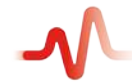# KaziHealth

Health Professional's Risk Assessment Guide

Teachers' Health Promotion Programme

The *KaziBantu* Project, Healthy Schools for Healthy Communities, has been jointly developed by the following institutions:
1. **University of Basel**, Switzerland
2. **Nelson Mandela University**, South Africa
3. **Swiss Tropical and Public Health Institute**, Switzerland

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Foreword

It is our pleasure to present to you the transnational research project entitled: "Effects of a school-based health intervention programme in marginalized communities of Port Elizabeth, South Africa: The *KaziBantu* Project". The *KaziBantu* project stems from a collaboration between the University of Basel in Switzerland, the Nelson Mandela University in Port Elizabeth, and the Swiss Tropical and Public Health Institute. These institutes are working together to provide knowledge, tools and support needed to improve the overall quality of life of individuals most in need.

This project is a continuation of a project entitled: "Impact of disease burden and setting specific interventions on schoolchildren's cardiorespiratory physical fitness and psychosocial health in Port Elizabeth, South Africa: The DASH Project". While the initial DASH project, an acronym for 'Disease, Activity and Schoolchildren's Health, was carried out within the scope of the Swiss-South African Joint Research Program (SSAJRP) and funded by the Swiss National Science Foundation (SNSF) and the National Research Foundation (NRF) in South Africa, the follow-up, *KaziBantu* project, is funded by the Novartis Foundation.

The *KaziBantu* Project aims to improve health literacy and overall wellbeing in primary school settings situated in disadvantaged communities. What makes the KaziBantu project unique is the dual-focus, not only focusing on schoolchildren's health, but their teachers' health and wellbeing as well. The *KaziBantu* project is devoted to creating and embedding long-lasting positive lifestyle changes and to provide more opportunities for physical activity by implementing a multi-faceted approach to address the unique health problems faced within underprivileged settings of South Africa.

Message from the *KaziBantu* Ambassador

Zanele Mdodana, former Proteas Netball Captain and Laureus Ambassador

I value the significant role of my teachers and their contributions towards my love for exercise. I started playing netball in primary school and from there on my passion for sport grew. I was able to use sport as a vehicle which paved my career path as sports manager and Netball coach, and I have the opportunity to impart what I have learned to others. Contributing towards the development of others is a fulfilling experience that I embrace.

On this journey I have realized that teaching is a noble profession. Teachers carry great responsibility to share knowledge and values in order to make a difference in the lives of a diverse group of children. The good health and wellbeing of our educators is vital for the provision of quality education, so it is for this reason that I actively support the *KaziBantu* project. Our teachers grapple with many challenges in the school environment which may influence their health, therefore our teachers need our support.
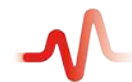
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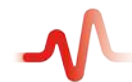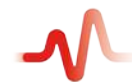
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Abbreviations

ACSM	American College of Sports Medicine		mg/dL	Milligrams per Decilitre
AHA	American Heart Association		ml	Millilitres
BMI	Body Mass Index		mmHg	Millimetres Mercury
BP	Blood Pressure		Mmol/d	Millimole per day
CAA	Circulating Anodic Antigen		mmol/mol	Millimoles per mole
CAD	Coronary Artery Disease		MPA	Moderate Intensity Physical Activity
CCA	Circulating Cathodic Antigen		MVPA	Moderate-to-Vigorous Intensity Physical Activity
CDC	Centres for Disease Control and Prevention		PAR-Q	Physical Activity Readiness Questionnaire
cm	Centimetres		POC-CCA	Point-of-Care Circulating Cathodic Antigen
DBP	Diastolic Blood Pressure		PSS4	4-item Perceived Stress Scale
DXA	Dual-Energy X-ray Absorptiometry		SBP	Systolic Blood Pressure
EPG	Eggs per Gram		SMBM	Shirom Melamed Burnout Measure
ERI	Effort-Reward Imbalance Questionnaire		SOP	Standard Operating Procedure
g/dL	Grams per Decilitre		STH	Soil Transmitted Helminths
GHQ-12	General Health Questionnaire		$\dot{V}O_2\,max$	Maximal Volume of Oxygen Consumed (ml/kg/min)
Hb	Haemoglobin Concentration		$\dot{V}O_2\,R$	Oxygen Uptake Reserve
HbA1c	Glycosylated Haemoglobin		VPA	Vigorous Intensity Physical Activity
HDL-C	High Density Lipoproteins Cholesterol		VWHRS	Vigorous Intensity Physical Activity per Week in Hours
HEPA	Health Enhancing Physical Activity		VWMINS	Vigorous Intensity Physical Activity per Week in Minutes
HR max	Maximal Heart Rate		WAFCS	Work and Family Conflict Scale
HRR	Heart Rate Reserve		WC	Waist Circumference
IFG	Impaired Fasting Glycaemia		WHO	World Health Organization
IGT	Impaired Glucose Tolerance		WHR	Waist-to-Hip Ratio
IPAQ	International Physical Activity Questionnaire		μL	Microlitre
ISI	Insomnia Severity Index			
Kg	Kilograms			
LDL-C	Low Density Lipoproteins Cholesterol			
LPA	Light Intensity Physical Activity			
MET	Multiples of the Resting Metabolic Rate			
mg	Milligrams			

Introduction

The *KaziHealth* workplace health promotion programme, designed specifically for teachers working in disadvantaged communities, focuses on improving lifestyle behaviours with five easy-to-follow steps. The disease profile of South Africa is moving towards a profile seen in Western countries, where more and more deaths are being attributed to chronic non-communicable- and cardiovascular diseases. With up to 80% of these diseases preventable with lifestyle modification, the intervention programme focuses on improving physical activity, improving psychosocial wellbeing by reducing stress and improving sleep, and increasing nutrition and promoting a more balanced diet.

The *KaziHealth* workplace health promotion programme is illustrated below and comprises of the following phases. First, an individual health risk assessment is completed to establish a health risk profile. The components assessed are body composition, cardiovascular disease risk, physical activity and physical fitness levels, infectious disease risk, psychosocial health and current dietary habits. This is followed by lifestyle coaching sessions, where the intervention model is explained and individualised based on the teacher's health risk profile. Self-monitoring and motivation is provided for the entire intervention period with the *KaziHealth* mobile application and a self-guided workbook. A final health risk assessment is completed to establish the teacher's personal goal achievement.

The main aim of *KaziHealth* is to provide teachers with the necessary knowledge and skills to make better lifestyle related choices and ultimately live healthier lives.

Figure 1: KaziHealth workplace health promotion programme steps

Description of Assessment Protocol Components

The *KaziHealth* workplace health promotion programme is primarily created for low-resourced settings, and therefore, the programme was designed with adaptability and flexibility in mind. The health risk assessment can be completed in any order. Furthermore, any test or section of the assessment can be omitted, should the healthcare facility not have access to the specific equipment required. Each component assessed will be classified, and no minimum number of components needs to be assessed. This allows each healthcare facility to adapt the testing protocol to their needs.

The health risk assessment consists of the following components: an initial consultation, anthropometry and body composition assessment, clinical examination, physical activity and physical fitness testing, psychosocial health screening, diet and nutrition assessment and communicable disease testing.

Instructions to Participant before the Health Risk Assessment

1. Please wear comfortable training shoes and clothes that allow freedom of movement.
2. Females should wear comfortable sport underwear without a wire as this may interfere the scanning equipment.
3. Do not wear clothing with buckles, belts or metal fasteners and remove all jewellery.
4. Please refrain from eating and drinking 8 hours prior to performing the cholesterol tests as the test requires that you are fasting. This means you are not allowed to eat or drink anything after dinner on the night before testing. Non-fasting results will produce a false reading.
5. Please refrain from ingesting alcohol, caffeine or using tobacco products within 30 minutes of testing as this can elevate readings.
6. To participate in the fitness tests of the risk assessment, teachers should report a temporary illness such as a cold or fever.
7. Please take note of the following contraindications for performing the bone density scan:
   a. Pregnant women may not complete this test.
   b. Individuals who have participated in any investigation using radioisotope that were carried out in the last 10 days may not complete this test.
   c. Internal metal artefacts will affect body composition results.

Braided hair will affect body composition results as the scan identifies this as fat mass.

Assessment Protocol Components

1. Initial Consultation

1.1. Informed Consent
1.2. Personal Information
    1.2.1 Caregiving Responsibility
    1.2.2 Socioeconomic Status
    1.2.3 Education
    1.2.4 Lifestyle Behaviour

1.3. Subjective Perceived Health
1.4. Family and Medical History
1.5. Physical Activity Readiness Questionnaire (PAR-Q)

2. Anthropometry and Body Composition

2.1. Height and Weight (Body Mass Index)
2.2. Waist and Hip Circumference (Waist-to-Hip Ratio)
2.3. Dual-Energy X-Ray Absorptiometry (DXA scan – body fat percentage and bone mineral density)

3. Clinical Examination

3.1. Blood Pressure
3.2. Blood Lipid Profile (TC, HDL-C, LDL-C, TG, Non-HDL, C-HDL ratio)
3.3. Glycated Haemoglobin (HbA1c)
3.4. Haemoglobin Concentration (Hb)

4. Physical Activity and Physical Fitness

Physical Activity
4.1. Self-Reported Physical Activity (IPAQ-Short Form)
4.2. Objective Assessed Physical Activity (7-Day Accelerometery)

Physical Fitness
4.3. Estimated Cardiorespiratory Fitness (Cooper 12-minute Run)
4.4. Upper Body Strength (Hand Grip Strength Test)

5. Psychosocial Health

5.1. General Perceived Stress (PSS)
5.2. Work-Related Stress (ERI)
5.3. Work-Family Conflict (WAFCS)
5.4. Burnout Symptoms (SMBM)

5.5. Health-Related Quality of Life (GHQ-12)
5.6. Sleep Complaints (ISI)

6. Communicable Diseases

6.1. Soil Transmitted Helminths (*Ascaris lumbricoides*, hookworm, *Trichuris trichiura*)
6.2. Schistosoma mansoni / haematobium

Personal Health Risk Profile

Each teacher assessed will receive a personal health risk profile, that can be seen in Figure 2. For each parameter tested, internationally accepted classification criteria will be used to estimate health risk. Furthermore, a face-to-face feedback session, explaining the profile and the parameters assessed, will be provided to each teacher after the completion of the assessment.

Health 'profile'

John Doe!
Birth date: 01 Januar 1975!
Testing date: 30 May 2018!

Health indicator	Your score	Status	Risk
Blood pressure (systolic)	xx mmHg	Normal	🟢⚫⚫
Blood pressure (diastolic)	xx mmHg	Normal	🟢⚫⚫
Percent Body Fat	xx%	At risk	⚫🟡⚫
Body Mass Index	xx kg/m2	At risk	⚫🟡⚫
Total cholesterol	xx mmol/l	At risk	⚫🟡⚫
LDL cholesterol	xx mmol/l	At risk	⚫🟡⚫
HDL cholesterol	xx mmol/l	At risk	⚫🟡⚫
Triglycerides	xx mmol/l	At risk	⚫🟡⚫
Blood glucose (HbA1c)	xx%	Normal	🟢⚫⚫
Haemoglobin concentration	xx g/dl	Normal	🟢⚫⚫
Physical activity	xx min/week	At risk	⚫🟡⚫
Fitness VO$_2$max	xx ml*kg^{-1}*min^{-1}	At risk	⚫🟡⚫
General perceived stress	xx	Increased risk	⚫⚫🔴
Work-related stress	xx	Increased risk	⚫⚫🔴
Work-family conflict	xx	Increased risk	⚫⚫🔴
Burnout symptoms	xx	Increased risk	⚫⚫🔴
Health-related quality of life	xx	Increased risk	⚫⚫🔴
Insomnia symptoms	xx	Increased risk	⚫⚫🔴

Figure 2: Personal Health Risk Profile

Testing Environment

It is important that the testing environment is properly set-up by ensuring the following:

- Ensure privacy in the testing room by separating each testing area with curtains.
- Ensure a clean, quiet testing environment with appropriate room temperature and efficient lighting.
- Ensure all equipment is calibrated and ready for use.
- The health professional must be well prepared and give clear instructions to the participant.
- Ensure changing facilities and bathrooms are available on site.
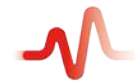
1. Initial Consultation

The *KaziBantu* Research Team extends a very warm welcome to you. We would like to thank you for your willingness to participate in the Healthy Schools for Healthy Communities project. We also appreciate your time to attend the assessment of your health. We hope that this process will be informative and beneficial to you.

The health risk assessment will start with an initial consultation. Anthropometry and body composition will be assessed thereafter, followed by a clinical examination consisting of blood pressure measurements and blood tests. Furthermore, physical activity and physical fitness tests, psychosocial health screening through questionnaires, a diet and nutrition assessment, and finally communicable disease tests will be done.

Your participation in this assessment is entirely voluntary; however, your permission is required. You are free to withhold consent or to stop the assessment at any point without any disadvantages or further consequences, if you so desire. You are also encouraged to ask questions about the procedures used in the assessment.

All the afore-mentioned assessment measures entail minimal risks. Capillary blood sampling (providing a drop of blood via a finger prick) is minimally invasive. Standardized procedures for capillary blood sampling specified by the World Health Organization will be followed to ensure the lowest risk status, and the sampling will be conducted by a trained nurse. Nevertheless, in some rare cases, infections, excessive bleeding, fainting or feeling light-headed can occur. Despite these potential risks, capillary blood sampling is a frequently used procedure, with minimal burden to you. Furthermore, the physical activity assessment may cause the following changes: abnormal blood pressure, disorder of the heartbeat, and in rare instances, a heart attack. Every effort will be made to minimise these risks before thoroughly evaluating the information relating to your health, fitness and wellbeing, and by making observations during the assessment. Emergency equipment and trained personnel are available to deal with any situations that may arise. Your prompt reporting of unusual feelings during the assessment will assist in the diagnosis of a potential illness or in determining the type of intervention programme applicable to you.

After the individual risk assessment, you will receive a personal health risk profile containing your results. Should your results indicate that you are at risk or show any abnormalities, appropriate medical treatment will be advised, regardless of whether you decide to withdraw from the project or not. If you have one or more severe chronic disease(s), for example type 2 diabetes or high blood pressure, you will be referred to your general practitioner for treatment and care. Should you be diagnosed with parasitological (i.e. worm) infection(s), you will receive deworming medication.

Once you have obtained your individual risk assessment results, the next step in the project will be the intervention phase. Your intervention programme will be provided and explained to you during your first lifestyle coaching session, which will be conducted by trained health care professionals. It is your responsibility to clarify any uncertainty you might have, and to indicate if you are not entirely comfortable with the techniques and methods used to implement the intervention programme effectively and safely. For maximum benefits from the programme, you have a responsibility to perform the tasks and activities prescribed, either at home, work, or in a group setting on a regular basis. Please report symptoms aggravated by these tasks and activities immediately and clarify any

uncertainty regarding any part of the programme. You must accept that if you do not adhere to the recommendations, you cannot expect positive results.

After the intervention phase (roughly 6 months later), a repeat of the individual risk assessment will be scheduled. This is done to determine whether there have been any improvements since your initial assessment, whether your health risk profile has improved and whether there is a positive change in your lifestyle behaviours.

With introductory formalities explained, we can commence with the individual risk assessment after receiving your informed consent. We are looking forward to this exciting collaboration and we are delighted about joining you on this journey towards improved health and wellbeing.

1.1. Informed Consent

Project Title

Teacher's workplace health promotion programme

Statement by researcher

I have been accurately informed about the purpose, objectives and procedures of the study and given enough information regarding the potential benefits and risks in order to explain the planned study to the participant. I confirm that the participant was given an opportunity to ask questions and that all questions have been answered correctly. I confirm that the participant has not been forced into giving consent, and consent has been given freely and voluntarily.

First name(s) _____Surname _____

Signature _____Date _____

Location _____

Statement by participant

I, as a potential participant, have read and understand the information regarding the planned study. I had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I am aware of the purpose, objectives, procedures, risks and benefits of the study. I understand that I can withdraw from the study at any time without further consequences. I have also received a letter of information that I can keep for future reference.

First name (s) _____ Surname _____

School _____ Telephone number   _ _ _ _ _ _ _ _ _ _

Signature _____ Date _____

Location _____

1.2. Personal Information

Unique ID   ZAF / 1 / 4 / 4

Date of Birth   Click or tap to enter date of birth   **Age**   years

Gender   Female ☒   Male ☐

If female, are you pregnant?   Yes ☐   No ☒

Ethnicity

Black African ☒   Coloured ☐   Indian ☐   White ☐   Other ☐

If other, please specify   Click or tap here to enter ethnicity

1.2.1. Caregiving Responsibility

Current relationship status

Single ☒   Married / in a permanent relationship   ☐

Number of dependants Click or tap to enter number of dependants

Do you have children who still live at home?   Yes ☐   No ☒

If 'yes', how many? Click or tap to enter number of children

Are you currently responsible for a person in need of care in your household?

Yes ☐   No   ☒

For example an elderly family member or a person with a disability.

1.2.2. Socioeconomic Status

Number of people employed in your household
Click or tap to enter number employed in household

Average household income per month

< R 10 000	☐
R 10 000 – R 20 000	☐
R 20 000 – R 30 000	☒
R 30 000 – R 40 000	☐
R 40 000 – R50 000	☐
> R50 000	☐

Your current Post Level

1. Teacher	☒
2. Grade Head	☐
3. Deputy Principal	☐
4. Principal	☐

How many years have you been working as a teacher?

Choose number of years working as a teacher

Type of employment at school

Permanently employed by the Department of Education	☒
Employed by the School Governing Body (SGB)	☐

Teaching Phase

Foundation phase	☐
Intermediate phase	☒
Senior phase	☐

Assets

Car ownership   Yes ☐   No ☒
If yes, how many cars in your household?

Property ownership   Yes ☐   No ☒
If yes, how many properties?

Internet Access

Internet at home
Yes ☒   No ☐

Internet on your cell phone or tablet
Yes ☒   No ☐

Internet at school
Yes ☐   No ☒

1.2.3.   Education

Level of Post-School Education

Diploma	☐
University Degree	☒
Postgraduate Degree	☐

How many years of post-school education did you complete?
Choose number of years of education completed

1.2.4. Lifestyle Behaviour

Cigarette smoking

How many cigarettes do you smoke per day?

Non-smoker	☒
1 – 9 cigarettes per day	☐
10 – 19 cigarettes per day	☐
> 20 cigarettes per day	☐

	Yes		No	
Quit within the past 6-months	Yes	☐	No	☒
Exposed to environmental smoke	Yes	☐	No	☒

For example: pollution, industrial or factory plant

Alcohol use

How often do you drink alcohol per week?

0	day	☐
1	day	☐
2	days	☐
3	days	☐
4	days	☐
5	days	☐
6	days	☐
7	days	☐

On days that you drink, how may units do you usually consume?
Click or tap here to enter number of drinks

One unit / drink corresponds to 1 can (340 ml) of beer / cider or 1 glass (150 ml) of wine / sparkling wine or 1 single tot of hard liquor (40% alcohol, e.g. brandy)

Screen Time

Screen time refers to the number of hours per day you spend in front of a television, computer, tablet or cell phone.

