. The test calculates the CRF by means of the distance covered within a 12-minute run on a four-hundred metre track. The test was developed by Dr Ken Cooper in 1968, and was used for the estimation of relative  $\dot{V}O_{2\max}$  of military personnel of which he later found that there was a high correlation between a person's  $\dot{V}O_{2\max}$  value and the distance they can run or walk (FITDAY, 2013). This test can be administered to unfit individuals. There are Cooper test norm tables for general guidelines for which the results can be interpreted. There are also several equations that can be used to estimate  $\dot{V}O_{2\max}$  (in ml/kg/min) from the distance score

(FITDAY, 2013). The validity of this test was reported to have a correlation of 0.90 between  $\dot{V}O_{2\max}$  and the distance covered in a 12-minute walk/run of which its reliability depends on practice, pacing strategies and motivation level (Wood, 2008:1). In the study of Penry (2008:1) who examines the validity and reliability evidence of two field tests of aerobic fitness of Cooper's 12-minute run (12MR) and the multistage shuttle run (MSR) among sixty healthy adult participants in Oregon with mean age of  $21.8 \pm 3.6$  years found a high reliability coefficient ( $\phi = 0.96$ ), with the largest amount of systematic error variance (4.3%) attributable to an interaction between participants and test occasions. Therefore, test administrators must be cautious when attempting to use field test data to predict criterion relative  $\dot{V}O_{2\max}$  scores.

#### 2.5.1.3.2 Six-Minute walk distance test

The 6-minute walk test (6MWT) is a useful and simple test where no exercise equipment or advanced training is required for healthcare practitioners who intend to use it, only a 100-ft passage (American Thoracic Society Statement, 2002:111). This test measures the distance that a subject can quickly walk on a flat, hard surface in a period of 6 minutes. According to the American College of Rheumatology (2015), the main purpose of the 6MWT was to test exercise tolerance in chronic-respiratory disease and heart failure, or the submaximal level of functional capacity. The test has since been used as a performance-based measure of functional exercise capacity in other populations including healthy older adults, people undergoing knee or hip arthroplasty, fibromyalgia, and scleroderma. It has also been used in children. A short 6-minute walk distance (6MWD) fairly accurately predicts morbidity and mortality from heart or lung disease.

The 6MWT was developed in frail elderly patients 60-90 years of age, and also targets community-dwelling frail elders (American College of Rheumatology, 2015). The test has also been used in a variety of chronic disease adult and paediatric populations as well as healthy populations. The test-retest reliability of 6MWT has been reported as high, with an ICC of 0.90 at baseline, 0.88 at 18 weeks, and 0.91 at 43 weeks in a cohort of patients with heart failure. An ICC of 0.80 (95% CI=0.69-0.87) was reported after a year in a group of patients with congestive heart failure (CHF) and associated co-morbidities including diabetes and hypertension. An ICC of 0.73 to 0.98 has been reported in individuals with fibromyalgia following a timeframe of 10 days or four weeks in two independent studies (American

College of Rheumatology, 2015). Furthermore, the content validity for patients with severe heart failure and pacemakers has been found, in addition to moderate to high relationships reported ( $r=0.56$  to  $r=0.88$ ) between the 6MWT distance and peak  $\dot{V}O_{2\max}$  obtained by maximal exercise testing in persons with heart failure. In Rikli and Jones' study (1998:363) which assessed the reliability and validity of 6MWT as a measure of physical endurance, 77 older adults aged 60-87 performed three separate 6MWT and a treadmill test, as well as completed a questionnaire which assessed PA and functional status. A good test-retest reliability of  $0.88 < r < 0.94$  was revealed when a practice trial preceded the test trial with a moderate correlation of  $0.71 < r < 0.82$  for convergent validity on a treadmill performance. Riley *et al.* (1992:789) stated that in certain sub-populations, the 6MWT sub-maximal test shows a moderate high relationship with those of maximal exercise tests.

#### 2.5.1.3.3 Step tests

There are several protocols for graded step tests for the assessment of CRF (Chatterjee *et al.*, 2013:10 & Takayama *et al.*, 2012:200). The graded step tests, such as the multi-stage step test (Watkins, 1984:84), Single stage test (Sekeljic *et al.*, 2012:183) and Queens College step test (McArdle *et al.*, 1972) are all based on a fixed step box height with an increase in the step rate as the principle of increasing intensity of the test. For the indirect determination of the relative  $\dot{V}O_{2\max}$ , the heart rate during stepping and recovering is applied to calculate the indirect relative  $\dot{V}O_{2\max}$  values.

Chatterjee *et al.* (2013:10) determined the effect of step height on cardiorespiratory responses during aerobic step tests in young women aged between 18-24 years in Indian. The aim was to safely develop and maintain CRF at a cadence of 120 beats per minute. Eight physically fit and active female university students with mean age of  $19.7 (\pm 2.3)$  years, height  $156.2 (\pm 6.5)$  cm, weight  $51.2 (\pm 7.9)$  kg, and  $\dot{V}O_{2\max}$   $35.7 (\pm 4.8)$  ml.min<sup>-1</sup>.kg<sup>-1</sup> participated in the study. Each subject performed 30 minutes of step test in two Reebok steps heights (6 inch and 8 inches) with a rhythm of 120 beats.min<sup>-1</sup>. At this cadence 30 cycles of stepping up and down were completed in 1 min. Relative work load ( $\% \dot{V}O_{2\max}$ ), energy expenditure (EE), Heart rate (HR), percentage of age predicted maximum HR were measured using K4b2 Cosmed system. The results shows that aerobic stepping based on cadence is a useful exercise mode to develop, improve and maintain CRF.

The graded 8-minute step test is also based on cadence and is determined by a device that can report an indirect measurement of CRF in terms of relative  $\dot{V}O_{2\max}$  and by recording the heart rate during the test. During the measurement of the  $\dot{V}O_{2\max}$ , a polar heart rate monitor can be worn to determine the heart rate maximum of the participants. Further, unless a measured heart rate maximum has been determined for participants manually, the Tanaka equation can be applied by default to calculate the maximum heart rate. This is considered so as to minimize the degree of error. The 8-minute graded step test records the heart rate during the entire test as well as a two-minute post-test rest period of which the participant is seated with a heart rate monitor (i.e. ActiHeart) fitted directly, allowing for an improved calculation of indirect relative  $\dot{V}O_{2\max}$ . The 8-minute test can be performed by stepping at a starting speed of 15-step cycles (1 step cycle is “up-up, down-down”) per minute, to 33 step cycles per minute at the end of the test. The stepping speed during the testing is dictated by a drum beat or voice command (ActiHeart User Manual, 2010). Furthermore, the drum beat or the command voice is in two forms for which the participants can choose either to perform the stepping with a metronome or music beat. The ActiHeart<sup>®</sup> device has been demonstrated to be technically reliable and valid (ActiHeart User Manual, 2010).

Brage *et al.* (2005) examined aspects of ActiHeart<sup>®</sup> (CamNTEch, UK) reliability and validity in mechanical settings and during walking and running in eight ActiHeart<sup>®</sup> units. Technical reliability (coefficients of variation, CV) and validity for movement were assessed with sinusoid accelerations (0.1–20m/s<sup>2</sup>), and for HR by simulated R-wave impulses (25-250 beats per minute). Agreement between the ActiHeart<sup>®</sup> and electrocardiograph (ECG) was determined during rest and treadmill locomotion (3.2-12.1 km/h). Walking and running intensity (in J/min/kg) was assessed with indirect calorimetry in 11 men and nine women aged between 26-50 years with a BMI ranging from 20-29 kg/m<sup>2</sup>) and modelled from movement, HR, and movement plus HR, by multiple linear regression, adjusting for sex. The results revealed that the median intra-instrument variation coefficient for movement was 0.5 and heart rate was 0.03%. Furthermore, a corresponding inter-instrument variation coefficient of 5.7 for movement, and 0.03% for heart rate, with some evidence of heteroscedasticity for movement were found. A strong linear correlation ( $r = 0.99$ ,  $p < 0.001$ ) between movement and acceleration was found. Also, within one beat per minute (bpm) from 30-250 bpm, a

simulated *R*-wave was discovered, while 95% limits of agreement between ActiHeart<sup>®</sup> and ECG were 4.2-4.3 beats per minute (bpm). A high correlation ( $r > 0.84$ ,  $P < 0.001$ ) was found with the intensity significantly higher when combining HR and movement (Brage *et al.*, 2005). Therefore, the ActiHeart<sup>®</sup>, as a combined heart rate and movement sensor is a reliable instrument to assess aerobic capacity by determining the relative  $\dot{V}O_{2\max}$  of individuals. In addition, despite the range of step heights provided, it is important to note that the step test of combined heart rate and accelerometry has only been validated for a height of 215 mm. Consistent aerobic capacity assessment using the graded 8-minute testing can optimise individual's performance. Appraising exercise functioning competence is vital in determining the fitness level of an individual and for that reason CRF could be accomplished either by stepping, cycling or running (Watkins, 1984:84). Sub-maximal step tests are frequently used for the assessment of exercise working capacity (de Andrade *et al.*, 2012:116) because they can be administered to a large group of people (Watkins, 1984:84). Furthermore, step tests do not require expensive apparatus or exceptionally capable persons (Heyward, 2006:84). Therefore, it seems that a higher level of encouragement is required during the assessment in order to ensure a reliable and appropriate measurement. In addition, orthopaedic limitations or impairments are also considered to be a major setback for individuals' cardiorespiratory fitness performance using step test.

The use of a consistent test to assess the level of CRF is a necessity (Watkins, 1984:84). The rate at which work is done in a step test is based on the result of the step height and the level of step rate, while the overall work done is based on the amount and period of time taken. Furthermore, performance measures could be based on heart rate assessment during step tests to determine aerobic capacity (Watkins, 1984:85). This type of performance necessitates high-priced apparatus and cannot be administered to large numbers of people simultaneously. Step tests which are suitable for large number of participants entail the assessment of heart rate during the recovery phase by counting the number of beats per minute (Watkins, 1984:85). One of the step test tools that can be used for a large group of participants to determine CRF, is a graded 8-minute step test which has a built-in function of the combined heart rate and accelerometry device (ActiHeart<sup>®</sup>) for estimating relative  $\dot{V}O_{2\max}$ .

### **2.5.2 Optimising performance during cardiorespiratory fitness testing**

There have been very few literature reviews examining the optimal circumstances for optimal performance during CRF testing. Viru *et al.* (2009:22) explored the mechanism by which exercise performance can be increased in the competitive condition. In his study, he found that the motivation received by the athlete can enhance performance in exercise and lead to an increased peak oxygen uptake (Virus *et al.*, 2009:22). Furthermore, competitive conditions also raise the cortisol response to exercise, proposing that magnification of sympatho-adrenal system activation occurs in such situations, which could be a motivating influence behind performance improvement (Virus *et al.*, 2009:22).

Plonczynski (2000:695) stated that motivation is at the core of health behaviour performance and key to health promotion effort of physical activity. Optimising motivation and performance during CRF testing is important to obtain reliable relative  $\dot{V}O_2$  max measurements. Most of the indirect relative  $\dot{V}O_2$  tests are accompanied by a metronome in order to ensure repeatability of the test pace. The metronome is a tool that produces a synchronized easy sound, usually used to create a fixed beat or tempo which can be calculated in beats per minute for the performance of musical contexts (Fitnessforworld, n.d.). The purpose of the metronome is to regulate accurate stepping speed. Stepping to a metronome may be considered monotonous in some cultures, leading to termination of the step test prior to fatigue. An alternative to a metronome is the accompaniment of music. When music is used in place of the metronome during graded fitness testing, it is always at the same standardised speed, beat, and timing as the metronome.

Lin and Lu (2013:388) stated that music as accompaniment during exercise intervention is quite simple and convenient. Groups that listened to music spent more time exercising than those that did not (Lin & Lu, 2013:388). Spending more time exercising could depend on different experimental designs which are based on the manipulation of the intensity, continuity, rhythm, motivational qualities and music compilation. In addition, music has a positive influence on strength, endurance, technique, heart rate (HR), and rating of perceived exertion (RPE) (Lin & Lu, 2013:388).

A study by Lin and Lu (2013:388) investigating the effect of using different types of media on motor fitness and perceived exertion was divided into two parts. The second part of the study examined how music preference influenced physical performance for which the Brunel

Music Rating Inventory (BMRI) was used. Running tasks were used where the participants were asked to run as hard as possible. Large samples were recruited (75 university students) and were assigned into five groups (high preference and high motivation, high preference and low motivation, low preference and low motivation, low preference and high motivation, and control). It was found that music preference, but not its motivational quality, had a significant positive effect on motor fitness. In total, the results showed an increased motor fitness and reduced perceived exertion in American university level students when listening to music, and in particular preferred music.

Savita *et al.* (2013:167) investigated the effect of vocal and instrumental music on various physiological parameters during sub-maximal exercise in 46 male healthy adult volunteers, aged 18-25 years. Each participant underwent three sessions of exercise procedure; without music, with vocal music, and with instrumental versions of same piece of music. The study procedure consisted of 10 minutes of treadmill exercise at 70% HRmax and 20 minutes of recovery. Minute-to-minute heart rate and breath-by-breath recording of respiratory variables, rate of energy expenditure and perceived exertion levels were measured. The results showed significantly that the participants exercised at lower heart rate and oxygen consumption, reduced metabolic cost, and perceived exertion level with music compared to no music at the same intensity of exercise. Savitha and colleagues then stated that the result of this study could be due to relaxant effect of music (Savitha *et al.*, 2013:167). Therefore, music accompaniment during exercise training may prevent an individual from meeting the targeted heart rate maximum and cause a lower CRF test performance.

Many factors that influence motivation to exercise have been proposed, including satisfaction (Hardy & Rejeski, 1989:308), self-efficacy (McAuley & Courneya, 1993), and social influence (Carron *et al.*, 1996:7). One major area that is not well-researched is group exercise (Irwin *et al.*, 2012:151), most especially when testing aerobic fitness in adults. Group exercise programmes have supported higher exercise adherence compared to programmes based on individual participation (Annesi, 1999:542) to gain a reasonable level of CRF. Field tests are mostly conducted in groups, while step tests, in particular the 8-minute graded step test, are performed on an individual basis. Individual and group CRF testing may both result in optimal performance during testing; one protocol may be more acceptable in certain cultures than others, making it more appropriate for application in research. However, people who lack self-confidence, materials, equipment and time might not be willing to participate in

group exercise programmes (Bain *et al.*, 1989) hence a lower completion of CRF testing will be observed.

Irwin *et al.* (2012:158) stated that working as a group compared to working individually both motivates and influences performance. Working together as a group under normal conditions can boost task motivation. Furthermore, the individual with low working capacity in a group tends to be more inspired when working together with a moderately more capable colleague, especially when the group's final level of performance depends primarily upon the feeble members. Motivation could come about in two ways: either a striving to meet up or to surpass the performance of others. This could be achieved through a social comparison process and a propensity to work harder based on one's own level of fitness (Irwin *et al.*, 2012:151).

In a study that examined the Kohler motivation gain effect in a health game using an absent partner, presented virtually to 181 healthy young university adults, it was revealed that exercising with a partner can increase individual performance by 24% compared to individual exercise (Feltz *et al.*, 2011:506). Considering the positive effect of a vocal music beat during cardiorespiratory fitness training, no peer-reviewed published data for South African adults was found in order to better understand if these international (and mostly Western) community-based findings hold true in the South African context. Personal observations during CRF testing with field tests have indicated that adults from low-resourced communities are either not motivated to complete the graded step tests for CRF, or the level of fitness is truly so low that there is a lack of aerobic capacity to complete the CRF testing protocols.

### **2.5.3 Consequences of low cardiorespiratory fitness**

Low cardiorespiratory fitness is associated with various detrimental health conditions and is prominent in all scientific studies. In a study by LaMonte *et al.* (2000:1628), it was shown that CRF can be significantly influenced by coronary heart disease (CHD) risk factors free of age, percent body fat, and family history in spite of CHD status, in persons with a low-risk. These findings hold up community health advice for improved PA and CRF to prevent (or decrease) the morbidity and death rates connected with CHD. This elucidates understanding that risk factors linked with NCDs can easily manipulate the CRF status in adults. According to the findings of Loprinzi and Pariser (2013:32), the majority of adults with diabetes report

fairly low cardiorespiratory fitness. Physical activity levels and body mass status may influence cardiorespiratory fitness among people. Furthermore, authorities in the field should be advised to integrate structured physical activity treatment strategies into their practice to assist patients with diabetes improve glycaemic control cardiorespiratory fitness (Loprinzi & Pariser, 2013:32).

#### **2.5.4 Relationship between cardiorespiratory fitness and risk factors for non-communicable diseases**

The relationship between CRF and non-communicable risk factors cannot be underestimated. Non-communicable disease is a chronic condition that does not result from an (acute) infectious process and hence is “not communicable”, while risk factors are seen as an aspect of personal behaviour or lifestyle, an environmental exposure, or a hereditary characteristic that is associated with an increase in the occurrence of a particular disease, injury, or other health condition (CDC, 2013). Non-communicable risk factors can be categorised into two main parts: the first known as non-modifiable risk factors i.e. a risk factor that cannot be reduced or controlled by intervention, such as age, gender, race and family history (genetics) (CDC, 2013); and the second regarded as a modifiable risk factor i.e. a behavioural risk factor that can be reduced or controlled by intervention, thereby reducing the probability of disease caused by physical inactivity, tobacco use, alcohol use, and unhealthy diets (increased fat and sodium, with low fruit and vegetable intake).

##### **2.5.4.1 *Cardiorespiratory fitness and age***

The relationship between CRF and age has been established, in that CRF diminishes as age increases (Yazdanyar, 2011:26). Furthermore, the ability to participate in aerobic exercise reduces as one ages (Betik & Hepple, 2008:130). The reduction in CRF is also associated with a reduction in the higher levels of oxygen usage (Betik & Hepple, 2008:130). Cardiorespiratory fitness starts to reduce by at least 10% in the 10 years after the age of 30 in those who are not active, and 5% in 10 years in those who are active (Lovett, 2009:1). This is mostly worrying for individuals who engage in sports that require high levels of endurance although it may lessen by semi-disparity to the noticeable point in inactive persons determined by relative  $\dot{V}O_{2\max}$  (Anderson, 2014). Maximum oxygen consumption is a direct estimate of the total capacity of the heart as an oxygen drive and muscle fibre capability to use oxygen to transport it through the organ system that encompasses the heart and blood

vessels of the body (Anderson, 2014). The higher the  $\dot{V}O_{2\max}$ , the higher the level to uphold a long term aerobic activity (Anderson, 2014).

#### **2.5.4.2 Cardiorespiratory fitness and gender**

Gender is seen as another major factor that has been proven to be associated with CRF. Santos *et al.* (2011:243) investigated the effects of age, gender, body adiposity, and ethnicity on cardiorespiratory fitness in 266 [112 boys (80 Caucasians and 32 African-Portuguese, AP) and 154 girls (109 Caucasians and 45 AP)] sample of Portuguese adolescents aged 12-18 years and found that girls had lower relative  $\dot{V}O_{2\max}$  than boys. Lee *et al.* (2010:27) stated that women have approximately 2 METs lower CRF capacity than men, and the lower CRF capacity in women was attributed to their smaller muscle mass, lower haemoglobin and blood volume, and smaller stroke volume compared to men. Furthermore, the estimated mean CRF level for men and women aged 20-49 years was 12 and 10 METs respectively (Lee *et al.*, 2010:27). This finding indicates that gender differences may influence CRF levels.

#### **2.5.4.3 Cardiorespiratory fitness and genetic or hereditary**

Hereditary or genetic factors may also contribute to individual variations in CRF level (Lee *et al.*, 2010:27). The most common famous outcomes on the role of genotype in CRF were derived from the Heritability family study conducted on more than 700 healthy but sedentary men and women (Lee *et al.*, 2010:27) on which 20 weeks of exercise training was performed. After 20 weeks of exercise training, the mean CRF increased approximately 15-18% in all four sex and generation groups comprised of fathers, mothers, sons, and daughters. Furthermore, although limited data exists on the role of specific genes on CRF, family and genetic factors clearly contribute to CRF (Lee *et al.*, 2010:27). In addition, hereditary factor levels of effect on relative  $VO_{2\max}$  account for 25-40% of aerobic fitness (Yazdanyar, 2011:26).

#### **2.5.4.4 Cardiorespiratory fitness and physical inactivity**

Physical inactivity is a major determining factor of low CRF. Evidence from randomized controlled trials demonstrates a dose-response relationship between physical activity and improvement in CRF, proposing that an increase in the amount of physical activity seems to have extra effects on CRF (Lee *et al.*, 2010:27). Consequently, moderate intensity PA at 40-

55% of peak  $\dot{V}O_2$  is adequate to increase aerobic capacity (Lee *et al.*, 2010:27). Wang *et al.* (2010:426) stated that obese individuals may have approximately 10–15% lower CRF than non-obese individuals. But by participating in regular physical activity, an individual can maintain a normal weight, and if not smoking, this is related to significantly higher levels of CRF across adults' life span in both men and women (Lee *et al.*, 2010:27). Moderate to high levels of CRF and improvement in CRF are associated with a lower risk of mortality from all-causes, and CVD in both men and women regardless of age, smoking status, tobacco use, body composition and other risk factors (Lee *et al.*, 2010:27). Other risk factors, such as the state of medical conditions related to respiratory, cardiovascular, or skeletal muscle function can also have an influence on CRF (Lee *et al.*, 2010:27). Data from several studies show that the average METs in individuals with CVD, diabetes, or hypertension are roughly 10-25% lower than for relatively healthy individuals (Wang *et al.*, 2010:426; Gulati *et al.*, 2005:468 & Myers *et al.*, 2002:792). Risk factors such as hypertension, hypercholesterolemia, and low HDL-cholesterol levels were more predominant among adults with low CRF compared with individuals with moderate or high CRF (Lee *et al.*, 2010:27).

### **2.5.5 Health effect of improved cardiorespiratory fitness**

A pilot study of the feasibility and benefits of a 24-week step test and home-based exercise intervention that was conducted in Canada revealed that home-based exercise interventions, coupled with cognitive behavioural intervention therapy sessions, indicate significant improvements in relative  $\dot{V}O_2$  peak from baseline to six months. Furthermore, the patient HRQoL factors improved from baseline to six months ( $F(2, 14) = 6.905$ ,  $p = 0.008$ , partial  $\eta^2 = 0.497$ ). This pilot study provided evidence that a home-based exercise intervention focusing on improving CRF is possible, beneficial, feasible and effective (Moonsammy *et al.*, 2013:8) in reducing the menace of cardiovascular diseases and improving quality of life.

In a study that reported CRF levels among adults with diabetes and differences by demographic and behavioural (e.g. physical activity) variables, data was analysed from the 1999-2004 National Health and Nutrition Examination Survey (NHANES). The study shows that the majority (55.1%) of participants had low or moderate CRF. It was shown that normal weight individuals had greater CRF than obese individuals. The participants who sat during the day and did not walk enough had lower CRF (mean = 26.1 ml/kg/min [95% CI: 18.9-33.4]) than those doing heavy work or carrying heavy loads (mean = 34.6 ml/ kg/min [95%

CI: 30.2-39.1]). The study suggested that obese and inactive adults with diabetes may be at increased risk for morbidities and mortality associated with low CRF (Loprinzi & Pariser, 2013:32). The lower the CRF, the lower the health-related quality of life and could lead to an increased risk of death in adults. The level of CRF is therefore directly related to the level at which quality of life is perceived and experienced.

## **2.6 Quality of life**

The concept of quality of life broadly encompasses how an individual assesses the ‘goodness’ of multiple aspects of their life (Theophilou, 2013:150). These evaluations include one’s emotional reactions to life occurrences, disposition, sense of life fulfilment and satisfaction, and satisfaction with work and personal relationships (Theophilou, 2013:150). In the literature, the term ‘quality of life’ is also often regarded to as ‘well-being’ and the two terms can therefore be used interchangeably. Quality of life could also be specifically related to how a person views their health within a framework of well-being and ailments (Healthy People 2020, 2010:1). Health-related quality of life is a phenomenon which is affiliated to physical and psycho-social functioning (Healthy People 2020, 2010:1). Similarly, a health-related quality of life assessment includes either positive or negative facets of one’s life, such as feelings and fulfilment in life (Healthy People 2020, 2010:1).

### **2.6.1 Health-related quality of life in adults**

The alarming increase in the need for governments to provide high class and all-inclusive care for adults for an ageing population, combined with a lack of healthcare givers, has led to substantial increases in healthcare expenditure (Ploeg *et al.*, 2010:1). These modifications call for the improvement and appraisal of realistic and cost-efficient advances in healthcare for adults (Ploeg *et al.*, 2010:1). The major objective of healthcare providers is to preserve and improve the QoL of people (Chen *et al.*, 2005:936). Factors such as customs, belief, background, education, and economy can also influence how persons perceive QoL and are generally not catered for within the scope of healthcare in adults (Chen *et al.*, 2005:936). Chen *et al.* (2005:936) stated that HRQoL is the main concern of healthcare professionals and has turned out to be the main marker of health outcome, due to the increasing number of people living with chronic diseases and disability (Chen *et al.*, 2005:936). Furthermore, the change in populations’ morbidity pattern has called for other procedures to be introduced to assess illness outcomes (Chen *et al.*, 2005:936).

### ***2.6.2 Effect of exercise on health-related quality of life in adults***

Substantial evidence has been reported on the effect of regular physical activity or exercise on the lowering of risk factors for NCDs and also the improvement of health outcomes (Stiggelbout *et al.*, 2004). Understanding of the effect of exercise on HRQoL in adults, the role of exercise as a low-cost intervention to improve QoL, could be implemented in general healthcare practice. In order to understand the influence of exercise on HRQoL, research papers from randomised controlled trials conducted in the developed (America, Europe and Australia) countries were searched from 2004-2015 using the search terms health-related quality of life, adults, exercise, physical activity, and NCDs. There is limited information on the influence of physical activity/exercise on HRQoL. From the limited research published, a positive influence exists between regular exercise and health-related quality of life in adults. In addition, the drop-out rate from the exercise intervention on HRQoL was also considered. The most relevant published studies are summarised in Table 2.1.

**Table 2.1: A summary of randomised control trial (RCT) studies on the influence of physical exercise interventions on cardiorespiratory fitness and health-related quality of life in adults**

Study	Number of participants/ country	Age in years	Instruments/ number of groups/types of exercise intervention	Main finding	Dropped out
Stiggelbout <i>et al.</i> (2004)	386 community-dwelling healthy Dutch older adults in The Netherlands	65-80 years	Fitness level was determined using the Groningen Fitness test for the Elderly, PAR-Q. Three instruments were used to measure HRQoL, namely, the Vitality Plus Scale (VPS11), the RAND-36 and the TNO Leiden Academic Hospital Adult Quality of Life questionnaire (TAAQOL). Interview was conducted. Physical activity was assessed using a questionnaire that asked questions on household activities, sports activities, and leisure time activities. Three groups: two intervention groups (once a week =125 and twice a week=58) and one control group=193. The intervention is a group based exercise. Programmes known as Gymnastic which consist of aerobic exercise based on intensity and duration. Each exercise session lasted for 45 minutes and consisted of three stages: 5 minutes warm up, 35 minutes of light aerobic exercises (mainly muscle-strengthening exercise and exercises that improve coordination), followed by a 5 minute cool down period. The control group only received a health education programme.	Gymnastics once a week did not provide benefits in HRQoL and functional status after 10 weeks. Meanwhile, adults with a low level of PA may improve their HRQoL if they participate twice a week. It was suggested that to improve the health of the general public, sedentary older adults should be recruited and encouraged to combine More Exercise for Seniors (MBvO) with health-enhancing physical activity guidelines.	28.2 %

Brox & Froystein (2005)	129 employees in a community-based nursing home for the elderly in Norway	Mean age: 42.5 years	The UKK (Urhu Kaleva Kekkonen) 2-km walking test was used to determine cardiorespiratory test and questionnaire. Sickness absence data was collected from the community insurance register. The Co-operation-World Organization of Colleges Academics (COOP/WONCA) chart was used to evaluate health-related quality of life. Two groups: one intervention=65 and one control group=64. A work place intervention which consisted of once a week light group aerobic exercise, and a muscle strengthening and stretching Programme lasting for 1 hour was held for a 6-month period.	The finding shows that no differences between groups were found for aerobic fitness, health-related quality of life, or sickness absence when compared between the two groups. The intervention neither improved health-related quality of life nor reduced sickness absence	7.75 %
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Thorsen <i>et al.</i> , (2005)	111 young and middle-aged cancer patients shortly after curative chemotherapy in Norway	18-50 years	Supervised home-based flexible training Programme where CRF was measured by the Åstrand-Rhyming indirect test for maximal oxygen uptake (VO <sub>2</sub> max). The test was performed on a bicycle ergometer, with a pedalling frequency at 50 rpm. Borg scale to rate perceived exertion from 6-20 was used. A heart-rate recorder was also used. Mental distress was assessed by the Hospital Anxiety and Depression Scale. The assessment of HRQoL was performed by using the European Organisation for Research and Treatment of Cancer Core Quality of Life Questionnaire C30. Two groups (one intervention=59 and one control= 52 group). Fourteen weeks aerobic exercise intervention with a minimum of two exercise sessions per week of at least 30 minutes was used. The exercise intensity at 60-70% of maximal heart rate was established (220 beats per minute [bpm] -age).	A supervised, home-based, flexible training Programme had a significant effect on CRF in young and middle-aged cancer patients shortly after curative chemotherapy, but no favourable effect on patients' experience of fatigue, mental distress, or HRQoL.	16.2 %
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Fox <i>et al.</i> (2007)	176 healthy adults in UK, Italy and France	70 and over	Accelerometer (7-day period). WHOQoL-BREF, Satisfaction with Life Scale (SWSL), General Well-Being Schedule (GWB), Ageing Well Profile (AWP) & short clinical version of the Physical Self-Perception Profile (CPSPP). Interview on the perceived benefits and costs of taking part in the intervention to determine dropout rate and adherence was used. Two groups: one intervention (n=112) and one control group (n = 64). A standardised exercise intervention programme was developed by King's College, London University and involved engagement in two group-training sessions and one home-based exercise session per week for a period of 12 months lasting between 60-90 minutes, which included warm up, aerobic exercise, machine-based strength training and Tai Chi and flexibility exercise.	The study suggested that there was a minor improvement in psychological features. Perceived functions and social benefits were also experienced by the participants.	25 %
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Imayama <i>et al.</i> (2011)	439 overweight / obese post-menopausal women in USA	50-57 years	Graded exercise treadmill test, Minnesota Leisure Time Physical Activity, Polar heart rate monitor, Medical Outcome Study form SF-36 questionnaire. Four groups: (1) dietary weight loss with a goal of 10% weight reduction (N = 118) only, (2) moderate-to-vigorous intensity aerobic exercise for 45 minutes per day, 5 days in a week (N = 117), (3) combined exercise and diet (N = 117), and control groups (N = 87). The exercise intervention heart rate maximum was set at 70% and increased to 85% over the first 8-week. The intervention period was 12 months.	The findings suggest that improvements in weight, aerobic fitness and psycho-social factors were mediated by the intervention effects on HRQoL	9.1 %
Nicolucci <i>et al.</i> (2012)	606 Type 2 diabetic patients in Italy	60 years	Health-related QoL was assessed by the 36-Item Short Form (SF-36) Health Survey. Two groups: exercise and counselling (n=303) group and counselling alone (control) group (303). Aerobic intervention was performed using treadmill, step, elliptical, arm or cycle ergometer. Structured individualised counselling for subjects from both groups was performed to achieve the currently recommended amount of PA by encouraging any type of commuting, occupational, home, and leisure-time PA 3 months each. Intervention programme for the exercise group consisted of 150 min/week, twice-a-week supervised sessions of progressive mixed (aerobic and resistance) training for 12 months.	The finding shows that with supervised exercise training, there were improvements in physical and mental health-related quality of life.	7.1 %

<p>Brovold <i>et al.</i> (2013)</p>	<p>115 community-dwelling older adults recently discharged from hospital in Norway</p>	<p>70-92 years</p>	<p>Medical Outcomes Study 36-item Short Form Survey for HRQoL. Cardiorespiratory fitness was measured using the Senior Fitness Test, and PA was assessed using the Physical Activity Scale for the Elderly. The study involved two groups: high intensity aerobic interval exercise consisting of endurance, strength, and balance exercises (HIA) n=59 and home based low intensity exercise and telephone follow-up (HB) n=56. Participants exercised twice a week at the hospital and were asked to exercise at least once a week at home for 60 minutes (5 minutes of warm-up, three intervals of high-intensity exercise, two intervals of moderate-intensity exercise, and a cool-down). Borg Scale (11-13 for moderate intensity and 15-17 for high intensity) and beats per minute of the music pace was used. For HB, 3 times per week home exercise such as sit-to-stand, walking on heels, walking on toes, standing on one leg, stair climbing, and walking was given and were called for encouragement every 4 weeks for continuity. The intervention period was 3 months.</p>	<p>High-intensity aerobic interval exercise (HIA) participants significantly improved their cardiorespiratory fitness. Both groups increased their HRQOL and PA. The findings suggest that exercise therapy should be incorporated as a part of the treatment for older people at risk for functional decline.</p>	<p>22.6 %</p>
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Hayes <i>et al.</i> (2013)	194 Women with breast cancer in Australia.	20-69 years	<p>Quality of life Functional Assessment of Cancer Therapy-Breast (FACT-B +4) questionnaire and battery of physical test was used. A disability of the Arm, Shoulder and Hand Questionnaire was used to assessed upper-body function and treatment-related symptoms. Functional Assessment of Chronic Illness Therapy Fatigue Subscale, Greene Climacteric Scale, and Neuropathic Pain Scale were also used. A metronome accompanied 3-min (6 inches) step test was used as a measure of aerobic fitness set at 96 beats per minute and upper-body strength and endurance was assessed using hand weights for 20 seconds with 10 repetitions. Lymphedema status was assessed by bio-impedance spectrophy (BIS). Anthropometry variables were also assessed. The participants were randomised into three groups: Face-to-Face (FtF) delivered exercise intervention group (n=67), Telephone-delivered (Tel) exercise intervention group (n=67), and Usual-Care (UC) group as control (n=60). Face-to-Face and over-the-Telephone 12-month exercise intervention. Four days per week for 45 min incorporating both aerobic and strength-based exercises (at least two days per week).</p>	It was reported that there were improvements in health-related quality of life, an increase in cardiorespiratory fitness and function, and a decline in fatigue of FtF delivered exercise intervention group.	7.2 %
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The main findings from the research reported in Table 2.1 suggest that the influence of physical activity on the cardiorespiratory fitness and health-related quality of life are effective in different settings, populations and period of exercise intervention. Further to this, the number of times per week the exercise takes place, the duration, the intensity, the mode of exercise, and whether the group are purposefully selected based on some reasons as seen in the study of Thorsen *et al.* (2005:2378) in Norway and Haye *et al* (2013:175) in Australia. The effect of the intervention may also be dependent on the HRQoL questionnaire that was used for reporting HRQoL. Meanwhile, all the studies reported in this table were conducted in developed countries with no RCT found for South African based studies.

The majority of the studies used the SF-36 QoL questionnaire, while other studies have used questionnaires such as the World Health Organization's Quality of Life (WHOQOL-BREF), Vitality Plus Scale (VPS11), TNO Leiden Academic Hospital Adult Quality of Life questionnaire (TAAQOL), Co-operation-World Organization of Colleges Academics (COOP/WONCA), European Organisation for Research and Treatment of Cancer Core Quality of Life Questionnaire C30, and Quality of life Functional Assessment of Cancer Therapy-Breast (FACT-B +4) questionnaire of which the questionnaire was either in generic (non-specific) or disease (specific) survey forms. There are other versions of valid and reliable short form surveys to measure health-related quality of life in adults which are time efficient, and which have a reduced number of items. Evident from the data presented is that none of the studies reported were from African countries or more specifically from South Africa, which could be due to the lack of intervention studies on CRF and health-related quality, most especially in adults.

The type of exercise intervention that was delivered in these studies was a supervised aerobic exercise intervention of which one of them was home-based. The results from the majority of the selected intervention studies conducted revealed that a supervised aerobic exercise intervention improves CRF and health-related quality of life in adults. Most of the effects of the exercise intervention were based on the number of times (frequency) per week the intervention was performed. For example, the study of Brox *et al.* (2005:558) where exercise interventions were performed once a week for one-hour, which lasted for 6 months (although, the intervention was a work place intervention) revealed no improvement in CRF, HRQoL and sickness absence. Meanwhile, Stiggelbout *et al.* (2004) in their study compared the effect of 45 minutes once per week and twice per week exercise intervention for 10 weeks on the

HRQoL and functional status of independently living people aged 65 to 80 years in the Netherlands, and found that aerobic exercise intervention once a week did not provide benefits in HRQoL and functional status after 10 weeks, but found improvements in adults who participated in the intervention twice per week. Based on these findings, it can be concluded that exercise performed once-a-week might not be effective, irrespective of the population involved, where the study was conducted, the duration, instrument used, or type of intervention.

Furthermore, the findings from other studies (Brovold *et al.*, 2013:1580; Haye *et al.*, 2013:175; Nicolucci *et al.*, 2012:579; Imayama *et al.* 2011:118; Fox *et al.*, 2007:591 & Stiggelbout *et al.*, 2004:83) revealed a significant improvement on the functional status and health-related quality of life with more than twice per week of exercise intervention. In the study of Thorsen *et al.* (2005:2378), no improvement was noticed in health-related quality of life. The only improvement that occurred was on CRF. The reason for no improvement in HRQoL could be that the participants in this particular study were purposefully selected, with full knowledge that they were cancer patients recruited shortly after curative chemotherapy for which their level of psychological functioning has improved (Thorsen *et al.*, 2005:2378). In addition, based on the findings, it is clear that the aerobic exercise intervention improved the main two domains (physical and mental) of health-related quality of life (Nicolucci *et al.*, 2012:579).