How many hours per day do you spend in front of a:

Television

On a typical week day   hours per day
On a typical weekend day   hours per day

Computer, tablet or cell phone

On a typical week day ▢ hours per day
On a typical weekend day ▢ hours per day

1.3. Subjective Perceived Health

1.3.1. Introduction

Health and health-related quality of life tend to decline with an increase in age (Nguyen & Nguyen 2014). Subjectively perceived health, or self-perceived health, refers to the perception of an individual's health in general. Health means not only the absence of disease or injury but also physical, mental and social wellbeing (World Health Organization, 2005). Measures of health and health-related quality of life have become widely used in clinical trials and routine outcome assessment to provide information on these outcomes (Brazier & Roberts 2004). The SF-12 is a multipurpose short form (SF) generic measure of health status (Ware, JE., Kosinski, M., Keller 1994). It was developed to be a shorter, yet valid, alternative to the SF-36. This tool is one of the most commonly used measures of health-related quality of life in large surveys of general and specific populations, as well as large longitudinal studies of health outcomes. For this project, only one item of the SF-12 will be used. By using this one item and exploring the indicator of general health and health-related quality of life, personal evaluation of an individual's physical health can be interpreted and identified.

1.3.2. Equipment and Procedure

The SF-12 forms for self-administration and scripts for personal interviews can be administered to most people in two minutes or less and have been used with a high degree of acceptability and data quality (Ware, JE., Kosinski, M., Keller 1994). However, as previously mentioned, only one item will be utilized to evaluate the individual's perceived health. Thus, administration is significantly reduced to about ¼ page and a time duration of about one minute; and can be conducted in either a face-to-face or survey format.

Equipment for Electronic Capturing of Measurement

- Tablet, Laptop or PC

Equipment for Hard-Copy Capturing of Measurement

- Pen or pencil
- Paper Data Capturing Sheet

Only one trial is completed.

Pre-Test Instructions to Participant

- This survey asks your views about your health.
- This information will help keep track of how you feel or what you perceive your health to be.
- Please only tick one box (☒) when answering each question.
- Make sure we can see your mark clearly.

- If you have ticked something incorrectly, then cross out the field and mark the right place.
- Please answer each question as honestly and accurately as you can.
- If you are unsure how to answer a question, please give the best answer you can.
- If something is unclear, you can ask one of the investigators to clarify.

Subjective Perceived Health Measurement

	Excellent	Very Good	Good	Fair	Poor
In general, would you say your health is:	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)

	Highly motivated	Very motivated	Indifferent	Not motivated	Not interested
How motivated are you to improve your lifestyle?	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)

1.3.3. Classification of Subjective Perceived Health Measurement

Classification	Measurement
Poor Perceived Health	5
Moderate Perceived Health	3 – 4
High Perceived Health	≤ 2

Please note that when administering the test, the number values per question should not be seen by the participant.

Although the classification is noted by the healthcare professional, no scientific cut-off criteria is validated and therefore the classification is not provided to the participant.

1.4. Family and Medical History

1.4.1. Family History

Are there any of the following medical conditions present in your family history?

Myocardial Infarction   ☐   Coronary Revascularisation   ☒

Sudden death of biological father/other male first-degree relative before the age of 55 years   ☐
Sudden death of biological mother/other female first-degree relative before the age of 65 years ☐

1.4.2. Medical History

Are you currently, or have you previously, received medical treatment due to:

	No	Yes Previously	Yes Currently
• High blood pressure	☐	☐	☐
• Cholesterol or Dyslipidaemia	☐	☐	☐
• Diabetes	☐	☐	☐
• Rheumatism or back pain	☐	☐	☐
• Allergies (hay fever)	☐	☐	☐
• Heart disease (heart attack, palpitations, skipped heartbeat, tachycardia)	☐	☐	☐
• Headache, pressure in the head or facial pain	☐	☐	☐
• Sleep disorders (problems falling asleep, nocturnal awakenings)	☐	☐	☐
• Depression or nervous breakdown	☐	☐	☐
• Other physical conditions?	☐	☐	☐
Please specify	Click or tap here to specify physical condition		
• Other psychological conditions?	☐	☐	☐
Please specify	Click or tap here to specify psychological condition		

1.5. Physical Activity Readiness Questionnaire (PAR-Q)

1.5.1. Introduction

The Physical Activity Readiness Questionnaire or the PAR-Q for short, is an easy to use, self-screening tool, used to determine whether a participant can partake in physical activity or whether a medical clearance from a general practitioner is required prior to participation (Powers & Howley 2015). It is used by health professionals to determine the safety or possible risks of exercising for an individual based on her/his health history, as well as current symptoms and risk factors. The PAR-Q aims to discover heart, circulatory, balance, medication, emotional and joint problems that could result in exercise being difficult or dangerous.

1.5.2. Equipment and Procedure

Equipment for Electronic Capturing of Measurement

- Tablet, Laptop or PC
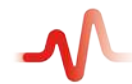
Equipment for Hard-Copy Capturing of Measurement

- Pen or pencil
- Paper Data Capturing Sheet

Number of Trials: Only one trial is completed.

Pre-Test Instructions to Participants

- This questionnaire will assess whether you are ready to safely participate in physical activity.
- This information will help determine whether you need to see a general practitioner before continuing with the program.
- Please tick the most appropriate box (☒) when answering each question.
- Make sure we can see your mark clearly.
- If you have ticked something incorrectly, then cross out the field and mark the right place.
- Please answer each question as honestly and accurately as you can.
- If you are unsure how to answer a question, please give the best answer you can.
- If something is unclear, you can ask one of the investigators to clarify.

Physical Activity Readiness Questionnaire (PAR-Q)

Please read the questions below carefully and answer each honestly.

	Yes	No
1. Has your doctor ever said that you have: Heart condition ☐ or High blood pressure ☐ ?	☐	☐
2. Do you feel pain in your chest at rest, during your daily activities of living, or when you do physical activity?	☐	☐
3. Do you lose balance because of dizziness or have you lost consciousness in the last 12 months? Please answer 'no' if your dizziness was associated with over-breathing (including vigorous exercise).	☐	☐
4. Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? Please list condition(s) here: Click or tap here to specify physical condition	☐	☐
5. Are you currently taking prescribed medication for a chronic medical condition? Please list condition(s) and medication here: Click or tap here to specify condition and medication	☐	☐
6. Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active?	☐	☐

	Please answer 'no' if you had a problem in the past, but it does not limit your current ability to be physically active. Please list condition(s) here: Click or tap here to specify physical condition		
7.	Has your doctor ever said you should only do medically supervised physical activity?	☐	☐

1.5.3.   Guidelines for Providing Physical Activity Readiness to Participant

If you answered 'Yes'

If you answered 'Yes' to one or more of the PAR-Q questions, are older than 50 years and have been inactive or are concerned about your health, consult a doctor before participating in a fitness assessment or substantially increasing your physical activity. You should get medical clearance from your doctor along with information about specific exercise limitations you may have. In most cases, you will still be able to do any type of activity you want, as long as you adhere to some guidelines.

If you answered 'No'

If you answered 'no' to all the PAR-Q questions, you can be reasonably sure that you can exercise safely and that you have a low risk of having medical complications from exercise.

2. Anthropometry and Body Composition

2.1. Height and Weight: Body Mass Index

2.1.1. Introduction

Body mass index (BMI) is a ratio of body weight to height, derived to estimate body composition. It is a measure which indicates whether an individual has the right weight for their height. BMI is computed by dividing weight (kg) by height^2 (m^2).

The advantages of using BMI to estimate body composition is the availability of extensive national reference data and its established relationship with levels of body fatness, morbidity and mortality in adults. Caution should however be used when evaluating athletes and persons with certain medical conditions, such as sarcopenia, where body weight may be altered significantly by changing proportions of muscle and fat masses.

2.1.2. Equipment and Procedures

Equipment for Height Measurement [7]

- Seca portable stadiometer model 213

Procedure for Height Measurement

- With shoes off, the participant stands against the stadiometer with feet together, back erect and shoulders relaxed.
- The feet, buttocks and upper part of the back have to make contact with the stadiometer.
- Weight is distributed evenly on both feet and the head held in the Frankfurt plane - the Frankfurt plane is achieved when the orbitale (inferior margin of the left orbit) is in the same horizontal plane as the tragion (upper margin of the ear canal).
- The moveable arm of the stadiometer is lowered to the vertex (the highest point or top of the head), applying gentle pressure to compress hair before taking the measurement.
- Height is recorded in cm to the nearest 0.1 cm, and only one trial is measured.

Equipment for Weight Measurement

- Micro T7E Scalemaster electronic platform scale

Procedure for Weight Measurement

- Place the digital weighing scale on a level surface and ensure that the reading is zero.
- Minimal clothing is worn by the participant, and shoes are removed.
- Participants stand in the centre of the scale with minimal movement, no support, and weight evenly distributed on both feet.
- The head is up and eyes looking directly ahead when the measurement is recorded.
- A value is recorded once the number on the scale is fixed. Body weight is measured in kilograms to the nearest 0.1 kg, and only one trial is measured.

(Norton, Olds & Australian Sports Commission 2007)

Figure 3: Height and Weight Measurement Equipment and Procedure

Body Mass Index

After the height and weight measurement has been taken, the Body Mass Index can be calculated by using the formula below:

$$\text{BMI} = \text{Weight (kg)} \div \text{Height (m)}^2$$

For example: $\text{BMI} = 70 \text{ kg} \div 1.8 \text{ m}^2$
    $= 21.6$

2.1.3.   Classification of BMI

Classification [8]	Measurement	
Underweight	< 18.5	kg.m^2
Normal weight	18.5 – 24.9	kg.m^2
Overweight	25.0 – 29.9	kg.m^2
Obese class 1	30.0 – 34.9	kg.m^2
Obese class 2	35.0 – 39.9	kg.m^2
Obese class 3	≥ 40. 0	kg.m^2

2.1.4.   Guidelines for Providing BMI Classification to Participant

When providing a participant with her/his BMI classification, the following guidelines can be followed:

Underweight	< 18.5	kg.m^2

- Explain that BMI is classified as underweight.
- Explain that the participant is at risk for malnutrition, vitamin deficiencies or anaemia.
- Furthermore, sudden and unexplained weight loss might be a sign of a serious health condition. Refer participant to a clinic for further examination.

Normal weight	18.5 – 24.9	kg.m^2

- Explain that BMI is classified as normal.
- Encourage the participant to continue leading a healthy, active lifestyle.

Overweight	25.0 – 29.9	kg.m^2

- Explain that BMI is classified as overweight or pre-obese.
- Explain the dangers of being overweight and the comorbidities that exist. Explain that the participant is at an increased risk for type 2 diabetes, hypertension and cardiovascular diseases.
- Encourage the participant to start adopting healthier lifestyle habits where she/he is currently lacking, to lose weight.

Obese class 1	30.0 – 34.9	kg.m^2

- Explain that BMI is classified as obese class 1.
- Explain the dangers of being obese and the comorbidities that exist. Explain that the participant is at a high risk for hypertension, hyperlipidaemia, hyperglycaemia, metabolic syndrome, cancers, gall bladder disease, sleep apnoea, osteoarthritis, renal disease, coronary artery disease (CAD), hormonal dysfunction and menstrual dysfunction.
- Encourage the participant to start adopting healthier lifestyle habits to lose weight.

Obese class 2	35.0 – 39.9	kg.m^2

- Explain that BMI is classified as obese class 2.
- Explain the dangers of being obese and the comorbidities that exist.
- Explain that the participant is at a very high risk for hypertension, hyperlipidaemia, hyperglycaemia, metabolic syndrome, cancers, gall bladder disease, sleep apnoea, osteoarthritis, renal disease, CAD, hormonal and menstrual dysfunction, osteoarthritis and premature mortality.
- Encourage the participant to start adopting healthier lifestyle habits to lose weight.

Obese class 3	≥ 40. 0	kg.m^2

- Explain that BMI is classified as obese class 3.
- Explain the dangers of being obese and the comorbidities that exist. Explain that the participant is at an extremely high risk for hypertension, hyperlipidaemia, hyperglycaemia, metabolic syndrome, cancers, gall bladder disease, sleep apnoea, osteoarthritis, renal disease, CAD, hormonal and menstrual dysfunction, osteoarthritis and premature mortality.
- Encourage the participant to start adopting healthier lifestyle habits to lose weight.
- Refer participant to a clinic for further examination.

2.2. Waist and Hip Circumference: Waist to Hip Ratio

2.2.1. Introduction

The waist-to-hip ratio (WHR) is a measure of obesity, which in turn determines the presence of chronic diseases. It is computed from the waist and hip circumferences. While the WHR is used as a simple method for determining body fat (adipose tissue) distribution, the waist circumference (WC) is an imperfect indicator of intra-abdominal fat, as it also includes subcutaneous fat deposition and visceral adipose tissue. This does not preclude its usefulness as it is associated with specific health risks.

2.2.2. Equipment and Procedures

Equipment Waist and Hip Circumference Measurements

- A 2-metre flexible steel tape marked in cm with mm degradations. The measuring tape should be non-extensible and is enclosed in a case with automatic retraction.

When reading the tape, the measurer's eyes should be at the same level as the tape, to avoid any error of parallax. A cross-hand technique is applied. A value is recorded when the tape zero is easily read and the two parts of the tape can be seen.

Procedure for Waist Circumference Measurement

- The participant stands in a relaxed position with arms across the chest and hands resting on the shoulders.
- The measurer stands in front of the participant to correctly locate the narrowing of the waist.
- The measurement is taken at the mid-point between the lower costal rib (10th rib) and the border of the iliac crest.
- The participant is instructed to lower the arms to the side in a relaxed position after the tape has been adjusted.
- The tape is in a horizontal plane to ensure it does not slip or indent the skin.
- The participant is instructed to breathe normally, and a measurement is taken at the end of normal expiration.
- The measurement is taken in cm, to the nearest 0.1 cm, and only 1 measurement is taken.

Procedure for Hip (Gluteal) Measurement

- The participant stands in a relaxed position with arms across the chest and hands resting **on** the shoulders.
- The feet are together, and the gluteal muscle relaxed.
- The measurer stands at the side of the participant and the measurement is taken at the most posterior aspect of the buttocks, and positioned parallel to the floor (horizontal plane).
- The tape is in a horizontal plane and should not slip or indent the skin.
- The measurement is taken in cm, to the nearest 0.1 cm, and only 1 measurement is taken.

(World Health Organization, 2008)
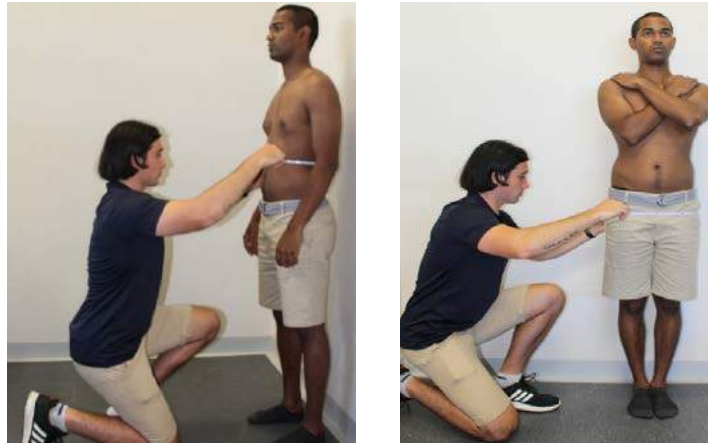
Figure 4: Waist and Hip Circumference Measurement Equipment and Procedure

Classification of Waist Circumference

Men

Classification	Measurement
Very low risk	< 80 cm
Low / normal risk	80-99 cm
High risk	100-120 cm
Very high risk	> 120 cm

Women

Classification	Measurement
Very low risk	< 70 cm
Low / normal risk	70-89 cm
High risk	90-109 cm
Very high risk	> 110 cm

(Pescatello, of Sports Medicine, Riebe & Thompson 2013)

Waist-to-Hip Ratio (WHR)

After the waist and gluteal (hip) circumference has been taken, the waist-to-hip ratio can be calculated by using the formula below:

WHR = Waist circumference (cm) ÷ Hip circumference (cm)

For example: WHR = 90 cm ÷ 120 cm
= 0.75

2.2.3. Classification of WHR

Men

Classification [8]	Measurement
Low risk	≤ 0.90
High risk	> 0.90

Women

Classification [8]	Measurement
Low risk	≤ 0.85
High risk	> 0.85

(Pescatello et al. 2013)

2.2.4.   Guidelines for Providing WHR Classification to Participant

When providing a participant with her/his WHR classification, the following guidelines can be followed:

Low risk

- Explain that the WHR classification places her/him at a low risk for type 2 diabetes, coronary artery disease, cardiovascular disease, diabetes and cancers.
- Encourage the participant to continue leading a healthy, active lifestyle.

High risk

- Explain that the WHR classification places her/him at a high risk for type 2 diabetes, coronary artery disease, cardiovascular disease, diabetes and cancers (also refer to BMI classification and obesity). Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours.

2.3.   Dual-Energy X-Ray Absorptiometry

2.3.1.   Introduction

The main outcome measure from the DXA scan is bone density, however, it also assesses the relative amounts of fat and lean tissue as well as regional body fat proportions. The DXA scan is able to derive values of regional soft tissue mass, total soft tissue mass, fat-free mass, fat %, total and regional fat %, android fat %, gynoid fat %, and BMI. Health care professionals can use these values to manage disease and conditions that are affected by the amount of fat and lean mass. The DXA scan cannot diagnose disease, treat or quantify treatment effectiveness. However, the health professional using it can use the results to make a judgement.

2.3.2.   Equipment and Procedures

Equipment for DXA Scan

- Discovery Hologic DXA QDR 4500A (APEX System Software Version 4.0.2)

Contra-indications for performing DXA scan

- Pregnant individuals.
- Any investigation using radioisotope that was carried out in the previous 10 days - these affect the body composition results.
- Having any internal metal artefacts will affect the body composition results.

Preparing the participant for a DXA scan

- Participants should remove all jewellery and not wear clothing with buckles, belts or metal fasteners.
- Participants must be positioned to move to and from the table with the scan arm to the left (foot-end) of the table, for access and stability.
- Participants must lay supine, with the head at the right end of the table and they must be positioned within the scan limit borders marked on the mattress.
- Arms must be placed by their sides but not touching their thighs.
- With large / obese participants, arms should be by their sides with palms touching their thighs.
- Participant's feet must be rotated slightly inwards, with a gap between the toes. A thin tape may be placed around the toes if participant moves. This is to support the legs in required position.
- Participants must be asked to breathe normally and keep still. Participants must be instructed to keep as still as possible until the scan arm has completed 7 passes of their bodies. This takes approximately 7.5 minutes.

Procedure for DXA Scanning

- Calibration is conducted prior to testing, using a Quality Check (QC) Test.
- The participant's height and weight are measured and entered in the computer.
- Participant's age, gender, birthdate and ethnicity is entered.
- Participant is asked to lay supine on the table within the specified position boundaries.
- With the participant lying still, the radiographer performs the scan.

Figure 5: DXA Measurement Equipment and Procedure

(Hologic 2014)

2.3.3. Classification of Body Fat Percentage and Bone Mineral Density

Classification of Body Fat Percentage

Classification [8]	Women	Men
Athletic	8 – 15 %	5 – 10 %
Good	16 – 23 %	11 – 14 %
Acceptable	24 – 30 %	15 – 20 %
Overweight	31 – 36 %	21 – 24 %
Obese	> 36 %	> 24 %

Classification of Bone Mineral Density

Classification	Measurement
Normal	> - 1.0
Low bone density / Osteopenia	- 1.0 to - 2.5
Very low bone density / Osteoporosis	< - 2.5

2.3.4. Guidelines for Providing Bone Mineral Density to Participant

2.3.5. Lifestyle Modification Behaviours to Improve BMI, WC, WHR and Body Fat Percentage

1. Regular physical activity

- Participate in moderate intensity aerobic activity (≥ 300 min / week) or vigorous intensity aerobic activity (≥ 150 min / week)
- Participant should also participate in muscle strengthening and endurance exercises. Refer to Biokineticist for exercise programming.

2. Diet

- A balanced diet is recommended with less saturated fat, sodium, alcohol, sugar and refined processed food, with more fruits and vegetables and plant-based protein.
- Refer to dietician for a dietary plan.

3. Behavioural intervention

- Quit smoking.
- Decrease stress.
- Seek social support.
- Improve sleep patterns.

3. Clinical Examination

3.1. Blood Pressure

3.1.1. Introduction

Proper diagnosis and treatment of hypertension depends on accurate measurement. Blood pressure is a powerful, consistent and independent risk factor for cardiovascular disease, cerebrovascular accidents (strokes) and renal disease. It is estimated that the prevalence of high blood pressure in South Africa is 26.1% for individuals older than 18 years, with males having a higher prevalence, as well as ethnic black individuals.

Blood pressure is defined as the pressure exerted by the blood on the artery walls as the heart contracts (systolic) and relaxes (diastolic). True blood pressure however, is defined as the average blood pressure over a prolonged period of time. Remember therefore, that high blood pressure may also occur during periods where physical blood pressure measurements are not being conducted; and as a result, hypertension may not be detected.

Blood pressure readings are of the most inaccurately performed measurements in medicine. Furthermore, imprecise measuring procedures and the presence of 'white coat syndrome' (an increased blood pressure reading when a doctor or nurse is present), can result in inaccurate / erroneous measurements or misdiagnoses.

3.1.2. Equipment and Procedure

Blood pressure measurements can be taken manually through auscultation with a mercury sphygmomanometer or through the automatic oscillometric method. The differences between manual and automatic blood pressure measurement are tabulated below:

Manual Measurement	Automatic Measurement
Epidemiologic data are mostly based on auscultated blood pressure measures	Readings typically lower than manual measurements
	Decrease tester error
	Procedure less complex
	Can be taken quicker than manual measurements, therefore more measurements can be taken

To increase the accuracy of clinical readings, the following recommendations should be followed when taking blood pressure measurements. (Pescatello et al. 2013)

Pre-Test Instructions to Participant

- Participant should avoid caffeine, alcohol and nicotine (smoking) 30 minutes before measurement, as this can elevate readings.

- Make sure the participant is relaxed by allowing 5 minutes to sit before the first reading is taken.

Manual Blood Pressure Measurement

Equipment for Manual Measurement

- Stethoscope
- Sphygmomanometer
- Appropriately sized blood pressure cuff, with the cuff bladder encircling 80% of the participant's arm circumference.
    - Adult arm circumference 27-34cm - cuff size adult 16 x 30cm
    - Adult arm circumference 35-44cm - cuff size large adult 16 x 36cm

Procedure for Manual Measurement

Prepare the participant

- Blood pressure is taken on the left arm, except in cases of severe injury or amputation of the left arm. In these cases, the right arm is used, and a note made when recording the measurements. This is done because a >10 mmHg difference between the right and left arm blood pressure reading can be found.
- Participant should be seated comfortably, with back supported, legs supported, and uncrossed, and upper arm bared.
- Participant's arm should be supported at heart level.
- Both the participant and the health professional should refrain from talking during blood pressure measurement.

Take resting heart rate value

- Palpate the pulse at the radial artery at the wrist. Record the number of heart beats for 30 seconds and multiply by 2 to get beats per minute. If the pulse is irregular, take heart rate measurement for a full minute.

Place the blood pressure cuff on the participant's arm

- Palpate or locate the brachial artery and position the cuff so that the 'artery marker' points to the brachial artery.
- Wrap the cuff snugly around the arm.

Determining blood pressure cuff inflation

- While keeping the fingers on the radial pulse, inflate the cuff until the pulse disappears and note the reading.
- When pumping up the cuff shortly to take blood pressure, inflation will be 20 mmHg above the radial pulse disappearance value.

Position the stethoscope

- On the arm on which the cuff is placed, palpate the arm at the antecubital fossa (crease of the arm at the elbow) to locate the strongest pulse sounds and place the bell of the stethoscope over the brachial artery at this location.

Inflate the cuff

- Inflate the cuff pressure to 20 mmHg above radial pulse absence.
- When the cuff has inflated enough to stop blood flow you should hear no sounds through the stethoscope.
- If pulse sounds are heard right away, inflate to a higher pressure.

Slowly deflate the cuff

- Begin deflation. The pressure should fall at 2-3 mmHg per second, anything faster may likely result in an inaccurate measurement.

Listen for the systolic reading

- The first occurrence of rhythmic sounds heard as blood begins to flow through the artery is the participant's systolic pressure.
- This may resemble a tapping noise at first.

Listen for the diastolic reading

- Continue to listen as the BP cuff pressure drops and the sounds fade.
- Note the gauge reading when the rhythmic sounds stop. This will be the diastolic reading.

Repeat the 2nd trial after at least a 1-minute rest interval, and the 3rd trial after a further 1-minute rest interval.

Automatic Blood Pressure Measurement

Equipment for Automatic Blood Pressure Measurement

- Automatic oscillometric blood pressure machine (Omron® M6 AC model)
- Appropriately sized blood pressure cuff, with the cuff bladder encircling 80% of the participant's arm circumference.
  - Adult arm circumference 27-34cm - Cuff size adult 16 x 30cm
  - Adult arm circumference 35-44cm - Cuff size large adult 16 x 36cm

Procedure for Automatic Blood Pressure Measurement

Pre-test instructions to the participant

- Participant should avoid caffeine, alcohol and nicotine (smoking) 30 minutes before measurement, as this can elevate readings.

- Make sure the participant is relaxed by allowing 5 minutes to sit before the first reading is taken.

Prepare the participant

- Blood pressure is taken on the left arm, except in cases of severe injury or amputation of the left arm. In these cases, the right arm is used, and a note made when recording the measurements. This is done because a >10 mmHg difference between the right and left arm blood pressure reading can be found.
- Participant should be seated comfortably, with back supported, legs supported, and uncrossed, and upper arm bared.
- Participant's arm should be supported at heart level.
- Both the participant and the health professional should refrain from talking during blood pressure measurement.

Place the blood pressure cuff on the participant's arm

- Palpate or locate the brachial artery and position the cuff so that the 'artery marker' points to the brachial artery.
- Wrap the cuff snugly around the arm.

Operating the automatic blood pressure recording machine (Omron® M6 AC model)

- Turn the machine on.
- Press the green 'start' button.
- Make sure that the participant remains still and quiet as the blood pressure cuff automatically inflates.
- Wait for the readings to appear on the screen and record the systolic, the diastolic and the heart rate.

Repeat the 2nd trial after at least a 1-minute rest interval, and the 3rd trial after a further 1-minute rest interval.

3.1.3. Classification of Blood Pressure

The 1st blood pressure measurement is discarded and the average of the last 2 measurements are used for classification. If the systolic and diastolic measurements fall in two different categories, the highest category is used for classification, regardless of whether it is the systolic or the diastolic value. (Pescatello et al. 2013)

Classification	Measurement
Low	<90 mmHg/<60 mmHg
Optimal	90-119 mmHg/60-79 mmHg
Normal	120-129 mmHg/80-84 mmHg
High normal / Pre-hypertensive	130-139 mmHg/85-89 mmHg
Stage 1 hypertension	140-159 mmHg/90-99 mmHg
Stage 2 hypertension	160-179 mmHg /100-109 mmHg
Stage 3 hypertension	> 180 mmHg/> 110 mmHg

3.1.4. Guidelines for Providing Blood Pressure Classification to Participant

When providing a participant with her/his blood pressure classification, the following guidelines can be followed:

Low	<90 mmHg / <60 mmHg

- Explain that the blood pressure reading classification is lower than normal.
- Low blood pressure might make an individual feel dizzy and lightheaded and even cause fainting in severe cases.
- Unfortunately, not a lot can be done to increase blood pressure. However, if an individual is taking chronic medication for hypertension, the dose might be too strong and a follow up visit to the general practitioner can be recommended.

Optimal	<120 mmHg / < 80 mmHg
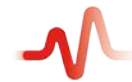
- Explain that the blood pressure reading classification is optimal.
- Encourage the participant to continue leading a healthy, active lifestyle.

Normal	120-129 mmHg / 80-84 mmHg

- Explain that the blood pressure reading classification is normal.
- Encourage the participant to start adopting healthier lifestyle habits where they are currently lacking, to maintain a normal blood pressure reading.

High normal / Pre-hypertensive	130-139 mmHg / 85-89 mmHg

- Explain that the blood pressure reading classification is high normal / pre-hypertensive.
- Encourage the participant to confirm classification by measuring his / her blood pressure again during the same week.
- Encourage the participant to start adopting healthier lifestyle habits where they are currently lacking, to decrease blood pressure reading.

Stage 1 hypertension	140-159 mmHg / 90-99 mmHg

- Explain that the blood pressure reading classification is high / hypertension stage 1.
- Refer the participant to a clinic to confirm classification by measuring his / her blood pressure again during the same week.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to decrease blood pressure reading.
- If blood pressure goal isn't reached within a month, medication may be required.

Stage 2 hypertension	160-179 mmHg / 100-109 mmHg

- Explain that the blood pressure reading classification is very high / hypertension stage 2.
- Refer the participant to a clinic to confirm classification by measuring her/his blood pressure again during the same week.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to decrease blood pressure reading.
- Medication may be required to alter blood pressure reading.

Stage 3 hypertension	> 180 mmHg / > 110 mmHg

- Explain that the blood pressure reading classification is dangerously high / hypertension stage 3.
- This is seen as a medical emergency. Refer the participant directly to the hospital.

3.1.5. Lifestyle Modifications to Decrease Blood Pressure

1. Lose weight and reduce your waistline – SBP ↓ 5-20 mmHg per 10 kg weight loss.
- Weight loss is one of the most effective lifestyle changes for controlling blood pressure.
- Waist circumference for men < 102 cm, for females < 89 cm.

2. Exercise regularly and be physically active – SBP ↓ 4-9 mmHg.
- Aerobic exercise for 30 minutes per day, for most days of the week.
- Examples of physical activity include brisk walking, dancing, playing soccer, gardening and taking the stairs instead of the lift.

3. Eat a healthy diet – SBP ↓ 2-14 mmHg.
- Decrease sodium to less than 2 300 mg per day (SBP ↓ 2-8 mmHg).
- Eat less salt by cooking at home and refrain from adding extra salt to your food.
- Ingest adequate potassium of 90 mmol/d.
- Decrease processed food (e.g. ham, bacon and polony), dietary fat and cholesterol (e.g. butter, full cream milk, yogurt, cream and coconut oil).
- Follow the DASH diet (Dietary Approach to Stop Hypertension) (SBP ↓ 8-14 mmHg).

4.   Decrease or eliminate harmful substance use.

- Limit alcohol intake – SBP ↓ 2-4 mmHg.
    - 30 ml of ethanol per day for men (720 ml of beer, 300 ml of wine, 60 ml of whiskey).
    - 15 ml of ethanol per day for women and people of lighter weight.
- Quit smoking as smoking raises your blood pressure and increases your risk for other heart diseases.

5.   Reduce stress as stress increases blood pressure significantly.

3.2.   Blood Lipid Profile

3.2.1.   Introduction

Elevated cholesterol and dyslipidaemia are major risk factors for heart attacks, cardiovascular disease and cerebrovascular accidents (strokes). High cholesterol has no symptoms, and hence it is important to perform a blood test to determine cholesterol levels.

Cholesterol refers to lipid particles that circulate within the blood stream. Cholesterol is not just bad for the body, it is essential to build cells and create certain hormones. Cholesterol, however, becomes problematic when levels become too high, and complications such as atherosclerosis (a disease in which plaque builds up inside your arteries) occur. Cholesterol in the body comes from two sources; it can be synthesized by the liver, or ingested through animal products (meat, poultry, full-fat dairy, etc.) in the diet.

Many different types of cholesterol particles are found within the body, but the two major types are low density lipoproteins (LDL-C) and high-density lipoproteins (HDL-C). LDL is also referred to as 'bad cholesterol', as it transports cholesterol from the liver, where it would have been excreted, to the body. HDL cholesterol, or 'good cholesterol' does the reverse, and transports cholesterol from the body to the liver to be excreted, therefore lowering cholesterol levels.

3.2.2.   Equipment and Procedure

If the necessary resources are available, it is recommended to evaluate a participant's full lipid profile, which includes total cholesterol, low density lipoproteins, high density lipoproteins, triglycerides, non-HDL cholesterol and the cholesterol / HDL ratio. (Abbott 2018)

If resources are limited, a total fasting cholesterol finger prick test can be done.

Pre-Test Instructions to Participant

Fast for 6 to 8 hours prior to the test. Fasting means not having any food or beverages, but take medication as prescribed.

Full Lipid Profile Equipment and Test Specifications

Analyser: Alere Afinion AS100 Analyzer
Cartridge: Full lipid profile test cartridge
Sample volume: 15 µL
Time of test: 8 minutes
Sample material: Capillary blood, plasma, or anticoagulated venous blood (EDTA / heparin)

Set-Up and Additional Information for the Alere Afinion AS100 Analyzer: Full Lipid Profile Test

- Place analyser on a horizontal, dry and clean surface.
- Make sure that there is at least 10 cm air space around the analyser.
- The analyser should be acclimated before use.
- Avoid exposure to humidity, large temperature variations, direct sunlight, vibrations and electromagnetic radiation.
- Store the test cartridge refrigerated (2-8°C) until the expiry date or at room temperature (15-25°C) for a maximum of 14 days.
- The test cartridge must reach a temperature of 18-30°C before use; leave the unopened foil pouch on a bench for at least 15 minutes.
- Use the test cartridge immediately after opening the foil pouch.
- While holding the test cartridge by the handle, turn it upside-down once and return to normal position before use.

Procedure for Full Lipid Profile Test

- Make sure that the full lipid profile test cartridge has reached room temperature before use. This takes approximately 15 minutes after it is removed from the refrigerator.
- Turn the analyser on by pressing the on / off button.
- Allow the self-test to complete, which takes approximately 3 minutes; hereafter, the red light will turn off and the green light will turn on.
- Ensure that the participant ID and operator ID are set to the desired settings.
- Remove the test cartridge from the film. The cartridge needs to be used immediately. Only grab hold of the cartridge by its handle, turn it upside-down once and return to normal position before use.
- Prick the participant 's finger by using the procedure for finger prick blood collection, described below.
- Pull the sampling device straight up from the cartridge.
- Hold the sampling device, tilted slightly higher than the finger and touch the surface of the blood drop. Fill the capillary completely with the participant 's sample.
- Replace the sampling device immediately into the test cartridge. Analysis must start within 5 minutes.
- If HbA1c test is done as well, use the 1st drop of blood for the HbA1c test, and the 2nd blood drop for the lipid panel.
- Touch the orange participant sample icon on the analyser. The lid opens automatically.

- Leave the lipid panel cartridge on the bench and start by analysing the HbA1c test. This takes only 3 minutes.
- Thereafter, insert the lipid test cartridge with the barcode facing left. Close the lid manually to start analysing.
- Enter the participant ID if the function is enabled.
- The lipid panel test takes 8 minutes to complete. Record the result when it appears on the screen. Only the last 500 results are stored on the device. Touch the green accept icon on the screen.
- The lid will open automatically. Remove the cartridge and immediately discard. Close the analyser lid manually.

Testing Procedure

1. Pull the sampling device straight up from the Test Cartridge.

2. Hold the sampling device tilted slightly upwards. Touch the surface of the patient sample or control material. Do not tilt the sampling device downwards. Fill the capillary completely with patient sample or control. Avoid air bubbles and excess sample on the outside of the capillary. Do not wipe off the capillary.

3. Replace the sampling device immediately. Analysis of the Test Cartridge must start within 1 minute.

4. Touch ⬛ for patient samples, or touch ⬛ for controls. The lid opens automatically.

5. Insert the Test Cartridge with the barcode facing left. Close the lid manually to start analysing.

6. Touch ⬛ and enter patient ID, or touch ⬛ and enter control ID. Touch ⬛ to confirm.

7. Record the result when it appears on the screen. Touch ⬛ to accept. The lid opens automatically.

8. Remove and immediately discard the used Test Cartridge. Close the lid manually when the Analyzer is not in use.

Figure 6: Blood Lipid Measurement Equipment and Procedure

Total Cholesterol Equipment and Test Specifications

Analyser: Accutrend Plus Cholesterol Meter
Strips: Accutrend Cholesterol Test Strip
Time of test: 3 minutes
Sample material: Capillary blood

Set-Up and Additional Information for the Accutrend Plus Meter

- Ensure that the batteries are inserted, and the time and date is set correctly.
- Ensure that the meter is coded with each lot of strips that you are about to use.

Procedure for Total Cholesterol Test

- Power the meter on. Ensure that the test strip on the left is flashing and that there is a code number in the display.
- Ensure that the date and time is correct and there is not a battery icon flashing on the display.
- Remove a test strip from the container and replace the cap on the container.
- With the test flap closed, insert the test strip as shown by the arrows. The application area needs to face up.
- The meter will beep twice, and the display will show an icon to open the flap.
- Open the flap and watch for a flashing blood drop close to the test strip icon.
- Collect the blood using the finger prick blood collection procedure below.
- The test strip can be removed to apply the blood to the application area. Do not touch the application area with the participant 's skin.
- The yellow application area should be completely covered with blood. Do not spread the blood or add blood from a second drop of blood. Rather repeat the procedure using a new strip and a fresh drop of blood.
- Replace the strip in the meter and close the flap. A count down should begin, and the test takes 3 minutes (180 seconds).
- Record the results when shown on the display. The past 100 results will be stored on the meter.
- Open the flap and immediately discard the strip.

Equipment for Finger Prick Blood Collection

- Medical gloves
- Sharps container
- Gauze or cotton balls and a plaster
- Alcohol wipes
- Lancets
- Bucket to collect waste
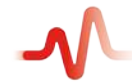
Procedure for Finger Prick Blood Collection

- Put on the medical gloves.
- Warm participant 's hands and position the participant's hand palm-side up.
- Choose the fingertip of the ring or middle finger, whichever is the least calloused.
- Apply intermittent pressure to the finger to help the blood flow to the fingertip.
- Clean the fingertip with alcohol. Start in the middle and work outward so as not to re-contaminate the area. Allow the finger to air dry.
- Use a new sterile lancet for each person. Show the lancet to the client so that they are reassured that it is new, unused and that the procedure is not too painful.
- Place the lancet off-centre on the fingertip. For an auto lancet hold the finger and firmly press the lancet against the finger and puncture the skin. Dispose the lancet in a biohazard sharps container.
- Wipe away the first drop of blood with a sterile gauze pad or cotton ball. To help the blood flow, you may need to hold the finger lower than the elbow.
- Next, collect the blood specimen. Do not excessively squeeze the finger as this may lead to an incorrect test result. Collect the blood directly from the finger onto the test device.
- After you have collected all the blood that is needed for the test, give the client a gauze pad or cotton ball to place on her/his finger until the bleeding stops. Make use of a plaster, if needed.
- Properly dispose of the gauze before the client leaves the testing area.