The findings from Table 2.1 show the range of the dropout rate from the intervention programme ranged between 7.1-28.2%. The study with the highest rate of dropout was that of Stiggelbout *et al.* (2004), followed by Fox *et al.* (2007:591) and Brovold *et al.* (2013:1580). In these three studies, it was found that the participants were very old adults with age ranging from 65-92 years old, thus the reason for the high rate of dropout might be due to lower aerobic capacity and HRQoL overall health and physical functioning (Brovold *et al.*, 2013:1580). Furthermore, the aerobic exercise intervention programme might have proved too challenging for them and thus they were unable to complete the programme (Brovold *et al.*, 2013:1580). In addition, results from this study suggest that a longer 12-month aerobic exercise intervention may reduce adherence and participation which would ultimately lead to dropout. However some of the other studies in Table 2.1 revealed relatively younger adults who are still very active, thus lowering the dropout rate compared to the older adults. The consensus finding from this table was that any exercise intervention with a frequency lower

than two times per week may not be sufficient for the improvement of aerobic capacity and health-related quality of life in adults. On the other hand, interventions carried out over a longer period of time may cause a higher dropout rate, most especially in older adults. The setting of the studies in highly developed countries with few barriers to PA, may explain the dropout rates of less than 30%. Dropout rates for South African based interventions were not available in published literature.

### **2.6.3 Measuring health-related life quality in adults**

The significance of measuring the status of one's HRQoL in medical examinations cannot be underestimated because, health-related quality of life is frequently used as a result of medical trials, efficiency of research, and making enquiries on quality of care (Wilson & Cleary, 1995:59). Three major features have been considered and this has led to the improved use of HRQoL assessments:

- (i) the evidence that HRQoL measurement is valid and reliable,
- (ii) numerous medical examinations' outcome, revealing that the outcomes are responsive to vital clinical change, and
- (iii) success in the use of a shorter instrument which is easier to understand and administer (Wilson & Cleary, 1995:59).

Health-related quality of life determinants describe or characterize what the patient has experienced as a result of medical care which is a useful and imperative complement to long-established physiological or genetic assessment of health status (Wilson & Cleary, 1995:59). Health-related quality of life symbolizes a biased appraisal of the impact of infirmity or its treatment. Individual patients with the same idea of health status can report a different HRQoL status due to unique differences in belief and coping abilities. Therefore, HRQoL must be measured from the individual's viewpoint rather than that of external reviewers (Peterman *et al.*, 2013:1). Peterman *et al.* (2013:1) stated that there is a variety of confirmed and dependable questionnaires available for assessment of HRQoL. This could be simply categorised into specific and non-specific type of instruments.

#### **2.6.3.1 Specific HRQoL measure instruments**

##### **2.6.3.1.1 Disease-specific instruments**

Disease-specific instruments are planned to assess the HRQoL of people with exact illnesses (e.g. cancer, diabetes), kind of treatment (e.g. chemotherapy, lung transplant) and symptoms

(e.g. nausea, urinary incontinence) (Peterman *et al.*, 2013:1). Compared to other types of instruments, these instruments provide a more complete appraisal in favour of exact ailment and are also expected to be more responsive due to precise treatment related to the sickness which brings about an improvement in HRQoL (Peterman *et al.*, 2013:1). The most commonly used disease-specific instruments include the following: the Diabetes Quality of Life instrument (DQoL), Functional Living Index - Cancer (FLIC), Brief Screening Questionnaire (BSQ), Comprehensive Assessment and Referral Evaluation (CARE), Elderly Assessment System (EASY) Care, Functional Assessment Inventory (FAI), Geriatric Postal Screening Questionnaire (GPSS), Geriatric Quality of Life Questionnaire (GQLQ), Geriatric Screening Questionnaire (GSQ), Iowa Self-Assessment Inventory (ISAI), Leiden-Padua questionnaire (LEIPAD), Older Americans Resource Study (OARS) Multidimensional Functional Assessment Questionnaire (OMFAQ), Perceived Well-being Scale (PWB), Philadelphia Geriatric Center Multilevel Assessment Instrument (PGCMAI), Quality of Life Cards (QLC), Quality of Life Profile - Seniors Version (QOLPSV), Quality of Life - Well-being Meaning and Value (QLWMV), Self-Evaluation of Life Function (SELF) Scale, SENOTS programme and battery, and The Wellness Index (WI) (Heywood *et al.*, 2010:1).

### **2.6.3.2 *Non-specific HRQoL measure instruments***

#### **2.6.3.2.1 *Generic health (non-specific) instruments***

Generic health (non-specific) instruments are designed to be applicable across a wide range of populations and treatments and to be able to capture data on a broad range of aspects of health status and disease consequences. Due to their broad range of content and more general applicability, these instruments have been used more frequently than disease-specific instruments to assess health status of non-hospital samples in the general population. The most used and common type of generic HRQoL questionnaires which have been mentioned in international literature are: the Medical Outcomes Study Short Form 36-item (SF-36) health survey, EuroQol Instrument (EQ-5D), TNO Leiden Academic Hospital Adult Quality of Life questionnaire (TAAQOL), WHOQoL, Assessment of Quality of Life Instrument (AQoL), COOP and WONCA/COOP charts, Functional Status Questionnaire (FSQ), Goteborg Quality of Life Instrument (GQL), Health Status Questionnaire 12 (HSQ-12), Index of Health-related Quality of Life (IHQL), Nottingham Health Profile (NHP), Quality of Life Index (QLI), Quality of Well-Being Scale (QWB), SF-12, SF-20, Sickness Impact Profile (SIP) and Spitzer Quality of Life Questionnaire (SQL) (Heywood *et al.*, 2010:1).

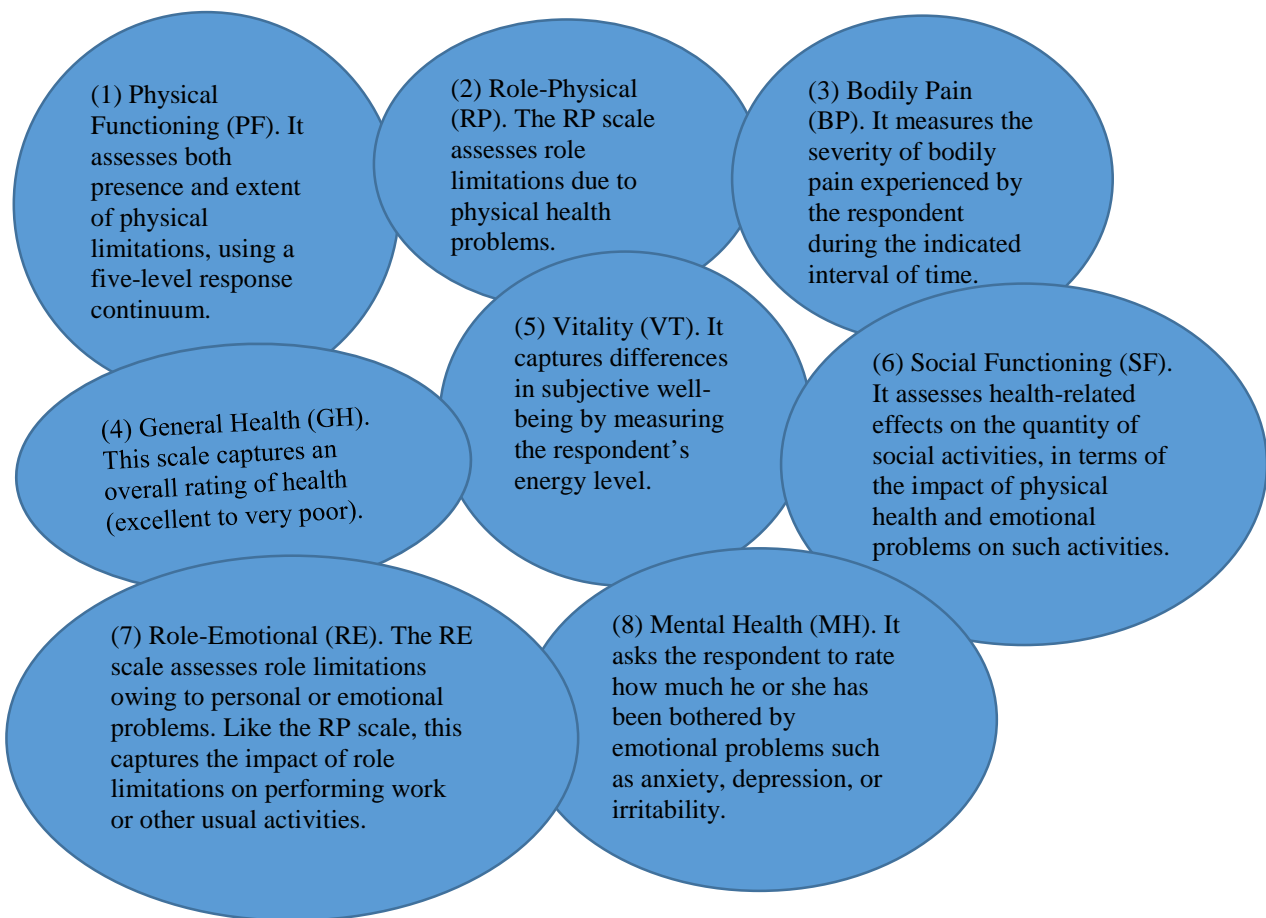
#### 2.6.3.2.2 *Short form-8 (non-specific) health survey*

The short form (SF-8™) health survey is a concise, non-specific, versatile survey of health status (Ware *et al.*, 2007). The measurement of eight health domains with a single item is seen as an improvement in the development of Short Form assessments. The SF-8™ health survey is the first to be assembled based on experimental studies that connect each of the comprehensive and widely used survey items certified to determine similar health concepts. Furthermore, the group of items in the questionnaire incorporated the questionnaire items that were established in the SF-36v2® Health Survey (Ware *et al.*, 2007) so the SF-8's single-item health domain scales and component summary measures can be scored on the same metric as the SF-36v2® and other Short Form survey scales and summary measures. Therefore, the SF-8™ makes available the acceptable, realistic instrument designed for openly connecting the standards of examining large populations with a purposeful outcome as well as monitoring effort in day-to-day clinical practice (Quality Metric, 2011).

It has been established that only one of the questionnaire items in SF-8 has similarity with the several pieces in the SF-36v2, despite the fact that the SF-8 items are not a direct subset of SF-36v2 items (Quality Metric, 2011). The positive advantage is that the SF-8, SF-36v2 and SF-12v2® health survey can be used to assess the same eight health fields (Ware *et al.*, 2010), although the SF-36v2 uses between 2-10 items to determine each health field, while the SF-8 uses just one item for each health domain, making it trouble-free to complete (Quality Metric, 2011). The two-component summary i.e. physical component summary (PCS) and mental component summary (MCS) can also be calculated from SF-8™ end results. The SF-8™ health survey instrument take into account the most excellent existing questions that can be used to assess each of the eight SF-36v2 health fields. Furthermore, the SF-8 short form has three diverse recall stages which are: 1-week, 4-week and 24-hour (Quality Metric, 2011).

The SF-8 health survey is a prospective tool which was designed to meet up with decisive factors of conciseness. It can be administered within a very short period of time (1-2 minutes) without experiencing difficulty in conversion and utilizations (Robert *et al.*, 2008:2). The tool makes available a broad assessment of physical and mental health positions which can be administered irrespective of a person's age, sickness and management reasons (Quality Metric, 2011). It can be administered by interviewing a group of people whose literacy status is below average (Robert *et al.*, 2008:2). Everyone with a better quality of life scored higher

according to the rating, compared to those without a better quality of life who have a lower score. The diagram below illustrates the SF-8 domain scale (Figure 2.2).



**Figure 2.2: SF-8 Health survey domain: Adapted from QualityMetric (2011)**

Psychometrically, the SF-8 health survey has been seen to be realistic, dependable and suitably rely on the ancient times studies (Robert *et al.*, 2008:2). For the 4-week recall form, alternate-form reliabilities based on the 2000 normative data were found to be 0.88 for the PCS measure and 0.82 for the MCS measure, while alternate forms' reliability for the health domain scales ranged from 0.70 for role emotion (RE), to 0.88 for bodily pain (BP) in a large US general population sample (Robert *et al.*, 2008:2). Based on a sample of recent headache sufferers, 2-week test-retest reliabilities of 0.73 and 0.74 were found for the PCS and MCS measures respectively, using the 4-week recall form (Robert *et al.*, 2008:2). Health domain scale test-retest coefficients ranged from 0.59 role physical (RP), to 0.70 body pain (BP) and mental health (MH).

In a population-based study by Valles *et al.* (2010:1172) where the HRQoL questionnaire was authenticated in support of surgical patients, it was revealed that the SF-8 is a feasible, reliable, valid, and responsive tool for assessing HRQoL in a broad-spectrum surgical population. In another study conducted by Robert *et al.* (2008:2), which examined whether the SF-8 items were valid and reliable in 1,206 adult participants who were affected by conflict and displaced in Northern Uganda, it was revealed that the response to the items were well distributed and acceptable. Further, the test-retest showed a good intra-class correlation of 0.61 for PCS, and 0.68 for MCS. Also, the main components analysis showed strong construct validity and agreed with the results of the validity tests investigated by the developers of SF-8. The SF-8 also showed strong construct validity between the eight items and PCS and MCS summary score, moderate inter-instrument validity, and strong known-group validity (Robert *et al.*, 2008:2). Notably, the SF-8 short form survey is mainly in English and has been translated into many other languages including South African English. Meanwhile, the SF-8 has not been translated into any of the eleven native languages except the Afrikaans language.

#### **2.6.4 The relationship between exercise, cardiorespiratory fitness and health-related quality of life**

Based on the new conventional agreement, physical activity and cardiorespiratory fitness is connected and both have autonomous effects on health-related quality of life (Wildschutt, 2005:12). Research on the relationship between HRQoL and physical exercise to date has rarely been explored (Anokye *et al.*, 2012:624). Health-related quality of life, along with the inclusion of mental and physical well-being is a vital idea in health research that can help in informing decisions on the prevention and/or treatment of disease (Anokye *et al.*, 2012:624). According to Conn *et al.* (2002:190), the majority of adults with chronic diseases continue to be sedentary despite the evidence of potential health benefits that can be gained from increased physical activity (PA). Furthermore, the aim of exercise is to lower the disease risk factors and improve QoL. These potential benefits have added to the larger body of primary research of exercise interventions to increase PA (Conn *et al.*, 2002:190).

#### **2.6.5 Exercise interventions to increase physical activity**

The alarming increase of NCD risk factors and the positive consequence of physical activity or exercise intervention on those risk factors cannot be underestimated. Physical activity plans signify a low-cost, large-size behavioural intervention that won't hasten the progression

of psycho-physiological decline in healthy adults (Hayes *et al.*, 2013:1). Less than one-fifth of US adults engage in regular, sustained physical activity (Childress, 2009:20) in spite of the inexpensiveness of PA. Teaching awareness only is not adequate enough to result in a noteworthy boost in PA (Childress, 2009:20) so as to fight the threat of NCD risk factors by increasing PA. An abundant physical activity intervention agenda could be applied in an effort to promote and increase PA and CRF in a multiplicity of people (Childress, 2009:20) most especially in adults. Targeting individuals by the use of well thought-out exercise interventions with the guiding principles of frequency, intensity and time, has at all times been the most popular means of boosting PA (Dunn *et al.*, 1999:327). The structured aerobic exercise interventions process has been well-known to be efficient in ever-increasing PA (Dunn *et al.*, 1999:330), except for some barriers which reduced the levels of participation and adherence (Childress, 2009:20).

According to Dunn *et al.* (1999:330) in his study of randomized clinical trial in 235 healthy sedentary and moderately overweight men (n = 116) and women (n = 119) aged 35-60 years in Dallas, Texas, who lived and worked within a 16-km radius, who were randomized to either a lifestyle physical activity programme or a structured exercise programme at the intensity of 50-85% of maximal aerobic power 20-60 minutes per day, with six months of intensive and 18 months of maintenance intervention, it was reported that both groups significantly improved PA and levels of fitness after 24 months of intervention. Meanwhile, there was a bigger increase in the PA and fitness levels of the structured exercise group compared to the lifestyle group. Furthermore, there was a significant improvement from baseline to 6 months for total cholesterol (TC) to high-density lipoprotein cholesterol (HDL-C), systolic and diastolic blood pressure, and body fat percent in both groups (Dunn *et al.*, 1999:330). In addition, the component of the PA measurement showed that the lifestyle-group participants increased their moderate-intensity physical activities almost 3-times more than the structured exercise group, while the latter had a 2-times higher increase in their vigorous activities than the lifestyle group (Dunn *et al.*, 1999:330). The dropout rate in this particular study was 19.1%. Although, in spite of the long period of intervention, the dropout rate was not too high as the participants of this study were relatively young.

In a home-based lifestyle intervention study of 186 sedentary healthy adults out in Belgium aged between 60-83 years, a two-year follow-up of the effects of a lifestyle intervention and a structured exercise intervention on physical fitness and cardiovascular risk factors was

carried out in a randomised control trial study. The exercise programme included endurance, strength, flexibility, and balance training three times per week for 60-90 minutes each at a 70-80% heart rate reserve. An improvement in cardiorespiratory fitness, muscular fitness, and functional performance from post-test to follow-up in the structured intervention group was clear. No improvements were observed in the control group. Meanwhile, at 23 months, participants in both groups still showed improvements in cardiorespiratory fitness. The planned exercise group demonstrated long-term improvements in muscular fitness, while the lifestyle group showed long-term improvements in functional performance. Further, no long-term outcomes were found for blood pressure or body composition (Opdenacker *et al.*, 2011:1609). The rate of completion and dropout in the study of Opdenacker *et al.* data showed that 80% of the participants in the structured exercise group and 78.3% of the lifestyle participants adhered to the exercise intervention programme. Furthermore, the dropout rate for participants in structured exercise was 3.3%, lifestyle 8.3%, and control groups 4.5% at post-test, while there was an 18.3%, 23.3%, and 31.8% dropout at follow-up in the structured exercise, lifestyle, and control groups respectively, which was not significantly different between the groups (Opdenacker *et al.*, 2011:1609). The high rate of dropout during the follow up might be due to the age of the participants as well as a too long an intervention (two-year period).

In a web-based 12-week Internet intervention to increase physical activity in 368 sedentary older adults (men and women aged 55 and above), a randomized control trial study by Blair *et al.* (2013:8) exposed that at post-test, there was an enhancement on 13 of 14 results of the trial group in contrast to the controlled participants. At six months, treatment participants maintained large gains compared to the control participants on all 14 results measured. Holley *et al.* (2011:98) analytically reviewed the effects of physical activity on the psychological well-being of those with schizophrenia (mostly male adults) with a mean age of 39 years between 1978 and 2008, and found that physical activity had a favourable consequence on some traits linked with psychological well-being in persons with schizophrenia. These findings revealed that participation in exercise can improve adults' mental ability and overall quality of life.

Gordon *et al.* (2002:1266) examined the effectiveness of three intervention models intended to enhance PA in those diagnosed with coronary artery disease (CAD) in Savannah, Georgia. The scientific efficiency of two less expensive and possibly easier-to-get approaches to

cardiovascular risk reduction with that of modern Phase 2 cardiac treatment plans was evaluated. Low- or moderate-risk patients (n=155) with coronary artery disease (CAD) were randomised to 12 weeks, 3 days per week partaking in a current Phase 2 cardiac treatment programme (n=52), a physician-supervised, nurse-case-managed cardiovascular risk reduction (n=54), and a community-based cardiovascular risk reduction plan administered by exercise physiologists, guided by a computerized participant management structure, based on clinical procedure (n=49). National guidelines on aerobic exercise based on type and frequency performed (30-60 minutes) at 60-85% peak heart rate. One hundred and forty-two patients (91.6%) completed the test at baseline and after 12 weeks of intervention. In spite of the fact that there are patients with abnormal baseline values, there were statistically significant improvements in the three intervention groups for a variety of CAD risk factors. Furthermore, for patients with a baseline maximal oxygen uptake of less than seven metabolic equivalents, cardiorespiratory fitness improved in both the cardiac treatment group and the community-based group in comparison to the physician-supervised and nurse-case-managed case. Also, there were improvements in the participants' blood pressure, blood lipids and triglycerides. No significant differences were found in the body weight among the three intervention groups (Gordon *et al.*, 2002:1266). The findings of this study suggested that community-based intervention programmes, conventionally structured Phase 2 cardiac treatment programmes, and a physician-supervised/nurse-case-managed programme are effective in the reduction of risk factors for CAD (Gordon *et al.*, 2002:1266). Meanwhile the dropout rate in this study was 8.4%.

Breukelman (2012) examined the effect of a 12 week home based physical activity on cardiometabolic disease risks factor, among 67 sedentary individuals aged between 20-65 years old. The home based exercise intervention consisted of aerobic, resistance and stretching exercises performed 3 days per week for 30 minutes per session. The cardiovascular disease risk factors were assessed at pre-intervention and followed-up at 4-weeks, 8-weeks and 12 weeks. The results showed a decrease in BMI and body percent fat, resting systolic blood pressure, fasting blood glucose and significant decrease in resting diastolic blood pressure. Despite the improvement observed in this study, the dropout rate of the participant from the exercise intervention was 31%. In a Brazilian study that examined the viability and efficacy of a known quantity of exercise to facilitate body mass loss, among sedentary and irregular active overweight and obese adult women residing in a low resourced area, aged between 20-60 years, revealed that a moderate intense structured exercise can

reduce body weight when sustained for many weeks (Alves *et al.*, 2009). Although, a dropout rate of 9% was recorded.

Jackson *et al.* (2012) investigated the effect of a 4 weeks circuit training intervention, 3 days per week for 1h per day at 70-80% heart rate maximum in inactive overweight/obese and lean females on body weight control and metabolism. The participants of this study comprises of 10 inactive lean, with mean age of  $22.4 \pm 4.6$ , BMI of  $22.7 \pm 2.1 \text{kg.m}^{-2}$ , and  $\text{VO}_2$  peak of  $32.5 \pm 8.3 \text{ml.kg}^{-1}.\text{min}^{-1}$  and 7 inactive overweight/obese, with mean age of  $26.9 \pm 3.9$ , BMI of  $31.1 \pm 5.6 \text{kg.m}^{-2}$ , and  $\text{VO}_2$  peak of  $26.6 \pm 7.2 \text{ml.kg}^{-1}.\text{min}^{-1}$  women completed the study, with a 3 day diet diary completed each week during the study, 2 weeks before the exercise intervention and 2 weeks after the intervention which was analysed for energy and macronutrient intake. At the end of the 4 weeks exercise intervention, no significant changes were discovered in body mass and fat and lean mass in both groups. Also no significant changes were found for  $\text{VO}_2$  peak in both groups. Though, at 25 Watts, overweight/ obese participants exhibit a significant change in energy expenditure after the intervention ( $1.15 \pm 0.38$  to  $1.32 \pm 0.53 \text{kcal.min}^{-1}.\text{m}^{-2}$ ,  $P < 0.05$ ) demonstrating a change in aerobic metabolism. Respiratory exchange ratio (RER) during 50-110 watts of  $\text{VO}_2$  peak also improves in overweight/obese participants compared to the lean group. Furthermore, significantly higher plasma leptin concentrations and lower plasma adiponectin levels were found for overweight/obese participants compared to their lean counterpart. It was finally revealed that a 4 weeks exercise intervention in overweight/obese and lean women did not lead to weight/fat loss in the participants used in this study. This reason could be due to the unconscious dietary pattern of the participants (Jackson *et al.*, 2012).

Involvement in regular physical activity is a major component in preventing the global burden of chronic disease (Wildschutt, 2005:30). WHO (2005) stated that participating in regular physical activity within recommended guidelines can reduce the risk of heart disease and stroke as well as some cancers. Furthermore, it was suggested that physical activity could reduce the risk of colon cancer by a positive influence on prostaglandins which lower intestinal transportation moment and lower the rise in a substance which inhibits oxidation status (Wildschutt, 2005:30). Physical activity intervention can improve biochemical processes responsible for the formation, breakdown and mutual exchange of carbohydrates in

living organisms, reduce the fat deposited in the body and blood pressure (Wildschutt, 2005:30), and in addition, reduce the total risk factors of chronic diseases of lifestyle.

In Africa, most especially in South Africa, there is limited information on community-based physical activity/exercise interventions to reduce NCDs and improve quality of life in adults in low-resourced areas. One of the few intervention studies found was conducted by the School of Public Health at the University of the Western Cape (UWC) in 2001, to address the burden of NCDs in the low-resourced area of Khayelitsha, an urban township of Cape Town, among women aged ranged between 28-60 years (Puoane *et al.*, 2013:1). The intervention involved working with community health workers (CHWs) by using them as a change agent to reach out to this community to address NCDs (Puoane *et al.*, 2013:1) through health promotion programs. This was with the aims to identify cultural and environmental beliefs, and attitudes of the CHWs and the community members so as to influencing their lifestyle behaviours. The study revealed that obesity and risk factors for NCDs are common among CHWs and the community members (Puoane *et al.*, 2013:1). These participants are at the risk of developing NCDs related to their obesity, poor nutrition, physical inactivity, and cultural perceptions. Furthermore, findings from this health promotion intervention program in a low resourced area of Khayelitsha showed that black urban women were perceived to be affluent and happy being overweight (Puoane *et al.*, 2013:1). The participants preferred to be overweight because of the stigma associated with thinness as a manifestation of AIDS (Puoane *et al.*, 2013:1). Meanwhile, through these participatory processes, the CHWs and community women were motivated to take action to improve their lifestyles. Apart from this, no other study was found to have taken place in low-resourced areas in other provinces. In addition to the limited information which exists on community-based PA intervention and NCDs, there are barriers which can negatively affect adults' participation in PA, most especially physical activity preference based on cultural differences, which could thus increase the rate of dropout of participants in exercise intervention programmes.

In summary, the studies of Dunn *et al.* (1999:330), (Opdenacker *et al.*, 2011:1609) and Gordon *et al.* (2002:1266) revealed that the longer the follow-up period, the larger the dropout. Furthermore, the type of physical activity/exercise programme presented to the participants might not be totally acceptable, which then undermines the exercise preference of the participant. Another major obstacle for dropout could be other unknown barriers to

exercise. Optimising the preferred type of PA may reduce the long term dropout of participants in future exercise intervention programmes.

## **2.7 Preferred exercise based on cultural differences**

Physical exercise intervention is a vital shielding factor for many of the health disparities experienced by many people, most especially adults (Moy *et al.*, 2010:21). Considering peoples' culture when planning exercise intervention programmes to reduce NCD risk factors and improve HRQoL is essential because culture could play an important role in addressing the dropout rate of any community-based structured aerobic exercise programme. Culture is seen as a characteristic of a particular group of people distinct by all from language, religion, cuisine, social habits, music and arts (Zimmermann, 2012:1).

Belza *et al.* (2004:1) stated that physical activity programmes to improve adherence among ethnically diverse minority older adults include promoting relationships among participants and providing culture-specific exercise, among others. Engaging in moderate levels of physical activity could go a long way in reducing the risk of dying from heart disease, and symptoms of depression and anxiety, and assist in managing NCDs, such as diabetes and hypertension. In spite of the evidence, many South African adults do not engage in PA and are not physically active. Astle (2005:1) stated that exercise programmes in line with the culture of an individual could create interest and increase adherence to exercise interventions. Furthermore, having knowledge about what is already a popular form of exercise within an ethnic group may be effective and acceptable in improving exercise adherence and subsequent HRQoL. A study by Makamu *et al.* (2015), on the perception and knowledge of black Africans on physical activity and non-communicable diseases among 54 black South African adults showed that 84% were knowledgeable about PA, while almost 60% were knowledgeable about risk factors for NCDs (although the participants of this study know that the behaviour they portray does not reflect the knowledge they claim to have). Culturally-tailored aerobic exercise intervention programmes can increase activity intensity, cardiorespiratory fitness (Halvorson, 2008:1) and influence HRQoL positively. In order to achieve the positive health benefit outcomes of physical activity interventions, culture specific interventions should be a priority.

## **2.8 Health benefits of physical activity for South Africans**

Generally the health benefits of physical activity increase with increasing frequency, duration, and intensity of exercise (Lambert & Kolbe-Alexander, 1995:23). Data from longitudinal cohort studies suggest that physical inactivity is associated with at least a one-and-half to two-fold increased risk of most chronic diseases of lifestyle, such as ischaemic heart disease, Type 2 diabetes, and hypertension (Lambert & Kolbe-Alexander, 1995:23). Furthermore, studies corroborated the existing public health recommendation suggesting that 30 minutes of accumulated, moderate-to-vigorous physical activity on most days can guard against these chronic diseases (Lambert & Kolbe-Alexander, 1995:23). On the other hand, the associated risk of physical inactivity is related in a degree to many other well known risk factors, such as obesity and overweight, smoking and hyperlipidaemia (Lambert & Kolbe-Alexander, 1995:23). Everyone benefits from physical activity: children, adolescents, young- and middle-aged adults, older adults as well as people who are disabled or who have disease limitations. Physical activity improves quality of life, reduces the risk of heart disease and strokes, and provides many other health benefits (The Heart and Stroke Foundation South Africa, 2014). Coronary heart disease, hypertension, colon cancer, and diabetes mellitus can be reduced by PA which can go a long way in reducing the risk of untimely death (The Heart and Stroke Foundation South Africa, 2014). Physical activity also improves psycho-mechanical and psycho-physiological health (mental health and the health of muscles, bones and joints). Physical activity involvement could reduce (older) adult' falls, aches, warning signs of nervousness, and hopelessness. This could be achieved by adherence to the recommendations, most especially for adults (The Heart and Stroke Foundation South Africa, 2014).

## **2.9 Physical activity and health recommendation for adults**

Almost two decades ago the American College of Sports Medicine (ACSM) and the Centers for Disease Control and Prevention (CDCP) published national guidelines on Physical Activity and Public Health. These recommendations were endorsed and supported by the Committee on Exercise and Cardiac Rehabilitation of the American Heart Association. In 2003, the recommendations were updated by an expert panel of scientists in the field. The purpose of the recommendation was to provide a clear, concise, public health message that would encourage increased participation in physical activity by a largely sedentary US adult population (Haskell *et al.*, 2007:1081).

The updated recommendation statement applies to healthy adults between 18-65 years of age, and to persons in this age range with chronic conditions not related to physical activity (e.g., hearing impairment). The present updated preventive recommendations reveal how adults, by engaging in regular physical activity, can promote and maintain health, HRQoL and reduce the risk of chronic disease and premature mortality (Haskell *et al.*, 2007:1083). Yet more than 50% are not active and nearly 50% are living with NCDs. This calls for a change by using an appropriate exercise intervention with a correct assessment in order to intervene appropriately to increase PA participation and adherence and thus improve quality of life.

**Table 2.2:** The physical activity recommendations for adults

1	To promote and maintain good health and HRQoL, a physically active lifestyle should be maintained.
2	Moderate-intensity aerobic (endurance) physical activity for a minimum of 30 minutes on five days each week, or vigorous-intensity aerobic activity for a minimum of 20 minutes on three days each week should be performed.
3	Combinations of moderate- and vigorous-intensity activity can be performed to meet this recommendation. For example, a person can meet the recommendation by walking briskly for 30 minutes twice during the week and then jogging for 20 minutes on two other days.
4	These moderate-or-vigorous intensity activities are in addition to the light intensity activities frequently performed during daily life (e.g., self-care, washing dishes, using light tools at a desk), or activities of very short duration (e.g., taking out trash, walking to parking lot, store or office).
5	Moderate-intensity aerobic activity, which is generally equivalent to a brisk walk and which noticeably accelerates the heart rate, can be accumulated towards the 30-min minimum by performing bouts each lasting 10 or more minutes.
6	Vigorous-intensity activity is exemplified by jogging, and causes rapid breathing and a substantial increase in heart rate.
7	In addition, at least twice each week adults can benefit by performing activities using the major muscles of the body that maintain or increase muscular strength and endurance.
8	Because of the dose-response relationship between physical activity and health, persons who wish to further improve their personal fitness, reduce their risk for

chronic diseases and disabilities, or prevent unhealthy weight gain may likely benefit by exceeding the minimum recommended amount of physical activity.
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Adapted from Haskell *et al.* (2007:1083)

Furthermore, according to the World Health Organization, their published guideline known as “Global Recommendations on PA for Health” (WHO, 2011) which is similar to that of ACSM is relevant to all healthy adults aged 18-64 years, unless specific medical conditions indicate to the contrary, irrespective of gender, race, ethnicity, or income level. They also apply to individuals in this age range with chronic non-communicable conditions not related to mobility, such as hypertension or diabetes. These recommendations can be applied to adults with disabilities (WHO, 2011). However they may need to be adjusted for each individual based on their exercise capacity and specific health needs. Pregnant, postpartum women and persons with cardiac events may need to take extra precautions and seek medical advice before striving to achieve the recommended levels of physical activity for this age group (WHO, 2011). Strong evidence demonstrates that compared to inactive adult men and women, individuals who are more active:

- a) Could have lower rates of all-cause mortality, coronary heart disease, high blood pressure, stroke, Type 2 diabetes, metabolic syndrome, colon and breast cancer, and depression (WHO, 2011).
- b) Are likely to have less risk of a hip or vertebral fracture (WHO, 2011).
- c) Exhibit a higher level of cardiorespiratory and muscular fitness (WHO, 2011).
- d) Are more likely to achieve weight maintenance, have a healthier body mass and composition (WHO, 2011).

The recommendations by the WHO (2011) are as follows:

In adults, physical activity should include leisure time physical activity, transportation (e.g. walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.

The recommendations in order to improve cardiorespiratory and muscular fitness, bone health, reduce the risk of NCDs and depressions are:

- a) To promote and maintain health, at least 150 minutes of moderate-intensity aerobic physical activity, or at least 75 minutes of vigorous-intensity aerobic physical activity or an equivalent combination of moderate - and vigorous-intensity activity, should be performed throughout the week.
- b) For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate - and vigorous-intensity activity (WHO, 2011).
- c) Muscle-strengthening activities should be performed involving major muscle groups on two or more days a week.

Inactive people should start with small amounts of physical activity and gradually increase duration, frequency, and intensity over time. Inactive adults and those with disease limitations will have added health benefits when they become more active (WHO, 2011).

## **2.10 Summary**

Physical activity intervention is associated with many improved psycho-physiological health benefits which are seen to reduce NCD risk factors, increase CRF and consequently improve HRQoL. A low level of involvement in physical activity, with a subsequent decrease in CRF and HRQoL has been observed in many Southern African countries (Walker *et al.*, 2001:368). This in turn increases the rate of chronic NCD risk factors in society, most especially in adults. For any physical activity/exercise intervention to take place, assessment of CRF is a necessity in terms of observing physiological changes. Meanwhile, the objective estimation of exercise testing of CRF is a most important outcome in various clinical and research settings to ensure high quality research (Jones *et al.*, 2008:757).

Although maximal exercise testing is regarded as the gold standard for assessing maximal aerobic capacity, it has been observed that the role of direct testing is limited in people whose performance may be decreased because of pain or fatigue rather than exertion, and in cases where maximal exercise testing is contra-indicated (de Andrade *et al.*, 2012:116). Sub-maximal step tests are frequently used for the assessment of exercise working capacity (de Andrade *et al.*, 2012:116) because they can be administered to a large group of people in a field situation. Furthermore, step tests do not require expensive equipment or highly trained personnel (Heyward, 2006:84). This has shown valuable results because of its reliability and validity and is useful when conducting research that involves the evaluation of CRF, most

especially in adults. Current protocols have been standardised among western populations while cultural perceptions may elucidate different acceptability for CRF testing. In South Africa standardised tests, information on the HRQoL, and exercise intervention of adults in low socio-economic environments is lacking. Socio-economic status and culture are linked with the involvement of PA (Garcia, 2006:20S). Valid and reliable instruments are necessary in South Africa to accurately measure and assess the well-being of the adult population.

The lack of exercise interventions contributes to the lack of information with regard to the most appropriate interventions strategy to follow in the specific cultures of ethnic groups in South Africa. Furthermore, identifying cultural perceptions and intervention strategy to address NCDs in low resourced communities (Pouane, 2013) is the key. It is important that adults establish positive lifestyle habits and healthy levels of CRF to improve HRQoL. There are significant health benefits associated with physical activity for adults (Haskell *et al.*, 2007:1083). Continuous involvement over time could reveal the association. South African studies on fitness testing, exercise intervention and HRQoL in Setswana-speaking community-dwelling adults could not be found. Moreover, no data exists which describes the most appropriate exercise interventions strategy to follow in the specific cultures of ethnic groups in South Africa and the drop-out rates to expect. Therefore, future research should address questions as to what reliable and valid measuring instruments should be used to determine quality of life and fitness in community dwellers in South Africa. More RCT should be conducted to determine the effect of exercise interventions in low resourced communities on QoL and risk factors for NCDs. Understanding dropout rates access and barriers to regular PA, more appropriate intervention to promote PA can be conducted. Information will contribute to adaptations in both government and non-government organisations to address NCDs in more practical and low cost ways, and improve public healthcare in South Africa.

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## CHAPTER 3: ARTICLE 1

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### **Validity and reliability of the Setswana translation of SF-8 health related quality of life health survey in adults**

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## **Abstract**

### **Background**

Accurate assessment of health-related quality of life is important in determining the indicators such as satisfaction, freedom of choice, life style and mental behaviour. The absence of culturally relevant measures in indigenous languages could pose a challenge to epidemiological studies on health-related quality of life in developing nations. In this study we explored the feasibility and determined the aspect of validity and reliability of the Setswana translation of Short Form-8 (SF-8) quality of life health survey among Setswana-speaking adults in Potchefstroom, South Africa.

### **Methods**

The original English version of the SF-8 questionnaire was adapted and translated into Setswana language. Sixty healthy men (n=26/42%) and women (n=34/58%) with a mean age of  $45.5 \pm 9.3$  years completed a Setswana translation of the SF-8 questionnaire and the original English version twice, with a four week interval between completions. The questionnaire included eight itemised questions measuring : physical functioning (PF), role-physical (RP), body pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE) and mental health (MH), and reporting two component summary measures: physical components summary (PCS) and mental components summary (MCS). A test-retest reliability of the instrument was evaluated by Spearman correlation coefficient.

### **Results**

The Setswana SF-8 has good concurrent validity with the spearman correlation coefficients ( $\rho$ ) ranging from 0.72 for role physical to 0.91 for social functioning. Cronbach alpha coefficient for first and second measurement was 0.87 and 0.87 for the Setswana-translated SF-8 and for the original English SF-8 was 0.86 and 0.89 conferring to translated and original index a good internal consistency. The reliability coefficients were moderate for the mental health ( $\rho= 0.60$ ), social functioning ( $\rho= 0.56$ ) and role-emotional ( $\rho= 0.50$ ) domains and the MCS ( $\rho= 0.50$ ) and PCS ( $\rho= 0.45$ ) components, but fair for the role-physical ( $\rho= 0.43$ ), bodily pain ( $\rho= 0.43$ ), general health ( $\rho= 0.42$ ), physical functioning ( $\rho= 0.41$ ) and vitality ( $\rho= 0.38$ ) domains on the translated Setswana version of SF-8.

### **Conclusion**

The Setswana SF-8 version is feasible, acceptable and has acceptable concurrent validity and fair to moderate evidence of test-retest reliability for assessing health-related quality of life among adults Setswana speaking community dwellers in Potchefstroom South Africa.

**Keywords:** SF-8, QoL, Low socio-economic, South Africa, Adults, Setswana.

## **Introduction**

Over the past 20 years, the interest in the field of health-related quality of life (HRQoL) has been stepped up to increase health services and policy research [1] and recommendations. The main reasons for stepping up the interests are to enable a comparison or aggregation of results across different language and cultural groups, and facilitate the extrapolation of results of effectiveness and cost-effectiveness studies from one country to another [1].

HRQoL evaluations are used as health indicators to monitor the health status of populations and for program appraisal [2]. The personal attributes of understanding the meaning of life could help people look for a higher existential level of their life [1]. This can be achieved by understanding the individual's satisfaction with life dimensions compared to an ideal life which depends on one's value system [1]. Quality of life could also be dependent on external factors which could influence the living condition of individuals [1]. These external factors, which could influence the quality of life, could be accommodation, employment status, income, welfare, moral attitudes, family life, social support, stress and crisis, education, and environment, among others [1].

The concept of QoL is in general use and has cut across different healthcare fields, with the major aim to clinically improve the current health status of people and communities at large [3]. It is an all-inclusive concept with a complete understanding of health and its various meanings [4]. The approach of HRQoL based on this study is from the paradigm of healthcare and well-being. Meanwhile, it has been approved by professionals in the field, in that, HRQoL possesses important components [4], which include the physical, emotional, mental, social and behavioural-related components of well-being [4]. The Short Form-8 (SF-8) has become an accepted and decisive instrument to clinically determine health status among individuals [4].

The SF-8 (QualityMetric, USA) is seen as a standard instrument that is easy to administer within a very short period of time [9]. It is a general survey instrument that can be used to clinically assess health status regardless of age, illness and treatment [10]. The SF-8 health survey can also be administered by mode of interview, most especially among people with low educational qualifications [13]. Turn-Baker *et al* [12] found that the SF-8 could be used to access HRQoL in a group of people suffering from migraines and other chronic ailments. Compared with the Short Form-36 (SF-36) which was extensively used, the SF-8 survey

achieved adjusted multiple correlations of 0.88 and 0.83 in the prediction of MCS-36 and PCS-36 respectively [7]. The reason for using SF-8 was established after the slow response from the participants due to time constraints in responding to the 36 questions in the SF-36 health survey instrument [7].

Considering the different sociocultural and physical environments from those in the other parts of the world compared to those in the sub-Saharan Africa, mere translation of a questionnaire may not be adequate to maintain content validity [8]. Meanwhile, it is important to produce translated versions that do not lack experimental and theoretical sameness [8].

In cultural terms adapting a questionnaire, rather than developing a new questionnaire could be economical, and could facilitate future comparisons among populations. The SF-8 has been translated into many languages with a good reliability including English adaptation [7, 9, 12]. Culturally, it is important that this health survey be translated into more languages in order to reach full understanding (most especially where English is not a local or official language) and be able to compare the results across different language and cultural groups from one country to another.

The Setswana language is one of the local and official languages spoken by 3 million Setswana people, one of the larger black minorities who span South Africa [11], of which the majority reside in the North-West Province and Botswana. However, the translated Setswana version of SF-8 aspect of validity and reliability has not been demonstrated in this population. The purpose of this study was to translate and cross-culturally adapt the South Africa original SF-8, and to evaluate aspect of validity and reliability of the Setswana translated and culturally adapted version of the SF-8.

## **Method**

### **Research design**

The aspect of validity and test-retest reliability of the Setswana translated and English versions of the SF-8 was assessed by repeated administration of the questionnaire with a four-week interval

## **Participants**

Convenience sample of 60 participants was recruited among community dwellers in Ikageng, a low-resourced area in Potchefstroom, North-West Province of South Africa. Healthy Setswana-speaking men and women, aged 35-65 years, with no orthopaedic limitations were included in the study. Persons were considered apparently healthy when they were not taking any chronic medication or suffered from any known diseases or lung conditions. All the participants were requested to complete an informed consent form before participation in the study.

## **Measuring Instruments**

### **Demographic Information**

Demographic information regarding the participants' date of birth, age, sex, marital status, employment status, level of education, type of house in which they live, and household income, was completed by the participants themselves.

## **Questionnaires**

### **SF-8 HRQoL Survey**

The SF-8 was selected based on its simplicity for administrator and participants, easy translations, cultural adaptation and the establishment of psychometric properties [10]. The SF-8 questionnaire consists of eight questions which measure the following broad domains: PF, RP, BP, GH, VT, SF, RE and MH. It has two component measurements, namely, PCS and MCS. The scoring in SF-8 was based on this two-component summary and was calculated by weighting each SF-8 item using a norm-based procedure in the instrument guidelines. The SF-8 was a 5 and 6-Likert scale questionnaire of which one response per question could be selected [14]. The original South African English SF-8 questionnaire was obtained from Quality Metric Incorporated (an Optimum Insight Company; USA) with licence number QM021030.

### **Translation and cultural adaptation**

The SF-8 was translated and adapted according to forward and backward translation guidelines [5]. Two separate translations into Setswana were made by two native Setswana persons with more than five years of experience in the process, both of whom were fluent in both English and Setswana and experienced in translation. The SF-8 was then translated back into English by two students, one psychology student, and the other from the Setswana

department of North-West University. Both translators were fluent in Setswana and English and also experienced in translation. The translation and back-translations were compared and inconsistencies resolved by consensus. To determine the ideal and item sameness, a correction group was consulted for the appraisal of the back-translated questionnaire which was conducted by one of the study team members. The purpose was to make sure that the meanings and the concepts of the questionnaire items remained the same [10]. The study team member who appraised the translation was also fluent in both the Setswana and English languages. The participants were requested to complete the questionnaire twice exactly four weeks apart. A day interval was allowed during the data collection between the translated Setswana version and the English version.

The Cronbach alpha correlation co-efficient was set at above 0.70 for reliability.

### **Pre-testing of the Setswana SF-8 translated questionnaire**

The pre-testing of the Setswana-translated SF-8 questionnaire was done to check accuracy of translation and was piloted on a sample of Setswana-speaking people. Twenty (20) participants who were not part of the main survey were randomly selected from the same area from which the participants were to be recruited. Furthermore, answers to the translated questionnaire were provided by these participants in order to verify if the questions were acceptable or not [5]. A group review was held by the study team, who were also part of the data collectors used for pre-testing to check for errors or problems [10] and were fluent in both Setswana and English. Finally, the current Setswana version of SF-8 was produced based on the forward and back-translation, with a final review conducted by the study team [10]. Based on the fact that the questions were responded to without any difficulty it was assumed that the participants understood the questions [10].

### **Psychometric properties of the scale**

The psychometric testing of the Setswana-translated version of SF-8 was based on data collected from a sample of 60 participants.

#### **Face validity**

The satisfactoriness of the item (as well as its acceptability) was studied, while the time needed to complete the questionnaire was noted [5].

### **Procedure for the administration of questionnaires**

Before the data collection, permission to administer the questionnaires was granted by the Department of Health, North-West Province. Approval for the study was also received from the Health Research Ethics Committee – Humans, Faculty of Health Sciences of North-West University, Potchefstroom Campus (NWU-00002-14-A1). Upon arrival at 09h00, the participants were allowed to gather inside the community hall. Letters of informed consent were distributed and the purpose of the study explained. Participants interested in partaking in the study returned the following day and signed the informed consent letter. The purpose of the Setswana-translated SF-8 HRQoL survey was explained to the participants in their mother tongue by the team of researchers who are well grounded in communicating in the Setswana language. Demographic information regarding the participants' date of birth, age, sex, marital status, employment status, level of education, type of housing and household income were completed within five to ten minutes by each participant. The SF-8 questionnaire was then completed by each participant in private within five minutes. The participants were asked to place the completed surveys in a holder near the door upon leaving the room. Participants who needed clarification on some of the questions were assisted by the researcher supervising the process. The participants were requested to return the following day in order to complete the English version of the SF-8. After completion of the English version of the SF-8, participants were requested to return in four weeks, at which time the surveys were repeated by all participants again one day apart for the Setswana and English. A token of appreciation was given to each participant who returned to complete the questionnaire four weeks later.

### **Data analyses**

Data analyses were carried out using the SPSS 22.0 [6] statistical software package. All statistical tests were two-tailed and  $p < 0.05$  was considered statistically significant. Descriptive statistics, such as mean, standard deviation, and frequencies reported as percentages, were used to examine the demographic information of the participants. Internal consistency was assessed using the Cronbach's alpha coefficient. A coefficient alpha of 0.70 or greater is generally considered to be acceptable [5]. Test-retest reliability was estimated by calculating the Spearman's rank correlation coefficient. Furthermore, the concurrent validity was also assessed using non-parametric Spearman's rank correlation coefficient. Spearman's rank coefficient values were interpreted as follows: excellent relationship  $\rho = >0.91$ ; good relationship  $\rho = 0.90-0.71$ ; moderate relationship  $\rho = 0.70-0.51$ ; fair relationship  $\rho = 0.50-0.31$ ; and little or no relationship  $\rho = <0.30$  [5].

## **Results**

Basic demographic characteristics of the participants in this study are presented in Table 1. A sample of 60 (men, n=26 and women n=34) participated in the study. The mean age of the participants in the study was  $45.4 \pm 9.4$  years with an age range of 35-65 years. More than half of the participants were female (58.3%). The mean years of working were  $14.2 \pm 11.1$  years. The majority of participants were not married (38.3%) and not working (56.7%). The majority of the respondents (60%) completed high school, while 56.7% were unskilled. The largest percentage of the participants (63%) earn less than a thousand rand every month, while 35% earn between a thousand and five thousand rand, and 1.7% more than five thousand rand per month respectively per household. More than half (58.3%) of the participants live in a brick house, while 1.7% live in a flat or apartment, and the remaining 40% in an informal type of house (shack) respectively.

**Table 1: Demographic characteristics of the participants**

Demographic Variables	Mean (SD)	N (%)
Age	45.4 (9.39)	
Gender		
Men		26 (43.3)
Women		34 (56.7)
Race		
Black		57 (95.0)
Coloured*		3 (5.0)
Marital status		
Never married		23 (38.3)
Currently married		16 (26.7)
Living with partner		14 (23.3)
Widowed		2 (3.3)
Separated		4 (6.7)
Divorced		1 (1.7)
Education level		
None		3 (5.0)
Primary school		20 (33.3)
High school		36 (60.0)
College/Univ.		1 (1.7)
Current employment		
Full time		14 (23.3)
Shift		4 (6.7)
Part time (>10hr/wk.)		1 (1.7)
Casual work		7 (11.7)
Not working		34 (56.7)
Occupation level		
Professional		4 (6.7)
Skilled		22 (36.7)
Unskilled		34 (56.7)
Net income per month		
<R1000		38 (63.3)
R1000-R5000		21 (35.0)
>R5000		1 (1.7)
Type of residence		
Brick detached housing		35 (58.3)
Brick cluster living		1 (1.7)
Informal (Shack)		24 (40.0)
Years of work	14.2 (11.1)	

\* Coloured: is a South African term for mixed ancestry

## Translation

The forward translation was carried out by two people, with its synthesis leading to a unique version. Furthermore, the two backward translations of this version were compared to the original scale [5].

## Pre-testing

Twenty participants in total, with the mean age of 47 years (min. 35 and max. 64 years) participated at this stage, after which minor corrections were made to the instrument and a final translated version was acquired.

## Metric properties of the scale

Sixty participants (26 men and 34 women) answered the questionnaire twice (4-week recall). Table 2 shows the test-retest reliability of both translated Setswana and original English version of SF-8 items.

**Table 2: Test-retest reliability of SF-8 items in Setswana and South African English**

Variables	Translated Setswana Version		SA Standard English Version	
	$\rho$	p-value	P	p-value
<b>Q1-General health</b>	0.42**	0.001	0.51**	0.000
<b>Q2-Physical functioning</b>	0.41**	0.001	0.42**	0.001
<b>Q3-Role-physical</b>	0.43**	0.001	0.50**	0.000
<b>Q4-Bodily pain</b>	0.43**	0.001	0.44**	0.000
<b>Q5-Vitality</b>	0.38**	0.003	0.52**	0.000
<b>Q6-Social functioning</b>	0.56**	0.000	0.53**	0.000
<b>Q7-Role-emotional</b>	0.50**	0.000	0.51**	0.000
<b>Q8-Mental health</b>	0.60**	0.000	0.61**	0.000
<b>PCS</b>	0.45**	0.000	0.63**	0.000
<b>MCS</b>	0.50**	0.000	0.61**	0.000

\*\* Correlation is significant at  $p \leq 0.01$  levels (2-tailed)

PCS-physical component summary; MCS-mental component summary

## Acceptability

The face validity indicated the acceptability of the questionnaire by participants based on time to completion and understanding of the questions. It took participants an average of 3

minutes 30 seconds to complete each questionnaire (minimum of 2 minutes and maximum of 5 minutes). The entire questionnaire was accepted by the participants based on the fact that all questions were completed with limited explanation required and no complaints received from the participants after the completion of the questionnaires. The South African Setswana version of SF-8 was composed of the same number of items and dimensions as the SF-8 South African original English version.

### **Test retest reliability**

The results of the test-retest reliability for the translated Setswana and original English version of SF-8 are presented in Table 2. The reliability coefficients were moderate for the mental health ( $\rho = 0.60$ ), social functioning ( $\rho = 0.56$ ) and role-emotional ( $\rho = 0.50$ ) domains and the MCS ( $\rho = 0.50$ ) and PCS ( $\rho = 0.45$ ) components, but fair for the role-physical ( $\rho = 0.43$ ), bodily pain ( $\rho = 0.43$ ), general health ( $\rho = 0.42$ ), physical functioning ( $\rho = 0.41$ ) and vitality ( $\rho = 0.38$ ) domains on the translated Setswana version of SF-8. Except for the domains of general health ( $\rho = 0.51$ ) and vitality ( $\rho = 0.52$ ) on the original English version of SF-8, all other domains and components demonstrated similar reliability values to the translated Setswana version.

### **Internal consistency**

The Cronbach's alpha coefficient was also carried out to assess the aspect of the reliability of both Setswana and original English version of SF-8 questionnaires to determine the consistency between the two versions. The Cronbach's alpha coefficient applied for the SF-8 Setswana version was 0.87/0.87 for measurements taken at first and second time-point. For the South Africa original English version the Cronbach's alpha coefficient was 0.86/0.89 for the first and second measures respectively.

**Table 3****Internal consistency**

<b>Variables</b>	<b>SF-8 Setswana version</b>	<b>SF-8 Original English version</b>
	<b><math>\alpha</math></b>	<b><math>\alpha</math></b>
<b>Q1-General health</b>	0.87	0.86
<b>Q2-Physical functioning</b>	0.84	0.85
<b>Q3-Role-physical</b>	0.84	0.84
<b>Q4-Bodily pain</b>	0.86	0.86
<b>Q5-Vitality</b>	0.85	0.83
<b>Q6-Social functioning</b>	0.84	0.84
<b>Q7-Role-emotional</b>	0.85	0.84
<b>Q8-Mental health</b>	0.86	0.85
<b>SF-8 global score</b>	0.87	0.86

$\alpha$ : Cronbach's alpha coefficient.

**Concurrent validity**

Spearman correlation coefficient ranged from moderate ( $\rho = 0.72$ ) to excellent ( $\rho = 0.91$ ) relationship. These results indicate that the concurrent validity of the Setswana SF-8 was good. Total social functioning from Setswana SF-8 version was significantly and highly correlated with the total social functioning from the original English south Africa SF-8 ( $\rho = 0.91$ ,  $p < 0.001$ ). Role emotional of Setswana SF-8 also revealed a very high positive and significant relationship when compared with original English SF-8 ( $\rho = 0.90$ ,  $p < 0.001$ ). Furthermore, an encouraging significant correlations were found for RP ( $\rho = 0.72$ ,  $p < 0.001$ ), BP ( $\rho = 0.76$ ,  $p < 0.001$ ), PF ( $\rho = 0.82$ ,  $p < 0.001$ ), MH ( $\rho = 0.83$ ,  $p < 0.001$ ), VT ( $\rho = 0.82$ ,  $p < 0.001$ ) and the two component summary of PCS ( $\rho = 0.83$ ,  $p < 0.001$ ) and MCS ( $\rho = 0.87$ ,  $p < 0.001$ ) when compared with English original version of SF-8. There were no important gender differences in the correlation coefficients of the entire item between Setswana SF-8 and original English version (Table 3).

**Table 4 Concurrent validity of Setswana SF-8**

Setswana SF-8 vs Original SF-8	Total	p-value	Women	p-value	Men	p-value
	(N= 60)		(N= 34)		(N= 26)	
	$\rho$		$\rho$		$\rho$	
<b>Q1-General health</b>	0.83**	0.001	0.90**	0.001	0.73**	0.001
<b>Q2-Physical functioning</b>	0.82**	0.001	0.91**	0.001	0.70**	0.001
<b>Q3-Role-physical</b>	0.72**	0.001	0.76**	0.001	0.70**	0.001
<b>Q4-Bodily pain</b>	0.76**	0.001	0.82**	0.001	0.70**	0.001
<b>Q5-Vitality</b>	0.82**	0.001	0.85**	0.001	0.83**	0.001
<b>Q6-Social functioning</b>	0.91**	0.001	0.91**	0.001	0.94**	0.001
<b>Q7-Role-emotional</b>	0.90**	0.001	0.98**	0.001	0.80**	0.001
<b>Q8-Mental health</b>	0.83**	0.001	0.90**	0.001	0.80**	0.001
<b>PCS</b>	0.83**	0.001	0.84**	0.001	0.81**	0.001
<b>MCS</b>	0.87**	0.001	0.90**	0.001	0.84**	0.001

$\rho$ - Spearman correlation coefficient between Setswana SF-8 and Original SF-8

\*\* Correlation is significant at  $p \leq 0.01$  levels (2-tailed)

## Discussion

The purpose of this study was to determine the aspect of validity and reliability of the Setswana translation of the SF-8 HRQoL survey and alongside, to check the reliability of the SF-8 South Africa Standard English version in adult Setswana-speaking community dwellers living in Potchefstroom, South Africa. This study mainly described the successive steps in translating and adapting the SF-8 into Setswana psychometric properties for use among the Setswana population of South Africa. Furthermore, the reliability of the English version also proved to be good as a standardised measure instrument. This study shows that all the consented participants were able to read and write, which makes self-administration possible.

Translation and adaptation were the first steps taken in the study, while the popular forward and backward translation method was used. The content of the questionnaire was translated into Setswana. The scale was worded in a simple and currently used language to allow for its use among Setswana people in South Africa. Semantic and conceptual equivalences were performed as a necessity to acquire the suitable [5] Setswana version of SF-8 HRQoL, while the number of items and response modalities remained the same i.e. unchanged [5]. Based on the psychometric properties, the reliability was judged good.

The alternate-form reliabilities based on the 2000 normative data were found to be 0.88 for the physical component score (PCS) measure, and 0.82 for the mental component score (MCS) measure for the SF-8 four-week recall form. Alternate forms reported reliabilities for the health domain scales with a range from 0.70 for role emotional (RE) to 0.88 for body pain (BP) in a large U.S. general population sample [9]. On the other hand, a 2-week test-retest reliability of 0.73 and 0.74 were found for the PCS and MCS measures, respectively in a sample of recent headache sufferers using the four-week recall survey [9]. Health domain scale test-retest coefficients ranged from 0.59 for role physical (RP) to 0.70 for BP and MH [9].

Furthermore, the test-retest coefficient correlation between two quantitative variables was assessed using non-parametric Spearman's rank correlation coefficient. Based on the interpretation of Spearman's rank correlation coefficient, the value ranged from as low as 0.38 to as high as 0.60 for the translated Setswana version and 0.42 to as high as 0.63 for the South African original English version. The results indicate that the relationship falls between fair - to - moderate. The Spearman's rank correlation coefficient for the PCS and MCS for the translated Setswana version was 0.45 and 0.50 respectively, with fair relationships, while South African Standard English version was 0.63 and 0.61 respectively with a moderate relationship [5].

The internal consistency of each dimension ranged from 0.84 (for physical functioning and role physical) to 0.87 (for general health) for Setswana version, and 0.83 (for vitality) to 0.86 (for general health and bodily pain) Table 3. The result from the internal consistency of the translated Setswana version was considered high in that, the Cronbach alpha were well above 0.7 which was recommended for group comparison. These results were consistent with the result found in Robert *et al.* [10] and Guermazi *et al.* [5] study.

In this study, we found higher concurrent validity for the Setswana version of SF-8. Our study is in line with the study of Robert *et al.* [10] who tested the validity and reliability of the SF-8 with a conflict-affected population in Northern Uganda, among 1206 adults in camps for internally displaced persons aged 18 years and above. The results revealed that the SF-8 was a reliable and valid instrument that can be used to assess health related quality of life. Our findings also corroborates the findings of Guermazi *et al.* [5] who studied the translation in Arabic and validate the short form-36 (SF-36) (SF-8 is a shorter version of SF-

36) quality of life index, in 130 participants [50 healthy subject, 80 subject with chronic disease (40 patients with bipolar disorders, and 40 patients with chronic renal failure)] Tunisian Arabic population aged between 16-80 years. The results showed that the translated and adapted scale has good and acceptable reliability and validity. Undeviating contrasting of our findings with previous studies should be made with mindfulness, because majority of these studies were conducted in a different socioeconomic background and settings.

### **Strength and Limitations**

One of the main strength of this study was that this was the first time the South African English version of SF-8 was translated into South African Setswana for use in South Africa. Since this study represents the first of its kind, more studies need to be conducted to establish the validity and reliability of the Setswana SF-8 version. The main limitation of this study was the use of a small sample size. The small sample size could reduce statistical power and limit generalization of findings. Also, the non-evaluation of construct validity could be considered another limitation of the study. Issues related to large sample size and the other aspect of validity should be considered in future studies.

### **Conclusion**

In conclusion, we translated in Setswana and adapted SF-8 index to suit Setswana people. This study found that the Setswana SF-8 version feasible, acceptable and has acceptable concurrent validity and fair to moderate evidence of test-retest reliability for assessing the health-related quality of life in adults Setswana population. Social functioning demonstrated an excellent concurrent validity, but only moderate test-retest reliability. The translated Setswana version of SF-8 for Setswana people is a valid and reliable instrument for determining health-related quality of life in community-dwelling persons. More studies are needed to confirm such hypothesis in a large sample.

### **List of abbreviations**

HRQoL- health related quality of life; QoL- quality of life; PF-physical functioning; RF-role physical; BP-body pain; GH-general health; V-vitality; SF-social functioning; RE-role emotional; MH-mental health; PCS-physical component summary; MCS-mental component summary.

### **Conflict of interest**

The authors declare that they have no conflicts of interest concerning this article.

### **Authors' contributions**

SO conducted the statistical analyses and drafted the manuscript. SO, SJ designed the data collection protocol and coordinated the data collection. SO, SJ and MC participated in the interpretation of the data, helped to draft the manuscript, and revised it for important intellectual content. All authors read and approved the final manuscript.

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## CHAPTER 4: ARTICLE 2

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### **Cardiorespiratory fitness testing in Setswana-speaking adults in Potchefstroom, South Africa**

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## Abstract

Accurate measurement of cardiorespiratory fitness is important for observing changes induced by exercise interventions. To obtain accurate measurements, the testing protocol should be acceptable to participants so as to ensure a high level of compliance. The purpose of this study therefore was to compare individual and group cardiorespiratory fitness testing, and to determine whether metronome-accompanied fitness testing compared to culturally-specific music accompaniment increased the rate of completion of an eight-minute graded step test among Setswana-speaking adults. Twenty-seven men ( $41.9 \pm 6.22$  years) and 25 women ( $43.0 \pm 6.32$  years), all apparently healthy, were recruited for this once-off acute exercise testing of four different protocols. Participants were randomly allocated to four protocols: Individual Metronome (MTI), Individual Music (MUI), Group Metronome (MTG), and Group Music (MUG) one week apart. The sub-maximal exercise protocols were performed according to the graded eight-minute step test, a built-in function of the combined heart rate and accelerometry device (Actiheart®) for estimating  $\dot{V}O_{2\max}$ . Alpha level (significance) was set at  $p < 0.05$ . Testing was undertaken in a facility in Ikageng, Potchefstroom, South Africa. Acceptability was determined based on the percentage of persons completing the step test protocol. The results revealed that the largest percentage of participants (67.3%) completed the MTI eight-minute graded step test. This was followed by the MUI testing (63.4%), then the MUG testing (61.6%), and finally the MTG testing (59.7%). The participants' predicted indirect  $\dot{V}O_{2\max}$  based on the four protocols were between  $28.7 \pm 5.66$  ml/min/kg and  $27.3 \pm 4.48$  ml/min/kg with no significant differences ( $F=0.730, > 0.05$ ). Cardiorespiratory fitness testing on an individual basis accompanied by a metronome is an acceptable protocol for community-dwelling adults, and appears to be useful for intervention studies in low-resourced settings.

**Keywords:** CRF testing, physical activity intervention, adults, health-related quality of life, Potchefstroom

## **Introduction**

Regular exercise is an established factor in the management of non-communicable diseases worldwide (Lachat, Otchere, Roberfroid, Abdulai, Seret, Milesevic, Xuereb, Candeias & Kolsteren, 2013). Exercise is a subcategory of physical activity that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective (WHO, 2015). In order to quantify the changes observed during the implementation of exercise in the management of NCDs, it is important to objectively observe any changes in cardiorespiratory fitness brought about by changes in physical activity levels through the accurate measurement of cardiorespiratory fitness.

Cardiorespiratory fitness (CRF) is a health-related component of physical fitness defined as the ability of the circulatory, respiratory, and muscular systems to supply oxygen during sustained physical activity (Lee, Artero, Sui & Blair, 2010). Cardiorespiratory fitness can be assessed using a maximal or submaximal test. A maximal exercise test requires expensive materials and highly qualified personnel when assessing the maximal aerobic capacity, unlike sub-maximal exercise testing (Noonan & Dean, 2000). Thus, due to the expensive requirements of maximal exercise tests, submaximal fitness test should be considered as they can be administered to a large group of people at the same time (Noonan & Dean, 2000). Cardiorespiratory fitness in terms of maximum oxygen consumption assessment can also be influenced by factors such as genetics (Shapesense, 2015), age (Katch, Katch & McArdle, 2007) fitness levels (Plowman & Smith, 2003), form of exercise (Shapesense, 2015), body mass and composition (Shapesense, 2015), and gender (Keller & Katch, 1991).

Cardiorespiratory fitness can be predicted from sub-maximal fitness tests, which typically require fewer resources, can be completed in community settings, are less costly than maximal tests, and are acceptable to untrained and non-athletic populations because they do not require progression of the test to physiological exhaustion. Submaximal testing protocols are hampered by the tendency of untrained participants to ‘finish’ the test early, thus providing insufficient data for prediction of maximal capacity. It is postulated that motivation during exercise testing can alter performance, and subsequently accuracy, in cardiorespiratory fitness (CRF) determination.

A change in motivation and performance during physical activity (PA) can be affected through the presentation of rhythmic auditory cue devices. Studies with clinical samples demonstrated that the effectiveness of rhythmic auditory cue devices, such as a metronome or music with an identifiable tempo can improve locomotion (Rowe, Kang, Sutherland, Holbrook & Barreira, 2013). A study was conducted by Bood, Nijssen, van der Kamp and Roerdink (2013) on the relative effects of auditory-motor synchronisation, and the motivational impact of acoustic stimuli on running performance was determined with 19 participants on different conditions. The participants ran until they were fatigued under three different conditions: without acoustic stimuli, synchronisation of metronome-beeping condition to match the participants' cadence, and under a music condition with synchronous motivational music on a separate day. It was reported that the time to fatigue was longer with stimulation than without. Despite the motivational quality, there were no significant differences between the metronome and motivational music condition. Meanwhile the beat of the metronome (TTE = 746 seconds,  $t(18) = 2.97$ ,  $p = 0.008$ ) condition helped the participants to better maintain a consistent pace to the prescribed tempo than did the music (TTE = 733 seconds,  $t(18) = 2.43$ ,  $p = 0.026$ ). In another study in which 20 participants ran for 42 minutes per session for nine weeks with the use of an MPtrain/metronome (a prototype to enhance performance through music feedback and a mobile and personal system that users wear while exercising combining heart-rate and accelerometry device), and without MPtrain. The results show that running with the MPtrain/Metronome was significantly superior to without it. Furthermore, the participants were able to achieve the predefined work-out goal and efficiently improve their performance (Olivier & Kreger-Stickle, 2006). In particular, the use of music during exercise performance yielded a positive effect (Olivier & Kreger-Stickle, 2006). Some of the positive effects included the notions that music provides the following:

- (i) stride enhancement,
- (ii) postpones the onset of fatigue during exercise,
- (iii) improves mood,
- (iv) increase one's confidence and self-esteem, and
- (v) motivates users to optimise performance during exercise programmes (Olivier & Kreger-Stickle, 2006).

A reasonable number of studies have agreed that exercise endurance, performance perception, and rate of perceived exertion (RPE) levels are positively influenced by music (Olivier & Kreger-Stickle, 2006; Pujol & Langenfeld, 1999). Investigating the research

output on studies that involve the effect of music on aerobic exercises revealed that music has a beneficial effect on sub-maximal physical performance (Pujol & Langenfeld, 1999). Furthermore, research conducted in the past showed that people are more motivated listening to music during exercise (Fearon, Hendrick & Polasek, 2011), and stepping to a consistent music beat or cadence can produce optimal effect and economise running (Bood *et al.*, 2013). Also, a metronome-guided walking pace can improve functional capacity and health-related quality of life (HRQoL) (Lee, Kim, Jin, Oh, Lee, Yang & Park, 2013), while listening to music can increase lower limb muscle contraction before and during exercise performance (Jarraya, Chtourou, Aloui, Hammouda, Chamari, Chaouachi & Souissi, 2012). Walking velocity, stride length, and cadence can significantly increase due to external auditory cues (Ford, Malone, Nyikos, Yelisetty & Bickel, 2010) while metronome cueing can produce benefits on stepping rate (Wright, Masood, MacCormac, Pratt, Sackley & Wing, 2013).

It has been observed that various standardised fitness test were performed with the use of a metronome, such as calibration of combined heart rate and accelerometry device (ActiHeart<sup>®</sup>), Bleep test, Harvard step test, Tuttle step test, Ohio step test, and YMCA step test. Many of these tests have not been used and standardised for African populations. The familiarisation and response to these type of rhythmic cues has not been established, thus it is unknown whether it has any influence on the performance of the participants, most especially in adults. However, it was stated that rhythmic cues such as metronomes or music can provide a stimulus for synchronisation, and they also possess motivational qualities that may improve performance (Bood *et al.*, 2013).

There appear to have been hardly any studies of graded 8-minute step tests from a combined heart rate and accelerometer device to estimate CRF status of adults in Africa. Testing adults' CRF level is of high importance in health promotion using rhythmic auditory cue devices such as metronomes and music. Therefore, given the importance of CRF testing the aim of this study was to determine if individual cardiorespiratory fitness testing compared to group fitness testing, and metronome-accompanied compared to culturally-specific music, increased the rate of completion of an eight-minute graded step test in Setswana-speaking adults living in an informal settlement in Potchefstroom, South Africa.

The findings of this study will indicate the most appropriate testing protocol to apply when testing cardiorespiratory fitness with a graded step test to ensure accurate measurement of

this fitness components. For this current study, it was considered that any of the four protocols in which the larger percentage of participants completed the cardiorespiratory fitness step test would be appropriate and acceptable.

## **Methodology**

### ***Research design***

In this study, once-off acute exercise testing of four different protocols was used.

- Protocol A - individual Metronome (Week 1),
- Protocol B - individual Music (Week 2),
- Protocol C - Group Metronome (Week 3), and
- Protocol D - Group Music (Week 4).

All participants were first subjected to the MTI protocol, followed by the MUI protocol, one week apart. Participants were then grouped into pairs such that those with an even number were paired with the next participants with uneven numbers (e.g. 1 and 2, 3 and 4). After one week of wash-out the pairs were subjected to the MTG protocol, and one week later to the MUG protocol. All participants were subjected to all protocols within a period of four weeks.

### ***Participants***

The research involved a group of men (n=27) and women (n=25) aged between 35 and 65 years, recruited from Ikageng, a low socio-economic area of the Kenneth Kaunda district of Potchefstroom. All participants were requested to complete informed consent forms before their participation in the study. The participants were asked to provide demographic information in terms of date of birth, age, sex, marital status, current employment status, level of education, type of house in which they lived and household income. Apparently healthy Setswana-speaking men and women, aged 35-65 years, with no orthopaedic limitations were included in the study. Participants were considered to be apparently healthy if they were not taking any chronic medication or suffering from any known disease. Those who displayed the presence or symptoms of chronic disease, such as multiple sclerosis (ACSM, 2006) and those who said “yes” to any question on the physical activity readiness questionnaire (PAR-Q) were told to collect a certified clearance document from their physician. Volunteers with a blood pressure reading higher than 160 mmHg (systolic) and 95 mmHg (diastolic), pregnant, lactating or a body temperature  $> 37.5^{\circ}\text{C}$ , were excluded from the study.

## ***Measure Instruments***

### ***Anthropometric and physiological assessments***

The participants' height, body weight and circumferences of the waist and hip were measured according to the protocol of the International Society for the Advancement of Kinanthropometry (ISAK) (Marfell-Jones, 2011). The waist-hip ratios (WHR) were calculated by dividing the waist circumference measurement to the nearest 0.1 cm by the hip circumference to the nearest 0.1 cm (Owens, Gutin, Allison, Riggs, Ferguson & Thompson, 1999). Body mass index (BMI) was calculated from the body weight estimated to the nearest 0.1 kg divided by the square of height to the nearest 0.1 m ( $\text{kg/m}^2$ ) (WHO, 2006). Blood pressure (BP) was measured after the participants had rested for 10 minutes in a semi-recumbent position. Blood pressure measurements were taken with a sphygmomanometer (Omron Xinxiang Golden Elephant Sci-Tech Co., Ltd., China) using the Riva-Rocci/Korotkoff method on the left arm (Verrij, Van Montfrans & Bos, 2008). Two measurements were taken at 5-minute rest interval. The heart rate (HR) was measured with a stethoscope (3M™ Littmann® Stethoscope, USA) by counting the beats in a set period of 15 seconds and multiplying by 4 to arrive at the number of beats per minute. During the recovery stage HR and BP were measured immediately in a seating position.

### ***Step test for cardiorespiratory fitness measurements***

The sub-maximal exercise protocols were performed according to the graded eight-minute step test which is an in-built function of a combined heart rate and accelerometry device (Actiheart®, CamNTEch, UK). The device reports an indirect measurement for CRF ( $\text{VO}_2$  max) based on the graded step test. The eight-minute test was performed by stepping at a speed starting at 15 step cycles (1 step cycle is “up-up, down-down”) per minute, to 33 beats per minute by the end of the cycle. The stepping speed during the test was dictated by a drum beat or voice command. For persons with hearing disability, colours changed on the computer screen at the step rate to assist with the performance of the step test cadence. After completion of the step test, and as part of the protocol, the participants were requested to stay seated for two minutes without talking in order to determine the recovery heart rate. All participants were seated on a chair in an upright position. From the step test a predicted indirect  $\text{VO}_2$  max ( $\text{ml/min/kg}$ ) was calculated by means of the ActiHeart® software (Actiheart User Manual, 2010).

### ***Measurement procedures***

Permission to conduct the study was granted by the district office of the Department of Health, North West Province. Approval for the study was also received from the Health Ethics Committee for Humans of North-West University, Potchefstroom Campus (NWU-00002-14-A1). Participants that responded to the recruitment flyers for the study were requested to complete an informed letter of consent after the procedures of the study were explained to them. Those participants who gave informed consent were requested to report at the testing facility on a predetermined date. After the demographic information was collected, participants' height, weight and circumferences were measured. After being seated for five minutes, blood pressure (BP) and heart rate (HR) was measured. The physical activity readiness questionnaire (PAR-Q) was then completed prior to the preparation of the eight-minute step test. In preparation for the step test the participants were in an upright position with the device attached to the chest with two EKG stickers (Actiheart User Manual, 2010).