3.2.3. Classification of Blood Lipid Profile

(Pescatello et al. 2013)

Classification	Measurement	
Total Cholesterol		
Desirable	< 5.2	mmol/L
Borderline High	5.2 – 6.2	mmol/L
High	> 6.2	mmol/L

Classification	Measurement	
Low Density Lipoproteins		
Optimal	< 2.6	mmol/L
Near Optimal	2.6 – 3.3	mmol/L
Borderline High	3.4 – 4.1 mmol/L	
High	4.2 – 4.9	mmol/L
Very High	≥ 5	mmol/L

Classification	Measurement	
High Density Lipoproteins		
Low for Men	< 1.3	mmol/L
Low for Women	< 1.0	mmol/L
High	≥ 1.6	mmol/L

Triglycerides

Optimal	< 1.7	mmol/L
Borderline High	1.7 – 2.3	mmol/L
High	2.4 – 5.6	mmol/L
Very High	≥ 5.7	mmol/L

Non-HDL-C

Determined by subtracting HDL cholesterol from total cholesterol.
Non-HDL-C level goal should be 30 mg/dL higher than LDL cholesterol level goal.

Cholesterol / HDL Ratio

Determined by dividing HDL-C into total cholesterol.	
Optimal	1 – 3.4
Borderline High	3.5 – 4.9
Hight Risk	> 5

3.2.4. Guidelines for Providing Blood Lipid Classification to Participant

Optimal / Desirable

- Explain that the lipid reading indicates a low risk for the development of cardiovascular disease, diabetes and strokes.
- Encourage the participant to continue leading a healthy, active lifestyle.

Borderline High

- Explain that the lipid reading indicates a moderate risk for the development of cardiovascular disease, diabetes and strokes.
- Encourage the participant to start adopting healthier lifestyle habits where they are currently lacking, to decrease this risk.

High / Very High

- Explain that the lipid reading indicates a high risk for the development of cardiovascular disease, diabetes and strokes.
- Explain the complications of cardiovascular disease, diabetes and strokes.
- Explain that dyslipidaemia does not present with any symptoms but still causes considerable damage over time.
- Explain the effect of having more than one risk factor present.
- Encourage the participant to start adopting healthier lifestyle habits, to decrease this risk.

It is important to note that because HDL-C is considered 'good cholesterol', a high value is desirable. If this value is low (< 40 mg/dL for men and < 50 mg/dL for women), the participant is at risk for cardiovascular disease.

3.2.5. Lifestyle Modifications to Decrease Cholesterol

1. Lose weight and reduce your waistline.
- Waist circumference for men < 102 cm, for females < 89 cm.
- Aim for a normal BMI value of between 18.5-24.9 kg.m^2.

2. Exercise regularly and be physically active.
- Aerobic exercise for 30 minutes per day, for most days of the week.
- Moderate physical activity helps:
  - Raise high-density lipoprotein (HDL) cholesterol, the "good" cholesterol, and
  - Reduce LDL cholesterol and total cholesterol.
- Examples of physical activity include brisk walking, dancing, playing soccer, gardening and taking the stairs instead of the lift.

3. Eat a healthy diet.
- Choose healthier fats, eliminate trans fats, eat foods rich in omega-3 fatty acids and increase soluble fibre.
- Saturated fats, found primarily in red meat and dairy products, raise your total cholesterol and low-density lipoprotein (LDL) cholesterol, the "bad" cholesterol.
- Eat at least 5 fruits and vegetables per day.
- Eat a balanced diet consisting of vegetables, whole grains and protein (plant-based protein such as legumes and beans).

4. Decrease or eliminate harmful substance use.
- Limit alcohol intake.
  - 30 ml of ethanol per day for men (720 ml of beer, 300 ml of wine, 60 ml of whiskey).
  - 15 ml of ethanol per day for women and people of lighter weight (360 ml of beer, 150 ml of wine, 30 ml of whiskey).
- Quit smoking.

5. Reduce stress as stress can lead to unhealthy dietary habits and gaining weight, all of which are known risk factors for high cholesterol.

3.3. Blood Glucose

3.3.1. Introduction

Diabetes is diagnosed based on blood glucose levels and symptoms (excessive thirst and hunger, frequent urination, blurred vision and weight loss) which affect the heart, eyes, kidneys, nerves or feet. Blood sugar levels which are higher than normal but not diagnosed as diabetes are referred to as pre-diabetes, a risk factor for future diabetes. A test result should be confirmed on two separate occasions before a diagnosis can be made.

3.3.2.   Equipment and Procedure

The term HbA1c refers to glycated haemoglobin. It develops when haemoglobin, a protein within red blood cells that carries oxygen throughout your body, joins with glucose in the blood, becoming 'glycated'. The HbA1c test is used to measure the percentage of glycated haemoglobin, meaning haemoglobin changed by a high glucose concentration. Glycated haemoglobin reflects an average blood glucose level over the previous two to three months with a general participant goal of <5.7% for non-diabetic participants and <6.5% for diabetic participants. If resources are limited, a fasting or non-fasting blood glucose finger prick test can be performed using a glucose meter. (Schnell, Crocker & Weng 2017).

Pre-Test Instructions to Participant

No pre-test instructions are required.

Equipment for Finger Prick Blood Collection

- Medical gloves
- Alcohol wipes
- Lancets
- Cotton wool balls
- Red waste bag for disposal soft waste
- Sharps container for disposal of lancets and other sharp objects

Procedure for Finger Prick Blood Collection

- Put on the medical gloves.
- Ensure participant 's hands are warm and position the participant's hand palm-side up.
- Choose the fingertip of the ring or middle finger.
- Apply intermittent pressure to the finger to help the blood flow to the fingertip.
- Clean the fingertip with alcohol. Start in the middle and work outward so as not to re-contaminate the area. Allow the finger to air dry.
- Use a new sterile lancet for each participant. Show the lancet to the clients so that they are reassured that it is new, unused.
- Place the lancet off-centre on the fingertip. For an auto lancet hold the finger and firmly press the lancet against the finger and puncture the skin. Dispose the lancet in a biohazard sharps container.
- Wipe away the first drop of blood with a sterile cotton ball.
- Next, collect the blood specimen. Do not excessively squeeze the finger as this may lead to an incorrect test result. Collect the blood directly from the finger onto the test device.
- After you have collected all the blood that is needed for the test, give the participant a cotton ball to place on her/his finger until the bleeding stops. Make use of a plaster, if needed.

HbA1c Equipment and Test Specifications

Analyser:	Alere Afinion AS100 Analyzer
Cartridge:	HbA1c test cartridge
Sample volume:	1.5 µL
Time of test:	3 minutes
Sample material:	Capillary blood or venous blood

Set-Up and Additional Information for the HbA1c Test

- Place analyser on a flat, dry and clean surface.
- Make sure there is at least 10 cm air space around the analyser.
- The analyser should be acclimated before use.
- Avoid exposure to humidity, large temperature variations, direct sunlight, vibrations and electromagnetic radiation.
- Store the test cartridge refrigerated (2-8°C) until the expiry date or at room temperature (15-25°C) for a maximum of 14 days.
- The test cartridge must reach room temperature before use, open the foil pouch immediately before use.
- Use the test cartridge within 10 minutes after opening the foil pouch.
- Remove the cartridge by the handle (do not touch the bottom part of the cartridge) from the foil pouch and place on a flat surface.

Procedure for HbA1c Test

- Ensure that the test cartridge has reached room temperature before use.
- Turn the analyser on by pressing the on / off button.
- Allow the self-test to complete, which takes approximately 3 minutes; hereafter, the red light will turn off and the green light will turn on.
- Ensure that the participant ID and operator ID are set to the desired settings.
- Remove the test cartridge from the foil pouch (the cartridge needs to be used within 10 minutes). Hold the cartridge by the handle (do not touch the bottom part of the cartridge).
- Pull the sampling device straight up from the test cartridge.
- Hold the sampling device, tilted slightly higher than the selected finger and touch the surface of the blood drop. Fill the cartridge capillary with the participant 's blood sample. Avoid air bubbles and any excess sample on the outside of the capillary.
- Replace the sampling device immediately into the test cartridge. Analysis must start within 1 minute.
- Touch the orange participant sample icon on the analyser. The lid opens automatically.
- Insert the test cartridge with the barcode facing left. Close the lid manually to start analysing.
- Enter the participant ID if the function is enabled.
- Record the result when it appears on the screen. The last 500 results are stored on the device. Touch the green accept icon on the screen.

- The lid will open automatically. Remove the cartridge and immediately discard. Close the analyser lid manually.

Blood Glucose Meter Test

Blood Glucose Meter Equipment and Test Specifications

Analyser: Blood glucose meter
Strips: Glucose test strip
Time of test: Less than 10 seconds
Sample material: Capillary blood
Power supply: Four AA batteries

Set-Up and Additional Information for the Blood Glucose Meter

- Ensure that the batteries are inserted correctly.
- Ensure that the meter is correctly coded with the strips that you are about to use. The meter will beep, and the corresponding code number will appear briefly on the screen.

Procedure for Blood Glucose Test

- Select a test strip from the container, close container afterwards. This protects the remaining strips.
- Insert the test strip into the meter.
- A blood drop will appear and flash on the screen indicating that the meter is ready to test.
- Massage the selected finger to increase blood flow, rather use the side edge instead of the fingertip.
- Place the lancet firmly against the selected finger and press the lancet firmly down.
- The green application area should be completely covered with blood.
- Record the results when shown on the display.

3.3.3. Classification of Blood Glucose

(Schnell et al. 2017)

HbA1c Classification

Test	Normal	Pre-diabetes	Diabetes
mmol/mol	<39 mmol/mol	39 – 47 mmol/mol	≥ 48 mmol/mol
percentage	< 5.7 %	5.7 – 6.4 %	≥ 6.5%
Estimated average glucose (eAG)	< 6.5 mmol/L	6.5 – 7.7 mmol/L	≥ 7.7 mmol/L

Blood Glucose Classification

Test	Normal	Pre-diabetes	Diabetes
Fasting glucose test mmol/L and mg/dL	< 5.5 mmol/L ≤ 100 mg/dl	5.55 – 6.94 mmol/L 100 – 125 mg/dL	≥ 6.99 mmol/L ≥ 126 mg/dl
Random glucose test mmol/L and mg/dL	4.4 – 7.8 mmol/L 80 – 140 mg/dl	7.9 – 11.1 mmol/L 142 – 200 mg/dl	> 11.1 mmol/L > 200 mg/ dl

3.3.4. Guidelines for Providing Blood Glucose Classification to Participant

Optimal / Desirable

- Explain that the glucose reading indicates a low risk for the development of diabetes.
- Encourage the participant to continue leading a healthy, active lifestyle.

Borderline High (pre-diabetes)

- Explain that the glucose reading indicates a moderate risk for the development of diabetes.
- Encourage the participant to start adopting healthier lifestyle habits to decrease this risk.

High / Very High (diabetes)

- Explain that the glucose reading indicates a high risk for the development of diabetes.
- Explain the complications of diabetes.
- Encourage the participant to start adopting healthier lifestyle habits, to decrease this risk.

3.3.5. Lifestyle Modifications to Decrease Elevated Blood Sugar Levels

1. Lose weight and reduce your waistline.

- Waist circumference for men < 102 cm, for females < 89 cm.
- Aim for body mass index value of between 18.5-24.9 kg.m^2.

2. Exercise regularly and be physically active.

- Perform Aerobic exercise for 30 minutes per day, for most days of the week.

3. Eat a healthy diet.

- Plan meals by choosing healthy meal options to maintain consistent blood glucose levels while meeting energy needs for exercise and other activities.
- It is encouraged that one eats at least every four to six hours during the day to keep energy levels up.
- Individuals with diabetes may have better blood glucose control if their meals are spaced evenly throughout the day.

- Diet should promote weight loss or weight maintenance, depending on your current weight status. Recommendations:
  - Include a variety of whole grains, fruits, vegetables, and low-fat dairy and meat in your diet.
  - Minimize the intake of saturated fat and sodium.
  - Plan meals with regard to medications and exercise. Extra snacks may be needed before or after exercise.
  - Avoid food options such as sugary foods, full fat dairy, white rice, bread and flour, fatty cuts of meat, fried food and processed food.

4. Decrease or eliminate harmful substance use.
- Limit alcohol intake.
- Quit smoking.

5. Reduce stress.

3.4. Haemoglobin Concentration

3.4.1. Introduction

Haemoglobin enables the red blood cells to carry oxygen from the lungs to the body and to carry carbon dioxide from the body to the lungs so that it can be exhaled. The body suffers from a condition known as anaemia if there are not enough healthy red blood cells to carry adequate oxygen to the body's tissues. At first anaemia can be so mild that it goes unnoticed, but symptoms worsen as anaemia worsens. Signs and symptoms of anaemia may vary, depending on the cause. The participant may complain of fatigue, weakness, dizziness or light-headedness, headaches, shortness of breath, chest pain or cold hands and feet.

Pre-Test Instructions to Participant

No pre-test instructions are required.

3.4.2. Equipment and Procedure

(Yang, Telama, Leino, Viikari, Deelder, et al. 2011)

Analyser:	HemoCue Hb 301 analyzer
Microcuvettes:	HemoCue Hb 301 microcuvettes
Time of test:	10 seconds
Sample material:	Capillary blood
Power supply:	Four type AA batteries (1.5 V) or mains adapter

Equipment for Finger Prick Blood Collection

- Medical gloves
- Alcohol wipes
- Lancets
- Cotton wool balls

- Red waste bag for disposal soft waste.
- Sharps container for disposal of lancets and other sharp objects.

Procedure for Finger Prick Blood Collection

- Put on the medical gloves.
- Ensure participant's hands are warm and position the participant's hand palm-side up.
- Choose the fingertip of the ring or middle finger.
- Apply intermittent pressure to the finger to help the blood flow to the fingertip.
- Clean the fingertip with alcohol. Start in the middle and work outward so as not to re-contaminate the area. Allow the finger to air dry.
- Use a new sterile lancet for each participant. Show the lancet to the client so that she/he is reassured that it is new, unused.
- Place the lancet off-centre on the fingertip. Puncture the fingertip with the lancet and dispose of the lancet in biohazard sharps container.
- Wipe away the first drop of blood with a sterile cotton ball.
- Next, collect the blood specimen. Do not excessively squeeze the finger as this may lead to an incorrect test result. Collect the blood directly from the finger onto the test device.
- After you have collected all the blood that is needed for the test, give the participant a cotton ball to place on her/his finger until the bleeding stops. Make use of a plaster, if needed.

Figure 7: Haemoglobin Measurement Finger Prick Procedure

Procedure for HemoCue Hb 301 Analyzer

- Check the expiry date of the microcuvettes and the date of opening of the vial.
- Switch the machine on; press and hold left button. The display is activated.
- The display shows 3 flashing dashes; the analyser is ready to use.
- Pull out the cuvette holder.
- The most recent result is displayed.
- Fill the microcuvette in one continuous process. Ensure that the correct amount of blood (10 µl) is drawn into the microcuvette.
- The microcuvette should be completely filled. Do NOT refill!!
- Check for air bubbles in the filled microcuvette. If present, use a new microcuvette.
- Place the filled microcuvette in the cuvette holder (within 40 seconds after filling the cuvette!).
- Push the cuvette holder to its measuring position.
- After 10 seconds the haemoglobin measurement is displayed.
- Read and record the result.

- Remove and discard the microcuvette in the appropriate bio-hazard container.
- Push the cuvette holder back into the instrument.

Figure 8: Haemoglobin Measurement Equipment and Procedure

(Yang et al. 2011)

3.4.3.   Classification for Haemoglobin Concentration

Non-anaemic (At sea level)	Non-pregnant women:	≥ 12 g/dL
	Pregnant women:	≥ 11 g/dL
	Men:	≥ 13 g/dL
Mild anaemia	Non-pregnant women:	11 – 11.9 g/dL
	Pregnant women:	10 – 10.9 g/dL
	Men:	11 – 12.9 g/dL
Moderate anaemia	Non-pregnant women:	8 – 10.9 g/dL
	Pregnant women:	7 – 9.9 g/dL
	Men:	8 – 10.9 g/dL
Severe anaemia	Non-pregnant women:	< 8 g/dL
	Pregnant women:	< 7 g/dL
	Men:	< 8 g/dL

3.4.4.   Guidelines for Providing Haemoglobin Classification to Participant

Optimal – non-anaemic

- Explain that the haemoglobin reading indicates a low risk for the development of anaemia.
- Encourage the participant to continue leading a healthy, active lifestyle.

Mild

- Explain that the haemoglobin reading indicates a moderate risk for the development of anaemia.
- Encourage the participant to start adopting healthier lifestyle habits to decrease this risk.

Moderate / Severe

- Explain that the haemoglobin reading indicates a high risk for the development of anaemia.

- Explain the complications of anaemia.
- Encourage the participant to start adopting healthier lifestyle habits, to decrease this risk.

3.4.5. Lifestyle Modifications to Improve Haemoglobin Concentration

1. Eat a vitamin-rich diet.

Many types of anaemia can't be prevented, but iron deficiency anaemia and vitamin deficiency anaemia can be avoided by eating a diet that includes a variety of vitamins and nutrients, including:

- **Iron**
  Iron-rich foods include beef and other meats, beans, lentils, iron-fortified cereals, dark green leafy vegetables, and dried fruit.

- **Folate**
  This nutrient, and its synthetic form folic acid, can be found in fruits and fruit juices, dark green leafy vegetables, green peas, kidney beans, peanuts, and enriched grain products, such as bread, cereal, pasta and rice.

- **Vitamin B-12**
  Foods rich in vitamin B-12 include meat, dairy products, and fortified cereal and soy products.

- **Vitamin C**
  Foods rich in vitamin C include citrus fruits and juices, peppers, broccoli, tomatoes, melons and strawberries. These items help increase iron absorption.

- **Consider a multivitamin**
  If you are concerned about getting sufficient vitamins from your diet, ask your doctor whether a multivitamin may supplement your diet.

4. Physical Activity and Physical Fitness

Physical Activity

Introduction

Physical activity, exercise and physical fitness are terms that describe different concepts. However, they are often confused with one another, and are sometimes used interchangeably. Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity in daily life can be categorized into occupational, sport, conditioning, household, or other activities. Exercise is a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective, the improvement or maintenance of physical fitness. Physical fitness is a set of attributes that is either health- or skill-related[8] .

Physical inactivity has been identified as the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths globally[13]. The health benefits associated with regular physical activity and physical fitness are widely established [14-16]. Research has shown that an increased level of physical activity reduces the risk for cardiovascular diseases, type 2 diabetes, some cancers, and obesity[17]. There is a growing body of knowledge suggesting that physical activity has beneficial effects on mental health and psychological well-being[15, 18]. Regular participation in physical activity has also been linked with improved brain function and cognition. Reasons given as to why exercise benefits cognition include the increased blood and oxygen supply to the brain[19], the reduction of stress and improvement of mood resulting from increased levels of norepinephrine and endorphins[20], and improved synaptic transfer[19, 21].