The software was allowed to count down from at least 90 seconds to allow time to prepare the participants for the test. The countdown during the last five seconds was a vocal prompt "five, four, three, two, one", after which the software started the test. The participants were informed to step in time to either the metronome or music depending on the group tested. The participants were also informed to immediately stop the test if at any time he or she felt uncomfortable (Actiheart User Manual, 2010). During the first measurement all the participants of both genders underwent a graded eight-minute step test for individual assessment using metronome modality in the first week (Protocol A), and music modality in the second week (Protocol B), after which the researcher provided each of the participants a number and time to return for his or her test. During the third and fourth week, the same participants who had performed the step test on an individual basis were allocated into paired groups (e.g. 1 and 2, 3 and 4, etc.), and then underwent the same test using a metronome (Protocol C), and music (Protocol D) modality. All the participants who completed the eight-minute step test were given a token of appreciation. To minimise the loss of interest among participants, data collection was spread throughout the week for four weeks.

### ***Data analyses***

Data were collected, presented and statistically analysed using SPSS statistical package for windows Version 22 (IBM Corporation, 2012). Descriptive statistics, such as mean, standard deviation and frequencies and Chi square test were used to determine the participants'

characteristics. An independent sample *t*-test was performed to determine if there were significant sex differences in the participants' anthropometric and physiological profiles. Simple percentages were used to determine the best adaptation as determined by the duration of participants' completion of specific step tests. A normality test for all variables was performed using the Shapiro-Wilk test. A one-way ANOVA was also performed to test for significant differences in participants' VO<sub>2</sub> max measurements. The level of significance used was set at 0.05 or less.

## **Results**

The purpose of this study was to determine if individual cardiorespiratory fitness testing compared to group fitness testing, and metronome-accompanied compared to culturally-specific music, could increase the rate of completion of an eight-minute graded step test in Setswana-speaking adults. The characteristics of the studied participants (Table 1) indicate that the participants were in their early forties for which the clinical horizon begins (Joubert & Bradshaw, 2006). The males reported an average of five years more working experience than their female counterparts. The participants were mostly educated to a high school level, with limited skills, and earning a minimum wage as prescribed by the South African labour law.

Women were insignificantly older than men while men were significantly taller than women. Women were heavier and possess higher BMI than men. Although, the total mean value for both men and women showed that they are overweight. The WHR revealed higher value in men compare to their women counterpart. The predicted VO<sub>2</sub> max in men were higher than that of women of this study (Table 2). The results of the predicted VO<sub>2</sub> max of the participants revealed that MTG has higher mean and standard deviation (28.7±5.66 ml/kg/min) value with class interval of 27.1-30.2 (Table 3). On the other hand, the results revealed that MTI (40.4% of male, and 26.95% of female) was the most completed modality (Fig. 1)

**Table 1:** Demographic characteristics of the participants

Demographic Variables		N (%)
Gender	Men	27(51.9)
	Women	25(48.1)
Race	Black	52(100.0)
Marital status	Never married	22(42.3)
	Currently married	12(23.1)
	Living with partner	11(21.2)
	Widowed	4(7.7)
	Separated	1(1.9)
	Divorced	2(3.8)
Education level completed	None	4(7.7)
	Primary school	11(21.2)
	High school	31(59.6)
	College/University	6(11.5)
Current employment	Full time	23(44.2)
	Shift	4(7.7)
	Part time (>10hr/wk.)	3(5.8)
	Part time (<10hr/wk.)	2(3.8)
	Casual work	7(13.5)
	Not working	13(25.0)
Occupation level	Professional	4(7.7)
	Semi Professional	2(3.8)
	Skilled	27(51.9)
	Unskilled	19(36.5)
Earnings per month	>R1000	20(38.5)
	R1000-R5000	24(46.2)
	<R5000	8(15.4)
Type of house lived	Brick	30(57.7)
	Informal (shacks)	21(40.4)
	Others	1(1.9)

**Table 2:** Anthropometric measurements and physiological profile of participants

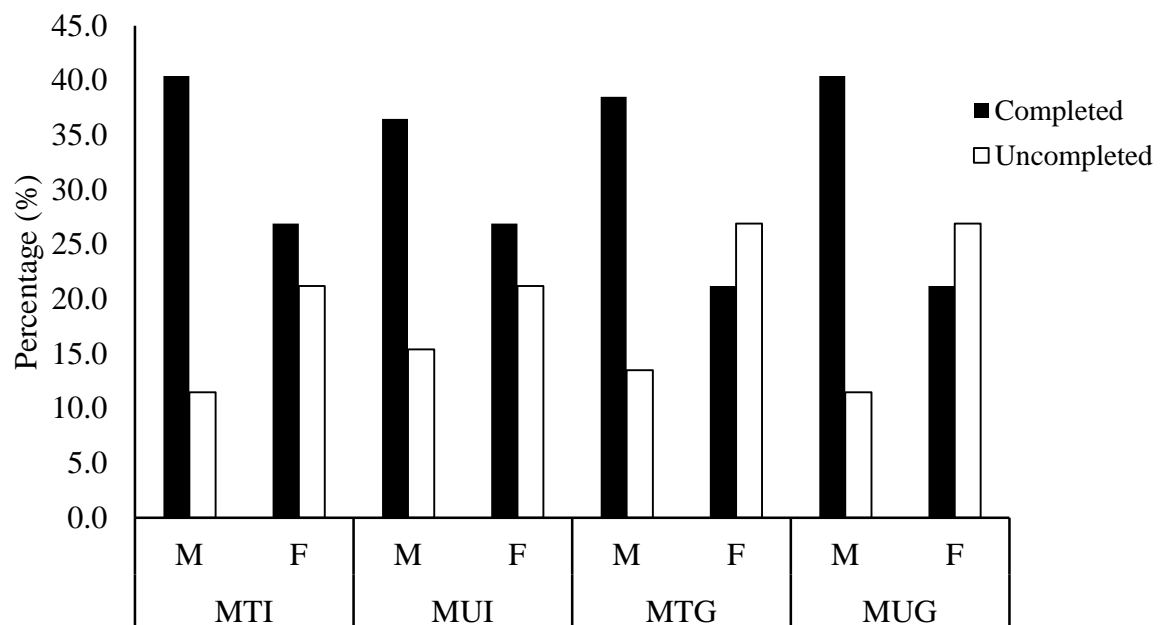
Characteristics	Total		Men		Women		<i>P-value</i>
	<i>N</i>	Mean $\pm$ SD	<i>N</i>	Mean $\pm$ SD	<i>N</i>	Mean $\pm$ SD	
Age (years)	52	42.5 $\pm$ 6.24	27	41.9 $\pm$ 6.22	25	43.0 $\pm$ 6.32	0.539
Height (m)	52	1.64 $\pm$ 0.08	27	1.70 $\pm$ 0.05	25	1.56 $\pm$ 0.05	0.001*
Weight (kg)	52	71.5 $\pm$ 20.5	27	68.4 $\pm$ 15.7	25	74.8 $\pm$ 24.5	0.268
BMI (kg/m <sup>2</sup> )	52	26.8 $\pm$ 8.40	27	23.5 $\pm$ 5.26	25	30.4 $\pm$ 9.80	0.002*
Waist (cm)	52	84.4 $\pm$ 14.5	27	80.9 $\pm$ 13.6	25	88.2 $\pm$ 14.7	0.071
Hip (cm)	52	101.8 $\pm$ 14.7	27	95.6 $\pm$ 10.3	25	108.5 $\pm$ 15.7	0.001*
WHR	52	0.83 $\pm$ 0.07	27	0.84 $\pm$ 0.06	25	0.81 $\pm$ 0.07	0.123
SBP (mmHg)	52	129.9 $\pm$ 9.97	27	130.8 $\pm$ 10.0	25	128.9 $\pm$ 9.94	0.482
DBP (mmHg)	52	85.4 $\pm$ 6.23	27	85.0 $\pm$ 7.22	25	85.8 $\pm$ 5.07	0.627
MaxHR (bpm)	52	178.3 $\pm$ 4.48	27	178.5 $\pm$ 4.46	25	177.8 $\pm$ 4.51	0.570
Pred.VO <sub>2</sub> max (ml/kg/min)	52	27.8 $\pm$ 5.53	27	29.4 $\pm$ 8.09	25	25.0 $\pm$ 3.01	0.012*

BMI - body mass index ( $W/(H \text{ in m})^2$ ), WC - waist circumference, HC - hip circumference, WHR - waist-hip ratio, SBP - systolic blood pressure, DBP - diastolic blood pressure, Pred.  $\dot{V}O_{2 \text{ max.}}$  - Predicted Maximum Oxygen Consumption, MaxHR - maximum heart rate; alpha level  $p < 0.05$

**Table 3:** Predicted maximum oxygen consumption of the participants grouped by cardiorespiratory fitness test modality

Variable	Modality	N	Mean	SD	95% CI
$\dot{V}O_{2\max}$	Metronome Individual	52	27.3	6.54	25.5-29.1
	Music Individual	52	27.6	5.27	26.2-29.1
	Metronome Group	52	28.7	5.66	27.1-30.2
	Music Group	52	27.3	4.48	26.0-28.5

$\dot{V}O_{2\max}$  - predicted maximum oxygen consumption, SD - Standard deviation, CI - Class interval



M - Men, F - Female, MTI - metronome individual, MUI - music individual, MTG - metronome group, MUG - music group

**Fig 1.** Percentage of participants completing the step-test by gender and test modes

## Discussion

The primary purpose of the present study was to determine if individual cardiorespiratory fitness testing compared to group fitness testing, and metronome-accompanied compared to culturally-specific music increased the rate of completion of an eight-minute graded step test in Setswana-speaking adults. The main finding of this study is that in a group of volunteers the largest

majority of participants stepping on a 21.5 cm bench completed the cardiorespiratory fitness test while accompanied by a metronome and performing the step test on an individual basis. Figure 1 shows that the largest number of participants (men and women) completed the CRF testing individually, using a metronome as the modality. Compared to other modalities, it was revealed that a fewer number of participants (men and women) could not complete the CRF testing using the same modality.

For the CRF testing performed individually with music as a modality, the majority of participants completed the test, while a lower number of participants were unable to do so. Meanwhile, the total number of the participants who could not complete the CRF testing for MUI was higher than that of the MTI with 3.9%. This result was in agreement with the study of Bood *et al.* (2013). These results suggest that the motivational quality of music may be less important during the CRF testing than a metronome beat (Bood *et al.*, 2013). It was reported that the lower perceived effort during sub-maximal running to music compared to the metronome can be reduced psychologically (Bood *et al.*, 2013). Furthermore, music may be advantageous in other submaximal exercises which are performed for a long period (endurance sports) and which lead to exhaustion, such as swimming, cycling and rowing, in terms of oxygen consumption (Terry, Karageorghis, Saha & D'Auria, 2012).

Music has been seen to be associated with positive mood responses in endurance sport compared to when it is absent (Terry *et al.*, 2012). It was observed that during the stepping with music, the state of excitement was seen to be one of the major reasons some of the participants could not fully concentrate, thus missing their step in the process, which was in contrast to when the metronome was used. However, the rate of the CRF testing completion and non-completion for both metronome and music performed individually was not significant. The rate of completion was significantly higher for men in both MTG and MUG. In the present study, none of the male participants used short test algorithm (STA) while very few women (1%) used STA which was observed in MTG and MUG. Significantly, the number of participants without the use of STA (99%) in total was higher. This could be attributable to the fact that some participants simply could not keep up with the group partners (metronome and music tempo) or felt uncomfortable performing the step-test in a group during the CRF test. It was also observed that none of the participants (both men and women) used STA during the CRF test performed individually with a metronome or music.

The findings from the mean and standard deviation of the predicted  $\dot{V}O_2\text{max}$  (Table 3) of the participants by CRF modality in the current study showed that MTG has a higher mean and standard deviation ( $28.7 \pm 5.66$  ml/kg/min) compared to the other adaptations. The findings of this study corroborate the findings of Olivier and Kreger-Stickle (2006) in that the metronome condition was the best in terms of targeted heart rate zone and pace. Music modality in determining CRF level could cause an emotional response which was contrary to the metronome (Olivier & Kreger-Stickle, 2006). It was also observed that some of the participants of this study were unable to correctly identify the tempo of the music sometimes, thereby synchronising their perceived tempo rather than actual tempo, causing the undesired stepping rate as a result of a lack of rhythm. This type of undesired movement never occurred with the metronome. It was also observed that the metronome beat was vocal as the participants were told what to do next (“up-up, down-down”) throughout the stepping period, which was contrary to the music adaptation.

Although stepping with the music modality was seen as more interesting and enjoyable (Olivier & Kreger-Stickle, 2006) than the metronome (according to some of the participants), individual differences could play a big role. In all four adaptations used in this study, the analysis of variance revealed that there was no significant difference in the predicted maximum oxygen consumption ( $F=0.730$ ,  $P>0.05$ ) in the studied participants based on the CRF test modality used (Table 3). Furthermore, looking at the rate of completion of the CRF test based on the various adaptations used in this present study, MTI proved to be the best modality with a higher rate of completion and lesser rate of incompleteness.

### **Conclusion**

Based on the findings of this study, cardiorespiratory fitness testing on an individual basis accompanied by a metronome was indicated to be the most completed protocol. Therefore, individual testing of cardiorespiratory fitness is proposed for this population with the accompaniment of a metronome rather than music.

### **Limitations**

One of the limitations of this study was that it was probably the first time this type of study which involved the eight-minute graded sub-maximal step-test with the in-built Actiheart®

software would be conducted in South Africa. Since this study probably represents the first of its kind in the use of step-test for the in-built Actiheart<sup>®</sup> software, more studies need to be conducted in order to establish the best adaptation in which the individual can complete the eight-minute graded sub-maximal step-test using the in-built Actiheart<sup>®</sup> software.

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# CHAPTER 5: ARTICLE 3

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**TITLE: PREFERRED MODALITY OF PHYSICAL ACTIVITY  
AMONG SETSWANA-SPEAKING COMMUNITY-  
DWELLING POTCHEFSTROOM ADULTS**

**TITEL: VOORKEUR FISIEKE AKTIWITEIT BY VOLWASSE  
POTCHEFSTROOMSE SETSWANA-SPREKENDE  
GEMEENSKAP**

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Running head: Preferred exercise modality for managing NCDs

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## **ABSTRACT**

The promotion of PA in a population by means of enjoyable activities may serve as motivation for long-term uptake of physical activity and improve health outcomes. Since PA could either be structured or unstructured, the purpose of this study was to determine the most preferred type of PA among adult Setswana-speaking community dwellers from a low socio-economic area of Potchefstroom to assist with future implementation of physical activity interventions. A sample of 130 people (men: n=50; 38.5%; women: n=80; 61.5%) aged 35-65 years ( $\bar{x} = 45.8$ ,  $SD = \pm 9.0$  years) agreed to participate in the study. Frequency analyses and chi-square tests were performed to determine the most preferred type and time of PA. Regression analyses were performed to determine the association between preferred type of PA and demographic variables. Most participants (87.7%) reported regular participation in PA. Walking (39.2%) was the most preferred type of PA, followed by domestic duties (13.8%). Exercising before 12 am was preferred by 70% of the participants. Age (OR = 8.75, CI = 1.33; 57.7) and marital status (living with partners) (OR = 0.015, CI = 0.001; 0.23) were the most likely associated with PA participation. In conclusion, weight-bearing activities such as walking and activities of daily living, such as domestic chores are recommended for future exercise interventions. The application of preferred activities for exercise interventions may improve adherence to PA interventions directed to reduce the burden of non-communicable diseases.

**Keywords:** PA preference, PA intervention, quality of life, NCDs, Setswana, Adults

## **PREFERRED MODALITY OF PHYSICAL ACTIVITY AMONG SETSWANA-SPEAKING COMMUNITY-DWELLING POTCHEFSTROOM ADULTS**

### **INTRODUCTION**

The high level of inactivity is associated with increased prevalence of mortality globally. The implementation of preferred physical activities in physical activity intervention may increase the adherence to interventions aimed at improving health outcomes. Physical activity (PA) is defined as a bodily movement through skeletal muscle activations which results in energy expenditure in kilocalories. Physical activity is also positively correlated with physical fitness (Caspersen *et al.*, 1985) and the general term for all structured (e.g. aerobic exercise, resistance training, or both) and unstructured (e.g. walking, for transport, domestic duties, or occupational PA) activities. Further, both PA and cardiorespiratory fitness were associated with reduced cardiometabolic risk factors (Dickie *et al.*, 2016). Structured PA includes exercise which has been defined as a planned, structured, and repeatable bodily drive to improve and preserve physical fitness components (Caspersen *et al.*, 1985). Regular PA participation has been proved to have a beneficial effect on total well-being and health status, which is known to improve total quality of life (QoL) (Haruna *et al.*, 2013).

One of the main beneficial effects of regular PA is the improvement of physiological processes in the body, which helps to prevent and/or manage several known diseases of lifestyle (Lambert & Kolbe-Alexander, 2006). In order to realise the benefits derived from PA engagement, the participator must meet the general public health guidelines. The general guidelines indicate at least 150 minutes of moderate-intensity aerobic PA throughout the week or at least 75 minutes of vigorous-intensity aerobic PA throughout the week or an equivalent combination of moderate- and vigorous-intensity activity (Caspersen *et al.*, 1985). Despite the benefit associated with PA, the inability of populations to meet the public health guidelines for PA has become an economic burden both in high-income countries (Short *et al.*, 2014) and low to middle-income countries.. In many Western nations, people who are socio-economically disadvantaged are not sufficiently physically active, most especially adults (Burton *et al.*, 2012). South Africa, as a developing country, report that more than 50% of the population are insufficiently physically active (WHO, 2012). It is not surprising that the trends in non-communicable diseases (NCDs) in the Western or industrial nations are now manifesting in developing countries.

In South Africa, the cross-sectional data that was collected on the prevalence of health-enhancing PA in various localised risk factor surveys showed that low levels of habitual PA was most common among women (Jane *et al.*, 2007). Furthermore, in a sample of a peri-urban community in the Western Cape, it was found that close to fifty percent (49.7%) of the participants do not meet public health recommendations of 150 minutes (at least 30 minutes per day) or more of health-enhancing PA per week (Steyn, 2007). In a more recent study, data reported that regular PA participation reduces both the risk of premature mortality and all the risk factors of non-communicable diseases (NCDs) (Burton *et al.*, 2012), either modifiable behavioural (use of tobacco, physical inactivity, unhealthy diet and dangerous use of alcohol), and metabolic and physiological risk factors (high blood pressure, overweight and obesity, high level of blood glucose and high level of blood fat) (Mayosi *et al.*, 2009). A study in black South African women indicated that even light-intensity physical activity resulted in health benefits (Dickie *et al.*, 2014).

Substantial evidence reveals that regular PA may be useful for improving cardiorespiratory health and muscular strength, reducing fatigue and depression, and improving the ability to function independently and improve total QoL (Haruna *et al.*, 2013; Trinh *et al.*, 2012; Christensen *et al.*, 2012). Regular PA participation as an intervention to chronic diseases of lifestyle may be more effective if individual interests or preferences with regard to physical activity are taken into consideration. Philip *et al.* (2014) stated that the PA preferred by individuals could facilitate positive changes in health behaviour. Furthermore, developing a PA intervention programme that is enjoyable, acceptable, and interesting to the broader population is a necessity for the promotion of mass participation (Short *et al.*, 2014). Burton *et al.* (2012) indicated that if the modality of PA is consistent with the individual's preference of PA, tiredness and rate of perceived effort is lowered, while adherence to PA and QoL improves. In addition, the individual's preference of PA could reduce the dropout rate in a structured aerobic exercise intervention (Burton *et al.*, 2012). The literature indicates that available time is often a barrier to participation in PA interventions. Should the preferences with regards to time of PA be considered during the planning of PA interventions, the adherence to interventions be improved.

On the other hand, the influence of demographic variables on PA has been established (Bergman *et al.*, 2008). For example, being married or living with partner has been understood to be

inversely associated with PA. Furthermore, increase in age has also been revealed to be inversely correlated with PA. Bergman *et al.* (2008) observed that people who received high income at the end of the month have frequently been found to report more leisure time PA than those who get low income. Higher educational level could be associated with increase in PA participation. This may be due to less physical demanding type of job compared to those with lower education, who may involve in more physically demanding work (Bergman *et al.*, 2008). Therefore, understanding the influence of socio-demographic correlates on physical activity preference is a necessity.

In South Africa, research regarding the most preferred and enjoyed PA by adults in order to stage long term PA intervention programmes remain scarce. While information exist for South African adolescent boys and girls (Pienaar *et al.*, 2012), no data exist for adults South Africans, especially from low-resource communities. The lack of peer-reviewed data on exercise interventions in adult South Africans from low-resource communities (Lambert & Kolbe-Alexander, 2006) contributes to the lack of information regarding the most appropriate PA intervention strategy to follow in South Africans who are residing in these communities. It is important to understand the PA preferences of a population in order to plan, execute and implement appropriate and effective public health interventions that will influence policy development (Dogra *et al.*, 2010). The purpose of this study therefore is to determine the most enjoyed and preferred modality of PA, and the preferred time of participation, among adult Setswana-speaking community dwellers in Potchefstroom. We also determined the association between the preferred PA and demographic variables.

## **METHODS**

### **Design**

An observational study with a descriptive design.

### **Participants**

A sample of 130 men and women between the ages 35-65 years of Setswana descent living in Ikageng, a low socio-economic area in Potchefstroom, were recruited for participation in the study. Recruitment was performed based on availability on consecutive days within the vicinity of community gathering place. All the participants were requested to complete an informed consent form before participation in the study. The study was approved by the Health Research Ethics

committee for Humans in the Faculty of Health Sciences of the North-West University with the approval number NWU 00002-14-A1.

## **Measures**

### ***Demographic data***

Demographic variables were assessed using self-reported questionnaire and included the participants' date of birth, age, gender, marital status, employment status, level of education, type of house in which they lived, and total household income.

### ***Preferred Physical Activity Questionnaire***

Based on the unavailability of a South African based survey to determine physical activity and exercise preferences in community-dwelling Setswana South Africans, a preferred physical activity questionnaire (PPA-Q) was compiled from literature paying attention to regular PA participation (Stevinson *et al.*, 2009), various activities (Philip *et al.*, 2014; Stevenson *et al.*, 2009), (McGowan *et al.*, 2013; Wilcox *et al.*, 1997), appropriate time for activity during the day (Stevinson *et al.*, 2009), frequency or number of time per week of PA/exercise (Philip *et al.*, 2014; Wilcox *et al.*, 1999; Booth *et al.*, 1997), the PA/exercise most preferred and enjoyed (Stevinson *et al.*, 2009), and how the participants perceive their exertion during their involvement in the most preferred activity (Philip *et al.*, 2014; Booth *et al.*, 1997; Olvera *et al.*, 2009). The questionnaire consists of six questions and was reviewed by a panel of experts in the field before tested in the field to ensure scientific correctness. The participants were told to tick the best option that corresponds to their preferences. The validity of the questionnaire was first determined before the data collection for the study was performed. Healthy Setswana-speaking men and women with no orthopaedic limitations were included in the study. Persons were considered apparently healthy if they were not taking any chronic medication nor suffered from any known or reported diagnosed diseases. Final adjustments were made to clarify questions and ensure completeness of the questionnaire. Reliability was then performed on the questionnaire.

### ***Validation of the PPA-Q***

The PPA-Q was pilot-tested and the validity determined by administering the questionnaire twice two weeks apart in 20 participants randomly selected from individuals attending a community

gathering and who were not included in the main survey. Cronbach's alpha coefficient was calculated to assess the reliability of the PPA-Q questionnaire. The Cronbach's alpha coefficient applied for the PPA-Q was 0.86 and was judged good.

### **Procedure for the administration of questionnaire**

Upon arrival the participants that had completed an informed consent had the purpose of the survey explained in English and their mother tongue by trained researchers fluent in both languages. Demographic information was recorded, after which the preferred type of PA survey was administered in privacy in a well-lit room. The researchers were available to clarify any questions and those that could not read were presented with the questions by a Tswana-speaking researcher in their mother tongue, and then completed by a researcher from the team.

### **Statistical analysis**

Participants' characteristics were determined by means of descriptive statistics reporting mean and standard deviations. Frequency on the data for the men, women and the total group with regards to preferred modality of PA and time of PA were determined with Chi-square analyses for significance. The Cronbach alpha co-efficient was performed to determine the reliability of the preferred physical activity questionnaire. Logistic regression analyses were performed to determine the association between preferred and enjoyed type of PA and demographic variables, reporting the adjusted odd ratios (ORs) and 95% confidence intervals (CI). Categories that had a small sample size were re-categorised for the regression analyses. These re-categorised variables included marital status, education and occupation. This was used to model the likelihood of physical activity preference relative to the reference category as a function of demographic variables. Odd ratios and class interval were reported to show the magnitude of associations. The level of significance was set at  $p \leq 0.05$ . All data was analysed by Statistical Package for the Social Sciences (SPSS) 22.0 (IBM SPSS Statistics, Chicago, IL, USA).

## **RESULTS**

### ***Demographic variables***

The means age of the 130 black participants were  $45.8 \pm 9.0$  years. Almost 40% of the groups were healthy adult men ( $n=50$ ). A high response rate for completion of the questionnaire was obtained (100%) (Table 1). More than 40% of the participants were single and nearly half of the participants completed high school education (49.2%). Nearly two-fifth of the participants was

employed (38%), and two-fifth was unemployed (38%). This culminated in 43% of the participants reporting skilled work as part of their activities, with the same number of participants performing unskilled work (43%). More than half of the participants earned between R1000-R5000 per month (56%) and nearly three-quarters of the participants live in brick houses.

**TABLE 1: Demographic characteristics of the participants**

<b>Demographic Variables</b>	<b>Mean (SD)</b>	<b>N (%)</b>
Age (yrs)	45.78 (8.98)	
	34-44	72(55.4)
	45-65	58(44.6)
Gender	Men	50(38.5)
	Women	80(61.5)
Ethnicity	Black	130(100.0)
Years of work	13.48 (11.7)	
	0-15	65(50)
	16-30	40(30.8)
	31-44	25(19.2)
Marital status	Never married	55(42.3)
	Currently married	34(26.2)
	Living with partner	26(20.0)
	Widowed/Separated/Divorced	15(11.5)
Education level	Below high school	46(35.4)
	High school	64(49.2)
	More than high school	20(15.4)
Current employment	Full time	49(37.7)
	Shift	13(9.9)
	Casual work	19(14.6)
	Not working	49(37.7)
Occupation level	Skilled	56(43.1)
	Unskilled	56(43.1)
	Professional	18(13.8)
Earnings per month	<R1000	32(24.6)
	R1001-R5000	74(56.9)
	>R5000	24(18.5)
Type of house lived	Brick	94(72.3)
	Informal (shack)	36(27.7)

### ***Preferred physical activity***

Cronbach's alpha coefficient for the PPA-Q was determined as good ( $\alpha = 0.86$ ). The largest number of participants (87.7%) revealed that they do participate in PA, with the rest of the participants that are currently not participating in PA (12.3%), willing to take part in PA intervention programmes. The statistical test for chi-square ( $\chi^2$ ) showed that the number of participants who take part in PA was highly significant with ( $\chi^2=73.90$   $p<0.0001$ ) compared to the participating in no PA. Almost forty percent (39.2%) of the participants expressed that walking was their preferred and most enjoyed type of PA ( $\chi^2=173.10$ ;  $P<0.0001$ ) within the list of eleven items (Table 2). Participants indicated that the majority (30%) preferred PA 6-7 times per week. This was significant percentage compared with the lesser times per week presented to the participants ( $\chi^2=43.20$ ;  $p<0.0001$ ). Results of the duration that the participants would be willing to spend on a PA intervention, indicated a significant number of participants (44.6 %) would spend > 60 minutes on enjoyed PA ( $\chi^2=137.32$ ;  $p<0.0001$ ). Furthermore, when questioned on the rate of perceived exertion that participants would perform PA, a significant number of participants indicated "very easy" and "comfortable" (29.2%) as their level of intensity for most enjoyable PA ( $\chi^2=126.20$ ;  $p<0.0001$ ). The most preferred time of the day to perform PA was indicated by 70% of the participants, which was significantly more than any of the other times of the day ( $\chi^2=143.42$ ;  $p<0.0001$ ).

**TABLE 2: Descriptive statistics for the preferred modality of PA in the Setswana-speaking Potchefstroom adults**

PA preference variable		Men (n/%)	Women (n/%)	Total = N (%)	X <sup>2</sup>	df	p-value
Do you take part in PA	Yes	42 (84.0)	72 (90.0)	114(87.7)	73.90	1	<0.0001
	No	8(16.0)	8(10.0)	16 (12.3)			
Preferred/most enjoyed PA	Walking	19(38.0)	32(40.0)	51(39.2)	173.10	10	<0.0001
	Dancing	1 (2,0)	4(5.0)	5(3.8)			
	Dancing with choir singing	2(4.0)	2(2.5)	4(3.1)			
	Football	5(10.0)	-	5(3.8)			
	Running	2(4.0)	5(6.3)	7(5.4)			
	Rope skipping	-	1(1.3)	1(0.8)			
	Gardening	6(12.0)	10(12.5)	16(12.3)			
	Domestic work	1(2.0)	17(21.3)	18(13.8)			
	Cycling	5(10.0)	-	5(3.8)			
	Other	1(2.0)	1(1.3)	2(1.5)			
	Do not do exercise	8(16.0)	8(10.0)	16(12.3)			
	How many times per week	None applicable	8(16.0)	8(10.0)			
Less than 1x/week		-	5(6.3)	5(5.0)			
1x/week		6(12.0)	4(5.0)	10(7.7)			
2-3 x/week		9(18.0)	26(32.5)	35(26.9)			
4-5 x/week		13(26.0)	12(15.0)	25(19.2)			
6-7x/ week		14(28.0)	25(31.3)	39(30.0)			

**Table 2 (cont.)**

<b>PA preference variable</b>		<b>Total = N (%)</b>			<b>X<sup>2</sup></b>	<b>df</b>	<b>p-value</b>
How many minutes per session	>10 min.	1(2.0)	4(5.0)	5(3.8)	137.32	7	<0.0001
	10-19 min.	-	3(3.8)	3(2.3)			
	20-29 min.	1(2.0)	7(8.8)	8(6.2)			
	30-39 min.	7(14.0)	14(17.5)	21(16.2)			
	40-49 min.	6(12.0)	2(2.5)	8(6.2)			
	50-59 min.	4(8.0)	7(8.8)	11(8.5)			
	>60 min.	23(46.0)	35(43.8)	58(44.6)			
	Do not do PA	8(16.0)	8(10.0)	16(12.3)			
Rate of perceived exertion	Nothing	-	1(1.3)	1(0.8)	126.20	8	<0.0001
	Very easy	11(22.0)	27(33.8)	38(29.2)			
	Easy	6(12.0)	15(18.8)	21(16.2)			
	Comfortable	15(30.0)	23(28.7)	38(29.2)			
	Somewhat difficult	6(12.0)	4(5.0)	10(7.7)			
	Difficult	-	1(1.3)	1(0.8)			
	Hard	3(6.0)	-	3(2.3)			
	Exhausted	1(2.0)	1(1.3)	2(1.5)			
Do not do PA	8(16.0)	8(10.0)	16(12.3)				
Time of day	Morning (05:00-11:59am)	33(66.0)	58(72.5)	91(70.0)	143.42	3	<0.0001
	Afternoon (12:00-15:59pm)	2(4.0)	3(3.8)	5(3.8)			
	Evening (16:00-11:59pm)	7(14.0)	11(13.8)	18(13.8)			
	Do not do PA	8(16.0)	8(10.0)	16(12.3)			

### ***Demographic factors associated with PA preference***

The results for logistic regression model are presented in Table 3. The model revealed that being within the age range of 34-44 years was significantly associated with a greater likelihood of PA participation (OR = 8.75, CI = 1.33; 57.7), preferring to walk (OR = 6.18, CI = 1.47; 25.9), and time of the day to participate in PA (OR = 3.67, CI = 1.07; 12.5), but smaller likelihood of preferred number of times per week compared to people within 45-65 age group. Those who are single (OR = 0.08, CI = 0.01; 0.65), currently married (OR = 0.025, CI = 0.002; 0.37), and living with partner (OR = 0.015, CI = 0.001; 0.23) are significantly less likely associated with participation in PA, but significantly more likely correlated with preferred number of days per week of participation (OR = 12.2, CI = 1.52; 98.6; OR = 40.3, CI = 2.66; 611.0; and OR = 67.4, CI = 4.28; 1062.8) respectively. Meanwhile, only those who are living with partner was significantly associated with smaller likelihood of preferred time of the day (OR = 0.11, CI = 0.016; 0.80). Current employment status showed that those who engaged in casual (OR = 0.071, CI = 0.009; 0.52) and shift (OR = 0.06, CI = 0.006; 0.64) type of work are significantly less likely associated with walking compared to those that are not working. Participants who received less than a thousand rand per month was significantly less likely associated with walking (OR = 0.03, CI = 0.002; 0.57).

TABLE 3: Association between PA preference and demographic variable of the participants

PA preference variable	Participate in PA		Preferred walking activity		Preferred domestic duties		Preferred number of times/week		Preferred time of day	
	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
<b>Demographic</b>										
<b>Age</b>										
34-44	8.75 (1.33; 57.7)	0.024	6.18 (1.47; 25.9)	0.013	0.41 (0.05; 3.04)	0.390	0.11 (0.017; 0.75)	0.024	3.67 (1.07;12.5)	0.038
45-65	1		1		1		1		1	
<b>Male gender</b>	0.27 (0.06; 1.26)	0.098	0.96 (0.28; 3.30)	0.959	0.08 (0.005; 1.48)	0.091	3.63 (0.78; 16.7)	0.098	0.68 (0.23;1.95)	0.476
<b>Years of work</b>										
0-15	1.31 (0.20; 8.34)	0.774	0.23 (0.05; 1.006)	0.051	0.56 (0.09; 3.47)	0.538	0.76 (0.12; 4.84)	0.774	1.54 (0.39;6.00)	0.529
16-30	6.44 (0.88; 47.1)	0.066	0.19 (0.036; 1.03)	0.055	0.36 (0.05; 2.59)	0.311	0.15 (0.02; 1.13)	0.066	3.28 (0.74;14.4)	0.116
31-44	1		1		1		1		1	
<b>Marital status</b>										
Never married	0.08 (0.01; 0.65)	0.018	1.03 (0.09; 10.7)	0.978	0.547 (0.05; 5.27)	0.602	12.2 (1.52; 98.6)	0.018	0.20 (0.039;1.01)	0.053
Currently married	0.025 (0.002; 0.37)	0.008	0.44 (0.039; 5.05)	0.514	1.23 (0.07; 20.5)	0.881	40.3 (2.66; 611.0)	0.008	0.30 (0.05; 1.73)	0.182
Living with partner	0.015 (0.001; 0.23)	0.003	0.81 (0.06; 10.8)	0.876	0.31 (0.01; 9.48)	0.505	67.4 (4.28; 1062.8)	0.003	0.11 (0.016;0.80)	0.029
Widowed/separated/divorced	1		1		1		1		1	
<b>Education level</b>										
Below high school	4.11 (0.02; 760.7)	0.596	2.51 (0.06; 98.2)	0.623	-	-	0.24 (0.001; 45.0)	0.596	0.06 (0.003;1.35)	0.078
High school	1.57 (0.017; 150.0)	0.845	3.97 (0.19; 82.29)	0.372	-	-	0.63 (0.007; 60.5)	0.845	0.08 (0.005;1.46)	0.089
More than high school	1		1		1		1		1	
<b>Current employment</b>										
Full-time	1.16 (0.20; 6.55)	0.866	0.26 (0.05; 1.31)	0.103	1.96 (0.15; 24.4)	0.599	0.86 (0.15; 4.87)	0.866	2.57 (0.65; 10.1)	0.178
Shift	0.35 (0.029; 4.38)	0.419	0.06 (0.006; 0.64)	0.020	8.99 (0.38; 210.3)	0.172	2.82 (.022; 35.0)	0.419	0.67 (0.10; 4.39)	0.684
Casual work	0.28 (0.028; 2.95)	0.293	0.071 (0.009; 0.52)	0.010	3.68 (0.25; 54.1)	0.341	3.50 (0.33; 36.1)	0.293	0.42 (0.07; 2.47)	0.343
Not working	1		1		1		1		1	

<b>Occupation level</b>										
Skilled	0.10 (0.001; 8.91)	0.315	5.86 (0.25; 135.7)	0.270	-	-	9.96 (0.11; 885.7)	0.315	1.27 (0.07;21.9)	0.866
Unskilled	0.29 (0.006; 14.8)	0.543	0.69 (0.045; 10.5)	0.789	-	-	3.36 (0.06; 168.1)	0.543	0.84 (0.05; 12.5)	0.903
Professional	1		1		1		1		1	
<b>Earnings</b>										
<R1000	5.55 (0.148; 208.9)	0.354	0.03 (0.002; 0.57)	0.019	2.56 (0.036;185.0)	0.666	0.18 (0.005; 6.77)	0.354	2.69 (0.26; 27.9)	0.406
R1001-R5000	3.00 (0.12; 74.5)	0.502	0.32 (0.037; 2.83)	0.308	0.47 (0.01; 21.3)	0.698	0.33 (0.013; 8.25)	0.502	1.44 (0.19; 10.5)	0.717
>R5000	1		1		1		1		1	
<b>Brick house type</b>	1.59 (0.31; 8.05)	0.575	1.67 (0.41; 6.68)	0.469	1.05 (0.12; 8.94)	0.961	0.62 (0.12; 3.18)	0.575	1.08 (0.33;3.46)	0.892

**CI**-indicates confidence intervals; and **OR**, odds ratio.

$p \geq 0.05$ - The demographic variable such as age were classified to between 34-44 years, and 45-65 years. Years of work were classified as between 0-15 years, 16-30 years, and 31-44 years. Marital statuses were classified as never married, currently married, living with partner, and widowed/separated/divorced. Educations were classified as below high school, high school, and more than high school. Current employments were classified as full-time, shift, casual work and not working. Occupations were classified into skilled, unskilled, and professional. Earnings were classified into less than R1000, between R1001- R5000, and above R5000, while type of house lived were classified to brick house and informal house.