Despite the benefits of regular physical activity, there are decreasing levels of physical activity and increasing levels of overweight and obesity world-wide, thus making physical inactivity a global concern[22]. Apart from the decline in habitual physical activity, modernization (automation and technology) has freed many individuals from heavy physical work and manual labour[23]. This, in conjunction with the rise in passive modalities of entertainment and interaction (video games, television, mobile phones and the internet), has decreased physical activity demands so drastically as to be nearly non-existent in industrialized and urbanized environments[24]. Increasing physical activity is a societal, not just an individual problem[25]. Therefore, it demands a population-based, multi-sectoral, multi-disciplinary and culturally relevant approach.

Physical Activity Recommendations

The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) guidelines are age-group specific, and include guidelines for adults (18-65 years)[8]:

An adult is referred to as 'active' if she/he engages in aerobic activity of:

- Moderate intensity for a minimum of 150 minutes per week; or
- Vigorous intensity for a minimum of 75 minutes per week; these can be achieved by accumulating 10-minute bouts; In addition,
- Participation in muscle-strengthening activities that require the functioning of all major muscle groups (legs, hips, back, abdomen, chest, shoulders, and arms) on 2 or more days; or

- A combined equivalent (both moderate and vigorous intensity aerobic activity), and muscle-strengthening activities that require the functioning of all major muscle groups (legs, hips, back, abdomen, chest, shoulders, and arms) on 2 or more days.
- In addition, the ACSM/AHA recommends that individuals exceed the aerobic activity guidelines and aim to double the duration of moderate intensity (≥300 min/week) and/or vigorous intensity (≥150 min/week) physical activity, in order to increase cardiorespiratory fitness and gain greater health-enhancing benefits.

Physical Activity Principles

- **Frequency:** Three to five days a week.
- **Intensity:** 55% to 90% of maximum heart rate (HR $_{max}$), or 40% to 85% of maximum oxygen uptake reserve or (HR $_{max}$). The lower intensity values, i.e. 40% to 49% of $\dot{V}O_2\,R$ or heart rate reserve (HRR) and 55% to 64% of HR $_{max}$, are most applicable to individuals who are quite unfit.
- **Duration:** 20 to 60 minutes of continuous or intermittent (minimum of 10-minute bouts accumulated throughout the day) aerobic activity. Duration is dependent on the intensity of the activity; thus, lower intensity activity should be conducted over a longer period of time (30 minutes or more). Conversely, individuals training at higher levels of intensity should train for at least 20 minutes or longer.
- **Mode:** Any activity that uses large muscle groups, which can be maintained continuously, and is rhythmical and aerobic in nature, e.g., brisk walking, hiking, running-jogging, cycling-bicycling, cross-country skiing, aerobic dance/group exercise, rope skipping, rowing, stair climbing, swimming, skating, and various endurance game activities, or some combination thereof.

Benefits of Physical Activity

- Cardiovascular: Improves cardiovascular and coronary artery disease risk factor profiles, such as lowering resting systolic and diastolic blood pressures, reducing serum triglycerides, total body fat and intra-abdominal fat, lowering insulin needs with improved glucose tolerance, and reducing blood clotting[26]. Furthermore, it improves the cardiovascular and respiratory function as it increases myocardial oxygen supply, decreases oxygen demand, improves myocardial contraction and its electrical impulses stability[27], increases the diameter and dilatory capacity of coronary arteries, increases collateral artery formation and reduces rates of progression of coronary artery atherosclerosis[28].

- Increases in cardiorespiratory fitness are associated with a reduction in death from all causes, and high levels of cardiorespiratory fitness are associated with higher levels of habitual physical activity, which in turn are associated with many health benefits.

- Musculoskeletal: Maintains and improves the musculoskeletal system and associated tendon and connective tissue functions[29], reduces chances of injury, and may combat the effects of degenerative arthritis due to healthier lubrication of joint surfaces[30].
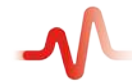
Furthermore, developing muscle strength and flexibility through exercise is important for overall activity to improve one's ability to perform tasks and to reduce the potential of injury. Flexibility improves joint range of motion and posture and helps to prevent and treat lower back pain[31], and strength activities help to maintain lean and flaccid muscle mass.

- Body Composition: Modifies both energy intake and body composition - regulates energy balance and enhances weight management, thus preventing obesity-related diseases and excessive weight gain. A greater total fat loss occurs with exercise in conjunction with food restrictions, than with food restriction alone[30], despite similar changes of body weight; alters fuel oxidation, and modifies the composition of weight loss produced by food restriction alone; increases fat loss and decreases the loss of fat free mass, which is essential for long-term weight maintenance[32].

- Mental and Psychological: Improves mood, reduces depression and anxiety, and ameliorates cognitive function, self-esteem, self-efficacy and feelings about the self[33]; reduces tension and helps one to manage stress more effectively and sleep better[34]; improves one's quality of life by enhancing psychological well-being and by improving physical functioning in persons compromised by poor health or depression[35].

- Economic: Associated health problems have substantial economic consequences for the health care system - both medical and financial risk for many chronic diseases of lifestyle, and the economic outcome influence individuals, businesses and nations.

- Social: Significant in education, socialization and working life, among other things[36]. Provides opportunities for social interaction and can help promote community integration, assists people to gain an understanding of other groups and share values, provides opportunities for self-expression, builds self-confidence and feelings of achievement and integration, reduces a sense of isolation and loneliness, encourages community networks, and prolongs independence in older people[37]. Physical inactivity in youth may be associated with other risky and health-compromising behaviours, including cigarette smoking, drugs, unsafe sex or violence (including vandalism and petty crime), and more hours of watching television[38].

4.1.   Self- Reported Physical Activity: IPAQ – Short Form

4.1.1.   Introduction

The International Physical Activity Questionnaire (IPAQ) was developed to standardize the capturing of PA surveillance data in adults aged 15 to 69 years[39]. The IPAQ short-form instrument assesses PA undertaken across a comprehensive set of domains including leisure time, domestic and gardening (yard) activities, work-related and transport-related activity. This instrument collects information on physical activity participation in four domains; namely sitting, and the three introduced above. The specific types of activity assessed encompass vigorous intensity (VPA), moderate intensity (MPA), walking or light intensity (LPA) physical activities and sitting behaviours. Frequency (measured in days per week) and duration (time per day) are collected separately for each specific type of activity.

Advantages: This method is most frequently used, easiest to administer, and most time- and cost-efficient[40]. Because of the exceptionally large number of people in many epidemiologic studies, self-administered questionnaires are often used to capture time spent or activity engaged in at work, in exercise, at home, in transportation and in leisure settings[41].

Disadvantages: Difficulty of determining the actual frequency and intensity of physical activity because of the cognitive demands of recall - individuals tend to overestimate their participation in VPA and underestimate participation in light-to-moderate-intensity activities; it is the least accurate, though objective monitoring devices can help to eliminate discrepancies[42]. Because of the exceptionally large number of people in many epidemiologic studies, self-administered questionnaires are often used to capture time spent or activity engaged in at work, in exercise, at home, in transportation and in leisure settings[41].

4.1.2. Equipment and Procedures

The IPAQ-Short Form is a two-page questionnaire to obtain internationally comparable data on health-related physical activity[39, 43]. This version is to be used through self-administration, and scripts for personal interviews can be administered to most people in about 10 minutes or less. It can be conducted in either a face-to-face or survey format, as displayed below:

Think of all the vigorous activities that take hard physical effort that you did in the last 7 days. Vigorous activities make you breathe much harder than normal and may include heavy lifting, digging, aerobics, or fast bicycling. Think only about those physical activities that you did for at least 10 minutes at a time.

		Days per week
1.	During the last 7 days, on how many days did you do vigorous physical activities?	___ (0-7)

If participant answers zero (0), skip to Question 3.

		Hours per day	Minutes per day
2.	How much time did you usually spend doing vigorous physical activities on one of those days?	___ (0-16)	___ (0-960)

An average time for one of the days on which you do vigorous activity is being sought. If the participant can't answer because the pattern of time spent varies widely from day to day, ask:

	Hours per week	Minutes per week
How much time in total would you spend over the last 7 days doing vigorous physical activities?	___ (0-16)	___ (0-960)

Now think about activities that take moderate physical effort that you did in the last 7 days. Moderate activities make you breathe somewhat harder than normal and may include carrying light loads, bicycling at a regular pace, or doubles tennis. Do not include walking. Again, think about only those physical activities that you did for at least 10 minutes at a time.

		Days per week
3.	During the last 7 days, on how many days did you do moderate physical activities?	___ (0-7)

If participant answers zero (0), skip to Question 5.

	Hours per day	Minutes per day
4. How much time did you usually spend doing moderate physical activities on one of those days?	_____ (0-16)	_____ (0-960)

An average time for one of the days on which you do moderate activity is being sought. If the participant can't answer because the pattern of time spent varies widely from day to day, or includes time spent in multiple jobs, ask:

	Hours per week	Minutes per week
What is the total amount of time you spent over the last 7 days doing moderate physical activities?	_____ (0-16)	_____ (0-960)

Now think about the time you spent walking in the last 7 days. This includes at work and at home, walking from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

	Days per week
5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?	_____ (0-7)

If participant answers zero (0), skip to Question 7.

	Hours per day	Minutes per day
6. How much time did you usually spend walking on one of those days?	_____ (0-16)	_____ (0-960)

An average time for one of the days on which you walk is being sought. If the participant can't answer because the pattern of time spent varies widely from day to day, ask:

	Hours per week	Minutes per week
What is the total amount of time you spent walking over the last 7 days?	_____ (0-16)	_____ (0-960)

Now think about the time you spent sitting in the last 7 days. Include time spent at work, at home, while doing coursework, and during leisure time. This may include time spent sitting at a desk, visiting friends, reading or sitting or lying down to watch television.

	Hours per day	Minutes per day
7. During the last 7 days, how much time did you spend sitting on a week day?	_____ (0-16)	_____ (0-960)

An average time per day spent sitting is being sought. If the participant can't answer because the pattern of time spent varies widely from day to day, ask:

	Hours on Wednesday	Minutes on Wednesday
What is the total amount of time you spent sitting last Wednesday?	_____ (0-16)	_____ (0-960)

Equipment for Electronic Capturing of Measurement

- Tablet, Laptop or PC

Equipment for Hard-Copy Capturing of Measurement

- Pen or pencil
- Paper Data Capturing Sheet

Number of Trials: One

Procedure for Electronic and Hard-Copy Capturing of Measurement

Pre-Test Instructions to Participant

- This survey asks for your views about your time spent being physically active over the last 7 days.
- Please answer each question, even if you do not consider yourself to be an active person.
- Think about the activities you do at work, in your house and yard, to get from place to place, and in your spare time for recreation.
- Please respond to all questions as spontaneously as possible, and as honestly and accurately as you can.
- Answer each question by filling in one answer/response.
- If you are unsure how to answer a question, please give the best answer you can.
- If something is unclear, you can ask one of the investigators to clarify.
- There are no right or wrong answers, only your subjective perception matters.

4.1.3 Classification of Physical Activity

Scoring[39]

The items are structured to provide separate scores on walking, moderate intensity, and vigorous intensity as well as a combined total score to describe overall level of activity. Computation of the total score requires summation of the duration (in minutes) and frequency (days) of walking, moderate intensity and vigorous intensity activity.

Another measure of volume of activity can be computed by weighting each type of activity by its energy requirements defined in METs (METs are multiples of the resting metabolic rate) to yield a score in MET-minutes. A MET-minute is computed by multiplying the MET score by the minutes performed. Met-minute scores are equivalent to kilocalories for a 60-kg person. Kilocalories may be computed from MET-minutes using the following equation:

MET-min x (Weight in kg ÷ 60 kg)

The following values are used for the analysis of IPAQ data[39]:

Walking	3.3 METs
Moderate Intensity Physical Activity	4 METs
Vigorous Intensity Physical Activity	8 METs

Analysis of IPAQ

Both categorical and continuous indicators of physical activity are possible from the IPAQ short form. However, given the non-normal distribution of energy expenditure in many populations, the continuous indicator is presented as median minutes or median MET-minutes rather than mean minutes or mean MET-minutes.

Categorical Score

Regular participation is a key concept included in current public health guidelines for physical activity. Therefore, both the total volume and the number of days/sessions are included in the IPAQ analysis algorithms. There are three levels of physical activity suggested for classifying populations which take account of the concept of total physical activity of all domains. These are:

1. Inactive
2. Minimally active
3. HEPA active (Health enhancing physical activity, a high active category)

The criteria for these levels are shown below:

1.   Inactive (Category 1)

This is the lowest level of physical activity. Those individuals who do not meet criteria for Categories 2 or 3 are considered "insufficiently active" (Category 1).

2.   Minimally Active (Category 2)

The minimum pattern of activity to be classified as "sufficiently active" is any one of the following 3 criteria:
- 3 or more days of vigorous activity for at least 20 minutes per day; OR
- 5 or more days of moderate intensity activity or walking for at least 30 minutes per day; OR
- 5 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum of at least 600 to 2999 MET-min/week.

Individuals meeting at least one of the above criteria would be defined as achieving the minimum recommendation to be considered "minimally active" (Category 2). This category is more than the minimum level of activity recommended for adults in current public health recommendations but is not enough for "total physical activity" when all domains are considered. The IPAQ measures total physical activity, whereas the recommendations are based on activity (usually leisure time or recreational) over and above usual daily activities.

3. HEPA Active (Category 3)

A separate category labelled "HEPA" level, which is a more active category (Category 3) can be computed for people who exceed the minimum public health physical activity recommendations and accumulate enough activity for a healthy lifestyle. This is a useful indicator because it is known that higher levels of participation can provide greater health benefits, although there is no consensus on the exact amount of activity for maximal benefit. Also, in considering lifestyle physical activity, this is a total volume of being active which reflects a healthy lifestyle. It is at least 1.5 – 2 hours of "being active" throughout the day, which is more than the leisure time physical activity-based recommendations of 30 minutes.

In the absence of any established criteria, the IPAQ scientific group proposes this new cut off point, which equates to approximately 1.5 – 2 hours of total activity per day, of at least moderate intensity activity. It is desirable to have the "HEPA" activity category, because in some populations, a large proportion of the population may be classified as "minimally active" because the IPAQ instrument assesses all domains of activity. Category 3 sets a higher threshold of activity and provides a useful mechanism to distinguish variation in sub-population groups.

The two criteria for classification as "HEPA Active" are:

- Vigorous intensity activity on at least 3 days achieving a minimum of at least 1 500 MET-min/week; OR
- 7 or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum of at least 3000 MET-min/week.

Continuous Score

Data collected with the IPAQ can be reported as a continuous measure and reported as median MET-minutes. Median values can be computed for walking (W), moderate intensity activities (M), and vigorous intensity activities (V) using the following formulae:

MET values and Formula for computation of MET-minutes:

Walking MET-minutes/week   = 3.3 x walking minutes x walking days

Moderate MET-minutes/week   = 4.0 x moderate intensity activity minutes x moderate days

Vigorous MET-minutes/week   = 4.0 x vigorous intensity activity minutes x vigorous intensity days

A combined total PA MET-min/week can be computed as the sum of Walking + Moderate + Vigorous MET-min/week scores.

IPAQ Sitting Score

The IPAQ Sitting questionnaire is an additional indicator variable and is not included as part of any summary score of physical activity. Data on sitting should be reported as median values and interquartile range. To date there are few data on sedentary (sitting) behaviours and no well-accepted thresholds for data presented as categorical levels.

Data Processing Rules

In addition to a standardized approach to computing categorical and continuous measures of physical activity, it is necessary to undertake standard methods for the cleaning and treatment of IPAQ data sets. The use of different approaches and rules would introduce variability and reduce the comparability of data.

There are no established rules for data cleaning and processing on physical activity. Thus, to allow more accurate comparisons across studies IPAQ has established and recommends the following guidelines:

1.   Data Cleaning

- Time should be converted from hours into minutes.
- Ensure that responses in "minutes" were not entered in the "hours" column by mistake during self-completion or during data entry process, values of "15", "30", "45", "60" and "90" in the "hours" column should be converted to "15", "30", "45", "60" and "90" minutes, respectively, in the "minutes" column.
- Time should be converted to daily time (usually is reported as daily time, but a few cases will be reported as optional weekly time – e.g. VWHRS, VWMINS – convert to daily time).
- Convert time to MET-mins (see above; days x daily time).
- Must have the number of days for the "day" variables; for the "time" variables, either daily or weekly time is needed.

2.   Maximum Values for Excluding Outliers

This rule is to exclude data which are unreasonably high; these results are to be considered outliers and thus are excluded from analysis. All Walking, Moderate and Vigorous time variables which total "16 hours" or more should be excluded from the analysis. The day's variable can take the range 0 – 7 days; values greater than 7 should be excluded from analysis.

3.   Truncation of Data Rules

This rule is concerned with data truncation and attempts to normalize the distribution of levels of activity which are usually skewed in national or large population data sets. It is recommended that all Walking, Moderate and Vigorous time variables exceeding "4 hours" or "240 minutes" are truncated (that is re-coded) to be equal to "240 minutes" in a new variable. This rule permits a maximum of 28 hours of activity in a week to be reported for each category of physical activity.

When analysing IPAQ data and presenting the results in categorical variables, this rule has the important effect of preventing misclassification in the "high active" category. For example, an individual who reports walking for 2.5 hours every day and no other physical activity would be classified as "HEPA Active" (reaching the threshold of 7 days, and ≥ 3000 MET-mins). Similarly, someone who reports walking for 90 minutes on 5 days, and 4 hours (240 mins) of moderate activity on another day and 70 minutes of vigorous activity on another day, would also be coded as "HEPA Active" because this pattern meets the "7 day" and "3000 MET-min" criteria for "HEPA Active".

4. Minimum Values for Duration of Activity

Only values of 10 or more minutes of activity will be included in the calculation of summary scores. The rationale being that the scientific evidence indicates that episodes or bouts of at least 10 minutes are required to achieve health benefits. Responses of less than 10 minutes (and their associated days) should be re-coded to "zero".

Summary of Data Processing Rules 1 – 4 above

Data management rules 2, 3 and 4 deal with first excluding outlier data, then secondly, re-coding high values to "4 hours", and finally describing minimum amounts of activity to be included in analyses. These rules will ensure that highly active people remain coded as highly active, while decreasing the chances that fewer active individuals are coded as highly active.

5. Calculating Total Days for "Minimally Active" (Category 2) and "HEPA Active" (Category 3)

Presenting IPAQ data using categorical variables requires the total number of "days" on which all physical activity was undertaken to be assessed. This is difficult because frequency in "days" is asked separately for walking, moderate intensity and vigorous intensity, thus allowing the total number of "days" to range from a minimum of 0 to a maximum of 21 "days" per week. The IPAQ instrument does not record if different types of activity are undertaken on the same day.

In calculating "Minimal Activity", the primary requirement is to identify those individuals who undertake a combination of walking and/or moderate intensity activity on at least "5 days"/week. Individuals who meet this criterion should be coded in a new variable called "at least 5 days".

Below are two examples showing this coding in practice:

- An individual who reports "2 days of moderate" and "3 days of walking" should be coded as a value indicating "at least 5 days".
- An individual reporting "2 days of vigorous", "2 days walking" and "2 days moderate" should be coded as a value to indicate "at least 5 days" (even though the actual total is 6).

The original frequency of "days" for each type of activity should remain in the data file for use in other calculations.