## DISCUSSION

The main finding of this study was that the majority of participants in the study reported that they were physically active. Walking was indicated as the most preferred and enjoyed type of activity by the majority of the participants. This finding supports what has been reported by various researchers (Trinh *et al.*, 2012; Christensen *et al.*, 2012; Philip *et al.*, 2014; Stevinson *et al.*, 2009; Ussher *et al.*, 2007), that reported walking as the most common form of physical activity. This finding is not surprising, considering the fact that the participants are from a low socio-economic area and active commuting by walking is a large part of daily life (Ford *et al.*, 1990). Walking is a low-cost activity that is easy for the majority of adults whom do not experience health limitations with regards to walking. . The majority of participants also reported willingness to participate in walking activities six to seven times (6-7 times) per week. These findings are most probably based on the fact that the participants are already performing activities on most days of the week. The participants therefore in fact adhere to the recommendations presented in the generally accepted guidelines of PA participation on most days of the week. The accumulation of PA can be obtained either in short (10 minutes) or long (30-60 minutes) bouts to meet the energy expenditure goals (McGowan *et al.*, 2013) for general health maintenance. The findings from this study indicate that the participants are also willing and prefer to partake in at least 60 minutes of PA per day. The finding can also be interpreted against the background of the participants commuting by means of walking to and from work, as well as the performance of potential manual labour in unskilled-work related activities.

Furthermore, more than or equal to 150 minutes of moderate intensity PA is advocated three to five times per week to maintain general health of the body. One of the most used psychophysical tools in assessing the subjective intensity during the exercise programme is the rating of perceived exertion scale (McGowan *et al.*, 2013). Rate of perceived exertion preferred for physical activity from the community dwellers, indicated “very easy” and “comfortable” exertion. This indicates that the volume of exercise for improved health outcomes such as a reduction in risk factors for NCDs and improved QoL would not be achieved. The reason being that the intensity of PA that is preferred is not sufficient to elicit an improvement (Lambert & Kolbe-Alexander, 2006) in this population.

Regarding the most preferred time of the day to perform physical activity/exercise, the majority (70%) of the participants of this study preferred to perform exercise in the morning. This was corroborated by the study of Atkinson and Reilly (1995) which examined the effect of age and time of the day on preferred work rates during prolonged, self-paced exercise at two time frames of the day. Participants (eight young athletes between the age of 19-25 and eight old athletes between the age of 48-62 years) were told to pedal on a Monark cycle ergometer at 07h00 (morning) and 17h00 (evening) at their self-preferred intensity that could be sustained for 80 minutes. The results showed that the participants' average rate of work remained constant throughout the time of exercise in the morning session compared to the evening session. Stevinson *et al.* (2009) in their study to determine the preferences of ovarian cancer survivors regarding PA participation, a population-based postal survey among 359 women in Canada, revealed that morning (48.9%) was best considered as the most preferred time of the day to exercise. Our findings indicate that in healthy community-dwelling persons, morning is also the most preferred time for PA. Within the South African context this finding may be due to the good climate and least likelihood of detrimental weather conditions in the morning.

Participation in PA, preferred modality, duration, time of the day, and intensity of PA were associated with age, gender, year of work, marital status, current employment, occupation levels, earnings, and education levels. These findings were supported by Stevinson *et al.* (2009) and McGowan *et al.* (2013) that demographic variables such as marital status, age, education, employment and earnings were mostly associated with PA preference. The finding for marital status revealed that those who never married, currently married, and living with partner are significantly less likely to be associated with physical activity participation, but significantly more likely associated with the preference to participate in physical activity 6-7 times in a week. It was interesting to see that married men and women in this study were less active which corroborated with the findings of Dowda *et al.* (2003). Meanwhile, for those who are married, it has been observed that marriage does not influence PA, but child bearing significantly lower PA by almost three hours per week compared to those who do not have children (Hull *et al.*, 2010). The results suggest that those who are currently married and have children could possibly be less likely to participate in PA.

Our findings that indicate people relatively young (aged between 34-44 years) being six times more likely to be involvement in PA and preferring walking activity, compared to older persons, support the findings by Short *et al.* (2014). This finding also shows the utmost agility and dynamism of young adults and preference to walk from one location to the other (Phillip *et al.*,

2014) in the morning, preferably 6-7 times per week. Observationally, the work force of a nation may be clustered within this age group. Furthermore, the levels of productivity may also be high within this age group although, assessing productivity level might be a challenge.

The findings of this study revealed that those who received less than a thousand rand (\$70) per month were significantly less likely to prefer walking. Shelton *et al.* (2011) who examined the influence of communal factors on PA in a large sample of low-income earners in the United States also reported a low likelihood of PA when the level of income was low. One of the reasons found was that the people who received low income may have limited communal links and might result in living inactive lifestyle. This result suggests that having many social connections might bring about a higher preference in walking activity. Lack of sufficient income may lead to lack of social engagements and non-wellness manners, which may negatively impact health and quality of life (Shelton *et al.*, 2011). On the other hand, the findings of this study was contrary to the study of Stevinson *et al.* (2009) and McGowan *et al.* (2013) who found that the preference for walking might be stronger for participants with low-income earners.

Furthermore, those who do casual type of work and shift job might not likely prefer walking activity. Shift and casual work could involve a specific number of hours outside the traditional regular day-time work, and might fluctuate. Inability to find a standard job or full time type of work has been found to be associated with low levels of PA (Bushnell *et al.*, 2010). On the other hand, sleep deficiency for those who work night shift or PA happening at uncommon time of the day could limit their PA participation, specifically walking activity (Atkinson *et al.*, 2008). Individual with low education levels might not consider walking as important due to their lack of understanding the advantage of regular PA. Therefore, there is a need to strongly advocate and embark on the physical active lifestyle promotion educational program, for those with low qualification and knowledge level (Hong *et al.*, 2007), most especially for those who are not skilled (Short *et al.*, 2014).

Evidently, PA interventions tailored according to individual preference based on duration, intensity and mode is beneficial to persons due to improvement of health outcomes (Wilcox *et al.*, 1999). The findings from this study should be interpreted against the background of the following limitations. The study was conducted on an available population, from Tswana decent

only, which means that the findings cannot be generalised. Also to be considered is the low level of sample used in this study which may have likely generates imprecise results due to small within group sample. The strength of this study is that it is a first study to investigate the preferred types of PA on which future PA interventions can be based to improve health outcomes.

## **CONCLUSION**

In conclusion the findings from this study indicate that adults Setswana-speaking community-dwelling persons prefer walking in the morning as a form of PA. Walking on most days of the weeks is preferred, but at a low intensity. The findings from this study will direct future PA interventions on the type, duration and intensity of PA interventions in communities to improve health outcomes and QoL.

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## CHAPTER 6: ARTICLE 4

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### **Managing non-communicable diseases in an African community: Effects, compliance, and barriers to participation in a four-week exercise intervention**

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Running title: Compliance and barriers to physical activity intervention in NCDs

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## **Abstract**

**Objective:** To determine the compliance, barriers, and effects of participation in a four-week exercise intervention to reduce risk factors for NCDs among Setswana-speaking community-dwelling Potchefstroom adults from a low resourced area of South Africa. **Design:** An exercise program and associated pre-post test were performed by 76 participants (men, n= 26 and women, n= 50) aged 35 to 65 years. Baseline and end tests included height, weight, hip and waist circumference, heart rate, blood pressure, glucose, cholesterol, quality of life, and cardiorespiratory fitness measurements. The intervention consisted of three days/week combined aerobic and resistance exercise at an intensity of 70% HRR as determined at baseline. Compliance and barriers to participation were determined post-intervention by means of attendance registers and interviews. ANCOVA with adjustment for pre-test was performed for all repeated variables. The Cronbach's alpha coefficients for exercise benefits were 0.81 and for barriers 0.84. **Results:** Of the 26 men ( $40.8 \pm 5.45$  years) and 50 women ( $43.6 \pm 7.8$  years) recruited, 54 completed the intervention (71% compliance). The four-week aerobic exercise intervention significantly reduced body mass, RPE and MCS in men, and body mass, BMI,  $\dot{V}O_2$  max, RPE, glucose, PCS and MCS in women. Participants reported that the exercise milieu as a major barrier to exercise compliance while the interviews reported lack of time. **Conclusion:** A one month exercise intervention elucidated positive changes in risk factors for NCDs in a low-resource community. A drop-out rate of 29 % in this study is consistent with other exercise intervention trials. Exploration of the reported barriers may be useful for planning to increase compliance with future programs.

## **Keywords**

Physical activity intervention, cardiorespiratory fitness, quality of life, non-communicable diseases, adults, Setswana

## Introduction

The main goal of Healthy People 2020 is to achieve health equity, eliminate disparities and improve overall health for all [1]. Consequently, the risk factors linked to non-communicable diseases as a result of a detrimental lifestyle have been cited several times in literature [1]. The diseases most cited are increased risk of coronary heart disease, Type 2 diabetes, cancer, hypertension, dyslipidaemia, stroke, liver disease, gall-bladder disease, sleep apnoea, respiratory problems and osteoarthritis, low quality of life (QoL) and physical inactivity [1]. Regular physical activity (PA) and exercise is beneficial by improving the overall health and aerobic capacity and minimizing the afore-mentioned risks factor and chronic diseases of lifestyle [1, 2]. The World Health Organization (WHO) physical activity guidelines recommend that, adults should accumulate at least 150 minutes per week of moderate intensity PA or 75 minutes of vigorous-intensity aerobic PA or a combination of the two [3]. The same guidelines are currently advocated for South Africa [4]. In spite of the guidelines, more than 50% of South Africans are not sufficiently physically active to elucidate health improvement [5].

In conjunction with the high levels of physical inactivity in South Africa more than 28.5% of all deaths occur from chronic diseases of lifestyle in persons between the age of 35 and 64 years while more than 56% of the population between ages 15-64 years has at least one modifiable risk factor for chronic disease of lifestyle [4]. South Africa is a country where many communities are still going through rapid epidemiological, nutrition and demographic transition [4]. It was reported that the level of PA in the urban population mirrored the level of PA in developed nations because South Africa is seen as a sporting nation [4], the changes in PA levels among the urban populace is not reflected in low-resourced communities due to a lack of facilities [6, 7], a safe environment [8] and poverty [9]. Therefore based on these barriers, the proportion of the South African population that is participating in PA is decreasing in low resource communities despite the known benefits of regular PA on health outcomes. However, *Healthy People 2020* has specified that physical inactivity needs to be addressed as a matter of urgency in order to decrease the number of adults who do not participate in regular PA [1].

Regular PA at intensities presented by the guidelines improves cardiorespiratory fitness (CRF) [10]. In addition, research indicated that PA and CRF are linked to a sound mental ability [11] and functional work capacity [12]. This improvement in mental ability and functional capacity

could be linked to the two component summary (mental and physical) of the health-related quality of life assessment. A known relationships exist between PA and risk factors for chronic diseases of lifestyle, therefore, aerobic PA interventions should be developed and implemented [13] to reduce risk factors for chronic diseases and improve the aerobic capacity, and health related quality of life (HRQoL) of people. Additionally, a community-based physical exercise intervention that targets many individuals coupled with modern exercise recommendations for frequency, intensity and duration are key to a solution [13].

In a study by Gordon *et al.* [14], a community-based aerobic exercise training on the functional status and health-related quality of chronic stroke survivors, a randomized controlled trial study involving 64 participants who exercised for 30 minutes, 3 times per week for 12 weeks showed that there was an improvement in the physical components of QoL and fitness levels of the participants. A high quality systematic review to identify controlled community-based PA interventions published between 2001 and 2012 comprising 55 studies with 20,532 participants reveals that half of the studies reported a positive exercise intervention outcome [15]. Arslan [16] studied the effect of eight-week step-aerobic dance exercise on body composition among 49 healthy sedentary women and found that there were significant improvements in body mass index (BMI), body weight, waist-hip ratio (WHR), waist circumference (WC), fat percentage, lean body mass (LBM) and basal metabolic rate (BMR) in the experimental group after eight weeks. Regular PA can lead to a significant change by reducing many health risk factors. Ickes and Sharma [1] reviewed existing community-based PA intervention on Hispanic adults between 1988 and 2011 for which family-based and faith-based settings were represented. The report of the review shows that in relation to PA, each of the intervention was successful.

Another important situation which could threaten the recommendations stated above are those barriers which could negatively affect adults' PA participation such as age, income, time, motivation, physique (in terms of obesity and overweight) and poor health perception [1]. These barriers stated above could cause a high rate of dropout during a structured aerobic exercise intervention. Nam *et al.* [17] reported 27% dropped out rate among the participants randomised into exercise intervention group and 10% dropped out rate in control group. It is therefore important to consider these challenges and barriers and minimise them. South Africa is a community regarded as a transitional process community for which a development of successful community-based physical activity interventions is related in parts to overcoming cultural, socio-demographic, physical and financial barriers to participation [4]. There are thus very few community-based interventions for lifestyle and physical activity data, with the exception of one

regional initiative aimed at increasing participation in PA. This was the Community Health Intervention Programmes (CHIPS) which was organised among privately funded and non-profit academic institutions and a national insurance company [4]. The programme aimed at promoting good health among both adults and children in communities by involving them in regular PA to improve general well-being [4]. Therefore, this study has been specifically designed to examine the compliance, barriers, and effect of a four-week exercise intervention on risk factors for non-communicable diseases (NCDs) among Setswana speaking community-dwelling Potchefstroom adults from a low-resourced area. The findings from this study will form the basis of future PA interventions in other low-resourced communities in South Africa or the rest of Africa to improve PA adherence.

## **Method**

### ***Research design***

This was a pre-test post-test exercise intervention study primarily designed to determine the compliance, barriers and effect of aerobic exercise intervention on NCD risk factors among adult Setswana speaking-community-dwellers aged 35-65 years in a low-resourced community from Potchefstroom.

### ***Participants***

Seventy six (76) men (n=26) and women (n=50) aged between 35 and 65 years were recruited from the Kenneth Kaunda district, a low-resourced area in Potchefstroom. All the participants gave voluntary, informed consent in writing before participating in the study. The study was approved by the Health Research Ethics Committee for Humans from the North-West University (NWU 00002-14-A1). The participants were asked to provide demographic information: date of birth, age, sex, marital status, current employment status, level of education, type of house in which they live and household income. Apparently healthy Setswana-speaking men and women, aged 35-65 years, with no orthopaedic limitations were included in the study. Persons were considered “apparently healthy” if they were not taking any chronic medication or diagnosed with any known diseases. Potential participants who showed any signs of chronic disease [18] or answered “yes” to any question on the physical activity readiness questionnaire (PAR-Q) were asked to see their physician for a letter confirming suitability to participate. However, only participants with a low risk for exercise were included in the study. People with blood pressure

higher than 160mmHg (systolic) or 95mmHg (diastolic), or had a temperature > 37.5°C, as well as pregnant or lactating women, were excluded.

### ***Anthropometric measurements***

Participants' height, body weight and body circumference of the waist and hip were measured according to the protocol of the International Society for the Advancement of Kin-anthropometry (ISAK) [19]. Waist-hip ratios (WHR) were calculated by dividing the waist measurement by the circumference obtained for the hips [20]. Body mass index (BMI) was calculated by dividing the weight in kilograms by the square of the height in meters (kg/m<sup>2</sup>) [21].

### ***Blood pressure and heart rate***

Resting blood pressure was measured after participants had rested for 10 minutes in a semi-recumbent position. Blood pressure (BP) was measured with a sphygmomanometer (Omron Xinxiang Golden Elephant Sci-Tech Co., Ltd., China) using the Riva-Rocci/Korotkoff method on the left arm [22]. Duplicate measures were taken with a five minute resting period between each measurement. The average of the two measurements was used in the statistical analyses. The pulse rate was measured with a stethoscope (3M™ Littmann® Stethoscope, USA) by counting the beats in a set period of 15 seconds and multiplying by 4 to arrive at the number of beats per minute (BPM). Maximal heart rate and blood pressure were also measured by the same method immediately at the end of the cardiorespiratory fitness step test while in a sitting position.

### ***Fasting peripheral blood measurements***

Fasting peripheral blood measurements of glucose and total cholesterol were measured by puncturing a finger with a lancet and applying a drop of blood on a strip for automatic analyses with the Accutrend® Plus (Roche, Germany) according to the user's manual [23]. The calibration of the Accutrend® machine was performed by inserting the code on the meter batch-related strip before taking the first measurement.

### ***Questionnaires***

#### ***Health related Quality of Life Short Form-8 Survey (SF-8)***

The South Africa Setswana version of the SF-8, a translated version of the original SF-8, is an eight-itemized questionnaire which measures the following broad domains: Physical Functioning (PF), Role-Physical (RP), Body Pain (BP), General Health (GH), Vitality (VT), Social Functioning (SF), Role-Emotional (RE) and Mental Health (MH). The SF-8 has two component

measurements, namely, the physical components summary (PCS) and the mental components summary (MCS). The scoring in Setswana version of SF-8 was based on this two-component summary (PCS & MCS) and was calculated by weighting each SF-8 item using a norm-based procedure in the instrument guidelines. The Setswana version of SF-8 was a 5 and 6 Likert scale questionnaire respectively (i.e. the options are either 5 or 6 of which the participant can only select one). The participants were requested to complete the questionnaire during the pre-test (baseline) and post-test. The post-test questionnaire was completed four weeks after the exercise intervention programme.

#### *Perceived exercise benefits and barriers scale (EBBS)*

Perceived benefit and barrier strengths to participation in exercise were evaluated by the perceived exercise benefits and barriers scale (EBBS) questionnaire, which was categorised into two different components (as it reflected in the name above):

- 1) the benefits of exercise, and
- 2) the barriers of exercise.

For the exercise benefit category, twenty-nine (29) items were categorised into five sub-scales which were:

- a) life enhancement
- b) physical performance
- c) psychological outlook
- d) social interaction, and
- e) preventative health.

For the exercise barrier category, fourteen (14) items were categorised into four (4) sub-scales which were:

- a) exercise milieu
- b) time expenditure
- c) physical exertion, and
- d) family discouragement.

The items under the two categories of this questionnaire can be scored on a compulsory-choice 4-point Likert scale [(1= strongly agree (SA), 2=agree (A), 3=disagree (D) and 4=strongly disagree (SD)] response format. The internal consistency (alpha) for the exercise benefits scale

was 0.95, and for the barrier scale was 0.86. The test-retest reliability for the benefits scale was 0.89 and barriers scale was 0.77 [24]. Table 1 represents the Scales and Sub-scales of the Exercise Benefits/Barriers Questionnaire.

Table 1: Scales and sub-scales of the Exercise Benefits/Barriers Questionnaire

Perceived Benefits to Exercise (29 items)	Perceived Barriers to Exercise (14 items)
Life enhancement (8 items)	Exercise milieu (6 items)
Physical performance (8 items)	Time expenditure (3 items)
Psychological outlook (6 items)	Physical exertion (3 items)
Social interaction (4 items)	Family discouragement (2 items)
Preventative health (3 items)	

*Source:* Scales and sub-scales of the exercise benefits/barriers questionnaire [24].

### *Cardio-respiratory fitness measurements*

Cardio-respiratory fitness (CRF) by means of an eight-minute step test assisted with a combined heart rate and accelerometry device (Actiheart<sup>®</sup>, CamNTEch, UK) that calculate a predicted CRF in the format of a relative  $\dot{V}O_{2 \max}$  [25]. The 8-minute step test was performed by stepping on a 21.5 cm box with a speed that ramps linearly from 15 step cycles (one step cycle is “up-up, down-down”) per minute to 33 step cycles per minute by the end of the test. The stepping speed of the software was dictated by a metronome beat testing each person individually. After the 8-minute step test, the participant was requested to stay seated for two minutes without talking in order to determine the recovery heart rate. CRF was estimated relative  $\dot{V}O_{2 \max}$  in ml/min/kg.

### **Exercise intervention**

Planning for the exercise intervention programme was based on the findings of the Preferred PA questionnaires, and set at three days a week for a period of four weeks. The intervention was aimed at obtaining 70% of peak  $\dot{V}O_{2 \max}$  maximum heart rate during the exercise for a period of 45 minutes. The intervention consisted of five-minute warm-up, 20 minutes of aerobic exercises, 15 minutes of muscle strength and endurance by means of body weight, and five minutes flexibility for cool down. Pulse rate was monitored by counting the pulse at the wrist for 10 seconds during the aerobic exercise intervention and multiplying by six to determine the intensity of the exercise. The Modified Borg scale for rate of perceived exertion (RPE) was used to assess participants’ perceptions of exertion during the aerobic exercise on the 1-10 scale [26]. Participants’ compliance to the exercise intervention was determined by means of an attendance

register. All the participants raised their heart rates adequately to obtaining VO<sub>2</sub>max aimed at during the aerobic exercise intervention. Compliance was calculated as a percentage of sessions attended out of the maximum 12 training sessions.

### **Semi-structured interviews**

In order to understand the reasons why people participated or dropped out of the exercise intervention, semi-structured individual interviews were undertaken. Two (2) major interview questions were developed from a brief literature review of the main construct of benefits and barriers for exercise. Questions posed during the interviews were:

- 1) What is the reason that you attended the programme?
- 2) What is the reason why you did not participate in the programme?

The interviews (N=15) were audio recorded with permission. Nine (9) [Men=3, Women=6] participants who completed the exercise intervention and six (6) [Men=2, Women=4] participants who did not complete the exercise intervention, were interviewed. The information obtained from the interviews was to obtain an in depth understanding of the perceived benefits and barriers for participation in exercise for which the responses were audio recorded.

### *Data analyses*

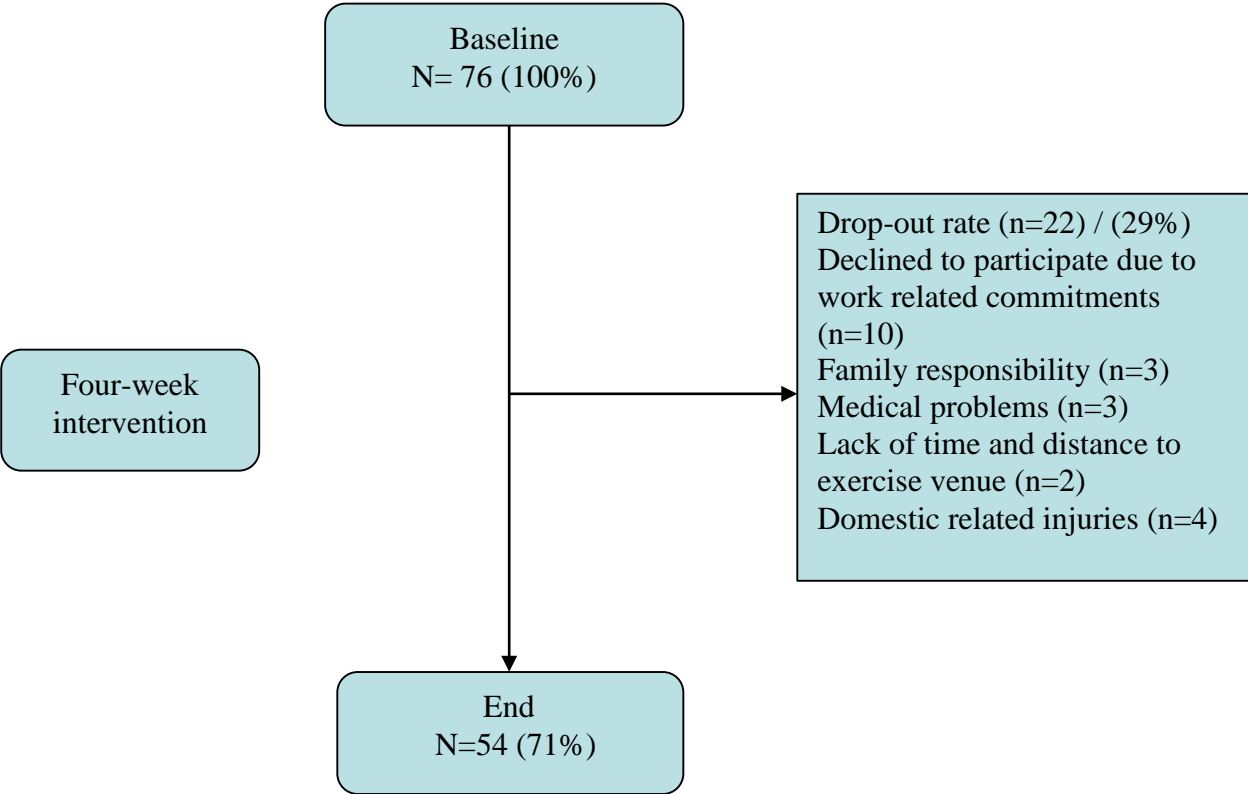
Data analyses were carried out using the Statistical Package for Social Science (SPSS) software Version 22.0 [27]. All statistical tests were two-tailed, and  $p \leq 0.05$  was considered statistically significant. Descriptive statistics, such as mean, standard deviation, and percentages were used to examine the baseline characteristics of the participants. Independent sample *t*-tests were performed to determine the significant difference of the baseline variables between men and women. A normality test for all variables was assessed using the Shapiro-Wilk test. Variables which were not normally distributed (<sup>b</sup>) were analysed by Wilcoxon matched-pairs signed-rank test. Variable which were normally distributed (<sup>a</sup>) were analysed by a paired sample *t*-test. For the pre and post QoL measure, two QoL indicators were used, namely, PCS and MCS, to assess the changes in the QoL components due to the PA intervention. Analysis of covariance (ANCOVA) was performed to determine if the changes from baseline to end were significant, adjusting for baseline (pre-test). Internal consistency of the EBBS was assessed using the Cronbach's alpha coefficient calculated for the scale. A coefficient alpha of 0.70 or greater is generally considered to be acceptable. Furthermore, mean and standard deviation were computed

for each sub-scale of EBBS to allow straight forward comparisons between each sub-scale. The recordings of the response from the interview were transcribed verbatim to support the real data and trustworthiness and used as a quote using code manager and code family manager, and analysed for major themes using AtlasTi7 (ATLAS.ti Scientific Software Development GmbH, Berlin).

**Results**

*Participants*

Of the 76 (100%) participants who enrolled and participated in the first assessment (baseline), only 54 (71%) completed the four-week aerobic exercise intervention programme (See Figure 1). Twenty-two participants (29%) dropped-out from baseline to end. Their reasons were due to work-related commitments (n=10), family responsibilities (n=3), medical problems (n=3), lack of time and distance to exercise venue (n=2), and domestic-related injuries (n=4). Meanwhile, the internal consistencies based on the samples of this current study for benefits scale was 0.81 and barriers scale was 0.84.



**Figure 1. Flow of participants during the intervention**

### Baseline characteristics

The baseline characteristics of the participants revealed that the participants were in their early forties (Table 2). Men are taller and thinner than the women in this study and less fit. From the HRQoL questionnaire data, it would appear that the men are physically stronger than the women, while the women scored higher in the mental component. Both men and women reported BP measurements above the ideal value of 120/80 mmHg.

Table 2. Baseline characteristics of the total group and per gender (Mean±SD)

Variables	N	Total	Men	Women	P-value
		Mean±SD	Mean±SD	Mean±SD	
Age (years)	76	42.6±7.20	40.8±5.48	43.6±7.78	0.11
Work experience (years)	76	11.6±9.90	11.0±8.58	11.9±10.5	0.73
Height (m)	76	1.62±0.09	1.71±0.09	1.57±0.06	0.00*
Body Mass (kg)	76	79.5±19.8	77.1±20.0	80.6±19.8	0.47
Body mass index (kg/m <sup>2</sup> )	76	30.4±8.30	26.1±6.02	32.5±8.49	0.00*
Waist-hip ratio	76	0.83±0.08	0.88±0.06	0.80±0.07	0.00*
Systolic BP (mmHg)	76	126.9±14.3	125.8±15.6	127.3±13.6	0.67
Diastolic BP (mmHg)	76	83.7±11.6	82.9±15.0	84.0±9.42	0.70
Resting Heart Rate (bpm)	76	80.5±12.8	79.0±13.7	81.2±12.2	0.47
Glucose (mmol/L)	76	5.20±1.60	4.97±1.23	5.25±1.69	0.46
Total Cholesterol (mmol/L)	76	4.60±0.60	4.55±0.68	4.59±0.55	0.76
Relative $\dot{V}O_{2\max}$ (ml/kg/min)	69	27.8±5.13	31.3±5.37	25.7±3.75	0.00*
Rate of perceived exertion	69	3.85±0.85	3.60±0.82	4.00±0.84	0.58
Physical component summary	54	49.9±8.78	54.4±6.59	48.1±8.96	0.02*
Mental component summary	54	50.4±8.91	48.7±9.26	50.9±8.81	0.42

\* Significant difference between men and women  $p \leq 0.05$ ;  $\dot{V}O_{2\max}$  - maximum oxygen consumption; bpm-beats per minute

These results demonstrate that men and women recruited for this study were significantly different to each other in at least five key ways. The women were significantly shorter than the men, therefore also reporting a BMI higher than the men and categorized as obese. The men

however reported significant higher fitness levels than the women as well as a significantly higher physical component summary than the women for QoL. Because of these baseline differences, all subsequent analyses were completed according to men and women sub-groupings. The baseline and end data for men and women who started and completed the aerobic exercise intervention includes 54 participants. The NCD risk factor measurements are summarized in Table 3 and are reported as overall mean values for each risk factor. The drop-out rate in this current study was 29%. The mean score for the age of the participants shows that women were slightly older than men. Overall improvements on the health-related quality of life of the participants were noticed at the end of four-week exercise intervention. The results of the ANCOVA evaluating the change from baseline to end of the exercise intervention shows that there was no statistically significant difference in all the variables between the groups when adjusted for the covariates (pre-test) ( $p \leq 0.05$ ). Covariates were height, weight, BMI, WHR, systolic, diastolic, RHR, glucose, cholesterol, predicted maximum oxygen consumption, RPE, PCS and MCS.

Table 3. The descriptive statistics of changes in variables from baseline to end for men and women who started and completed the aerobic exercise intervention

Variables	Men				Women			
	<i>N</i>	Baseline	End	P-value	<i>N</i>	Baseline	End	P-value
Age (years)	15	39.6±4.59			39	42.6±7.44		
Height (m)	15	1.73±0.10	1.73±0.10	0.41 <sup>a</sup>	39	1.58±0.06	1.58±0.06	0.12 <sup>a</sup>
Body Mass (kg)	15	80.9±23.9	79.9±23.8	0.02 <sup>b*</sup>	39	80.4±19.0	79.5±19.4	0.00 <sup>a*</sup>
BMI (kg/m <sup>2</sup> )	15	26.2±7.06	26.3±7.10	0.41 <sup>a</sup>	39	31.6±7.82	31.9±8.05	0.003 <sup>a*</sup>
WHR	15	0.87±0.07	0.86±0.67	0.17 <sup>a</sup>	39	0.79±0.07	0.78±0.08	0.15 <sup>a</sup>
SBP (mmHg)	15	129.6±15.8	126.8±12.2	0.25 <sup>a</sup>	39	126.7±13.1	123.5±15.2	0.05 <sup>a</sup>
DBP (mmHg)	15	85.4±17.5	82.8±14.9	0.23 <sup>b</sup>	39	83.4±9.88	83.9±9.83	0.73 <sup>a</sup>
RHR (bpm)	15	74.6±10.6	75.2±14.4	0.83 <sup>a</sup>	39	77.5±10.0	77.7±11.7	0.89 <sup>a</sup>
FBG (mmol.L)	15	4.88±0.79	5.21±1.85	0.53 <sup>a</sup>	39	5.20±1.84	4.75±1.85	0.04 <sup>b*</sup>
FTC (mmol.L)	15	4.70±0.81	4.69±0.93	0.77 <sup>b</sup>	39	4.57±0.52	4.84±0.86	0.07 <sup>b</sup>
$\dot{V}O_2$ max (ml/kg/min)	15	33.5±5.11	32.2±5.62	0.19 <sup>a</sup>	39	25.9±3.72	28.0±3.64	0.003 <sup>a*</sup>
RPE	15	3.53±0.91	3.06±0.96	0.03 <sup>a*</sup>	39	3.94±0.85	3.43±0.82	0.00 <sup>b*</sup>
PCS	15	54.4±6.59	55.8±3.41	0.36 <sup>a</sup>	39	48.1±8.96	55.7±4.38	0.00 <sup>b*</sup>
MCS	15	48.7±9.26	55.9±4.19	0.003 <sup>b*</sup>	39	50.9±8.81	55.1±4.95	0.00 <sup>b*</sup>

<sup>a</sup> *p*-value calculated from paired sample *t*- test; <sup>b</sup> *p*-value calculated from Wilcoxon matched-pairs signed-rank test. BMI; bpm-beats per minute.

The results of the improvement in the HRQoL of the participants measured based on the 8 broad domains of the SF-8 questionnaire are summarised in Table 4.

Table 4. The descriptive statistics of changes in HRQoL variables for baseline and end for men and women who started and completed the aerobic exercise intervention

Variables	Men				Women			
	<i>N</i>	Baseline	End	P-value	<i>N</i>	Baseline	End	P-value
Age (years)	15	39.6±4.59			39	42.6±7.44		
Physical functioning (PF)	15	49.8±7.33	52.1±2.79	0.299 <sup>b</sup>	39	46.3±9.91	52.3±3.16	.000 <sup>b*</sup>
Role physical (RP)	15	50.3±7.50	52.5±2.92	0.197 <sup>b</sup>	39	47.0±8.25	52.6±3.31	.000 <sup>b*</sup>
Body pain (BP)	15	57.6±6.68	58.0±6.22	0.317 <sup>b</sup>	39	50.6±11.4	56.6±6.28	.001 <sup>b*</sup>
General health (GH)	15	50.1±7.58	53.6±6.22	0.178 <sup>a</sup>	39	48.3±7.87	54.1±7.21	.001 <sup>b*</sup>
Vitality (VT)	15	54.4±9.46	59.8±4.61	0.057 <sup>b</sup>	39	52.6±10.9	59.8±3.64	.000 <sup>b*</sup>
Social functioning (SF)	15	47.7±10.9	52.9±2.93	0.223 <sup>b</sup>	39	50.2±8.30	53.4±3.79	.007 <sup>b*</sup>
Role emotional (RE)	15	48.8±3.49	50.6±3.09	0.102 <sup>b</sup>	39	46.8±7.96	49.3±5.22	.017 <sup>b*</sup>
Mental health (MH)	15	47.2±10.3	53.8±4.71	0.017 <sup>b*</sup>	39	49.3±8.93	53.2±4.44	.001 <sup>b*</sup>
PCS	15	54.4±6.59	55.8±3.41	0.357 <sup>a</sup>	39	48.1±8.96	55.7±4.38	.000 <sup>b*</sup>
MCS	15	48.7±9.26	55.9±4.19	0.003 <sup>b*</sup>	39	50.9±8.81	55.1±4.95	.000 <sup>b*</sup>

<sup>a</sup> p-value calculated from paired sample *t*- test; <sup>b</sup> p-value calculated from Wilcoxon matched-pairs signed-rank test.

Table 5: Mean and standard deviation of each exercise benefits scale questionnaire item.

Perceived Benefit Items		Total			Men			Women		
		<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>
Life Enhancement Sub-scale										
25	My disposition is improved by exercise	54	1.72	0.63	15	1.80	0.60	39	1.69	0.70
26	Exercising helps me sleep better at night	54	1.30	0.50	15	1.60	0.63	39	1.17	0.40
29	Exercise helps me decrease fatigue	54	1.61	0.87	15	1.93	0.60	39	1.89	0.97
32	Exercising improves my self-concept	54	1.61	0.78	15	1.53	0.64	39	1.64	0.84
34	Exercising increases my mental alertness	54	1.61	0.85	15	1.60	0.91	39	1.62	0.85
35	Exercise allows me to carry out normal activities without becoming tired	54	1.44	0.57	15	1.70	0.72	39	1.35	0.50
36	Exercise improves the quality of my work	54	1.50	0.54	15	1.60	0.63	39	1.46	0.51
41	Exercise improves overall body functioning for me	54	1.56	0.63	15	1.40	0.51	39	1.62	0.70
Physical performance Sub-scale										
7	Exercise increases my muscle strength	54	1.57	0.63	15	1.80	0.86	39	1.49	0.51
15	Exercising increases my level of physical fitness	54	1.56	0.69	15	1.60	0.83	39	1.54	0.50
17	My muscle tone is improved with exercise	54	1.59	0.63	15	1.70	0.62	39	1.56	0.64
18	Exercising improves functioning of my cardiovascular system	54	1.44	0.57	15	1.50	0.64	39	1.44	0.60
22	Exercise increases my stamina	54	1.61	0.63	15	1.70	0.62	39	1.59	0.64
23	Exercise improves my flexibility	54	1.50	0.51	15	1.60	0.51	39	1.46	0.51
31	My physical endurance is improved by exercising	54	1.57	0.63	15	1.53	0.64	39	1.59	0.64
43	Exercise improves the way my body looks	54	1.43	0.60	15	1.40	0.63	39	1.44	0.60
Psychological Outlook Sub-scale										

1	I enjoy exercise	54	1.00	0.00	15	1.00	0.00	39	1.00	0.00
2	Exercise decreases feelings of stress and tension for me	54	1.44	0.57	15	1.50	0.64	39	1.44	0.60
3	Exercise improves my mental health	54	1.52	0.66	15	1.40	0.51	39	1.56	0.72
8	Exercise gives me a sense of personal accomplishment	54	1.54	0.54	15	1.40	0.51	39	1.59	0.55
10	Exercising makes me feel relaxed	54	1.46	0.61	15	1.53	0.64	39	1.44	0.60
20	I have improved feelings of well-being from exercise	54	1.48	0.61	15	1.70	0.82	39	1.41	0.50
Social Interaction Sub-scale										
11	Exercising lets me have contact with friends and persons I enjoy	54	1.74	0.73	15	1.80	0.80	39	1.72	0.72
30	Exercising is a good way for me to meet new people	54	1.79	0.76	15	1.93	0.80	39	1.74	0.60
38	Exercise is good entertainment for me	54	1.57	0.60	15	1.60	0.83	39	1.56	0.50
39	Exercising increases my acceptance by others	54	1.93	0.84	15	1.90	0.83	39	1.95	0.86
Preventive Health Sub-scale										
5	I will prevent heart attacks by exercising	54	1.37	0.48	15	1.53	0.52	39	1.31	0.50
13	Exercising will keep me from having high blood pressure	54	1.72	0.85	15	1.73	0.90	39	1.72	0.86
27	I will live longer if I exercise	54	1.59	0.84	15	1.73	0.90	39	1.54	0.82

Table 6. Mean and standard deviation of each exercise barrier scale questionnaire item

Perceived Barriers Items	Total			Men			Women			
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	
<b>Exercise Milieu Sub-scale</b>										
9	Places for me to exercise are too far away	54	2.65	0.87	15	2.53	0.92	39	2.70	0.90
12	I am too embarrassed to exercise	54	3.15	0.86	15	2.93	1.00	39	3.23	0.80
14	It costs too much money to exercise	54	3.02	0.92	15	2.53	0.83	39	3.21	0.90
16	Exercise facilities do not have convenient schedules for me	54	2.72	0.96	15	2.53	0.99	39	2.80	0.95
28	I think people in exercise clothes look funny	54	3.10	0.86	15	2.60	0.91	39	3.23	0.80
42	There are too few places for me to exercise	54	2.59	0.96	15	2.50	0.92	39	2.64	0.99
<b>Time Expenditure Sub-scale</b>										
4	Exercising takes too much of my time	54	2.78	0.82	15	2.70	0.62	39	2.82	0.90
24	Exercise takes too much time from family relationships	54	3.10	0.75	15	2.73	0.80	39	3.21	0.70
37	Exercise takes too much time from my family responsibilities	54	2.96	0.91	15	2.73	0.96	39	3.10	0.90
<b>Physical Exertion Sub-scale</b>										
6	Exercise tires me	54	2.70	0.82	15	2.30	0.96	39	2.90	0.70
19	I am fatigued by exercise	54	2.50	0.84	15	2.13	0.74	39	2.62	0.90
40	Exercise is hard work for me	54	2.91	0.83	15	2.93	0.80	39	2.90	0.90
<b>Family Discouragement Sub-scale</b>										
21	My spouse (or significant other) does not encourage exercising	54	2.96	0.87	15	2.53	0.83	39	3.13	0.83
33	My family members do not encourage me to exercise	54	3.02	0.94	15	3.00	1.00	39	3.03	0.93

## Interviews

The results of the interview highlighted the participants' "reasons for being part of the aerobic exercise intervention programme" and non-participants "reasons for not being part of the aerobic exercise intervention program". Participants' perceptions are presented in Table 7.

Table 7: Benefits (compliance) and barriers to exercise intervention

Main categories	Sub-categories	Direct quotation from response
Benefits (compliance)	Health improvement	I purposely came for my health so that I can improve everything, my fitness will be alright, even sometime, some disease, diabetes, high blood.
	Knowledge of health status	You have to know what, are you healthy or what your cholesterol and results of it.
	Fitness	I can do my washing, cook for the kids and everything I want to do, I can do it. Now I have a lot of energy, but it is because of you, because of the exercise.
	Combat disease	Even sometime, some disease, diabetes, high blood, they does not affect me easily
	Lose weight	I even lose the weight, my body is not like before
	Reduce tiredness	Even getting tired is reduced.
	Reduce disease	It is very important to check yourself every time because when I make the baseline I realized that my cholesterol was high, but the sugar was fine and blood pressure was ok, but the fitness was not up to standard.
	Reduce stress levels	It will be very helpful especially we the educated because the stress level was going down when you exercise.

	Age gracefully	Is fine as long as you keep yourself healthy and aging wise, it helps to age gracefully.
Barriers	Lack of time	The second one is time, afternoon we have to rush to do our personal things.
	Lack of interest	I have been given exercise outside the normal school time and exercise after hour that will be in the interest of the parties that are concern.
	Illnesses/diseases	I was having a little bit of flu, so it took something like 2 weeks.
	Job	The problem is that I don't have enough time because when you come in morning, the time of work.
	Unreadiness	I was not ready to come for the exercise.

## Discussion

In this study we explore the effects of a four-week exercise intervention on risk factors for NCDs among Setswana speaking community-dwelling Potchefstroom adults from a low-resource area of the Kenneth Kaunda district, Potchefstroom, North West Province of South Africa. This intervention followed a pragmatic approach in order to determine the acceptability of such an intervention in low-resourced communities by probing perceptions of benefit from exercise, and reasons for non-compliance in people who commenced the program but discontinued it. Resourced-poor community dwelling adults are somewhat ignored in exercise research, perhaps because many of the barriers explored in this research have also prevented their representation in other studies. For example, people without their own vehicles, who are reliant on public transport, reported some difficulties in participation in this study. Transport limitations may be so substantial that they consider themselves unable to attend exercise trials undertaken in universities, and thus do not even volunteer for them.

### *Physical activity intervention and changes in NCDs risks factor*

At the end of the four-week aerobic exercise intervention, there were statistically significant reduction in body weight, and an improvement in the rate of perceived exertion and mental component health-related quality of life in men. Significant reduction in body mass, BMI, fasting

blood glucose, improved predicted maximum oxygen, rate of perceived exertion, physical and mental component health-related quality of life were noticed in women who completed the aerobic exercise intervention program. This study also revealed an insignificant reduction in WHR and SBP. There was also an insignificant reduction in DBP and improved physical components in men.

The results showing a reduction in body weight and body mass index are in agreement with the findings of Mujica *et al.* [28] who evaluate the effects of a structured intervention programme of physical activity and nutritional counselling in adults with metabolic syndrome for 18 weeks. The intervention group showed a significant reduction in body weight and body mass index in both men and women. Another study was designed to examine the effects of light and moderate aerobic intensity on body composition and serum lipid profile in obese/overweight women- aged 25-40 years. The participants were randomised into three groups of light exercise, moderate exercise and a control group for a 10-week period, three times for 60 minutes each per week, and the results showed that both light and moderate aerobic exercise significantly reduced body weight, body mass index, and waist-hip ratio and also reduced fasting total cholesterol [29]. Based on the findings of this study, the increase in fasting total cholesterol (FTC) in women was not so clear. Meanwhile, physical activity is somewhat liable for the increase in the production of numerous enzymes that may alter the transport system of cholesterol [30]. Therefore, this may have increase the level of cholesterol in the blood [30].

The reduction noticed in the SBP and DBP of the participants of the current study after the four-week aerobic exercise intervention corroborates the findings of the review of Buttar *et al.* [31] in that regular aerobic exercise has a positive effect by reducing the blood pressure in hypertensive patients, considering the fact that the participants of this study were hypertensive, having blood pressure higher than normal of 120/80 mmHg. The reduction in BP could be clinically relevant in that a decrease of 10-12 mmHg systolic blood pressure and 5-6 mmHg diastolic blood pressure have previously been indicated to reduce the risk of stroke by 38%, the risk of coronary disease by 16% and the risk of premature death by 21% [32]. Further, the significant improvement in the participants' relative  $\dot{V}O_{2\max}$  in this current study was in agreement with the study of Boileau *et al.* [33] who examined the effects of moderate aerobic exercise training on cardiorespiratory fitness in sedentary participants aged 60-75 years for 40 minutes three times per week. The participants were

randomly assigned to exercise and control groups and pre and post measures were obtained. The result shows that both absolute and relative  $\dot{V}O_{2\max}$  significantly improved in the exercise group while it was reduced moderately in the control group. There was a significant improvement in the perceived rate of exertion after the four-week aerobic exercise intervention. This was supported by Grant *et al.* [34] who compare the physiological responses and ratings of perceived exertion to aerobic dance and walking sessions completed at a self-selected pace. The rate of perceived exertion was significantly improved for both aerobic dance and walking. There increase in resting heart rate after aerobic exercise intervention of both genders in this current study is supported by the findings of Almeida and Araujo [35] who stated that an individual who has a slow heart rate recovery in the first minute post-exercise is at increased risk of death.

#### *Physical activity intervention and QoL*

The changes in the overall health-related quality of life (HRQoL) of participants in this study indicated a statistically significant change after a four-week aerobic PA intervention. It has been reported that exercise intervention may have beneficial effects on overall HRQoL and its entire domain [36], as physical activity levels have been linked to the improvement of one or more health-related quality of life domains [37]. The findings revealed statistically significant improvement after the four-week aerobics exercise intervention in all domains of HRQoL (including PCS and MCS) in women compared to their men counterparts. Significant improvements were established in the women's physical functioning, role physical, body pain, general health, vitality, social functioning, role emotional, mental health and the two major components summary of physical and mental. Meanwhile, statistically significant improvements were seen in mental health and the mental component summary in men. Other health-related quality of life domains also gained improvement but were not statistically significant. The findings of this study corroborated the findings of some previous studies [38, 39]. Physical activity, if well-structured and supervised can improve many components of HRQoL, notwithstanding the mode of participation [39] because of its positive effect on overall health. Furthermore, the finding of this study shows that there is a possibility of improving all the domains and components summary of HRQoL, if a well-structured aerobic exercise intervention is in place.

#### *Exercise benefits and barriers*

An increase in exercise adherence could be promoted by understanding the role of perceived benefits and barriers to exercise, which could serve as a mediator to behavioural change [40]. The burden of

premature death from physical inactivity could be reduced by regular participation in physical exercise programmes [40]. Based on the findings of this study, the majority of the participants (men and women) showed that they understood the exercise benefits and barriers. The greatest perceived benefits and barriers in this study were denoted by higher mean values for each sub-scale (Table 5). The greatest perceived benefits of exercise for the participants of this current study were social interaction (“exercising increases my acceptance by others”). This was followed by preventive health (“exercising will keep me from having high blood pressure”), life enhancement (“my disposition is improved by exercise”), physical performance (“exercise increases my stamina”) and psychological outlook (“exercise gives me a sense of personal accomplishment”). These findings were contrary to the findings of Lovell *et al.* [24] who found that the greatest perceived exercise benefits were physical performance, followed by psychological outlook, preventive health, life enhancement and social interaction. On the other hand, the greatest perceived barriers by the participants of this study (Table 6) were in the order of sub-scale of exercise milieu (“I am too embarrassed to exercise”), followed by time expenditure (“exercise takes too much time from family relationship”), family discouragement (“my family members do not encourage me to exercise”), and physical exertion (“exercise is hard work for me”). This finding was contrary to the findings of Lovell *et al.* [24] who examine perceived benefits and barriers to exercise among non-exercising female university students in the United Kingdom and found that the greatest barriers were in the order of physical exertion, time expenditure, exercise milieu and family discouragement.

#### *Interviews: the reasons for participation and non- participation*

Participation in physical activity has been known to promote good health [24]. Considering that the participants from this study are from a low-resourced community, the participants still indicated during the interview that they understood the benefits of regular exercise. The most prominent barrier or reason for not participating in physical activity was lack of time due to the respondents’ job and personal reasons (Table 7). This finding was supported by Schutzer and Grave [41] who stated that lack of time due to office work is commonly cited by most adults. Lack of interest was another reason cited by the participants of this study and this was corroborated by the findings of Moschny *et al.* [42]. Other reasons such as un-readiness, illness, and disease, not able to exercise alone and work/job related matters were also cited. Furthermore, the most cited reason for taking part in the aerobic exercise intervention was mainly because of their health. This was supported by

Schuler *et al.* [43] who identified and compared barriers and motivations to exercise associated with older African American (115) and European American (89) women with the mean age of 72 years and found that the most cited reason for their participation was because of their health. The other reasons cited by the participants of this current study were to prevent diseases, reduce tiredness and fatigue, for relaxation, to reduce pain, increase fitness, age gracefully, feel good, lose weight, and improve their quality of life.

### **Limitation**

The main limitation of this study was the rate of drop-out of the participants. Some of the participants were unable to complete the study because of one engagement or the other, such as work-related commitments, family responsibility, medical problems, lack of time, distant exercise venue, and domestic-related injuries, which are seen as barriers to physical activity intervention. On the other hand these results cannot be generalised and should be interpreted with cautions. Furthermore, cold weather was seen as another limitation that restricted many people from taking part in the study.

### **Conclusion**

A four-week exercise intervention in community-dwelling persons of African descent indicated that a third of the participants were lost to the intervention. Those who participated however still indicated an improvement in the risk factor profile with this short intervention period in particular to the HRQoL. Exercise milieus on the sub-scale of perceived benefits and barriers, and lack of time on the basis of interview were the major barriers to exercise participation. Further, a higher drop-out rate is expected to occur during a long term aerobic exercise intervention. Future studies on physical activity intervention will be required to be conducted for a longer period of time, while effort should be made during planning to consider and minimise those barriers of physical activity, most especially in adults.

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## **Abbreviations**

NCDs- non-communicable diseases; PA- physical activity; CRF-cardiorespiratory fitness; HRQoL- health related quality of life; QoL- quality of life; PF- physical functioning; RF-role physical; BP- body pain; GH-general health; V-vitality; SF-social functioning; RE-role emotional; MH-mental health; PCS-physical component summary; MCS-mental component summary; BMI-body mass index; WHR- waist-hip-ratio; SBP-systolic blood pressure; DBP-diastolic blood pressure; RHR- resting heart rate; FBG-fasting blood glucose; FTC-fasting total cholesterol;  $\dot{P}V\text{O}_{2\text{max}}$ -predicted maximum oxygen consumption; RPE-rate of perceived exertion; EBBS- exercise benefits/barriers scale; HRR- heart rate reserved.

## **Disclosure**

The author declares that there was no conflict in interest

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# **CHAPTER 7: SUMMARY, CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS**

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## **7.1 INTRODUCTION**

The role of physical activity (PA) as an intervention to reduce the menace of chronic diseases caused by an unhealthy lifestyle cannot be underestimated. Globally, as the level of involvement in PA declines, people's health and quality of life are being reduced in direct proportion. Sixty-three percent of all deaths worldwide are attributed to non-communicable diseases (NCDs). Cardiovascular diseases (CVDs) such as hypertension and stroke, cancers, chronic-respiratory diseases and diabetes, all contribute to the prevalence of NCDs, for which almost 80% of deaths occur in low-middle income countries, consequently reducing the level of productivity and increasing healthcare expenses.

In South Africa, more than half (51.1%) of the adult population is insufficiently active while many deaths are known to be caused by lifestyle-related risk factors such as the use of tobacco, excess body weight, alcohol consumption and physical inactivity. Many of these chronic diseases of lifestyle can be prevented and managed with physical activity/exercise interventions that improve fitness levels, reduce NCDs, and improve health-related quality of life. Information on health-related quality of life and exercise intervention for South African adults in low-resourced environments is lacking. This lack of information available for appropriate exercise interventions may be the reason for the high levels of insufficient physical activity reported for South Africans. In order to objectively and effectively assess the effect of regular physical activity on the reduction of risk factors for NCDs, the accurate and acceptable assessment of changes in health-related QoL measurements, cardiorespiratory fitness, preferred type of exercise and dropout during exercise interventions, is essential. The availability of standardised, valid, and acceptable measurements may contribute to more effective interventions and increased compliance of interventions in community-dwelling populations of South Africa.

## **7.2 SUMMARY**

In summary, Chapter One of this thesis introduced the statement of the problem, objectives, stated hypotheses, and the structure of the thesis. The chapter identified the gap in the current literature indicating a lack of information on what exercise testing and interventions are likely to be suitable in

the cultural context of a low-resourced community. This lack of information has contributed in turn to a privation of the most appropriate intervention strategy to follow in specific cultures of ethnic groups in South Africa. The gap in the current knowledge resulted in the formulation of the research question: “What are the reliable and valid measure instruments to determine the effect of an exercise intervention on quality of life and fitness in community-dwellers in South Africa?”

Based on the above, the objectives for this study and the hypotheses to be tested were developed. The stated objectives for this study were to:

- (1) Assess the face validity of the Setswana translation of the SF-8 health-related quality of life health survey in community-dwelling Potchefstroom adults;
- (2) Determine if either individual fitness testing or group fitness testing increases the rate of completion of an 8-minute graded step test in Setswana-speaking community-dwelling Potchefstroom adults;
- (3) Determine if either a metronome or cultural-specific music accompaniment would increase the rate of completion of an 8-minute graded step test in Setswana-speaking community-dwelling Potchefstroom adults;
- (4) Determine the preferred modality of physical activity in Setswana-speaking community-dwelling Potchefstroom adults; and
- (5) Determine the compliance and barriers of a four-week exercise intervention for reducing risk factors of NCDs and improving HRQoL among Setswana-speaking community-dwelling Potchefstroom adults.

The review of the literature (Chapter 2) revealed that socio-economic status and cultural-specific behaviour are both linked to the magnitude of involvement in PA in different cultures. Valid and reliable instruments are necessary in South Africa to accurately measure and assess the well-being of the adult population, hence the translation into Setswana of the English-based questionnaire used to determine HRQoL. The lack of peer-reviewed data on exercise interventions specific to persons from low-resourced communities in South Africa, contributes to the lack of information with regard to the most appropriate intervention strategy to follow in the specific cultures of ethnic groups in South Africa. It is important that adults establish positive lifestyle habits and healthy levels of fitness

that will improve HRQoL. There are significant health benefits associated with physical activity for adults from Western and European populations; regular involvement in physical activity has been proved to increase physical fitness. No South African studies on fitness testing, exercise intervention and HRQoL in Setswana-speaking, community-dwelling adults in Potchefstroom could be found. Furthermore, no data exists that describes the most appropriate exercise interventions strategy to follow in specific cultures or ethnic groups in South Africa in order to limit dropout rates during exercise interventions. Until now, the majority of interventions aimed at improving the physical activity levels of South Africans were based on awareness campaigns via the media and *ad hoc* awareness drives with limited evidence-based outcomes.

In addition, there is limited research published within the South African context of the most appropriate protocols to use within low-resourced South African communities for fitness testing, HRQoL measure instruments, most preferred physical activity, and the dropout rate to be expected in exercise intervention studies of adults with NCDs. This dearth in current knowledge would indicate a need to examine the fitness status, health-related quality of life, and preferred modality for physical activity, and proffer a structured aerobic physical activity intervention that will lower dropout rates in order to reduce the economic burden of NCDs in South Africa. Based on the findings in the literature review, a series of studies were developed in order to address the current gap in the information on cardiorespiratory fitness testing, HRQoL assessment and preferred physical activity. Since the North-West Province is a large area with the majority of the community living in low-resourced areas, the findings from the series of studies were reported in the format of manuscripts prepared for peer-reviewed journals and presented in Chapters Three to Six.

In Chapter Three, the face validity, and test-retest reliability of the Setswana translation of the SF-8 quality of life health survey in Setswana-speaking adult community-dwellers in Potchefstroom, South Africa were determined. Alongside this main objective, the test-retest reliability between the Setswana-translated version and the South African standard English version of SF-8 HRQoL survey were compared. The translation and adaptation of the instrument used (South African English version of SF-8 health survey) were performed according to the forward and backward translation guidelines. Pre-testing, validity and the reliability of the instrument were also performed before being administered. The result of the analysis showed that there were no significant differences in the test and retest reliability of the scale used. This includes the value for both the physical component summary (PCS) and the mental component summary (MCS). Furthermore, the result of Spearman's rank correlation coefficient value (where normal distribution could not be demonstrated

for all the parameters studied) ranged from low to high. The results indicate that the relationship falls between fair to moderate. Therefore, Spearman's rank correlation coefficient for the PCS and MCS had a fair relationship respectively. The Setswana South African version of the SF-8 and Standard English version were found to be valid, brief, and reliable instruments that can be used to examine the quality of life among apparently healthy Setswana-speaking adult community-dwellers in Potchefstroom, South Africa.

In Chapter Four, cardiorespiratory fitness testing was compared both between persons being tested as a group and individually, and metronome-accompanied to music-accompanied testing. The findings indicated that a larger percentage of participants completed the CRF test when accompanied by the metronome and on an individual basis. Furthermore, there were no significant differences in the predicted maximum oxygen consumption (Pred.  $\dot{V}O_{2\max}$ ) of the participants based on all the different combinations of testing.

In Chapter Five, the most preferred and enjoyed mode of physical activity among Setswana-speaking adult community-dwellers in Potchefstroom was determined. Participants completed a compiled preferred physical activity questionnaire to enable researchers to determine the preferred modality of exercise for the population. The results of the analysis showed that the majority of the participants take part in physical activity, and that walking was the most preferred and enjoyed type of physical activity. This was followed by domestic duties and gardening. Meanwhile, the highest percentage of the participants preferred to exercise in the morning.

In Chapter Six, the compliance and acceptability alongside the effects of a four-week aerobic physical activity intervention on NCD risk factors, cardiorespiratory fitness, and quality of life were examined. Exercise benefits and barriers among Setswana-speaking adult community-dwellers living in a low-resourced area of Kenneth Kaunda district, Potchefstroom, North-West Province of South Africa, were determined after the completion of the intervention in order to understand the 29% dropout rate obtained from the interventions study. The results of the analysis show that a four-week aerobic exercise intervention can significantly reduce body mass, waist-to-hip ratio (WHR), body mass index (BMI), systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood glucose (FBG), fasting blood cholesterol (FTC), the predicted maximum oxygen consumption (P

$\dot{V}O_{2\max}$ ), rate of perceived exertion (RPE), and the physical (PCS) and mental (MCS) component summaries of the HRQoL questionnaire. However, no significant differences were found between the baseline and end for men (BMI, WHR, SBP, DBP, RHR, FBG, FTC,  $\dot{V}O_{2\max}$ , and PCS), or women (WHR, SBP, DBP, RHR, and FTC). Furthermore, statistically significant differences were seen in other variables measured in both men (body mass, RPE and MCS), and women (body mass, BMI, FBG,  $\dot{V}O_{2\max}$ , RPE, PCS and MCS).

### 7.3 CONCLUSION

The conclusions of this study are derived from the stated hypotheses.

#### 7.3.1 Hypothesis 1

*The Setswana translation of SF-8 HRQoL health survey will be a valid instrument for determining health-related quality of life in low socio-economic South Africans.*

The Setswana South African version of the SF-8 was found to be logically valid, brief and a reliable instrument that can be used to examine the quality of life among apparently healthy Setswana-speaking adult community-dwellers living in Potchefstroom, South Africa. The Cronbach alpha coefficient applied to the SF-8 Setswana version was 0.87 for the first and second measures respectively. The reliability for the original English version was 0.86 and 0.89 for the first and second measures. Furthermore, for the SF-8 Setswana version the test-retest reliability for both PCS ( $p=0.83$ ) and MCS ( $p=0.52$ ) was not statistically significant. Neither were the original English version for both PCS ( $p=0.49$ ) and MCS ( $p=0.10$ ) statistically significant. For the Setswana/English version, there is a fair/moderate relationship in the correlation co-efficient for the physical ( $\rho=0.45/\rho=0.63$ ) and mental ( $\rho=0.50/\rho=0.61$ ) component summaries. Hypothesis 1 is therefore **accepted**.

#### 7.3.2 Hypothesis 2

*Group cardiorespiratory fitness testing will increase the rate of completion of an 8-minute graded step test in Setswana-speaking community-dwelling Potchefstroom adults.*

The results revealed that a higher percentage (67.7%) of participants completed the CRF testing performed on an individual basis compared to cardiorespiratory fitness testing in a group setting. Therefore, Hypothesis 2 is *rejected*.

### 7.3.3 Hypothesis 3

*Cultural-specific music will increase the rate of completion of an 8-minute graded step test in Setswana-speaking community-dwelling Potchefstroom adults.*

The results revealed that a higher percentage (67.7%) of the participants completed the CRF test accompanied by the metronome adaptation in comparison to the cultural-specific music accompaniment. Therefore, Hypothesis 3 is *rejected*.

### 7.3.4 Hypothesis 4

*There will be no one preferred physical activity modality for exercise intervention for men and women among Setswana-speaking community-dwelling Potchefstroom adults.*

The results showed that a total of 87.7% of the participants take part in physical activity, with the remaining 12.3% physically inactive. Furthermore, the results also revealed that walking (39.2%) was the most preferred and enjoyed type of physical activity. This was followed by domestic duties and gardening, with 13.8% and 12.3% respectively. Meanwhile, the larger percentage (70%) of the participants preferred to exercise in the morning. Since a very large majority of participants chose walking as the most preferred exercise, this would indicate that one physical activity modality for exercise intervention is preferred over others; Hypothesis 4 is therefore *rejected*.

### 7.3.5 Hypothesis 5

*The compliance and acceptability of a four-week exercise intervention for NCD risk factors among Setswana-speaking-community-dwelling Potchefstroom adults will be higher than 80%.*

Based on the number of those who started compared with those who completed the aerobic physical activity intervention, the rate of compliance and acceptance of participation was 71% (less than 80%) with a dropout rate of 29%. Hypothesis 5 is therefore *rejected*.

Although this study presented five different objectives, the findings of the various objectives lead to an overall answer to the research question. As the first study to translate the SF-8 health-related quality of life survey from standard South African English to Setswana language for use among the Setswana population in a low-resourced area, these findings indicated that both the English or Tswana versions of the SF-8 are valid and reliable for use in the measurement of HRQoL in Setswana-speaking persons from the North-West Province. The main contribution to the knowledge and reason for SF-8 questionnaire translation is to establish whether one is able to use an instrument not available in the language of preference (Tswana) in the field. This was seen as a way of implementing the same instruments in the mother tongue in order to eliminate English language barriers to persons who are not schooled in English, most especially the older population living in the North-West Province of South Africa.

Cardiorespiratory fitness testing is important in the assessment of effective exercise interventions since an increase in fitness often indicates that the exercise intervention was successful in negotiating improved CRF, which is related to improved long-term health outcomes. CRF has been standardised across many developed countries and populations, and yet in South Africa, no previous researchers have reported the best mode of completing CRF testing in a specific cultural group or as a step-test protocol for use in the field. South Africans enjoy performing activities together such as choir singing, walking, gardening, and dancing. Therefore, one would expect them to perform better during group testing. In this research study, this hypothesis proved not to be true. The findings indicate that the majority of participants completed the step test when performed on an individual basis. The reason might be due to the concentration required for keeping to the rhythm of the step rate. Persons living in a low-resourced community are not often confronted with steps or stair climbing, since homes are mostly single-storey buildings. The participants are therefore not accustomed to step or stair climbing as needs to be performed with the step test, thus possibly requiring an increased concentration during the step-testing protocol.

In black African culture, the accompaniment of music is often very important and associated with traditional dancing. The researcher expected the step rate accompanied by traditional cultural music during the CRF testing to improve the completion rate. This was however not observed in the

research conducted in this study. In addition to the participants being unaccustomed to step or stair climbing (as mentioned earlier), the acceptance of the music may play a role in the motivational quality of music during the CRF testing that was not evident with the metronome beat. Also, the lower perceived effort during sub-maximal stepping to music compared to metronome may be reduced psychologically. Observationally, during the stepping with music, the excitement state was seen to be one of the major reasons some of the participants could not fully concentrate causing them to miss their step in the process, which was contrary to the observation during the metronome stepping.

The study reported in Chapter Five was the first to develop a survey from previous research to determine the preferred and most enjoyed type of physical activity among low-resourced community-dwelling adults, with the aim of increasing their motivation for future aerobic exercise intervention programmes, with the final objective of increasing cardiorespiratory fitness, reducing the risk factors of NCDs, and improving health-related quality of life. Walking activities in the morning were found to improve adherence to PA interventions, because walking was seen as the most inexpensive and common form of physical activity to move from one place to another. Also, taking into consideration the fact that the participants are from a low socio-economic area, active commuting by walking is part of daily life in low-resourced communities.

Further, to the best of our knowledge this study is the first to report on dropout rates of a community-based aerobic exercise intervention for adults performed in the low-resourced community of the Kenneth Kaunda district, in North-West Province, South Africa. The most common reason for dropout from the exercise intervention programme was reported as a lack of time due to work commitments, family responsibility, and long distances to exercise venues. Other reasons for dropout were due to medical problems and domestic-related injuries. In addition, lack of training space, travel cost, unsafe environment, ignorance, and taboos about exercise might be barriers causing dropout in this population. These findings indicate the importance of future physical activity interventions to remove the barriers, such as distance to exercise venue and work commitments, by organising exercise interventions in each of the wards that the Department of Health's Health Care workers frequently visit. This will take the exercise support closer to the homes

of persons, which will limit interference with work commitments. The findings therefore present useful information for the design of future community-based aerobic exercise interventions.

Meanwhile, the four papers included in this study are related, and together stand as a unit which has contributed to new knowledge about the important factors to be considered when planning an exercise intervention within a low-resourced community. The integration of the findings across the five studies indicate that in order to introduce an exercise intervention in a low-resourced community, either the Tswana or English version of the SF-8 HRQoL measurement can be used, because the SF-8 HRQoL translation into Tswana was found to be valid and reliable. This instrument revealed changes in the overall HRQoL domain of participants, most especially in women compared to men of which a statistically significant improvement was indicated after a four-week aerobic PA intervention.

In order to obtain the most accurate CRF testing in this population, the standardised step test as presented in the ActiHeart manual is appropriate for use. It was also found that individual testing is not inferior to the findings from group testing. Future CRF assessments could therefore be tested on an individual basis with metronome accompaniment. Physical activity intervention programmes should be structured and tailored according to the most preferred and enjoyed type of activity by participants. Since walking is the common type of physical activity (mostly performed in the morning), it should be considered in future intervention studies. Physiologically, some of the variables revealed no statistically significant change in the risk factors at the end of the four-week exercise intervention, most especially in men, which suggests that a PA intervention which runs for more than four weeks could be more beneficial. Intervention studies in low-resourced communities should take cognisance of the dropout rates obtained in this short four-week intervention in order to recruit sufficient participants for future studies so as to ensure statistical significance with intervention studies for NCDs. It was suggested that the dropout rate could be minimised by finding a means to educate people on the benefits to be gained by participating in physical activity intervention programmes. Once the population takes responsibility for their own health, compliance will be increased in intervention studies. Furthermore, people might be stimulated positively by the use of signposts encouraging physical activity with easy access to exercise venue. The use of telephone calls to prompt exercise could also be used to improve exercise frequency and compliance. Providing rewards such as awards, T-shirts, airtime or other prizes may be another effective way of reducing dropout rate when an exercise goal has been achieved.

## 7.4 LIMITATIONS AND RECOMMENDATIONS

The study results should be interpreted with some caution. Recommendations are presented in order to improve future exercise intervention studies for risk factors of NCDs and HRQoL in low-resourced communities:

- In testing the reliability of the HRQoL Tswana questionnaire, construct validity was not addressed, and this should be considered in future studies.
- These studies did not recruit a representative samples of participants due to the logistical limitations, and therefore the findings cannot be generalised to the wider South African population. It is recommended that future studies strive to obtain a broadly representative sample across South Africa in order to generalise the findings for future exercise intervention studies.
- Effort should be made when planning exercise intervention programmes to consider the barriers to physical activity so as to minimise them, most especially in adults.
- As a non- South African or Setswana-speaking researcher, language was seen as a barrier, which needs to be considered in future studies.

### **FUTURE RESEARCH**

Future studies could further explore the limitations that were observed in this study which affected the dropout rates, with a view to reducing them. It is suggested that future studies determine the barriers to physical activity in older adults, and the effect of an exercise intervention on the perception and knowledge of persons from low-resourced communities for physical activity, and potentially draw a representative sample across South Africa in order to obtain representative data for exercise interventions.

# APPENDICES

# APPENDIX A: GUIDELINES FOR AUTHORS BMC RESEARCH NOTES

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## Research article

Submission process | Preparing main manuscript text | Preparing illustrations and figures | Preparing tables | Preparing additional files | Style and language

See 'About this journal' for descriptions of different article types and information about policies and the refereeing process.

## Submission process

Manuscripts must be submitted by one of the authors of the manuscript, and should not be submitted by anyone on their behalf. The submitting author takes responsibility for the article during submission and peer review. Please note that *BMC Research Notes* levies an article-processing charge on all accepted Research article; if the submitting author's institution is a [BioMed Central member](#) the cost of the article-processing charge may be covered by the membership (see [about](#) page for detail). Please note that the membership is only automatically recognised on submission if the submitting author is based at the member institution. To facilitate rapid publication and to minimize administrative costs, *BMC Research Notes* prefers [online submission](#).

Files can be submitted as a batch, or one by one. The submission process can be interrupted at any time; when users return to the site, they can carry on where they left off. See below for examples of [word processor](#) and [graphics file formats](#) that can be accepted for the main manuscript document by the online submission system. Additional files of any type, such as [movies](#), animations, or [original data files](#), can also be submitted as part of the manuscript.

During submission you will be asked to provide a cover letter. Use this to explain why your manuscript should be published in the journal, to elaborate on any issues relating to our editorial policies in the '[About BMC Research Notes](#)' page, and to declare any potential competing interests.

Assistance with the process of manuscript preparation and submission is available from [BioMed Central customer support team](#). We also provide a collection of links to useful tools and resources for scientific authors on our [Useful Tools](#) page.

## File formats

The following word processor file formats are acceptable for the main manuscript document:

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- Rich text format (RTF)
- Portable document format (PDF)
- TeX/LaTeX (use [BioMed Central's TeX template](#))
- DeVice Independent format (DVI)

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### **Publishing Datasets**

Through a special arrangement with [LabArchives](#), LLC, authors submitting manuscripts to BMC Research Notes can obtain a [complimentary subscription to LabArchives](#) with an allotment of 100MB of storage. LabArchives is an Electronic Laboratory Notebook which will enable scientists to share and publish data files in situ; you can then link your paper to these data. Data files linked to published articles are assigned digital object identifiers (DOIs) and will remain available in perpetuity. Use of LabArchives or similar data publishing services does not replace preexisting data deposition requirements, such as for nucleic acid sequences, protein sequences and atomic coordinates. Instructions on assigning DOIs to datasets, so they can be permanently linked to publications, can be found on the LabArchives website. Use of LabArchives' software has no influence on the editorial decision to accept or reject a manuscript. Authors linking datasets to their publications should include an [Availability of supporting data](#) section in their manuscript and cite the dataset in their reference list.

### **Preparing main manuscript text**

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General guidelines of the journal's style and language are given [below](#).

### **Overview of manuscript sections for Research article**

Manuscripts for Research article submitted to *BMC Research Notes* should be divided into the following sections (in this order):

- [Title page](#)

- Abstract
- Keywords
- Background
- Results and discussion
- Conclusions
- Methods (can also be placed after Background)
- Availability of supporting data
- List of abbreviations used (if any)
- Competing interests
- Authors' contributions
- Authors' information
- Acknowledgements
- Endnotes
- References
- Illustrations and figures (if any)
- Tables and captions
- Preparing additional files

The **Accession Numbers** of any nucleic acid sequences, protein sequences or atomic coordinates cited in the manuscript should be provided, in square brackets and include the corresponding database name; for example, [EMBL:AB026295, EMBL:AC137000, DDBJ:AE000812, GenBank:U49845, PDB:1BFM, Swiss-Prot:Q96KQ7, PIR:S66116].

The databases for which we can provide direct links are: EMBL Nucleotide Sequence Database (EMBL), DNA Data Bank of Japan (DDBJ), GenBank at the NCBI (GenBank), Protein Data Bank (PDB), Protein Information Resource (PIR) and the Swiss-Prot Protein Database (Swiss-Prot).

For reporting standards please see the information in the About section.

### **Title page**

The title page should:

- provide the title of the article
- list the full names, institutional addresses and email addresses for all authors
- indicate the corresponding author

Please note:

- abbreviations within the title should be avoided
- if a collaboration group should be listed as an author, please list the Group name as an author. If you would like the names of the individual members of the Group to be searchable through their individual PubMed records, please include this information in the “acknowledgements” section in accordance with the instructions below. Please note that the individual names may not be included in the PubMed record at the time a published article is initially included in PubMed as it takes PubMed additional time to code this information.

### **Abstract**

The Abstract of the manuscript should not exceed 350 words and must be structured into separate sections: **Background**, the context and purpose of the study; **Results**, the main findings; **Conclusions**, brief summary and potential implications. Please minimize the use of abbreviations and do not cite references in the abstract. **Trial registration**, if your article reports the results of a controlled health care intervention, please lists the trial registry, along with the unique identifying number, e.g. Trial registration: Current Controlled Trials ISRCTN73824458. Please note that there should be no space between the letters and numbers of your trial registration number.

### **Keywords**

Three to ten keywords representing the main content of the article.

### **Background**

The Background section should be written in a way that is accessible to researchers without specialist knowledge in that area and must clearly state - and, if helpful, illustrate - the background to the research and its aims. The section should end with a brief statement of what is being reported in the article.

### **Results and discussion**

The Results and discussion may be combined into a single section or presented separately. The Results and discussion sections may also be broken into subsections with short, informative headings.

**Conclusions:** This should state clearly the main conclusions of the research and give a clear explanation of their importance and relevance. Summary illustrations may be included.

### **Methods**

The methods section should include the design of the study, the type of materials involved, a clear description of all comparisons, and the type of analysis used, to enable replication.

### **Availability of supporting data**

*BMC Research Notes* encourages authors to deposit the data set(s) supporting the results reported in submitted manuscripts in a publicly-accessible data repository, when it is not possible to publish them as additional files. This section should only be included when supporting data are available and must include the name of the repository and the permanent identifier or accession number and persistent hyperlink(s) for the data set(s). The following format is required:

"The data set(s) supporting the results of this article is(are) available in the [repository name] repository, [unique persistent identifier and hyperlink to dataset(s) in http:// format]."

Where all supporting data are included in the article or additional files the following format is required:

"The data set(s) supporting the results of this article is(are) included within the article (and its additional file(s))"

We also recommend that the data set(s) be cited, where appropriate in the manuscript, and included in the reference list.

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### **List of abbreviations**

If abbreviations are used in the text they should be defined in the text at first use, and a list of abbreviations can be provided, which should precede the competing interests and authors' contributions.