The same approach as described above is used to calculate total days for computing the "HEPA Active" category. The primary requirement according to the stated criteria is to identify those individuals who undertake a combination of walking, moderate and/or vigorous intensity activity on at least 7 days/week. Individuals who meet this criterion should be coded in a value in a new variable to reflect "at least 7 days".
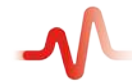
Below are two examples showing this coding in practice:

- An individual who reports "4 days of moderate" and "3 days of walking" should be coded as a value indicating "at least 7 days".

- An individual reporting "3 days of vigorous", "3 days walking" and "3 days moderate" should be coded as a value to indicate "at least 7 days" (even though the total adds to 9).

Summary

The algorithm(s) in the IPAQ Scoring Summary and IPAQ Analysis Flow Chart below show how these rules work in an analysis plan, to develop the categories 1 (Inactive), 2 (Minimally) and 3 (HEPA) levels of activity.

IPAQ Scoring Summary[39]

Categorical Score – Three Levels of Physical Activity

1. Inactive

- No activity is reported; OR
- Some activity is reported but not enough to meet Categories 2 or 3.

2. Minimally Active

Any one of the following 3 criteria:

- 3 or more days of vigorous intensity activity of at least 20 minutes per day; OR
- 5 or more days of moderate intensity activity or walking of at least 30 minutes per day; OR
- 5 or more days of any combination of walking, moderate or vigorous intensity activities achieving a minimum of at least 600 MET-min/week.

3. HEPA Active

Any one of the following 2 criteria:

- Vigorous intensity activity on at least 3 days and accumulating at least 1500 MET-min/week; OR
- 7 or more days of any combination of walking, moderate or vigorous intensity activities achieving a minimum of at least 3000 MET-min/week.

Continuous Score

Expressed as MET-min per week: **MET level x minutes of activity x events per week**

Sample Calculation:

MET Levels   **MET-min/week for 30 min episodes, 5 times/week**

Walking	= 3.3 METs	3.3 x 30 x 5	= 495 MET-min/week
Moderate Intensity	= 4.0 METs	4.0 x 30 x 5	= 600 MET-min/week
Vigorous Intensity	= 8.0 METs	8.0 x 30 x 5	= 1200 MET-min/week

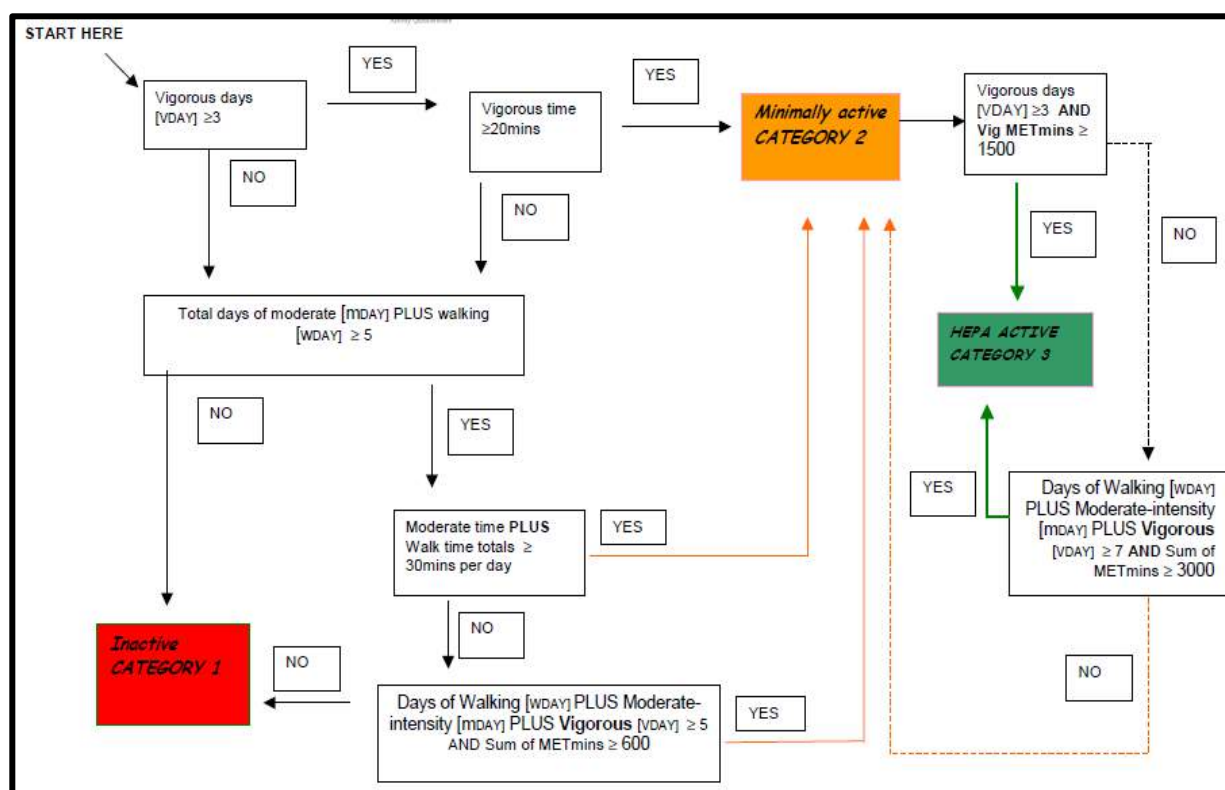Total MET-min/week = (Walk METs x min x days) + (Moderate METs x mins x days) + (Vigorous METs x mins x days)

IPAQ Analysis[39]

Figure 9: IPAQ analysis flow chart

Classification of Intensity of Physical Activity Measurement[39]

Walking	3.3 METs
Moderate Intensity Physical Activity	4 METs
Vigorous Intensity Physical Activity	8 METs

Classification of Self-Reported Physical Activity Measurement[39]

Low (Inactive)	Less than 600 MET-min./week (Does not meet the criteria for categories 2 or 3 and is insufficiently active).
Moderate	• Three or more days of vigorous activity of at least 20 minutes per day; OR • Five or more days of moderate intensity activity or walking for at least 30 minutes per day; OR • Five or more days of any combination of walking, moderate intensity or vigorous intensity (Minimally active) activities achieving a minimum total PA of at least 600 to 2999 MET-min/week. Therefore, if the individual meets at least one of the above 3 criteria, she/he is considered as minimally/sufficiently active.

High (HEPA)	• At least 1.5 – 2 hours of total activity per day, of at least moderate intensity activity; OR • Vigorous intensity activity on at least 3 days achieving a minimum of at least 1500 MET-min/week; OR • Seven or more days of any combination of walking, moderate intensity or vigorous intensity activities achieving a minimum total PA of at least 3 000 MET-min/week.

CHECK FOR REPETITION REGARDING GIVING OF FEEDBACK TO PARTICIPANTS IN THIS SECTION

4.1.4 Guidelines for Providing Self-Reported Physical Activity Classification to Participant

When providing participants with their self-reported physical activity classification, the following guidelines can be followed:

Low Physical Activity / Inactive

- Explain that the self-reported physical activity score classification is low (inactive).
- Explain that the participant is at an increased risk for chronic diseases such as accelerated biological aging/premature death, cardiovascular disease, metabolic syndrome, obesity, insulin resistance, prediabetes, type 2 diabetes, coronary artery disease, peripheral artery disease, hypertension, stroke, congestive heart failure, respiratory disorders, endothelial dysfunction, arterial dyslipidaemia, haemostasis, deep vein thrombosis, cognitive dysfunction, depression and anxiety, osteoporosis, osteoarthritis, bone fracture/falls, rheumatoid arthritis, colon cancer, breast cancer, gestational diabetes, gallbladder diseases, weight management, and musculoskeletal conditions.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to improve self-reported physical activity scoring and classification.
- No medication required to alter self-reported physical activity score.

Moderate Physical Activity

- Explain that the self-reported physical activity score classification is moderate (minimally active).
- Explain that the participant is at a low risk for chronic diseases.
- No clinic or general practitioner referral necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to improve and/or maintain self-reported physical activity scoring and classification.
- No medication required to alter self-reported physical activity score.

High Physical Activity (HEPA)

- Explain that the self-reported physical activity score classification is high (HEPA).
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue leading a healthy, active lifestyle.

4.2. Objective Physical Activity: 7-Day Accelerometery

4.3.1. Introduction

The ActiGraph is an accelerometer used to measure energy expenditure. The ActiGraph collects and reports physical activity in "counts" and then converts these counts to calories. Counts are the summation of the accelerations measured during the epoch period. The ActiGraph measures changes in acceleration 30 times each second. The ActiGraph also has a pedometer function, measuring the number of steps taken.

4.3.2. Equipment and Procedures

Equipment: ActiGraph Accelerometer (ActiGraph wGT3X+)

Number of Trials: One (ActiGraph worn for 7 consecutive days)

Scoring: Computer analysis

Measuring Procedure:

- The participants wear the ActiGraph on the waist with an elastic belt, either above or below their clothing.
- Participants are asked to wear the ActiGraph for seven days, putting it on first thing in the morning and removing it last thing at night and removing it when bathing or showering.
- The ActiGraph data are deemed valid if worn for at least five days.
- For activity counts, and time spent in moderate to vigorous activity, at least three to four days of monitoring is required to achieve reliability.
- The participants are reminded by the researcher to wear their ActiGraph via daily morning SMSs to their cell phones.
- After the seven-day period has expired, information collected on the ActiGraph is downloaded onto a computer for analysis.

4.3.3. Classification of Accelerometery and Guidelines Providing Feedback

Daily Step Count[44]

When providing a participant with the daily step count readings, the following can be explained:

Sedentary lifestyle	≤ 5000 steps/day
Low active	5001 – 7499 steps/day
Somewhat active	7500 – 9999 steps/day
Active	10000 – 12499 steps/day
Highly active	≥ 12500 steps/day

*Total physical activity / Total walking: 10 000 steps/day

Guidelines for Providing Classification of Daily Step Count

When providing participants with their classification, the following guidelines can be followed:

Sedentary lifestyle	≤ 5000 steps/day

- Explain that the daily step count classification is sedentary.
- Explain that the participant is at an increased risk for chronic diseases such as accelerated biological aging/premature death, cardiovascular disease, metabolic syndrome, obesity, insulin resistance, prediabetes, type 2 diabetes, coronary artery disease, peripheral artery disease, hypertension, stroke, congestive heart failure, respiratory disorders, endothelial dysfunction, arterial dyslipidaemia, haemostasis, deep vein thrombosis, cognitive dysfunction, depression and anxiety, osteoporosis, osteoarthritis, bone fracture/falls, rheumatoid arthritis, colon cancer, breast cancer, gestational diabetes, gallbladder diseases, weight management, and musculoskeletal conditions.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase daily step count.
- No medication is required to alter daily step count.

Low Active	5001 – 7499 steps/day

- Explain that the daily step count classification is low active.
- Explain that the participant is at an increased risk for chronic diseases.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase daily step count.
- No medication is required to alter daily step count.
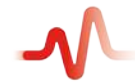
Somewhat Active	7500 – 9999 steps/day

- Explain that the daily step count classification is somewhat active.
- Explain that the participant is at an increased risk for chronic diseases.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting healthier lifestyle habits where they are currently lacking, to increase and/or maintain daily step count.

Active	10000 – 12499 steps/day

- Explain that the daily step count classification is active.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue with her/his healthy lifestyle habits to maintain daily step count.

Highly Active	≥ 12500 steps/day

- Explain that the daily step count classification is highly active.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue leading a healthy, active lifestyle.

Metabolic Equivalent (MET)[8]

When providing a participant with the Metabolic Equivalent (MET) classifications, the following can be explained:

Light Intensity Physical Activity	< 3 METs
Moderate Intensity Physical Activity	3 – < 6 METs
Vigorous Intensity Physical Activity	≥ 6 METs

Guidelines for Providing Classification of METs

When providing participants with their MET classifications, the following can be explained:

Light Intensity Physical Activity	< 3 METs

- Explain that the MET classification is light intensity physical activity.
- Explain that the participant is at an increased risk for chronic diseases such as accelerated biological aging/premature death, cardiovascular disease, metabolic syndrome, obesity, insulin resistance, prediabetes, type 2 diabetes, coronary artery disease, peripheral artery disease, hypertension, stroke, congestive heart failure, respiratory disorders, endothelial dysfunction, arterial dyslipidaemia, haemostasis, deep vein thrombosis, cognitive dysfunction, depression and anxiety, osteoporosis, osteoarthritis, bone fracture/falls, rheumatoid arthritis, colon cancer, breast cancer, gestational diabetes, gallbladder diseases, weight management, and musculoskeletal conditions.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase METs.
- No medication is required to alter METs.

Moderate Intensity Physical Activity	3 – < 6 METs

- Explain that the MET classification is moderate intensity physical activity.
- Explain that the participant is at a low risk for chronic diseases.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase and/or maintain METs.
- No medication is required to alter METs.

Vigorous Intensity Physical Activity	≥ 6 METs

- Explain that the MET classification is vigorous intensity physical activity.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue leading a healthy, active lifestyle.

CDC and ACSM Recommended Physical Activity Guidelines[8]

When providing a participant with the CDC and ACSM recommended physical activity guidelines, the following can be explained:

Light Intensity Physical Activity	Aerobic activity for < 30 minutes on < 5 days
Moderate Intensity Physical Activity	Aerobic activity for ≥ 30 minutes on 5 days per week
Vigorous Intensity Physical Activity	Aerobic activity for ≥ 20 minutes on 3 days per week

Guidelines for Providing Classification of CDC and ACSM Recommended Physical Activity Guidelines
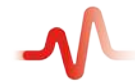
When providing participants with their classification, the following guidelines can be followed:

Light Intensity Physical Activity	Aerobic activity for < 30 minutes on < 5 days

- Explain that the physical activity guidelines classification is light intensity physical activity.
- Explain that the participant is at an increased risk for chronic diseases such as accelerated biological aging/premature death, cardiovascular disease, metabolic syndrome, obesity, insulin resistance, prediabetes, type 2 diabetes, coronary artery disease, peripheral artery disease, hypertension, stroke, congestive heart failure, respiratory disorders, endothelial dysfunction, arterial dyslipidaemia, haemostasis, deep vein thrombosis, cognitive dysfunction, depression and anxiety, osteoporosis, osteoarthritis, bone fracture/falls, rheumatoid arthritis, colon cancer, breast cancer, gestational diabetes, gallbladder diseases, weight management, and musculoskeletal conditions.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase physical activity.
- No medication is required to alter physical activity.

Moderate Intensity Physical Activity	Aerobic activity for ≥ 30 minutes on 5 days per week

- Explain that the physical activity guidelines classification is moderate intensity physical activity.
- Explain that the participant is at a low risk for chronic diseases.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase and/or maintain physical activity.
- No medication is required to alter physical activity.

Vigorous Intensity Physical Activity	Aerobic activity for ≥ 20 minutes on 3 days per week

- Explain that the physical activity guidelines classification is vigorous intensity physical activity.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue leading a healthy, active lifestyle.

WHO Recommended Physical Activity Guidelines[45]

When providing a participant with the WHO recommended physical activity guidelines, the following can be explained:

Light Intensity Physical Activity	< 150 minutes aerobic MPA and < 75 minutes aerobic VPA throughout the week
Moderate Intensity Physical Activity	≥ 150 minutes of aerobic activity throughout the week
Moderate-to-Vigorous Intensity Physical Activity	Equivalent combination of MVPA
Vigorous Intensity Physical Activity	≥ 75 minutes of aerobic activity throughout the week

Guidelines for Providing Classification of WHO Recommended Physical Activity Guidelines

When providing participants with their classification, the following guidelines can be followed:

Light Intensity Physical Activity	< 150 minutes aerobic MPA and < 75 minutes aerobic VPA throughout the week

- Explain that the physical activity guidelines classification is light intensity physical activity.
- Explain that the participant is at an increased risk for chronic diseases such as accelerated biological aging/premature death, cardiovascular disease, metabolic syndrome, obesity, insulin resistance, prediabetes, type 2 diabetes, coronary artery disease, peripheral artery disease, hypertension, stroke, congestive heart failure, respiratory disorders, endothelial dysfunction, arterial dyslipidaemia, haemostasis, deep vein thrombosis, cognitive dysfunction, depression and anxiety, osteoporosis, osteoarthritis, bone fracture/falls, rheumatoid arthritis, colon cancer, breast cancer, gestational diabetes, gallbladder diseases, weight management, and musculoskeletal conditions.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase physical activity.
- No medication is required to alter physical activity.

Moderate Intensity Physical Activity	≥ 150 minutes of aerobic activity throughout the week

- Explain that the physical activity guidelines classification is moderate intensity physical activity.
- Explain that the participant is at a low risk for chronic diseases.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase and/or maintain physical activity.
- No medication is required to alter physical activity.

Moderate-to-Vigorous Intensity Physical Activity	Equivalent combination of MVPA

- Explain that the physical activity guidelines classification is moderate-to-vigorous intensity physical activity.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue leading a healthy, active lifestyle.

Vigorous Intensity Physical Activity	≥ 75 minutes of aerobic activity throughout the week

- Explain that the physical activity guidelines classification is vigorous intensity physical activity.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue leading a healthy, active lifestyle.

4.3.4. Lifestyle Modifications to Increase Daily Step Count, METs and Physical Activity

Physical Fitness

4.3.   Establish Cardiorespiratory Fitness: Cooper 12-minute Run Test

4.3.1.   Introduction[46, 47]

The Cooper 12-minute Run Test is a frequently used test of aerobic physical fitness (the ability of the body to use oxygen to power it whilst running). It is a simple, self-paced, maximal running test that assesses and monitors the development of an individual's aerobic endurance in addition to obtaining her/his estimated VO_{2max}. The physiological parameter most closely linked to human endurance performance is maximal aerobic power, or VO_{2max}. Therefore, accurate tests of this attribute are important when prescribing physical activity in individuals of all ages.

In its original form, the aim of the test is to run as far as possible within 12 minutes, and the total distance covered is recorded. It is meant to measure the condition of the individual taking the test and therefore it is supposed to be run at a steady pace rather than sprinting and fast running. Walking is allowed, although the participants must be encouraged to push themselves as hard as they can to maximize the distance covered. The outcome is based on the distance run, age and gender of the individual tested.

Advantages: It uses a well-known type of exercise, i.e. walking and running; large groups can be tested at once; it is a very cheap and simple test to perform; and it does not require trained personnel.

Disadvantages: Practice and pacing is required, and performance on this test can be affected greatly by motivation.

The test should be performed outdoors, along a flat, oval track with a firm surface. If deemed necessary, the test may be performed indoors. The course must be 400-m in length or if performed indoors, at least 100-m in length. To aid in measuring the completed distance, the length of the track should be marked every 5-m. If performed outdoors, the start/end point should be marked with a cone (such as an orange traffic cone). Similarly, if the test is performed indoors, a cone should also be used to mark the turnaround points. A start line, which marks the beginning and end of each lap, should be marked on the floor using brightly coloured tape.