### **Competing interests**

A competing interest exists when your interpretation of data or presentation of information may be influenced by your personal or financial relationship with other people or organizations. Authors must disclose any financial competing interests; they should also reveal any non-financial competing interests that may cause them embarrassment were they to become public after the publication of the manuscript.

Authors are required to complete a declaration of competing interests. All competing interests that are declared will be listed at the end of published articles. Where an author gives no competing interests, the listing will read 'The author(s) declare that they have no competing interests'.

When completing your declaration, please consider the following questions:

### *Financial competing interests*

- In the past three years have you received reimbursements, fees, funding, or salary from an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future? Is such an organization financing this manuscript (including the article-processing charge)? If so, please specify.
- Do you hold any stocks or shares in an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future? If so, please specify.
- Do you hold or are you currently applying for any patents relating to the content of the manuscript? Have you received reimbursements, fees, funding, or salary from an organization that holds or has applied for patents relating to the content of the manuscript? If so, please specify.
- Do you have any other financial competing interests? If so, please specify.

### *Non-financial competing interests*

Are there any non-financial competing interests (political, personal, religious, ideological, academic, intellectual, commercial or any other) to declare in relation to this manuscript? If so, please specify.

If you are unsure as to whether you, or one your co-authors, has a competing interest please discuss it with the editorial office.

### **Authors' contributions**

In order to give appropriate credit to each author of a paper, the individual contributions of authors to the manuscript should be specified in this section.

According to [ICMJE guidelines](#), An 'author' is generally considered to be someone who has made substantive intellectual contributions to a published study. To qualify as an author one should 1) have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) have been involved in drafting the manuscript or revising it critically for important intellectual content; 3) have given final approval of the version to be published; and 4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship.

We suggest the following kind of format (please use initials to refer to each author's contribution):  
AB carried out the molecular genetic studies, participated in the sequence alignment and drafted the manuscript. JY carried out the immunoassays. MT participated in the sequence alignment. ES

participated in the design of the study and performed the statistical analysis. FG conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript. All contributors who do not meet the criteria for authorship should be listed in an acknowledgements section. Examples of those who might be acknowledged include a person who provided purely technical help, writing assistance, a department chair who provided only general support, or those who contributed as part of a large collaboration group.

### **Authors' information**

You may choose to use this section to include any relevant information about the author(s) that may aid the reader's interpretation of the article, and understand the standpoint of the author(s). This may include details about the authors' qualifications, current positions they hold at institutions or societies, or any other relevant background information. Please refer to authors using their initials. Note this section should not be used to describe any competing interests.

### **Acknowledgements**

Please acknowledge anyone who contributed towards the article by making substantial contributions to conception, design, acquisition of data, or analysis and interpretation of data, or who was involved in drafting the manuscript or revising it critically for important intellectual content, but who does not meet the criteria for authorship. Please also include the source(s) of funding for each author, and for the manuscript preparation. Authors must describe the role of the funding body, if any, in design, in the collection, analysis, and interpretation of data; in the writing of the manuscript; and in the decision to submit the manuscript for publication. Please also acknowledge anyone who contributed materials essential for the study. If a language editor has made significant revision of the manuscript, we recommend that you acknowledge the editor by name, where possible. If you would like the names of the individual members of a collaboration Group to be searchable through their individual PubMed records, please ensure that the title of the collaboration Group is included on the title page and in the submission system and also include collaborating author names as the last paragraph of the “acknowledgements” section. Please add authors in the format First Name, Middle initial(s) (optional), Last Name. You can add institution or country information for each author if you wish, but this should be consistent across all authors.

Please note that individual names may not be present in the PubMed record at the time a published article is initially included in PubMed as it takes PubMed additional time to code this information.

Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements section.

### **Endnotes**

Endnotes should be designated within the text using a superscript lowercase letter and all notes (along with their corresponding letter) should be included in the Endnotes section. Please format this section in a paragraph rather than a list.

### **References**

All references, including URLs, must be numbered consecutively, in square brackets, in the order in which they are cited in the text, followed by any in tables or legends. Each reference must have an individual reference number. Please avoid excessive referencing. If automatic numbering systems are used, the reference numbers must be finalized and the bibliography must be fully formatted before submission. Only articles and abstracts that have been published or are in press, or are available through public e-print/preprint servers, may be cited; unpublished abstracts, unpublished data and personal communications should not be included in the reference list, but may be included in the text and referred to as "unpublished observations" or "personal communications" giving the names of the involved researchers. Obtaining permission to quote personal communications and unpublished data from the cited colleagues is the responsibility of the author. Footnotes are not allowed, but endnotes are permitted. Journal abbreviations follow Index Medicus/MEDLINE. Citations in the reference list should include all named authors, up to the first six before adding 'et al.'. Any *in press* articles cited within the references and necessary for the reviewers' assessment of the manuscript should be made available if requested by the editorial office.

An Endnote style file is [available](#).

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reference lists are correctly formatted. An example of such software is Papers, which is part of Springer Science+Business Media.

### **Examples of the *BMC Research Notes* reference style**

#### *Article within a journal*

Smith JJ. The world of science. *Am J Sci*. 1999;36:234-5.

#### *Article within a journal (no page numbers)*

Rohrmann S, Overvad K, Bueno-de-Mesquita HB, Jakobsen MU, Egeberg R, Tjønneland A, et al. Meat consumption and mortality - results from the European Prospective Investigation into Cancer and Nutrition. *BMC Medicine*. 2013;11:63.

#### *Article within a journal by DOI*

Slifka MK, Whitton JL. Clinical implications of dysregulated cytokine production. *Dig J Mol Med*. 2000; doi:10.1007/s801090000086.

#### *Article within a journal supplement*

Frumin AM, Nussbaum J, Esposito M. Functional asplenia: demonstration of splenic activity by bone marrow scan. *Blood* 1979;59 Suppl 1:26-32.

#### *Book chapter, or an article within a book*

Wyllie AH, Kerr JFR, Currie AR. Cell death: the significance of apoptosis. In: Bourne GH, Danielli JF, Jeon KW, editors. *International review of cytology*. London: Academic; 1980. p. 251-306.

#### *OnlineFirst chapter in a series (without a volume designation but with a DOI)*

Saito Y, Hyuga H. Rate equation approaches to amplification of enantiomeric excess and chiral symmetry breaking. *Top Curr Chem*. 2007. doi:10.1007/128\_2006\_108.

#### *Complete book, authored*

Blenkinsopp A, Paxton P. *Symptoms in the pharmacy: a guide to the management of common illness*. 3rd ed. Oxford: Blackwell Science; 1998.

#### *Online document*

Doe J. Title of subordinate document. In: *The dictionary of substances and their effects*. Royal Society of Chemistry. 1999. <http://www.rsc.org/dose/title of subordinate document>. Accessed 15 Jan 1999.

### *Online database*

Healthwise Knowledgebase. US Pharmacopeia, Rockville. 1998. <http://www.healthwise.org>. Accessed 21 Sept 1998.

### *Supplementary material/private homepage*

Doe J. Title of supplementary material. 2000. <http://www.privatehomepage.com>. Accessed 22 Feb 2000.

### *University site*

Doe, J: Title of preprint. <http://www.uni-heidelberg.de/mydata.html> (1999). Accessed 25 Dec 1999.

### *FTP site*

Doe, J: Trivial HTTP, RFC2169. <ftp://ftp.isi.edu/in-notes/rfc2169.txt> (1999). Accessed 12 Nov 1999.

### *Organization site*

ISSN International Centre: The ISSN register. <http://www.issn.org> (2006). Accessed 20 Feb 2007.

### *Dataset with persistent identifier*

Zheng L-Y, Guo X-S, He B, Sun L-J, Peng Y, Dong S-S, et al. Genome data from sweet and grain sorghum (*Sorghum bicolor*). GigaScience Database. 2011. <http://dx.doi.org/10.5524/100012>.

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Illustrations should be provided as separate files, not embedded in the text file. Each figure should include a single illustration and should fit on a single page in portrait format. If a figure consists of separate parts, it is important that a single composite illustration file be submitted which contains all parts of the figure. There is no charge for the use of color figures.

Please read our [figure preparation guidelines](#) for detailed instructions on maximising the quality of your [figures](#).

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The following file formats can be accepted:

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The legends should be included in the main manuscript text file at the end of the document, rather than being a part of the figure file. For each figure, the following information should be provided: Figure number (in sequence, using Arabic numerals - i.e. Figure 1, 2, 3 etc); short title of figure (maximum 15 words); detailed legend, up to 300 words.

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Images must be 300dpi and 155mm square (1831 x 1831 pixels for a raster image).

Allowable formats - EPS, PDF (for line drawings), PNG, TIFF (for photographs and screen dumps), JPEG, BMP, DOC, PPT, CDX, TGF (ISIS/Draw).

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Each table should be numbered and cited in sequence using Arabic numerals (i.e. Table 1, 2, 3 etc.). Tables should also have a title (above the table) that summarizes the whole table; it should be no longer than 15 words. Detailed legends may then follow, but they should be concise. Tables should always be cited in text in consecutive numerical order.

Smaller tables considered to be integral to the manuscript can be pasted into the end of the document text file, in A4 portrait or landscape format. These will be typeset and displayed in the final published form of the article. Such tables should be formatted using the 'Table object' in a word processing program to ensure that columns of data are kept aligned when the file is sent electronically for review; this will not always be the case if columns are generated by simply using tabs to separate text. Columns and rows of data should be made visibly distinct by ensuring that the borders of each cell display as black lines. Commas should not be used to indicate numerical values. Color and shading may not be used; parts of the table can be highlighted using symbols or bold text,

the meaning of which should be explained in a table legend. Tables should not be embedded as figures or spreadsheet files.

Larger datasets or tables too wide for a landscape page can be uploaded separately as additional files. Additional files will not be displayed in the final, laid-out PDF of the article, but a link will be provided to the files as supplied by the author.

Tabular data provided as additional files can be uploaded as an Excel spreadsheet (.xls) or comma separated values (.csv). As with all files, please use the standard file extensions.

### **Preparing additional files**

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Although *BMC Research Notes* does not restrict the length and quantity of data included in an article, we encourage authors to provide datasets, tables, movies, or other information as additional files.

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Results that would otherwise be indicated as "data not shown" can and should be included as additional files. Since many weblinks and URLs rapidly become broken, *BMC Research Notes* requires that supporting data are included as additional files, or deposited in a recognized repository. Please do not link to data on a personal/departmental website. The maximum file size for additional files is 20 MB each, and files will be virus-scanned on submission.

Additional files can be in any format, and will be downloadable from the final published article as supplied by the author. We recommend CSV rather than PDF for tabular data.

Certain supported files formats are recognized and can be displayed to the user in the browser. These include most movie formats (for users with the Quicktime plugin), mini-websites prepared according to our guidelines, chemical structure files (MOL, PDB), geographic data files (KML).

If additional material is provided, please list the following information in a separate section of the manuscript text:

- File name (e.g. Additional file 1)
- File format including the correct file extension for example .pdf, .xls, .txt, .pptx (including name and a URL of an appropriate viewer if format is unusual)
- Title of data
- Description of data

Additional files should be named "Additional file 1" and so on and should be referenced explicitly by file name within the body of the article, e.g. 'An additional movie file shows this in more detail [see Additional file 1]'.

### **Additional file formats**

Ideally, file formats for additional files should not be platform-specific, and should be viewable using free or widely available tools. The following are examples of suitable formats.

- Additional documentation
  - PDF (Adode Acrobat)
- Animations
  - SWF (Shockwave Flash)
- Movies
  - MP4 (MPEG 4)
  - MOV (Quicktime)
- Tabular data
  - XLS, XLSX (Excel Spreadsheet)
  - CSV (Comma separated values)

As with figure files, files should be given the standard file extensions.

### **Mini-websites**

Small self-contained websites can be submitted as additional files, in such a way that they will be browsable from within the full text HTML version of the article. In order to do this, please follow these instructions:

1. Create a folder containing a starting file called index.html (or index.htm) in the root.
2. Put all files necessary for viewing the mini-website within the folder, or sub-folders.
3. Ensure that all links are relative (ie "images/picture.jpg" rather than "/images/picture.jpg" or "http://yourdomain.net/images/picture.jpg" or "C:\Documents and Settings\username\My Documents\mini-website\images\picture.jpg") and no link is longer than 255 characters.
4. Access the index.html file and browse around the mini-website, to ensure that the most commonly used browsers (Internet Explorer and Firefox) are able to view all parts of the mini-website without problems, it is ideal to check this on a different machine.

5. Compress the folder into a ZIP, check the file size is under 20 MB, ensure that index.html is in the root of the ZIP, and that the file has .zip extension, then submit as an additional file with your article.

## **Style and language**

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### **General**

Currently, *BMC Research Notes* can only accept manuscripts written in English. Spelling should be US English or British English, but not a mixture.

There is no explicit limit on the length of articles submitted, but authors are encouraged to be concise.

*BMC Research Notes* will not edit submitted manuscripts for style or language; reviewers may advise rejection of a manuscript if it is compromised by grammatical errors. Authors are advised to write clearly and simply, and to have their article checked by colleagues before submission. In-house copyediting will be minimal. Non-native speakers of English may choose to make use of a copyediting service.

### **Language editing**

For authors who wish to have the language in their manuscript edited by a native-English speaker with scientific expertise, BioMed Central recommends [Edanz](#). BioMed Central has arranged a 10% discount to the fee charged to BioMed Central authors by Edanz. Use of an editing service is neither a requirement nor a guarantee of acceptance for publication. Please contact [Edanz](#) directly to make arrangements for editing, and for pricing and payment details.

### **Help and advice on scientific writing**

The abstract is one of the most important parts of a manuscript. For guidance, please visit our page on [Writing titles and abstracts for scientific articles](#).

Tim Albert has produced for BioMed Central a [list of tips](#) for writing a scientific manuscript. [American Scientist](#) also provides a list of resources for science writing. For more detailed guidance on preparing a manuscript and writing in English, please visit the [BioMed Central author academy](#).

### **Abbreviations**

Abbreviations should be used as sparingly as possible. They should be defined when first used and a list of abbreviations can be provided following the main manuscript text.

### **Typography**

- Please use double line spacing.
- Type the text unjustified, without hyphenating words at line breaks.
- Use hard returns only to end headings and paragraphs, not to rearrange lines.
- Capitalize only the first word, and proper nouns, in the title.
- All lines and pages should be numbered. Authors are asked to ensure that line numbering is included in the main text file of their manuscript at the time of submission to facilitate peer-review. Once a manuscript has been accepted, line numbering should be removed from the manuscript before publication. For authors submitting their manuscript in Microsoft Word please do not insert page breaks in your manuscript to ensure page numbering is consistent between your text file and the PDF generated from your submission and used in the review process.
- Use the *BMC Research Notes* reference format.
- Footnotes are not allowed, but endnotes are permitted.
- Please do not format the text in multiple columns.
- Greek and other special characters may be included. If you are unable to reproduce a particular special character, please type out the name of the symbol in full. **Please ensure that all special characters used are embedded in the text, otherwise they will be lost during conversion to PDF.**
- Genes, mutations, genotypes, and alleles should be indicated in italics, and authors are required to use approved gene symbols, names, and formatting. Protein products should be in plain type.

### **Units**

SI units should be used throughout (liter and molar are permitted, however).

# **APPENDIX B: GUIDELINES FOR AUTHORS AFRICAN JOURNAL FOR PHYSICAL, HEALTH EDUCATION, RECREATION & DANCE (AJPHERD)**

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**GUIDELINES FOR AUTHORS** The African Journal for Physical, Health Education, Recreation and Dance (AJPHERD) is a peer-reviewed journal established to: i) provide a forum for physical educators, health educators, specialists in human movement studies and dance, as well as other sport-related professionals in Africa, the opportunity to report their research findings based on African settings and experiences, and also to exchange ideas among themselves. ii) afford the professionals and other interested individuals in these disciplines the opportunity to learn more about the practice of the disciplines in different parts of the continent. iii) create awareness in the rest of the world about the professional practice in the disciplines in Africa. **GENERAL POLICY** AJPHERD publishes research papers that contribute to knowledge and practice, and also develops theory either as new information, reviews, confirmation of previous findings, application of new teaching/coaching techniques and research notes. Letters to the editor relating to the materials previously published in AJPHERD could be submitted within 3 months after publication of the article in question. Such letter will be referred to the corresponding author and both the letter and response will be published concurrently in a subsequent issue of the journal. Manuscripts are considered for publication in AJPHERD based on the understanding that they have not been published or submitted for publication in any other journal. In submitting papers for publication, corresponding authors should make such declarations. Where part of a paper has been published or presented at congresses, seminars or symposia, reference to that publication should be made in the acknowledgement section of the manuscript. AJPHERD is published quarterly, i.e. in March, June, September and December. Supplements/Special editions are also published periodically. **SUBMISSION OF MANUSCRIPT** Three copies of original manuscript and all correspondence should be addressed to the Editor-In Chief: Professor L. O. Amusa Tel: +27 15 9628076 Centre for Biokinetics, Recreation Fax: +27 15 9628076/9628035 and Sport Science, University of Venda for E-mail: amusalbw@yahoo.com Science and Technology, P. Bag X5050, Thohoyandou 0950 Republic of South Africa Articles can also be submitted electronically, i.e. via e-mail attachment. However, the corresponding author should ensure that such articles are virus free. AJPHERD reviewing process normally takes 4-6 weeks and authors will be advised about the decision on submitted manuscripts within 60 days. In order to ensure anonymity during the reviewing process

authors are requested to avoid self-referencing or keep it to the barest minimum. PREPARATION OF MANUSCRIPT Manuscripts should be type written in fluent English (using 12-point Times New Roman font and 1½ line-spacing) on one side of white A4-sized paper justified fully with 3cm margin on all sides. Guidelines for Authors 317 In preparing manuscripts, MS-Word, Office 98 or Office 2000 for Windows should be used. Length of manuscripts should not normally exceed 12 printed pages (including tables, figures, references, etc.). For articles exceeding 10 typed pages US\$ 10.0 is charged per every extra page. Longer manuscripts may be accepted for publication as supplements or special research reviews. Authors will be requested to pay a publication charge of US\$ 350.0 to defray the very high cost of publication. The pages of manuscripts must be numbered sequentially beginning with the title page. The presentation format should be consistent with the guidelines in the publication format of the American Psychological Association (APA) (4th edition).

**Title page:** The title page of the manuscript should contain the following information: Concise and informative title. Author(s') name(s) with first and middle initials. Authors' highest qualifications and main area of research specialisation should be provided. Author(s') institutional addresses, including telephone and fax numbers. Corresponding author's contact details, including e-mail address. A short running title of not more than 6 words.

**Abstract** An abstract of 200-250 words is required with up to a maximum of 5 words provided below the abstract. Abstract must be typed on a separate page using single line spacing, with the purpose of the study, methods, major results and conclusions concisely presented. Abbreviations should either be defined or excluded. Text Text should carry the following designated headings: Introduction, materials and methods, results, discussion, acknowledgement, references and appendices (if appropriate).

**Introduction** The introduction should start on a new page and in addition to comprehensively giving the background of the study should clearly state the problem and purpose of the study. Authors should cite relevant references to support the basis of the study. A concise but informative and critical literature review is required.

**Materials and Methods:** This section should provide sufficient and relevant information regarding study participants, instrumentation, research design, validity and reliability estimates, data collection procedures, statistical methods and data analysis techniques used. Qualitative research techniques are also acceptable.

**Results** Findings should be presented precisely and clearly. Tables and figures must be presented separately or at the end of the manuscript and their appropriate locations in the text indicated. The results section should not contain materials that are appropriate for presentation under the discussion section. Formulas, units and quantities should be expressed in

the systeme 318 Guidelines for Authors internationale (SI) units. Colour printing of figures and tables is expensive and could be done upon request authors' expense. Discussion The discussion section should reflect only important aspects of the study and its major conclusions. Information presented in the results section should not be repeated under the discussion. Relevant references should be cited in order to justify the findings of the study. Overall, the discussion should be critical and tactfully written. References The American Psychological Association (APA) format should be used for referencing. Only references cited in the text should be alphabetically listed in the reference section at the end of the article. References should not be numbered either in the text or in the reference list. Authors are advised to consider the following examples in referencing: Examples of citations in body of the text:- For one or two authors; Kruger (2003) and Travill and Lloyd (1998). These references should be cited as follows when indicated at the end of a statement: (Kruger, 2003); (Travill & Lloyd, 1998). For three or more authors cited for the first time in the text; Monyeki, Brits, Mantsena and Toriola (2002) or when cited at the end of a statement as in the preceding example; (Monyeki, Brits, Mantsena & Toriola, 2002). For subsequent citations of the same reference it suffices to cite this particular reference as: Monyeki et al. (2002). Multiple references when cited in the body of the text should be listed chronologically in ascending order, i.e. starting with the oldest reference. These should be separated with semi colons. For example, (Tom, 1982; McDaniels & Jooste, 1990; van Heerden, 2001; de Ridder at al., 2003). Reference List In compiling the reference list at the end of the text the following examples for journal references, chapter from a book, book publication and electronic citations should be considered: Examples of journal references: Journal references should include the surname and initials of the author(s), year of publication, title of paper, name of the journal in which the paper has been published, volume and number of journal issue and page numbers. For one author: McDonald, A.K. (1999). Youth sports in Africa: A review of programmes in selected countries. *International Journal of Youth Sports*, 1(4), 102-117. For two authors: Johnson, A.G. & O'Kefee, L.M. (2003). Analysis of performance factors in provincial table tennis players. *Journal of Sport Performance*, 2(3), 12-31. For multiple authors: Kemper, G.A., McPherson, A.B., Toledo, I. & Abdullah, I.I. (1996). Kinematic analysis of forehand smash in badminton. *Science of Racket Sports*, 24(2), 99-112. Examples of book references: Guidelines for Authors 319 Book references should specify the surname and initials of the author(s), year of publication of the book, title, edition, page numbers written in brackets, city where book was published and name of publishers. Chapter references should include the name(s) of the editor(s) and other specific information provided in the third example below: For authored references: Amusa, L.O. & Toriola, A.L. (2003). *Foundations of Sport Science* (1st ed.) (pp. 39-45). Mokopane, South Africa: Dynasty Printers. For edited references: Amusa, L.O. and Toriola, A.L. (Eds.) (2003).

Contemporary Issues in Physical Education and Sports (2nd ed.) (pp. 20-24). Mokopane, South Africa: Dynasty Printers. For chapter references in a book: Adams, L.L. & Neveling, I.A. (2004). Body fat characteristics of sumo wrestlers. In J.K. Manny and F.O. Boyd (Eds.), *Advances in Kinanthropometry* (pp. 21-29). Johannesburg, South Africa: The Publishers Company Ltd. Example of electronic references: Electronic sources should be easily accessible. Details of Internet website links should also be provided fully. Consider the following example: Wilson, G.A. (1997). Does sport sponsorship have a direct effect on product sales? *The CyberJournal of Sport Marketing* (online), October, 1(4), at <http://www.cad.gu.au/cjasm/wilson.html>. February 1997.

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# APPENDIX C: GUIDELINES FOR AUTHORS

## SOUTH AFRICAN JOURNAL FOR RESEARCH IN SPORT, PHYSICAL EDUCATION AND RECREATION

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### INFORMATION FOR AUTHORS

The *South African Journal for Research in Sport, Physical Education and Recreation* is published by Stellenbosch University. Contributions from the fields of Sport Science, Physical Education, Recreation/Leisure Studies, Exercise Science and Dance Studies will be considered for publication. The articles submitted will be administered by the appropriate Subject Review Editor and evaluated by two or more referees. The decision as to whether a particular article is to be published or not, rests with the Editorial Board.

### SUBMISSION

Manuscripts that do not comply with the following requirements regarding process, style and format will not be handled.

Manuscripts should be typed with **one and a half spacing** in 12-point Times New Roman letter size. The original manuscript can be submitted by e-mail. The length may not exceed 20 pages (tables, figures, references, etc. included). The **page setup** (cm) must be in the following format:

### MARGINS PAPER SIZE

*Top:* 3.56 cm *Width:* 17.5 cm

*Bottom:* 1.78 cm *Height:* 24.5 cm

*Left:* 2.11 cm

*Right:* 2.11 cm

*Gutter:* 0.00 cm

*Header:* 2.03 cm

*Footer:* 0.89 cm

Original manuscripts may be submitted in English or Afrikaans and should be sent to:

The Editor **Editorial Office**

South African Journal for Research in Sport, Tel.: +27 (0)21-808 4915 / 4715

Physical Education and Recreation Fax.: +27 (0)21-808 4817

Department of Sport Science E-mail: [sajrsper@sun.ac.za](mailto:sajrsper@sun.ac.za)

Private Bag X1

7602 Matieland, STELLENBOSCH

Republic of South Africa

## CONDITIONS

Each manuscript must be accompanied by a cover letter in which the following is declared: (1) that the manuscript contains original research; (2) that the manuscript or parts of the manuscript has not been published elsewhere previously; (3) that the manuscript is not currently being presented elsewhere for publication; and (4) that all the authors have read and approved the manuscript. This signed declaration regarding the originality must accompany each manuscript.

Authors are also requested to name three (3) potential referees, of which one (1) **must** be an international referee (the journal is not bound to use these referees). Complete information regarding the referees (name, surname, e-mail address and telephone numbers) must be provided in the cover letter.

We discourage the practice of parts of one study in different journals. Authors who submit a manuscript from a study of which some data has been or will be published elsewhere, must provide a strong justification in an accompanying letter to the Editor. The justification for not publishing all the data together in one paper must also be motivated in the covering letter.

Should the article be taken from a master's thesis or doctoral dissertation, academic ethic requires that the student will be the first author.

The author should also ensure that the **LANGUAGE** of the manuscript has been thoroughly edited at the time of submission (English [UK]). The name, address and telephone number of the person who has done the language editing must be provided. Any expenses incurred by the journal dealing with language editing will be added to the author's page fees.

The manuscript must have an **ETHICAL CLEARANCE NUMBER** that was supplied by authentic ethical committee of a specific institution. The process that was followed to obtain ethical clearance must be described in the manuscript under the heading **Ethical clearance**. No manuscript can be published without this declaration.

Any uncertainty regarding the **STATISTICAL PROCEDURES** that arise during the assessment of the manuscript will be referred to a local statistician. Any expenses incurred by the journal dealing with statistical procedures will be added to the author's page fees.

## PREPARATION OF MANUSCRIPT

Manuscripts must be presented in a format that is compatible with *Microsoft Word for Windows* (PC). Tables, all figures (illustrations, diagrams, etc.) and graphs are also regarded as text and must be presented in a format that is compatible with *Word*. Photographs must be presented in *jpg* format.

Original manuscripts must contain the following sections in the following sequence: Title page, Abstract, Introduction, Methodology, Results, Discussion, Practical application, Conclusions, Acknowledgements and References.

### **Title page**

The first page of each manuscript should indicate the *title* in English and Afrikaans (will be translated for foreign authors), the *names* (**title, first name in full and other initials, surname**) of the author(s), the *telephone* numbers (work & home [Mobile – for local authors]), *facsimile* number, *e-mail* address (if available) and the *field of study*. The **complete mailing address** of the first named author and the institution where the work was conducted should be provided in full. When more than one author and/or authors from various departments are involved the **1author(s)** must be numbered according to their **1department(s)**. If any of the above-mentioned information should change during the review process, please inform the subject editor. A **short title**, of not more than **45 characters** including the spaces, should be provided for use as a running head.

### **Abstract**

Each manuscript must be accompanied by an abstract of approximately 150-200 words in *English* and should be set on a *separate page* as a SINGLE paragraph (one and a half spacing). A list of three to seven **key words** in *English* is required for indexing purposes and should be typed below the abstract. Articles in Afrikaans must include an **additional** extended summary (500-1000 words) in English. This summary must start on a new page (just before the reference list) and also provide the English title of the article at the beginning.

**Text:** Start the text on a new page with the title of the article (centred and *without* the names of the authors). Follow the style of the most recent issue of the journal regarding the use of headings and subheadings. Use only **one space** after a paragraph. Only make use of **section breaks** and not **page breaks**. The text, as well as the tables and figures, may under **no circumstances** be in any other format than **normal**. Thus, no **style sheets** may be used.

### **Tables and figures**

Tables and figures should be numbered in *Arabic* numerals (1, 2, etc.). Tables require the heading at the *top* while figures a legend *below* and both separate from the table/figure. **Note:** Use the decimal POINT (**not** the decimal comma). The site where the table or figure must be placed in the text must be indicated clearly in the manuscript. **Tables and figures are placed after the reference list with each on a separate page.**

### **References**

In the *text* the Harvard method must be adopted by providing the author's surname and the date placed in parentheses. *For example:* Daly (1970); King and Loathes (1985); (Botha & Sonn, 2002);

McGuines *et al.* (1986) or (Daly, 1970:80) when Daly is not part of the sentence. More than one reference must be arranged **chronologically** (Daly, 1970; King & Loathes, 1985). Note that *et al.* (italics) is used in the body of the text when there are **more than two authors**, but never in the list of references.

### **List of references**

Only the references cited in the text should be listed alphabetically according to surname (last name) of authors (capitals) after the body of text under the heading, **References** (capitals) starting on a new page. In the case where the TITLE of an article, book, etc., is in any other language than English, the author must also provide an English translation of the title in parentheses.

In the case of articles published in **JOURNALS**, references listed should include the surnames and initials (capitals) of all authors, the date of the publication in parentheses, the full title of the article, the full title of the journal (italics), the volume number, the serial number in parentheses (omitted **only** if the said journal does not use issue numbers), followed by a colon and a space with the first and last page numbers separated by a hyphen.

*Example:*

VAN WYK, G.J. & AMOORE, J.N. (1995). A practical solution for calculating instantaneous values of tension in the extensor muscles of the knee joint during extension and flexion. *South African Journal for Research in Sport, Physical Education and Recreation*, 18(1): 77-97.

If the reference is a **BOOK**, the surname (last name) and initials of the author or editor (Ed.) must be given, followed by the date of publication in parentheses, the title of the book (italics) as given on the title page, the number of the edition (ed.) in parentheses, the city (and abbreviation for the state in the case of the USA OR the country [in curved parentheses]) where published, followed by a colon, a space and the name of the publisher. *Example:*

JEWETT, A.E.; BAIN, L.L. & ENNIS, C.E. (1995). *The curriculum process in Physical Education* (2nded.). Madison, WI: WCB Brown & Benchmark.

For a **CHAPTER** from a book, the page numbers of the chapter cited must be provided in parentheses (not italics) after the title of the book. For further details, authors should consult the most recent publication of this Journal for other examples.

*Example:*

DE RIDDER, J.H. (1999). Kinanthropometry in exercise and sport. In L.O. Amusa, A.L. Toriola, I.U. Onyewadume (Eds.), *Physical Education and sport in Africa* (pp.235-263). Ibadan (Nigeria): LAP Publications.

If the reference is a THESIS (master's level) or DISSERTATION (doctoral level), italics is **not** used in the title as it is an unpublished work.

*Example:*

CRAVEN, D.H. (1978). The evolution of major games. Unpublished PhD-dissertation. Stellenbosch: Stellenbosch University.

For **ELECTRONIC SOURCES**, all references start with the same information that would be provided for a printed source (if available). The web page information follows the reference. It will usually contain the name of the author(s) (if known), year of publication or last revision, title of complete work in inverted commas, title of web page in italics, Uniform Resource Locator (URL) or access path in text brackets (do not end the path statement with a full stop) and date of access. See "*How to cite information from the Internet and the Worldwide Web*" at <http://www.apa.org/journals/webref.html> for specific examples. When citing a web site in the text, merely give the author and date (in this case: Ackermann, 1996).

*Example of Web Page:*

ACKERMANN, E. (1996). "Writing your own Web Pages. "*Creating Web Pages*. Hyperlink: [<http://www.mwc.edu/ernie/writeweb/writeweb.html>]. Retrieved on 22 October 1999.

When referencing an article in a **NEWSPAPER** the key word of the newspaper is typed in capitals, as this is how **it will appear in the alphabetical references**, namely *The CAPE ARGUS* will appear under "C" or *Die BURGER* will appear under "B".

*Example:*

*CAPE ARGUS (The)* (1980). 10 January, p.4.

### **INTERVIEWS**

*Example:*

POTGIETER, J.R. (2003). Personal interview with the Chairperson of the Department of Sport Science. 31 January. Stellenbosch: Stellenbosch University.

### **CORRESPONDENCE**

*Example:*

POTGIETER, J.J.J. (2003). Personal correspondence of the Director of the Sport Bureau, 5 February. Stellenbosch: Stellenbosch University.

### **CONGRESS PROCEEDINGS**

*Example:*

RENSON, R. (Ed.) (1976). *The history, the evolution and diffusion of sport and games in different cultures*. Proceedings of the 4th International HISPA Congress, Leuven, Belgium, 1-5 April 1975. Brussels (Belgium): B.L.O.S.O. When referring to a paper presented in the above-mentioned proceedings, it must be presented as follows:

REES, R. (1976). Organisation of sport in nineteenth century Liverpool. In R. Renson (Ed.), *The history, the evolution and diffusion of sport and games in different cultures* (pp.237-247). Proceedings of the 4th International HISPA Congress, Leuven, Belgium, 1-5 April 1975. Brussels (Belgium): B.L.O.S.O.

#### **ADMINISTRATION**

If authors honour the rules and specifications for the submission of manuscripts, unnecessary delays would be avoided. A manuscript that does not meet the requirements, as set out above, will be returned to the author without being evaluated. Requesting copying right concerning figures or photographs is the responsibility of the authors and should be indicated.

The corresponding author will receive a complimentary copy of the journal and five reprints of the article. The original manuscripts and illustrations will be discarded one month after publication unless a request is received to return the original to the first-named author. A page fee of **R150** per page is payable on receipt of an account issued by the Editor.

# APPENDIX D: GUIDELINES FOR AUTHORS

## INTERNATIONAL QUARTERLY OF COMMUNITY HEALTH EDUCATION

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### **Description**

The *International Quarterly of Community Health Education* is committed to publishing applied research, policy and case studies dealing with community health education and its relationship to social change. Since 1981, this rigorously peer-reviewed journal has contained a wide selection of material by contributors who are authorities in their field. Since its introduction the Journal has considered all manuscripts, especially encouraging stimulating articles which manage to combine maximum readability with scholarly standards. The Journal stresses systematic application of social science and health education theory and methodology to public health problems and consumer-directed approaches to control of preventive and curative health services. Environmental and structural changes are emphasized and victim-blaming approaches are closely examined. This Journal is a member of the Committee on Publication Ethics (COPE).

### **Aims and Scope**

The *Journal* publishes applied research, policy and case studies dealing with community health education and its relationship to social change. The Journal stresses systematic application of social science and health education theory and methodology to public health problems and consumer-directed approaches to control of preventive and curative health services. Environmental and structural changes are emphasized and victim-blaming approaches are closely examined.

### **Abstracting indexing**

- EBSCO: Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- PsycINFO
- PubMed: MEDLINE
- SCOPUS

### **Manuscript Submission**

SUBMIT ALL MANUSCRIPTS AS AN MS WORD FILE, VIA EMAIL TO THE EDITOR-IN-CHIEF:

Dr. George P. Cernada

PO Box 3585

Amherst, MA 01004-3585

E-mail:[gcernada@schoolph.umass.edu](mailto:gcernada@schoolph.umass.edu)

*Manuscripts* are to be submitted in triplicate. Including Word document copy recommended. Retain one copy, as manuscript will not be returned unless accompanied by a self-addressed, stamped envelope. Manuscript must be typewritten on 8-1/2" x 11" white paper, one side only, double-spaced, with wide margins. Paginate consecutively starting with the title page. The organization of the paper should be indicated by appropriate headings and subheadings.

*Originality* Authors should note that only original articles are accepted for publication. Submission of a manuscript represents certification on the part of the author(s) that neither the article submitted, nor a version of it has been published, or is being considered for publication elsewhere.

*Abstracts* of 100 to 150 words are required to introduce each article.

*References* should relate only to material cited within text and be listed in numerical order according to their appearance within text. State author's name, title of referenced work, editor's name, title of book or periodical, volume, issue, pages cited, year of publication, and DOI (digital object identifier).

Do not abbreviate titles. Please do not use *ibid.*, *op. cit.*, *loc. cit.*, etc. In case of multiple citations, simply repeat the original numeral. Detailed specifications available from the editor upon request.

*Footnotes* are placed at the bottom of page where referenced. They should be numbered with superior Arabic numbers without parentheses or brackets. Footnotes should be brief with an average length of three lines.

*Figures* should be referenced in text and appear in numerical sequence starting with Figure 1. Line art must be original drawings in black ink proportionate to our page size, and suitable for photographing. Indicate top and bottom of figure where confusion may exist. Labeling should be 8 point type. Clearly identify all figures. Figures should be drawn on separate pages and their placement within the text indicated by inserting: (Insert Figure 1 here).

*Tables* must be cited in text in numerical sequence starting with Table 1. Each table must have a descriptive title. Any footnotes to tables are indicated by superior lower case letters. Tables should

be typed on separate pages and their approximate placement indicated within text by inserting:  
(Insert Table 1 here).

# APPENDIX E: INFORMED CONSENT FORM

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Private Bag X6001, Potchefstroom  
South Africa 2520

Web: <http://www.nwu.ac.za>

**Physical Activity, Sport and Recreation**

Tel: +2718 2991821

Fax: +2787 231 5480

E-Mail: [hanlie.moss@nwu.ac.za](mailto:hanlie.moss@nwu.ac.za)

## **Fitness testing, exercise intervention and health-related quality of life validation in Setswana speaking community dwelling Potchefstroom adults**

### **CONSENT TO BE A RESEARCH PARTICIPANT**

I am SUNDAY ONAGBIYE working with a team of researcher from the North-West University on “fitness testing, exercise intervention and health-related quality of life”. We would like to invite you to give consent and participate in our study. To follow is information about the study so that you can make an informed decision.

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

The purpose of this study is to compare the results of the Setswana translation of SF-8 health related quality of life questionnaire after 4 weeks in order to determine whether the translation is valid.

#### **2. PROCEDURE**

On your arrival at 9 am informed consent will be explained and signed. The purpose of the Setswana translated health-related quality of life health survey questionnaire will be explained to you, if needed in your mother tongue by the team of researchers who are well grounded in speaking Setswana language. Demographic information regarding your year of birth, age, sex, marital status, and employment status, level of education, type of work,

household income, and private medical insurance will be completed. The questionnaire will then be completed. The questionnaire can be completed within 5 minutes and if you do not seem to understand some areas in the questionnaire you will be guided through by the team member of researchers. You will be told to come back after 4 weeks to complete the same questionnaire. For any of you who come to complete the questionnaire after 4 weeks will be given a token of appreciation.

### **3. RISKS/DISCOMFORTS**

For filling the questionnaire, you may be anxious or feel bored during the completion of the questionnaire. The anxiety and bored state will be minimized by explaining the importance and benefit of the study. You will be asked to complete the questionnaire again after 4 weeks. If you complete the questionnaire after 4 weeks you will be awarded a token of appreciation.

### **4. BENEFITS TO YOU**

Short term benefits to you include:

Immediate feedback and education regarding health factors and quality of life.

Long term benefits will not only apply to you but to the community you come from.

### **5. COSTS**

There will be no cost to you as a result of your participation in this study.

### **6. PAYMENT**

If you complete the questionnaire after 4 weeks you will be awarded a token of appreciation.

### **7. CONFIDENTIALITY AND ANONYMITY**

The researcher will use secure procedures for all questionnaires, computer-based (database) storage of protected health information including servers, laptops, handheld computers and any other type of data storage device. No identifying information will be present on questionnaires and data sheets security procedure such as encryption, password protection will also be used as a standard practice.

### **8. QUESTIONS**

You are welcome to ask any questions from a member of the research team before you decide to give consent. You are also welcome to contact Sunday Onagbiye, the project supervisor (060 484 0456) and Prof. S.J. Moss, the project head ((018) 2991821)

## 9. FEEDBACK OF FINDINGS

The findings of the research will be shared with you in a session that will be created for the participants who are interested in knowing the results which will be at your request. You are welcome to contact us regarding the findings of the research. We will be sharing the findings with you as soon as it is available.

### CONSENT FORM

#### PARTICIPATION IN THIS RESEARCH IS VOLUNTARY.

You are free to decline to be in this study, or to withdraw at any point even after you have signed the form to give consent without any consequences.

Should you be willing to participate you are requested to sign below:

I \_\_\_\_\_ hereby voluntarily consent to participate in the above mentioned study. I am not coerced in any way to participate and I understand that I can withdraw at any time should I feel uncomfortable during the study. I also understand that my name will not be disclosed to anybody who is not part of the study and that the information will be kept confidential and not linked to my name at any stage. I also understand what I might benefit from participation as well as what might be the possible risks and should I need further discussions someone will be available.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of the participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of the person obtaining consent

# APPENDIX F: INFORMED CONSENT FORM

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Private Bag X6001, Potchefstroom  
South Africa 2520

Web: <http://www.nwu.ac.za>

## **Physical Activity, Sport and Recreation**

Tel: +2718 2991821

Fax: +2787 231 5480

E-Mail: [hanlie.moss@nwu.ac.za](mailto:hanlie.moss@nwu.ac.za)

## **Fitness testing, exercise intervention and health-related quality of life validation in Setswana speaking community dwelling Potchefstroom adults**

### **CONSENT TO BE A RESEARCH PARTICIPANT**

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

The purpose of this study is to determine the most appropriate mode (metronome or music/individual or group) by which you are motivated to perform and complete a graded 8-minute step-test to determine your level of fitness.

#### **2. PROCEDURE**

If you agree to participate in this study you will be expected to do one/all of the following:

On your arrival at 9 am the study procedure will be thoroughly explained to you after which you will be asked to sign the Informed consent form. You will be asked to complete physical activity readiness questionnaire (PAR-Q). Then you will be directed to the next station to measure your height, weight and circumference. Your blood pressure (BP) and heart rate (HR) will be measured after you have rested quietly for 5 minutes. A finger prick will be done after your blood pressure and heart rate have been measured. Lastly

we will determine your fitness levels with the 8 minutes step test accompanied by either a metronome or cultural music.

You will be asked to perform the step test both individually and in a group on separate days, one week apart. Time and dates will be communicated to you for both individual and group assessment. If you complete the step test you will be given a token of appreciation.

### **3. RISKS/DISCOMFORTS**

Some of your privacy might be lost most especially during the body measurement of your height, weight and circumference but you will be allowed to be measured by the researcher of the same sex. During the finger prick, rubbing and swabbing of the side of your finger closest to the thumb fingertip with a sterile swab will be performed which could cause a discomfort. Lancing the massaged place on the fingertip with lancing device and pricking of your finger repeatedly and incorrectly could maximise discomfort and risk levels. Furthermore, not having a proper container to dispose the used lancet and materials properly in place could be a risk also. A standard procedure of obtaining peripheral blood for glucose and cholesterol will be performed by a Biokineticist, which forms part of the training and scope of the practice. All the used materials will be properly disposed to avoid any kind of infections and injury risk.

There is a risk for cardiac events during exercise testing. In order to minimize this risk, health risk screening (PARQ) and baseline measures of heart rate and blood pressure (should be below 160mmHg/95mmHg) will be done. Furthermore, if you have orthopedic limitations or pregnant or lactating or have a temperature of  $> 37.5^{\circ}\text{C}$  you will not be allowed to participate. During the test you will be monitored by researchers trained in basic life support and an AED. You will be monitored visually as well as with the use of the Borg rate of perceived exertion scale to be able to subjectively rate your feelings during the test and indicate impending fatigue. Additional medical help will be accessible if needed as the research will take place at a clinic.

Your name will never be made known and the data will be handled as confidential as possible. No individuals identifiers will be used in any publications resulting from this study and only the team of researchers will work with the information that is shared. All sensitive information will be protected by locking it up and storing it on a password protected computer.

#### **4. BENEFITS TO YOU**

Short term benefits to you:

- Immediate feedback and education regarding health factors, fitness and quality of life
- Health risk identification
- Identification of factors that would increase exercise participation (type of activity, duration, time of day)

The benefits will not only apply to you but to the community you come from. The study of this type also will help you improve your cardio-respiratory fitness level which could make you experience exercise tolerance and improve quality of life.

#### **5. COSTS**

There will be no cost to you as a result of your participation in this study.

#### **6. PAYMENT**

You will be awarded a token of appreciation.

#### **7. CONFIDENTIALITY AND ANONYMITY**

The researcher will use secure procedures for all questionnaires, computer-based (database) storage of protected health information including servers, laptops, handheld computers and any other type of data storage device. No identifying information will be present on questionnaires and data sheets security procedure such as encryption, password protection will also be used as a standard practice. Only partial confidentiality can be offered to you if you partake in the exercise testing.

#### **8. QUESTIONS**

You are welcome to ask any questions from a member of the research team before you decide to give consent. You are also welcome to contact Sunday Onagbiye, the project supervisor (060 484 0456) and Prof. S.J. Moss, the project head ((018) 2991821)

#### **9. FEEDBACK OF FINDINGS**

The findings of the research will be shared with you in a session that will be created for those who are interested in knowing the results which will be at your request. You are welcome to contact us regarding the findings of the research. We will be sharing the findings with you as soon as it is available.

**CONSENT FORM**

**PARTICIPATION IN THIS RESEARCH IS VOLUNTARY.**

You are free to decline to be in this study, or to withdraw at any point even after you have signed the form to give consent without any consequences.

Should you be willing to participate you are requested to sign below:

I \_\_\_\_\_ hereby voluntarily consent to participate in the above mentioned study. I am not coerced in any way to participate and I understand that I can withdraw at any time should I feel uncomfortable during the study. I also understand that my name will not be disclosed to anybody who is not part of the study and that the information will be kept confidential and not linked to my name at any stage. I also understand what I might benefit from participation as well as what might be the possible risks and should I need further discussions someone will be available.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of the participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of the person obtaining consent

# APPENDIX G: INFORMED CONSENT FORM

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Private Bag X6001, Potchefstroom  
South Africa 2520

Web: <http://www.nwu.ac.za>

## Physical Activity, Sport and Recreation

Tel: +2718 2991821  
Fax: +2787 231 5480  
E-Mail: [hanlie.moss@nwu.ac.za](mailto:hanlie.moss@nwu.ac.za)

## **Fitness testing, exercise intervention and health-related quality of life validation in Setswana speaking community dwelling Potchefstroom adults**

### **CONSENT TO BE A RESEARCH PARTICIPANT**

I am SUNDAY ONAGBIYE working with a team of researcher from the North-West University on “fitness testing, exercise intervention and health-related quality of life”. We would like to invite you to give consent and participate in the study. To follow is information about the study so that you can make an informed decision.

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

The purpose of this study is to determine your “most preferred modality of exercise” with a questionnaire.

#### **2. PROCEDURE**

On your arrival at 9 am informed consent will be explained and signed. The purpose of the most preferred physical activity questionnaire will be explained to you both in English and your mother tongue by the team of researchers who are well grounded in speaking Setswana language. You will be informed before giving your consent to participate that anyone who participates in the filling of the questionnaire will automatically participate in the exercise intervention programs. You will be asked to complete demographic information regarding your year of birth, age, sex, marital status, and employment status, level of education, type of work, household income, and private medical insurance. The questionnaires will then be completed. The questionnaire can be completed within 5 minutes, and if you do not seem to

understand some areas in the questionnaire, you will be guided through by the team member of researchers.

### **3. RISKS/DISCOMFORTS**

For filling the questionnaire, you may be anxious or feel bored during the completion of the questionnaire. The anxiety and bored state will be minimized by explaining the importance and benefit of the study. Furthermore, the team of researchers will be on ground to guide you through any difficult aspect of the questionnaire. Questions can also be translated in Setswana to help you with the full understanding and guidance.

### **4. CONFIDENTIALITY AND ANONYMITY**

The researcher will use secure procedures for all questionnaires, computer-based (database) storage of protected health information including servers, laptops, handheld computers and any other type of data storage device. No identifying information will be present on questionnaires and data sheets security procedure such as encryption, password protection will also be used as a standard practice. Only partial confidentiality can be offered to you partaking in the intervention studies.

### **5. BENEFITS TO YOU**

Short term benefits:

- Immediate feedback and education regarding physical activity
- Identification of factors that would increase exercise participation (type of activity, duration, time of day)
- Awareness on the benefit of the most preferred physical activity.

Long term benefits will not only apply to the participants but to the community they come from.

### **6. COSTS**

There will be no cost to you as a result of your participation in this study.

**7. PAYMENT**

No payment will be received for this study.

**8. QUESTIONS**

You are welcome to ask any questions from a member of the research team before you decide to give consent. You are also welcome to contact Sunday Onagbiye, the project supervisor (060 484 0456) and Prof. S.J. Moss, the project head ((018) 2991821)

**9. FEEDBACK OF FINDINGS**

The findings of the research will be shared with you in a session that will be created for the participants who are interested in knowing the results which will be at your request. You are welcome to contact us regarding the findings of the research. We will be sharing the findings with you as soon as it is available.

**CONSENT FORM**

**PARTICIPATION IN THIS RESEARCH IS VOLUNTARY.**

You are free to decline to be in this study, or to withdraw at any point even after you have signed the form to give consent without any consequences.

Should you be willing to participate you are requested to sign below:

I \_\_\_\_\_ hereby voluntarily consent to participate in the above mentioned study. I am not coerced in any way to participate and I understand that I can withdraw at any time should I feel uncomfortable during the study. I also understand that my name will not be disclosed to anybody who is not part of the study and that the information will be kept confidential and not linked to my name at any stage. I also understand what I might benefit from participation as well as what might be the possible risks and should I need further discussions someone will be available.

\_\_\_\_\_

Date

\_\_\_\_\_

Signature of the participant

\_\_\_\_\_

Date

\_\_\_\_\_

Signature of the person obtaining consent

# APPENDIX H: INFORMED CONSENT FORM

---



Private Bag X6001, Potchefstroom  
South Africa 2520

Web: <http://www.nwu.ac.za>

## **Physical Activity, Sport and Recreation**

Tel: +2718 2991821  
Fax: +2787 231 5480  
E-Mail: [hanlie.moss@nwu.ac.za](mailto:hanlie.moss@nwu.ac.za)

## **Fitness testing, exercise intervention and health-related quality of life validation in Setswana speaking community dwelling Potchefstroom adults**

### **CONSENT TO BE A RESEARCH PARTICIPANT**

I am SUNDAY ONAGBIYE working with a team of researcher from the North-West University on “fitness testing, exercise intervention and health-related quality of life”. We would like to invite you to give consent and participate in our study. To follow is information about the study so that you can make an informed decision.

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

The purpose of this study is to examine the effect of the most preferred physical activity or exercise to be used in an intervention program. Information collected in this study will be used to plan a long-term exercise intervention to address NCDs and improve quality of life.

#### **2. PROCEDURE**

If you agree to participate in this study you will be expected to do one/all of the following:  
On the arrival at 9 am you will be expected to complete and sign informed consent form within 5 minutes. You will be expected to complete a physical activity readiness questionnaire (PAR-Q) and a health risk assessment (this is especially important for participation in the exercise intervention which can be completed within 3-5 minutes).

For body measurements, your height, weight and circumference will be measured and you are expected to stand in minimal clothing in a private enclosure to be measured.

Your blood pressure and heart rate will be measured in less than a minute after the participant has rested or seated quietly for 5 minute without talking. A soft cuff will be wrapped around your upper arm and inflated with air. The cuff will press on the large artery in your arm. When inflated, it will briefly stop the flow of blood after which the air in the cuff will then be slowly released. The systolic and diastolic blood pressure will then be recorded heard through stethoscope.

In order to determine glucose and cholesterol, a finger prick will be done by the expert. There may be some anxiety and discomfort. In order to minimize the risk associated with finger prick test to you, you will be fully informed about the procedure and what you could expect to experience. Testing will be done correctly and confidently to avoid repetitions and minimise discomfort and risk levels. In order to minimize the risk to the researcher, gloves will be worn.

You will be expected to partake in aerobic exercise intervention. You might expect being tired during exercising, but you will be encouraged to continue with the session. Precautions will be taking beforehand to ensure your safety as mentioned with the baseline measures (baseline health risk assessment). You can expect that researchers will be trained in movement science and all other research team member will be trained in first aid if the need arises for such aid and an AED will be available. Furthermore, as the research takes place at a clinic, professional medical help will be available. At the end of this last study, baseline measures will be repeated. Mainly, your welfare is ensured by using appropriately trained (movement science and first aid) researchers. Furthermore research will be conducted at a health clinic which can provide additional support if an emergency arises. You may be anxious or feel bored during the completion of the tests. The researcher will make sure that the anxiety and bored state is minimized by explaining the importance and benefit of the study to you.

### **3. RISKS/DISCOMFORTS**

Some of your privacy might be lost most especially during the body measurement of your height, weight and circumference but you will be allowed to be measured by the researcher of the same sex. You might experience some discomfort of momentary squeezing as the cuff

inflates. The researcher will make sure that every likely discomfort will be explained to you, step taking during the measurement of resting blood pressure will be done correctly to minimize discomfort.

During the finger prick, rubbing and swabbing of the side of your finger closest to the thumb fingertip with a sterile swab will be performed which could cause a discomfort. Lancing the massaged place on the fingertip with lancing device and pricking of your finger repeatedly and incorrectly could maximise discomfort and risk levels. Furthermore, not having a proper container to dispose the used lancet and materials properly in place could be a risk also. A standard procedure of obtaining peripheral blood for glucose and cholesterol will be performed by a Biokineticist, which forms part of the training and scope of the practice. All the used materials will be properly disposed to avoid any kind of infections and injury risk.

There is a risk for cardiac events with the most preferred exercise modality. Cardiovascular events may be provoked in persons with pre-existing heart disease. In order to minimize this risk, health risk screening will be done with physical activity readiness questionnaire (PARQ) and baseline measures of heart rate and blood pressure (should be below 160mmHg/95mmHg) will be done. Furthermore, persons with orthopedic limitations, who are pregnant, lactating or have a temperature of  $> 37.5^{\circ}\text{C}$  will be excluded.

During the exercise intervention sessions, you will be monitored by researchers trained in first aid and an AED will be available. You will be closely supervised to ensure that you exercise within the prescribed (40-70% intensity) training range. In addition, your heart rate will be consistently monitored so that if you fall below or exceed your respective training range you can be identified and your exercise will be modified. Additional medical help will be accessible if needed as the research will take place at a clinic. To ensure overall safety, researchers will be trained in human movement science in order to ensure the safety and the correctness of the exercises. Being trained in human movement science also equips researchers with the knowledge and skills to be able to do the measurements and tests needed for this study. Any of the research team members that are not yet skilled in first aid and AED

will undergo training before the study commences. Anxiety will be minimized by explaining the importance of the study to you.

#### **4. BENEFITS**

Short term benefits for the participants of the study include:

- Immediate feedback and education regarding health factors
- Health risk identification
- Increased fitness and health

Long term benefits will not only apply to the participants but to the community they come from. The study of this type also will help you improve your cardio-respiratory fitness level which could make you experience exercise tolerance and improved quality of life.

#### **5. COSTS**

There will be no cost to you as a result of your participation in this study.

#### **6. PAYMENT**

You will be awarded a token of appreciation

#### **7. CONFIDENTIALITY AND ANONYMITY**

The researcher will use secure procedures for all questionnaires, computer-based (database) storage of protected health information including servers, laptops, handheld computers and any other type of data storage device. No identifying information will be present on questionnaires and data sheets security procedure such as encryption, password protection will also be used as a standard practice. Only partial confidentiality can be offered to you partaking in the intervention study.

#### **8. QUESTIONS**

You are welcome to ask any questions from a member of the research team before you decide to give consent. You are also welcome to contact Sunday Onagbiye, the project supervisor (060 484 0456) and Prof. S.J. Moss, the project head ((018) 2991821)

#### **9. FEEDBACK OF FINDINGS**

The findings of the research will be shared with you in a session that will be created for those who are interested in knowing the results which will be at your request. You are welcome to

contact us regarding the findings of the research. We will be sharing the findings with you as soon as it is available.

**CONSENT FORM**

**PARTICIPATION IN THIS RESEARCH IS VOLUNTARY.**

You are free to decline to be in this study, or to withdraw at any point even after you have signed the form to give consent without any consequences.

Should you be willing to participate you are requested to sign below:

I \_\_\_\_\_ hereby voluntarily consent to participate in the above mentioned study. I am not coerced in any way to participate and I understand that I can withdraw at any time should I feel uncomfortable during the study. I also understand that my name will not be disclosed to anybody who is not part of the study and that the information will be kept confidential and not linked to my name at any stage. I also understand what I might benefit from participation as well as what might be the possible risks and should I need further discussions someone will be available.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of the participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of the person obtaining consent

**APPENDIX I: PHYSICAL ACTIVITY READINESS QUESTIONNAIRE (PAR-Q)**

(A questionnaire for People Aged 15-69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with your doctor before you start.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check **YES** or **NO**

YES <input type="checkbox"/>	NO <input type="checkbox"/>	<b>1. Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?</b>
YES <input type="checkbox"/>	NO <input type="checkbox"/>	<b>2. Do you feel pain in your chest when you do physical activity?</b>
YES <input type="checkbox"/>	NO <input type="checkbox"/>	<b>3. In the past month, have you had chest pain when you were not doing physical activity?</b>
YES <input type="checkbox"/>	NO <input type="checkbox"/>	<b>4. Do you lose your balance because of dizziness or do you ever lose consciousness?</b>
YES <input type="checkbox"/>	NO <input type="checkbox"/>	<b>5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?</b>
YES <input type="checkbox"/>	NO <input type="checkbox"/>	<b>6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?</b>
YES <input type="checkbox"/>	NO <input type="checkbox"/>	<b>7. Do you have a diabetes or thyroid condition?</b>
YES <input type="checkbox"/>	NO <input type="checkbox"/>	<b>8. Do you know of <u>any other reason</u> why you should not do physical activity?</b>

<b>If you answered “Yes”:</b>	<b>YES to one or more questions</b>
	<p>A medical clearance form is required of all participants who answer ‘yes’ to any of the eight PAR-Q questions.                  Note: Personal training staff reserve the right to require medical clearance from any client they feel may be at risk.</p> <ul style="list-style-type: none"> <li>Discuss with your personal doctor any conditions that may affect your exercise program.</li> <li>All precautions must be documented on the medical clearance form by your personal doctor.</li> </ul>

<b>NO to all questions</b>
<p>If you answered NO honestly to <u>all</u> PAR-Q questions, you can be reasonably sure that you can:</p> <ul style="list-style-type: none"> <li>start becoming much more physically active - begin slowly and build up gradually. This is the safest and easiest way to go.</li> <li>take part in a fitness appraisal - this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.</li> </ul>



<p><b>DELAY BECOMING MUCH MORE ACTIVE:</b></p> <ul style="list-style-type: none"> <li>If you are not feeling well because of a temporary illness such a cold or a fever - wait until you feel better; or</li> <li>If you are or may be pregnant - talk to your doctor before you start becoming more active.</li> </ul> <p><b>PLEASE NOTE:</b> If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professionals.                  Ask whether you should change your physical activity plan.</p>
---

**Informed Use of the PAR-Q:** The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability to persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.  
 NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

**“I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction.”**

NAME \_\_\_\_\_  
 SIGNATURE \_\_\_\_\_  
 DATE \_\_\_\_\_  
 SIGNATURE OF PARENT \_\_\_\_\_  
 WITNESS \_\_\_\_\_

or **GUARDIAN (for participants under the age of majority)**

**Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.**



Supported by:  
 Questionnaire – PAR-Q



Health Canada / Santé Canada

Physical Activity Readiness  
 (revised 2006 by CW)

# APPENDIX J: SHORT FORM-8 (SF-8) QUALITY OF LIFE QUESTIONNAIRE (TSWANA)

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## Maphelo a gago – *le* – Itekanelo

*Patlisiso-potsolotso e e botsa ka ntlha e o nang le yone mabapi le itekanelo ya gago..  
Tshedimosetso e tlaa tomama ka mo o ikutlwang ka teng le ka mo o kgonang go dira ditiro  
tsa mmele tsa ka gale sentle sentle ka teng.*



Ke go lebogela go wetsa dipotso tse!

1. *Ka gotlhelele, o ka lekanyetsa itekanelo ya gago jang mo dibekeng tse 4 tse di fetileng? [Tshwaya ka  mo lebokosong le le lengwe le tlhalosang karabo ya gago*

Bontlente	Sentle Thata	Sentle	Kgotsofatsa	Bokoa	Bokoakoa
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6

2. *Mo dibekeng tse 4 tse di fetileng,ke mathata a fe a mmele a a go iditseng go dira ditiro tsa ka gale (go tsamaya,go tlhatlogella direpodu)?*

Le eseng	Go le gonnye	Motlhamong we	Ga ntsi	Ga ke a kgona go dira sepe
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

3. *Mo dibekeng tse 4 tse di fetileng, ke matsapa a fe a o nnileng nao a go dira tiro ya letsatsi le letsatsi, kwa gae le kwa ntle ga legae,ka ntlha ya itekanelo ya gago ya mmele?*

Le eseng	Ga nnye	Mo gongwe	Ga ntsi	Ga ke a kgona go di dira ditiro tsa letsatsi le letsatsi
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

4. *O nnile le ditlhabi tsa mmele tse di kana kang mo dibekeng tse 4 tse di fetileng?*

Le eseng	Botlhoshw ana thata	Botlhoshw ana	Tse di magareng	Tse di tseneletsen g	Tse di tseneletsen g thata
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6

5. *Mo dibekeng tse 4 tse di fetileng,o nnile le maatla a a kanakang?*

A a mantsi	A a mokawana	Motlha mongwe	Go senene	Le eseng
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

6. Mo dibekeng tse 4 tse di fetileng, itekanelo ya mmele kgotsa mathata a maikutlo a go kgoreleditse go dira ditiro tsa gago tsa ka gale tsa loago le balelapa kgotsa ditsala?

Le eseng	Go le gonnye	Motlhamon gwe	Ga ntsi	Ga ke a kgona go dira ditiro tsa matsogo
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

7. Mo dibekeng tse 4 tse di fetileng, o tshwentswe ke mathata a maikutlo (jaaka go tlhotlhonega, kgatello ya maikutlo kgotsa go babelelwa) go le go kae?

Le eseng	Botlhoshwan a	Magareng	Ga ntsi	Mo go tseneletseng
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

8. Mo dibekeng tse 4 tse di fetileng, mathata a sebele le a maikutlo a go thibetse go le go kae go dira ditiro tsa gago tsa ka gale, go ithuta, kgotsa ditiro tsa letsatsi le letsatsi?

Le eseng	Go le gonnye	Motlha mongwe	Ga ntsi	Ga ke a kgona go dira ditiro tsa matsogo
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

*Ke go lebogela go araba dipotso tse!*

# APPENDIX K: SHORT FORM-8 (SF-8) QUALITY OF LIFE QUESTIONNAIRE (ENGLISH)

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## Your Health– *and* –Well-Being

This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.



*Thank you for completing these questions!*

---

SF-8™ Health Survey  
Copyright © 1998, 2000 QualityMetric Incorporated All rights reserved.  
(SF-8 Standard South Africa/English Version 1.0)

1. Overall, how would you rate your health during the past 4 weeks? [Mark with a  in the one box that best describes your answer.]

Excellent	Very good	Good	Fair	Poor	Very poor
τ	τ	τ	τ	τ	τ
<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>

2. During the past 4 weeks, how much did physical health problems limit your usual physical activities (walking, climbing stairs)?

Not at all	Very little	Somewhat	Quite a lot	Could not do physical activities
τ	τ	τ	τ	τ
<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>

3. During the past 4 weeks, how much difficulty did you have doing your daily work, both at home and away from home, because of your physical health?

None at all	A little bit	Some	Quite a lot	Could not do daily work
τ	τ	τ	τ	τ
<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>

4. How much bodily pain have you had during the past 4 weeks?

None	Very mild	Mild	Moderate	Severe	Very severe
τ	τ	τ	τ	τ	τ
<input type="checkbox"/> <sub>1</sub>	<input type="checkbox"/> <sub>2</sub>	<input type="checkbox"/> <sub>3</sub>	<input type="checkbox"/> <sub>4</sub>	<input type="checkbox"/> <sub>5</sub>	<input type="checkbox"/> <sub>6</sub>

5. During the past 4 weeks, how much energy did you have?

Very much	Quite a bit	Some	A little	None
τ	τ	τ	τ	τ
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

6. During the past 4 weeks, how much did your physical health or emotional problems limit your usual social activities with family or friends?

Not at all	Very little	Somewhat	Quite a lot	Could not do social activities
τ	τ	τ	τ	τ
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

7. During the past 4 weeks, how much have you been bothered by emotional problems (such as feeling anxious, depressed or irritable)?

Not at all	Slightly	Moderately	Quite a lot	Extremely
τ	τ	τ	τ	τ
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

8. During the past 4 weeks, how much did personal or emotional problems keep you from doing your usual work, studies, or other daily activities?

Not at all	Very little	Somewhat	Quite a lot	Could not do daily activities
τ	τ	τ	τ	τ
<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

*Thank you for completing these questions!*

# APPENDIX L: PREFERRED TYPE OF PHYSICAL ACTIVITY QUESTIONNAIRE



## PREFERRED TYPE OF PHYSICAL ACTIVITY QUESTIONNAIRE (PPA-Q)

The Purpose of this questionnaire is to know the type, time, amount and physical activity/exercise you enjoy most.

Please tick  one box that best corresponds to your preferences.

**Date of Birth:**

**Sex:** Male  Female

### ACTIVE AEROBICS, PHYSICAL ACTIVITY, SPORTS & RECREATIONAL ACTIVITIES:

1 Do you take part in physical activity/exercise?

Yes  No

2 Please mark your preferred form/s of exercise (one or more, if more than one, number it in order of preference, 1= highest preference):

- Walking
- Dancing
- Dancing with choir singing
- Football (soccer)
- Running
- Swimming
- Rope skipping
- Hunting
- Gardening
- Domestic Duties (housework)
- Cycling (bicycle)
- If others, please specify \_\_\_\_\_

3 How many times per week do you take part in your most enjoyed physical activity mentioned in question 2?

- N/A (I am not physically active)
- Fewer than 1 time per week
- 1 time per week
- 2 – 3 times per week
- 4-5 times per week
- 6-7 times per week

4 How many minutes per session do you spend in the activity you enjoyed most in question 2?

- Fewer than 10 minutes
- 10-19 minutes
- 20 – 29 minutes
- 30 – 39 minutes
- 40-49 minutes
- 50-59 minutes
- More than 60 minutes

5 What is rate of perceived exertion of your most enjoyed physical activity/exercise chosen in question 2?

- |     |                    |                          |
|-----|--------------------|--------------------------|
| #1  | nothing            | <input type="checkbox"/> |
| #2  | very easy          | <input type="checkbox"/> |
| #3  | easy               | <input type="checkbox"/> |
| #4  | comfortable        | <input type="checkbox"/> |
| #5  | somewhat difficult | <input type="checkbox"/> |
| #6  | Difficult          | <input type="checkbox"/> |
| #7  | Hard               | <input type="checkbox"/> |
| #8  | Very hard          | <input type="checkbox"/> |
| #9  | extremely hard     | <input type="checkbox"/> |
| #10 | Exhausted          | <input type="checkbox"/> |

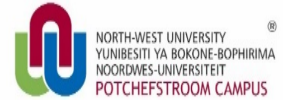
6. What time of the day do you normally take part in the most enjoyed physical activity/exercise chosen?

- Morning
- If morning, please specify time \_\_\_\_\_
- Afternoon
- If afternoon, please specify time \_\_\_\_\_
- Evening
- If evening, please specify time \_\_\_\_\_

**Thank you for your participation**

# APPENDIX M: PERCEIVED EXERTION RATING ASSESSMENT SCALE

---



## PERCEIVED EXERTION RATING ASSESSMENT

What is rate of perceived exertion of the cardio-respiratory fitness test you did just now?

#1	nothing	<input type="checkbox"/>
#2	very easy	<input type="checkbox"/>
#3	easy	<input type="checkbox"/>
#4	comfortable	<input type="checkbox"/>
#5	somewhat difficult	<input type="checkbox"/>
#6	Difficult	<input type="checkbox"/>
#7	Hard	<input type="checkbox"/>
#8	Very hard	<input type="checkbox"/>
#9	extremely hard	<input type="checkbox"/>
#10	Exhausted	<input type="checkbox"/>

Wildcat wellness. 2011. Measuring exercise intensity: RPE & Talk test.

<http://ukwildcatwellness.blogspot.com/2011/12/measuring-exercise-intensity-rpe-talk.html>



# APPENDIX O: LANGUAGE EDITOR CERTIFICATE

---

# FUNCTIONALITY

*Functions for Fun CC. CK/2001/067655/23 t/a Functionality*

*e-mail lswylde@mweb.co.za*

---

25 August 2015

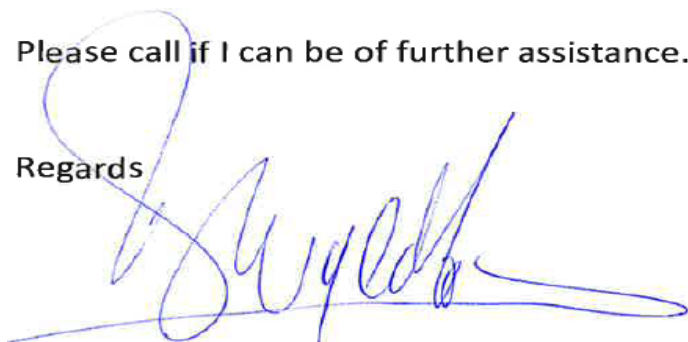
To Whom it May Concern

This serves to certify that I have copy edited the PhD thesis entitled ***“Fitness testing, exercise intervention and health-related quality of life validation in Setswana-speaking community-dwelling Potchefstroom adults”*** as submitted by Sunday Onagbiye for the PAHL study underway at North-west University, South Africa.

The edit consisted of checking grammar, punctuation and spelling.

Please call if I can be of further assistance.

Regards



Lesley Wyldbore

*Fully accredited member of Professional Editors Groups (PEG) SA*

**APPENDIX P: PROOF OF MANUSCRIPT  
SUBMITTED**

## BMC Research Note

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Vrywaringsklousule / Disclaimer: <http://www.nwu.ac.za/it/gov-man/disclaimer.html>

>>> "BMC Research Notes - Editorial Office" <em@editorialmanager.com> 2015/08/27 01:41 PM

>>>

Validity and Reliability of the Setswana Translation of SF-8 Health Related Quality of Life Health Survey in Adults

Sunday O Onagbiye, MA; Sarah Johanna Moss, PhD; Melainie Cameron, PhD  
BMC Research Notes

Dear Prof Moss,

Thank you for approving the changes and returning your submission entitled 'Validity and Reliability of the Setswana Translation of SF-8 Health Related Quality of Life Health Survey in Adults'.

You will be able to check on the progress of your manuscript during the peer review process by logging on to Editorial Manager as an author.

<http://resn.edmgr.com/>

If you have forgotten your username or password please use the "Send Username/Password" link to get your login information. For security reasons, your password will be reset.

Thank you for submitting your work to BMC Research Notes.

Best wishes,

Editorial Office  
BMC Research Notes

<http://www.biomedcentral.com/bmcresnotes/>

## AFRICAN JOURNAL FOR PHYSICAL, HEALTH EDUCATION, RECREATION & DANCE (AJPHERD)

---

Hanlie Moss <Hanlie.Moss@nwu.ac.za> Proof of submission Vrywaringsklousule / Disclaimer:  
<http://www.nwu.ac.za/it/gov-man/disclaimer.html> >>> Lateef Amusa <amusalbw@yahoo.com> 2015/08/14  
10:00 AM >>> Dear Prof Moss, Thank you very much f

To

Melainie Cameron Onagbiye Sunday O.

Today at 8:43 AM

Proof of submission

Vrywaringsklousule / Disclaimer: <http://www.nwu.ac.za/it/gov-man/disclaimer.html>

>>> Lateef Amusa <amusalbw@yahoo.com> 2015/08/14 10:00 AM >>>

Dear Prof Moss,

Thank you very much for submitting your manuscript titled "Cardiorespiratory fitness testing in Setswana-speaking community-dwelling Potchefstroom adults" for consideration in AJPHERD/AJPHEs. A feedback will be sent to you as soon as the manuscript has been reviewed.

L.O.Amusa

Editor-In-Chief, AJPHERD/AJPHEs

-----  
On Thu, 8/13/15, Hanlie Moss <Hanlie.Moss@nwu.ac.za> wrote:

Subject: Onagbiye et al Step tests AJPHERD August 2015

To: amusalbw@yahoo.com

Cc: "Lainie Cameron" <mcameron@usc.edu.au>, "Onagbiye Sunday O." <gbiyesunny@yahoo.com>

Date: Thursday, August 13, 2015, 10:57 AM

Dear Prof Amusa

Please find attached a manuscript and cover letter for your consideration to publish in AJPHERD.

Kind regards

Hanlie

Prof.

S.J. Moss

Mede Professor.

Direkteur: FASRek.

Tel: +2718 299 1821.

Faks: +2787 231 5480

Interne Bussie 481.

Vrywaringsklousule / Disclaimer:

<http://www.nwu.ac.za/it/gov-man/disclaimer.html>

# **SOUTH AFRICAN JOURNAL FOR RESEARCH IN SPORT, PHYSICAL EDUCATION AND RECREATION (SAJRSPER)**

---

Proof of submission

Vrywaringsklousule / Disclaimer: <http://www.nwu.ac.za/it/gov-man/disclaimer.html>

>>> "Van Deventer, KJ, Dr <sajrsper@sun.ac.za>" <sajrsper@sun.ac.za> 2015/09/28 09:30 AM >>>

Beste Hanlie

Baie dankie vir die artikel vir moontlike publikasie in die SATNSLOO. Die manuskrip nommer is MS 1169

Indien aanvaar sal dit egter eers volgende jaar gepubliseer word aangesien die 3de uitgawe vir vanjaar reeds vol is.

Hoop dit is reg so met julle?

Groete

Kallie

From: Hanlie Moss [mailto:Hanlie.Moss@nwu.ac.za]

Sent: 27 September 2015 05:40 PM

To: Van Deventer, KJ, Dr <sajrsper@sun.ac.za>

Cc: Melainie Cameron; Onagbiye Sunday O.

Subject: Manuscript for publication

Dear Prof Van Deventer

Please find attached a manuscript and the cover letter for review to be published in the South African Journal for Research in Sport, Physical Education and Recreation.

Kind regards

Hanlie

Prof. S.J. Moss

Mede Professor.

Direkteur: FASRek.

Tel: +2718 299 1821.

Faks: +2787 231 5480

Interne Bussie 481.

[cid:image001.png@01D0F9CF.1B7FC810]

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# INTERNATIONAL QUARTERLY OF COMMUNITY HEALTH EDUCATION

---

## Proof of Acceptance

From: buchanan@schoolph.umass.edu

To: Hanlie.moss@nwu.ac.za

Cc:

Date: Sat, 2 Apr 2016 12:48:03 -0400 (EDT)

Subject: International Quarterly of Community Health Education - Decision on Manuscript  
ID QCH-15-0002

02-Apr-2016

Dear Dr. Moss:

It is a pleasure to accept your manuscript entitled "Managing non-communicable diseases in an African community: Effects, compliance, and barriers to participation in a four-week exercise intervention" in its current form for publication in the International Quarterly of Community Health Education.

Thank you for your fine contribution. On behalf of the Editors of the International Quarterly of Community Health Education, we look forward to your continued contributions to the Journal.

Sincerely,

Dr. David Buchanan

Editor in Chief, International Quarterly of Community Health Education

[buchanan@schoolph.umass.edu](mailto:buchanan@schoolph.umass.edu)