4.3.2. Equipment and Procedure

Equipment for Electronic Capturing of Measurement

- Tablet, laptop or PC
- Flat indoor/outdoor running track
- Stopwatch
- Measuring tape
- 82 x small cones to mark turnaround points and 5-m points
- Chair
- Sphygmomanometer and stethoscope; OR automatic oscillometric blood pressure machine

Equipment for Hard-Copy Capturing of Measurement

- Pen or pencil
- Paper data capturing sheet
- Flat indoor/outdoor running track
- Stopwatch
- Measuring tape
- 82 x small cones to mark turnaround points and 5-m points
- Chair
- Sphygmomanometer and stethoscope; OR automatic oscillometric blood pressure machine

Number of Trials: One

Scoring: Manual capturing of measurement and computer analysis

Measuring Procedure

1. Repeat testing should be performed at approximately the same time of day to minimize intraday variability.

2. At about 15 minutes prior to initiating the test, the participant should sit at rest on a chair with back support, located near the starting position. During this time, check for contra-indications, measure pulse and blood pressure, and make sure that clothing and shoes are appropriate. Complete the first portion of the worksheet.

3. A "warm-up" of approximately 10 minutes should be performed before the test.

4. Set the timer to 12 minutes. Assemble all necessary equipment (timer, clip-board, data capturing sheet) and move to the starting point.

5. Instruct the participant as follows:

   a. "The object of this test is to run as far as possible for 12 minutes. You will run back and forth around this track/hallway. 12 minutes is a long time to run, so you will be exerting yourself. You will probably get out of breath or become exhausted. You are permitted to slow down, to walk, to stop, and to rest as necessary. You may lean against the wall while resting, but resume running or walking as soon as you are able. You will be running back and forth around the cones. You should pivot briskly around the cones and continue back the other way without hesitation.

   b. Now I'm going to show you. Please watch the way I turn without hesitation." Demonstrate by running one lap yourself. Run and pivot around a cone briskly. "Are you ready to do that? I am going to keep track of the number of laps you complete. Remember that the object is to run AS FAR AS POSSIBLE in 12 minutes. Start now, or whenever you are ready."

6. Position the participant at the start line. You should also stand near the start line during the test. Do not run with the participant. As soon as the participant starts to run, start the timer.

7. Do not talk to anyone during the run. Use an even tone of voice when using the standard phrases of encouragement. Watch the participant. Stay focused and keep an accurate count of the laps. Each time the participant returns to the start line, mark the lap on the data capturing sheet. Let the participant see you do it.

   a. After 3 minutes, tell the participant the following (in even tones): "You are doing well. You have 9 minutes to go."

   b. When the timer shows 6 minutes remaining, tell the participant the following: "Keep up the good work. You are halfway done."

   c. When the timer shows 3 minutes remaining, tell the participant the following: "You are doing well. You have only 3 minutes left."

   d. When the timer shows only 1-minute remaining, tell the participant: "Keep up the good work. You have only 1-minute left."

e. Do not use other words of encouragement (or body language to speed up).

f. If the participant stops walking during the test and needs a rest, say this: "You can lean against the wall if you would like; then continue walking whenever you feel able." Do not stop the timer. If the participant stops before the 12 minutes are up and refuses to continue (or you decide that they should not continue), wheel the chair over for the participant to sit on, discontinue the run, and note on the data capturing sheet the distance, the time stopped, and the reason for stopping pre-maturely.

g. When the timer is 15 seconds from completion, say this: "In a moment I'm going to tell you to stop. When I do, just stop right where you are, and I will come to you."

h. When the time is up, say this: "Stop!" Run over to the participant. Consider taking the chair if they look exhausted. Mark the spot where they stopped by placing a bean bag or a piece of tape on the floor.

8. Post Test: Immediately take the participant's maximum heart rate and blood pressure and record this.

9. Wait three minutes, take the recovery heart rate and blood pressure again and then record this.

10. Record the number of laps from the tick marks on the data capturing sheet.

11. Record the additional distance covered (the number of metres in the final partial lap) using the cone markers as distance guides. Calculate the total distance walked/run, rounding to the nearest metre, and record it on the data capturing sheet.

12. Congratulate the participant on good effort and offer a drink of water.

Participant preparation

1. Comfortable clothing should be worn.
2. Appropriate shoes for running should be worn.
3. The participant's usual medical regimen should be continued.
4. A light meal is acceptable before early morning or early afternoon tests.
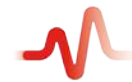5. Participants should not have exercised vigorously within 2 hours of beginning the test.

Image Displaying Cardiorespiratory Fitness (Cooper 12-minute Run Test) Set-Up

4.3.3. Classification of the Cooper 12-minute Run Test Measurement (Distance covered in metres)[(47)]

DISTANCE (in metres)				
MALE AGE CATEGORIES				
RATING	20 – 29	30 – 39	40 – 49	50+
Excellent	> 2800	> 2700	> 2500	> 2400
Above Average	2400 – 2800	2300 – 2700	2100 – 2500	2000 – 2400
Average	2200 – 2399	1900 – 2299	1700 – 2099	1600 – 1999
Below Average	1600 - 2199	1500 – 1899	1400 – 1699	1300 – 1599
Poor	< 1600	< 1500	< 1400	< 1300
FEMALE AGE CATEGORIES				
RATING	20 – 29	30 – 39	40 – 49	50+
Excellent	> 2700	> 2500	> 2300	> 2200
Above Average	2200 – 2700	2000 – 2500	1900 – 2300	1700 – 2200
Average	1800 – 2199	1700 – 1999	1500 – 1899	1400 – 1699
Below Average	1500 – 1799	1400 – 1699	1200 – 1499	1100 – 1399
Poor	< 1500	< 1400	< 1200	< 1100

4.3.4. Guidelines for Providing Classification for the Cooper 12-minute Run Test (Distance covered in metres)

When providing participants with their Cooper 12-minute Run Test results, the following can be explained:

Poor

- Explain that the Cooper 12-minute Run Test classification is poor.
- Explain that the participant is at an increased risk for chronic diseases such as accelerated biological aging/premature death, cardiovascular disease, metabolic syndrome, obesity, insulin resistance, pre-diabetes, type 2 diabetes, coronary artery disease, peripheral artery disease, hypertension, stroke, congestive heart failure, respiratory disorders, endothelial dysfunction, arterial dyslipidaemia, haemostasis, deep vein thrombosis, cognitive dysfunction, depression and anxiety, osteoporosis, osteoarthritis, bone fracture/falls, rheumatoid arthritis, colon cancer, breast cancer, gestational diabetes, gallbladder diseases, weight management, and musculoskeletal conditions.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase Cooper 12-minute Run Test result.
- No medication is required to alter Cooper 12-minute Run Test result.

Below Average

- Explain that the Cooper 12-minute Run Test classification is below average.
- Explain that the participant is at an increased risk for chronic diseases.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase Cooper 12-minute Run Test result.
- No medication is required to alter Cooper 12-minute Run Test result.

Average

- Explain that the Cooper 12-minute Run Test result classification is average.
- Explain that the participant is at an increased risk for chronic diseases.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting healthier lifestyle habits where they are currently lacking, to increase Cooper 12-minute Run Test result.

Above Average

- Explain that the Cooper 12-minute Run Test classification is above average.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue with her/his healthy lifestyle habits to maintain Cooper 12-minute Run Test result.

Excellent

- Explain that the Cooper 12-minute Run Test classification is excellent.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue leading a healthy, active lifestyle.

Classification of the Cooper 12-minute Run Test Measurement (VO$_{2max}$)[48]

VO_{2max} (ml.kg^{-1}min^{-1})						
MALE AGE CATEGORIES						
RATING	20 − 29	30 − 39	40 − 49	50 − 59	60 − 69	70 − 79
Superior	> 55	> 53	> 52	> 49	> 45	> 41
Excellent	51 − 55	48 − 53	46 − 52	43 − 49	39 − 45	36 − 41
Good	46 − 50	44 − 47	42 − 45	38 − 42	35 − 38	31 − 35
Fair	42 − 45	41 − 43	38 − 41	35 − 37	31 − 34	28 − 30
Poor	< 42	< 41	< 38	< 35	< 31	< 28
FEMALE AGE CATEGORIES						
RATING	20 − 29	30 − 39	40 − 49	50 − 59	60 − 69	70 − 79
Superior	> 49	> 45	> 44	> 34	> 35	> 35
Excellent	44 − 49	41 − 45	39 − 44	31 − 34	32 − 35	30 − 35
Good	40 − 43	37 − 40	35 − 38	29 − 30	29 − 31	27 − 29
Fair	36 − 39	34 − 36	32 − 34	25 − 28	26 − 28	24 − 26
Poor	< 36	< 34	< 32	< 25	< 26	< 24

Equation for calculating VO$_{2max}$ (ml.kg^{-1}min^{-1})

VO$_{2max}$ = (22.35 x kilometres) – 11.29

Where kilometres = distance covered in metres, converted to kilometres

Guidelines for Providing Classification for the Cooper 12-minute Run Test (VO$_{2max}$)

When providing participants with their Cooper 12-minute Run Test results, the following can be explained:
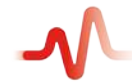
Poor

- Explain that the Cooper 12-minute Run Test classification is poor.
- Explain that the participant is at an increased risk for chronic diseases such as accelerated biological aging/premature death, cardiovascular disease, metabolic syndrome, obesity, insulin resistance, prediabetes, type 2 diabetes, coronary artery disease, peripheral artery disease, hypertension, stroke, congestive heart failure, respiratory disorders, endothelial dysfunction, arterial dyslipidaemia, haemostasis, deep vein thrombosis, cognitive dysfunction, depression and anxiety, osteoporosis, osteoarthritis, bone fracture/falls, rheumatoid arthritis, colon cancer, breast cancer, gestational diabetes, gallbladder diseases, weight management, and musculoskeletal conditions.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase Cooper 12-minute Run Test result.
- No medication is required to alter Cooper 12-minute Run Test result.

Fair

- Explain that the Cooper 12-minute Run Test classification is fair.
- Explain that the participant is at an increased risk for chronic diseases.
- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to increase Cooper 12-minute Run Test result.
- No medication is required to alter Cooper 12-minute Run Test result.

Good

- Explain that the Cooper 12-minute Run Test result classification is good.
- Explain that the participant is at a low risk for chronic diseases.
- No clinic or general practitioner referral is necessary to confirm classification.
- Encourage the participant to continue with their healthy lifestyle habits to maintain Cooper 12-minute Run Test result.

Excellent

- Explain that the Cooper 12-minute Run Test classification is excellent.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue with her/his healthy lifestyle habits to maintain Cooper 12-minute Run Test result.

Superior

- Explain that the Cooper 12-minute Run Test classification is superior.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue leading a healthy, active lifestyle.

4.3.5.   Lifestyle Modifications to Increase Cardiorespiratory Fitness

4.4.   Upper Body Strength: Hand Grip Strength Test

4.4.1.   Introduction

Hand grip strength is important for any activity and/or sport in which the hands are used for catching, throwing or lifting. As a general rule, individuals with strong hands tend to be strong elsewhere too and therefore, it can be used as an indication of general strength[49]. Hand grip strength is related to and predictive of other health conditions, however, the relationship is not stated to be causative. Research suggests that grip strength can be used as a screening tool for women at risk for osteoporosis, since normal hand grip strength is positively related to normal bone mineral density in postmenopausal women. In men, poor grip strength is predictive of increased mortality from cardiovascular disease and from cancer, even when factors of muscle mass and body mass index are adjusted for. Hand grip strength is negatively associated with physical frailty even when the effects of body mass index and arm muscle circumference are removed. Researchers suggest that the factor related to frailty and disability later in life, is the manner in which the muscles are used, and this can be measured by hand dynamometry[50].

Hand grip strength refers to the force applied by the hand to pull on or suspend objects and is a specific part of hand strength. It is defined as the measurable ability to exert pressure with the hand, fingers, or both [51].

4.4.2.   Equipment and Procedure

Equipment

- Saehan Hydraulic Hand Dynamometer
- Stopwatch
- Measuring tape
- Pen or pencil
- Paper data capturing sheet
- Tablet, laptop or PC

Number of Trials: Six (Three trials for each hand)

Scoring: Manual capturing of measurement and **c**omputer analysis

Procedure

Pre-Test Instructions to Participant[52]

- While explaining the test procedure, the individual may be seated.
- Explain that this is a test to measure upper body strength and that it requires maximal effort from the individual.
- The test is conducted whilst comfortably standing upright and with legs uncrossed.
- The participant is to perform three trials with each hand, alternating between the right and left hands, with at least a 30-second rest interval between each trial.
- The dynamometer is to be held in the hand to be tested, with the arm fully extended at the side and with the shoulder slightly abducted (10°) during the entire test.
- During this time, no other parts of the body should touch the dynamometer and the arm being tested cannot press against the body.

Prepare the participant

- Ask the participant which hand her/his dominant hand is and record this.
- Before the start of the test, the hand span (distance from the tip of the thumb to the tip of the little finger) of the participant's dominant hand must be measured (to the nearest 0.5cm).
- Adjust the dynamometer accordingly.
- The participant should stand comfortably with legs uncrossed.
- The participant holds the dynamometer in the hand to be tested, with the arm fully extended at the side and with the shoulder slightly abducted (10°) during the entire test.
- The handle of the dynamometer is adjusted, if required – the base should rest on the first metacarpal (heel of palm), while the handle should rest on the middle of four fingers.

Taking the hand grip strength reading

- When ready, the participant squeezes the dynamometer with maximum isometric effort, which is maintained for about 5 seconds.
- No other body movement is allowed.
- The participant should be strongly encouraged to give a maximum effort.
- Instruct participant to stop after about 5 seconds and record the reading from the dynamometer.
- Repeat the 2nd through to the 6th trial (alternating between right and left hands) after at least a 30-second rest interval between each trial.
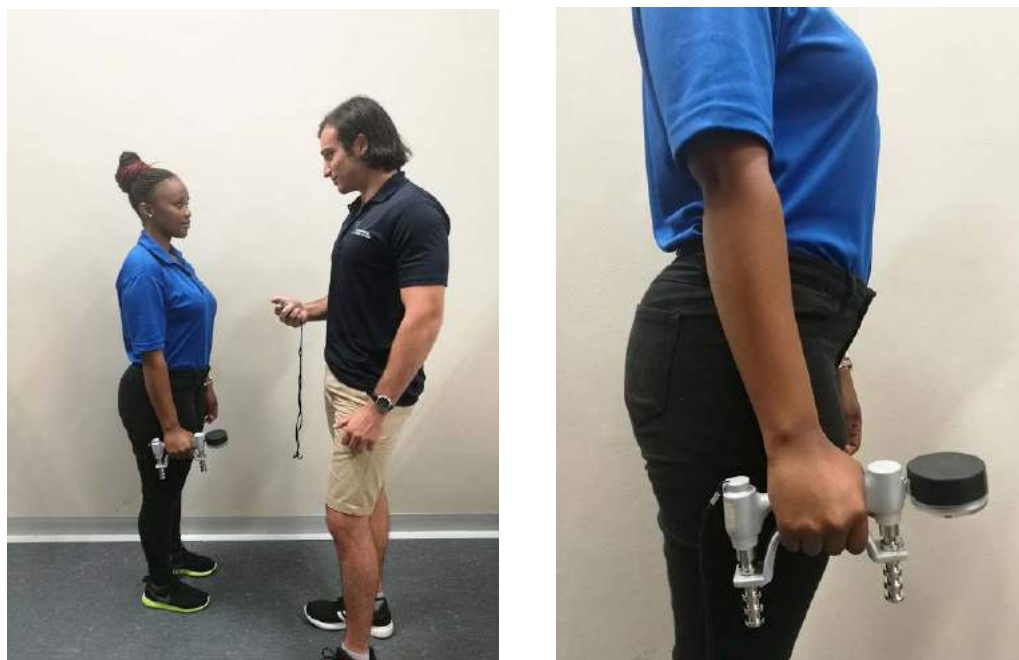
Figure 10: Hand Grip Strength Equipment and Procedure

4.4.3. Classification of Upper Body Strength Measurement[(53)]

GRIP STRENGTH RATINGS FOR MALES (KILOGRAMS)			AGE	GRIP STRENGTH RATINGS FOR FEMALES (KILOGRAMS)		
POOR	NORMAL	GOOD		POOR	NORMAL	GOOD
< 36.8	36.8 – 56.6	> 56.6	20 – 24	< 21.5	21.5 – 35.3	> 35.3
< 37.7	37.7 – 57.5	> 57.5	25 – 29	< 25.6	25.6 – 41.4	> 41.4
< 36.0	36.0 – 55.8	> 55.8	30 – 34	< 21.5	21.5 – 35.3	> 35.3
< 35.8	35.8 – 55.6	> 55.6	35 – 39	< 20.3	20.3 – 34.1	> 34.1
< 35.5	35.5 – 55.3	> 55.3	40 – 44	< 18.9	18.9 – 32.7	> 32.7
< 34.7	34.7 – 54.5	> 54.5	45 – 49	< 18.6	18.6 – 32.4	> 32.4
< 32.9	32.9 – 50.7	> 50.7	50 – 54	< 18.1	18.1 – 31.9	> 31.9
< 30.7	30.7 – 48.5	> 48.5	55 – 59	< 17.7	17.7 – 31.5	> 31.5
< 30.2	30.2 – 48.0	> 48.0	60 – 64	< 17.2	17.2 – 31.0	> 31.0
< 28.2	28.2 – 44.0	> 44.0	65 - 69	< 15.4	15.4 – 27.2	> 27.2

4.4.4. Guidelines for Providing Upper Body Strength Classification to Participant

When providing participants with their upper body strength classification, the following guidelines can be followed:

Poor

- Explain that the upper body strength score classification is poor.
- Explain that the participant is at an increased risk for chronic diseases such as accelerated biological aging/premature death, cardiovascular disease, metabolic syndrome, obesity, insulin resistance, prediabetes, type 2 diabetes, coronary artery disease, peripheral artery disease, hypertension, stroke, congestive heart failure, respiratory disorders, endothelial

dysfunction, arterial dyslipidaemia, haemostasis, deep vein thrombosis, cognitive dysfunction, depression and anxiety, osteoporosis, osteoarthritis, bone fracture/falls, rheumatoid arthritis, colon cancer, breast cancer, gestational diabetes, gallbladder diseases, weight management, and musculoskeletal conditions.

- No clinic or general practitioner referral is necessary to confirm classification.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to improve upper body strength scoring and classification.
- No medication required to alter upper body strength score.

Normal

- Explain that the upper body strength score classification is normal.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to start adopting healthier lifestyle habits where they are currently lacking, to improve and/or maintain upper body strength score.
- Provide lifestyle modification behaviours and encourage the participant to start adopting these behaviours to improve and/or maintain upper body strength scoring and classification.

Good

- Explain that the upper body strength score classification is good.
- Explain that the participant is at a low risk for chronic diseases.
- Encourage the participant to continue leading a healthy, active lifestyle.

4.4.5. Lifestyle Modifications to Improve Upper Body Strength Score

5.   Psychosocial Health

Wellness Questionnaires

Introduction

When we think about health, the first thing that comes to mind is physical health. Although physical health is important, human health encompasses several other dimensions. Psychosocial health can therefore be defined as mental (thinking), emotional (feeling), social (relating) and spiritual (being) dimensions of health and wellbeing.

Psychosocial health is the result of complex interactions among a person's history, his / her thoughts about and interpretations of the past and what the past means to the present. Psychosocially healthy individuals often present with the following traits: They like themselves and they accept their mistakes and are optimistic about the future. They also take care of themselves and have empathy for others. They are able to control their anger, hate, tension and anxiety. They can also work alone or along with others equally well.

The participants will be required to complete the *KaziHealth* Assessment Survey in the form of questionnaires. The questionnaires are brief, simple and useful tools for assessing psychosocial indicators. The survey will be used to screen for potential psychosocial stressors (perceived stress, work stressors, work-family conflict, insomnia, burnout and mood and anxiety disorders) but cannot be used for diagnosing psychopathology.

For the *KaziHealth* Assessment survey, the following parameters will be assessed:

- General perceived stress
- Work related stress
- Work family conflict
- Burnout symptoms
- Health related quality of life
- Sleep complaints

Pre-Test Instructions to Participant

- Please respond to all questions as spontaneously as possible.
- There are no right or wrong answers, only your subjective perception matters.
- Choose only one answer for each question.

Equipment for Electronic Capturing of Measurement

- Tablet, Laptop or PC

Equipment for Hard-Copy Capturing of Measurement

- Pen or pencil
- Paper Data Capturing Sheet

Number of Trials: Only one trial of each questionnaire is completed.

5.1. General perceived stress (PSS)

5.1.1. Introduction

It is generally accepted that stress negatively affects health status. Perceived stress is assumed to be an important mediator of the pathway linking stressful events and poorer health and health practices. There are confirmed associations among perceived stress and illness, illness symptoms and health behaviours.

Perceived stress will be assessed using the widely applied and validated four-item Perceived Stress Scale (PSS4). Questions will be answered on a Likert scale from 0 (never) to 4 (very often). Questions 1 and 4 are scored from 0 to 4, whereas questions 2 and 3 are reverse scored (4 to 0). The overall score ranges from 0 to 16 with a higher score displaying higher perceived stress.

5.1.2. Procedure

Questionnaire

The following section will assess your perceived stress level.

Stress	Never	Almost Never	Sometimes	Fairly Often	Very Often
1. In the last month, how often have you felt that you were unable to control the important things in your life?	☐ (0)	☐ (1)	☐ (2)	☐ (3)	☐ (4)
2. In the last month, how often have you felt confident about your ability to handle your personal problems?	☐ (4)	☐ (3)	☐ (2)	☐ (1)	☐ (0)
3. In the last month, how often have you felt that things were going your way?	☐ (4)	☐ (3)	☐ (2)	☐ (1)	☐ (0)
4. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	☐ (0)	☐ (1)	☐ (2)	☐ (3)	☐ (4)

TOTAL

5.1.3. Classification

Please note that when administering the questionnaire, the number values per question should not be seen by the participant.

The total score is obtained by adding all the values in the boxes ticked, and can range from 0 to 16. The higher the score, the higher the general perceived stress.

Although the classification is noted by the healthcare professional, no scientific cut-off criteria are

validated and therefore the classification is not provided to the participant.

5.2. Work related stress (ERI)

5.2.1. Introduction

To assess work related stress, one of the most widely used job-related theories of stress will be used, namely the short version of the original Effort-Reward Imbalance (ERI) questionnaire. The effort scale from the ERI model, consists of 5 items, and the reward scale consists of 11 items. Both scales are ranked on a Likert scale from 1 (strongly agree) to 4 (strongly disagree).

5.2.2. Procedure

Questionnaire

The following section will assess your stress level, specifically experienced at work.

		Strongly Agree	Agree	Disagree	Strongly Disagree
1.	I have constant time pressure due to a heavy work load.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
2.	I have many interruptions and disturbances in my job.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
3.	I have a lot of responsibility in my job.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
4.	I am often pressured to work overtime.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
5.	Over the past few years, my job has become more and more demanding.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
6.	I receive the respect I deserve from my superiors.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
7.	I receive the respect I deserve from my colleagues.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
8.	I experience adequate support in difficult situations.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
9.	I am treated unfairly at work.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
10.	My job promotion prospects are poor.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
11.	I have experienced, or I expect to experience an undesirable change in my work situation.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
	TOTAL				
12.	My job security is poor.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
13.	My current occupational position adequately reflects my education and training.	☐ (1)	☐ (2)	☐ (3)	☐ (4)

14. Considering all my efforts and achievements, I receive the <u>respect and prestige</u> I deserve at work.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
15. Considering all my efforts and achievements, my <u>work prospects</u> are adequate.	☐ (1)	☐ (2)	☐ (3)	☐ (4)
16. Considering all my efforts and achievements, my <u>salary/income</u> is adequate.	☐ (1)	☐ (2)	☐ (3)	☐ (4)

TOTAL

5.2.3. Classification

Please note that when administering the questionnaire, the number values per question should not be seen by the participant.

The Reward Scale total score is obtained by adding all the values in the boxes ticked for the Reward Scale (question numbers 1-11) and multiplying it by 0.4545. Then, separately add all the values in the boxes ticked for the Effort Scale (question numbers 12-16). The Effort Scale total is then divided by the Reward Scale total to obtain a final ERI score. An ERI ratio score above 1 reflects elevated levels of job distress.

Classification	Measurement
Low work-related stress	≤ 1
Elevated work-related stress	> 1

5.3. Work Family Conflict (WAFCS)

5.3.1. Introduction

To assess stressful experiences in the interplay between work and family, the Work and Family Conflict Scale (WAFCS) will be used. The WAFCS is a brief 10-item tool, containing two subscales for work-to-family (questions 1 to 5) and family-to-work (questions 6 to 10) conflict. The WAFCS was developed for parents of 2- to 12-year old children.

Items will be answered on a Likert scale from 1 (very strongly disagree) to 7 (very strongly agree).

5.3.2. Procedure

Questionnaire

The next section is focused on the compatibility of family and occupation. The questions are only applicable for people with children living at home. If you do not have any children living at your home, you can directly proceed to the next section.
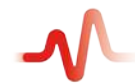
	Very Strongly Disagree (- - -)	Strongly Disagree (- -)	Disagree (-)	Neutral (=)	Agree (+)	Strongly Agree (+ +)	Very Strongly Agree (+ + +)
1. My work prevents me spending sufficient quality time with my family.	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)
2. There is no time left at the end of the day to do the things I'd like at home (e.g., chores and leisure activities).	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)
3. My family misses out because of my work commitments.	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)
4. My work has a negative impact on my family life.	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)
5. Working often makes me irritable or short tempered at home.	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)
						TOTAL	
6. My work performance suffers because of my personal and family commitments.	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)
7. Family related concerns or responsibilities often distract me at work.	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)
8. If I did not have a family I'd be a better employee.	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)
9. My family has a negative impact on my day to day work duties.	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)
10. It is difficult to concentrate at work because I am so exhausted by family responsibilities.	☐ (1)	☐ (2)	☐ (3)	☐ (4)	☐ (5)	☐ (6)	☐ (7)

TOTAL

5.3.3. Classification

Please note that when administering the questionnaire, the number values per question should not be seen by the participant.

Items on each subscale are summed to provide the total WFC score and FWC score, with higher scores indicating higher levels of conflict.

Although the classification is noted by the healthcare professional, no scientific cut-off criteria are validated and therefore the classification is not provided to the participant.

5.4. Burnout Syndrome (SMBM)

5.4.1. Introduction

Burnout is a mental condition resulting from continuous and long-term exposure to stress, particularly related to psychosocial factors at work. Burnout is considered to be a negative affective state, with feelings of emotional fatigue, physical fatigue, and cognitive weariness. It depletes energetic resources from cumulative exposure to chronic work and life stresses.

To assess burnout symptoms, a validated and widely used tool, the Shirom–Melamed Burnout Measure (SMBM) will be used to assess occupational burnout. The items are assigned to 3 dimensions, 6 items refer to the aspects of physical fatigue, 5 items to cognitive weariness, and 3 items refer to emotional exhaustion.

The questionnaire consists of 14 items and options range from 1 (almost never) to 7 (almost always), on a Likert scale.

5.4.2. Procedure

Questionnaire

Below are a number of statements that describe different feelings that you may feel at work. Please indicate how often, in the past 30 workdays, you have experienced each of the following feelings.

	Never / Almost Never	Very Infrequently	Quite Infrequently	Sometimes	Quite Frequently	Very Frequently	Always / Almost Frequently
1. I feel tired.	□(1)	□(2)	□(3)	□(4)	□(5)	□(6)	□(7)
2. I have no energy for going to work in the morning.	□(1)	□(2)	□(3)	□(4)	□(5)	□(6)	□(7)
3. I feel physically drained.	□(1)	□(2)	□(3)	□(4)	□(5)	□(6)	□(7)
4. I feel fed up.	□(1)	□(2)	□(3)	□(4)	□(5)	□(6)	□(7)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.	I feel like my "batteries" are "dead".	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)
6.	I feel burned out.	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)
7.	My thinking process is slow.	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)
8.	I have difficulty concentrating.	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)
9.	I feel I'm not thinking clearly.	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)
10.	I feel I'm not focused in my thinking.	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)
11.	I have difficulty thinking about complex things.	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)
12.	I feel I am unable to be sensitive to the needs of schoolchildren and fellow teachers.	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)
13.	I feel I am not capable of investing emotionally in schoolchildren and fellow teachers.	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)
14.	I feel I am not capable of being sympathetic to schoolchildren and fellow teachers.	☐(1)	☐(2)	☐(3)	☐(4)	☐(5)	☐(6)	☐(7)

TOTAL

5.4.3. Classification

Please note that when administering the questionnaire, the number values per question should not be seen by the participant.

The mean score is calculated to obtain an overall burnout index with values of ≥ 4.40 being considered as clinically relevant burnout.

Classification	Measurement
Low Burnout Symptoms	< 3.75
Moderately High Burnout Symptoms	3.75 – 4.39
Clinically Relevant Burnout Symptoms	≥ 4.40

5.5. Health Related Quality of Life (GHO-12)

5.5.1. Introduction

The General Health Questionnaire (GHQ-12) will be used to assess mental distress or minor psychiatric morbidities. The GHQ-12 has been frequently used in the literature and its validity and reliability have been extensively reviewed.

Participants will self-report their mental well-being during the previous week. The 12 items are answered on a Likert scale with response options ranging from 0 (not at all) t3 (much more than usual).

5.5.2. Procedure

Questionnaire

In the next few questions, we would like to know whether you have experienced any medical complaints, and how your health has been in general, over the past few weeks.

Over the past few weeks, …	Better than usual	Same as usual	Less than usual	Much less than usual
1. … have you been able to concentrate on whatever you're doing?	☐ (0)	☐ (0)	☐ (1)	☐ (1)

	More so than usual	Same as usual	Less so than usual	Much less than usual
2. … have you felt that you are playing a useful part in things?	☐ (0)	☐ (0)	☐ (1)	☐ (1)
3. … have you felt capable of making decisions about things?	☐ (0)	☐ (0)	☐ (1)	☐ (1)
4. … have you been able to enjoy your normal day-to-day activities?	☐ (0)	☐ (0)	☐ (1)	☐ (1)
5. … have you been able to face up to your problems?	☐ (0)	☐ (0)	☐ (1)	☐ (1)
6. … have you been feeling reasonably happy?	☐ (0)	☐ (0)	☐ (1)	☐ (1)
7. … have you lost much sleep because of worry?	☐ (1)	☐ (1)	☐ (0)	☐ (0)
8. … have you felt constantly under strain?	☐ (1)	☐ (1)	☐ (0)	☐ (0)
9. … have you felt you could not overcome your difficulties?	☐ (1)	☐ (1)	☐ (0)	☐ (0)
10. … have you been feeling unhappy and depressed?	☐ (1)	☐ (1)	☐ (0)	☐ (0)
11. … have you been losing confidence in yourself?	☐ (1)	☐ (1)	☐ (0)	☐ (0)

12. … have you been thinking of yourself as a worthless person? □ (1)   □ (1)   □ (0)   □ (0)

TOTAL

5.5.3.   Classification

Please note that when administering the questionnaire, the number values per question should not be seen by the participant.

Each item of the GHQ-12 has four possible response options. Items scores are coded according to the following method: 0-0-1-1. The scores for all items are then summed to compute a severity score, with higher scores reflecting higher levels of distress.

C**lassification of Health Related Quality of Life (GHQ-12)**

Classification	Measurement
Asymptomatic	0
Sub-Clinical Symptomatic	1 - 3
Symptomatic	4 - 6
Highly Symptomatic	7 - 12

5.6.   Sleep Complaints (ISI)

5.6.1.   Introduction

Insomnia is a highly prevalent condition and an increase in insomnia may lead to functional impairment, higher health care costs and an increased risk for depression. A brief and valid questionnaire can facilitate the initial screening and formal evaluation of insomnia.

Subjective sleep complaints will be assessed with the brief 7-item self-report Insomnia Severity Index (ISI). Referring to the previous month were participants state their difficulties falling asleep, difficulties maintaining sleep, early morning awakenings, daytime fatigue, daytime performance, satisfaction with sleep, and worrying about sleep.

Answers are given on a Likert scale, scored from 0 (no problem at all) to 4 (very severe problem).

5.6.2. Procedure

Questionnaire

In this section, we would like to ask you some questions about your sleep. Please rate the current (i.e., last 2 weeks) severity of your insomnia problem(s).

	None	Mild	Moderate	Severe	Very Severe
1. Difficulty falling asleep	☐ (0)	☐ (1)	☐ (2)	☐ (3)	☐ (4)
2. Difficulty staying asleep	☐ (0)	☐ (1)	☐ (2)	☐ (3)	☐ (4)
3. Problems waking up too early	☐ (0)	☐ (1)	☐ (2)	☐ (3)	☐ (4)

	Very Satisfied	Satisfied	Moderately Satisfied	Dissatisfied	Very Dissatisfied
4. How satisfied / dissatisfied are you with your current sleep pattern?	☐ (0)	☐ (1)	☐ (2)	☐ (3)	☐ (4)

	Not at All	A Little	Somewhat	Much	Very Much
5. How noticeable to others do you think your sleep problem is in terms of impairing the quality of your life?	☐ (0)	☐ (1)	☐ (2)	☐ (3)	☐ (4)
6. How worried / distressed are you about your current sleep problem?	☐ (0)	☐ (1)	☐ (2)	☐ (3)	☐ (4)
7. To what extent do you consider your sleep problem to interfere with your daily functioning (e.g. daytime fatigue, mood, ability to function at work, daily chores, concentration, memory, mood, etc.) currently?	☐ (0)	☐ (1)	☐ (2)	☐ (3)	☐ (4)

TOTAL

5.6.3. Classification

Please note that when administering the questionnaire, the number values per question should not be seen by the participant.

To obtain the final score, the respondents' choices are summed, with a higher score indicating higher insomnia complaints.

Classification of Sleep Complaints (ISI)

Classification	Measurement
Asymptomatic	0 – 7
Sub-threshold Insomnia	8 – 14
Moderate Insomnia	15 – 21
Severe insomnia	22 – 28

Guidelines for Providing Psychosocial Health Parameters Classification

Lifestyle Modifications to Improve Psychosocial Health Parameters

1. Exercise regularly and be physically active.

- Aerobic exercise for 30 minutes per day, for most days of the week.

2. Eat a healthy balanced diet.

3. Decrease or eliminate harmful substance use.

- Limit alcohol intake.
    - 30 ml of ethanol per day for men (720 ml of beer, 300 ml of wine, 60 ml of whiskey).
    - 15 ml of ethanol per day for women and people of lighter weight (360 ml of beer, 150 ml of wine, 30 ml of whiskey).
- Quit smoking.

5. Reduce stress.

6. **Diet and Nutrition**

7.   Communicable Diseases

Introduction

Communicable, or infectious diseases, are caused by micro-organisms such as bacteria, viruses, parasites and fungi that can be spread, directly or indirectly, from one person to another. Some are transmitted through bites from insects, while others are caused by ingesting contaminated food or water.

7.1.   Soil-transmitted Helminths: *Ascaris lumbricoides*, hookworm, *Trichuris trichiura*

7.1.1.   Introduction

Soil-transmitted helminth infections are among the most common infections worldwide and affect the poorest and most deprived communities. The three main soil-transmitted helminth infections are ascariasis, trichuriasis and hookworm, caused by *Ascaris lumbricoides* (roundworm)*, Trichuris trichiura* (whipworm) and *Necator americanus* and *Ancylostoma duodenale* (hookworms), respectively. Soil-transmitted helminths are transmitted by eggs that are passed in the faeces of infected people. Adult worms inhabit the intestine and produce many eggs per day and these eggs contaminate soil and infect people in several ways including attaching to vegetables which are not washed properly before ingestion, drinking contaminated water and coming into contact with contaminated soil directly.[54].

7.1.2.   Equipment and Procedure

Collection of stool sample

A stool sample is required for the determination of the presence of soil-transmitted helminths.

Equipment

- Stool collection container
- Disposable (sterile container with sufficiently large opening, only to be used once; volume = 125 ml)
- Tightly fitting lid (e.g. screw-cap)
- Spatula (separate or integrated)
- Container label including participant-specific ID and a space to note down the participant's name and the time of stool production
- 1 plastic bag per container, in which the container can be stored after stool collection
- Clean paper for stool collection
- Gloves for handling of the sample in the laboratory

Figure 11: Soil-transmitted helminth infection required equipment

It is important to explain to the participant why the stool sample is needed. The material and equipment used in the collection process must be introduced to the participant. Individuals need to be instructed to use their assigned container for their sample.

The following details need to be explained to the study participant:

1. How to deposit stool (on clean paper or aluminium foil in case of watery diarrhoea; in case of very young children, diapers may also be used).
2. How to scoop the stool.
3. Specify the volume (fill the container up to a marked line at about 80% of the total height of the container; aim = 60 grams of stool material).
4. How to place the stool sample into the container.
5. How to close the cap tightly and how to write down the time of stool collection in the respective space on the stool container label.
6. How to put the closed container into the plastic bag.
7. Any leftover stool should be properly discarded as medical waste.
8. Filled containers are to be stored at room temperature and in the shade.
9. Immediately transfer the fresh stool samples to the laboratory for diagnostic processing.

The qualified study personnel must take note of the following:

1. Pre-label the stool container with a printed, unique ID code (refer to respective SOP) before giving the stool collection kit to the participant.
2. Ensure that the unique ID on the printed label corresponds to the ID that has been assigned to this participant.
3. Indicate to the participant a specific time and location for handing in of the stool container.

Detection and quantification of helminth eggs using the Kato-Katz technique

The Kato-Katz technique facilitates the detection and quantification of helminth eggs that have infected an individual and will pass in their faeces. The Kato-Katz technique is a co-promicroscopic technique that is widely used in epidemiological surveys because of its simplicity, low cost and its established system to stratify infection intensity into different classes based on cut-offs of egg-counts. Its major drawback is its low sensitivity, but this can be increased by examining multiple Kato-Katz thick smears.

A thick smear is prepared on a microscope slide and helminth eggs are enumerated using a light microscope. Each helminth species is recorded separately.

Safety

Handle all faecal samples as potentially infectious and wear gloves at all times. At each study site, i.e. where the sample is being analysed, the safety precautions for handling and disposing of infectious materials should be practiced according to the laboratory safety rules of the participating hospital. It is also important not to use equipment that has passed its expiry date or to use contaminated equipment as this may result in a false positive result.

Equipment

- Standard Kato-Katz plastic template with a punched hole for 41.7 milligrams (mg) of stool
- Aluminium foil
- Wire/plastic mesh
- Small plastic spatula
- Cellophane, pre-soaked in methylene blue for at least 24 hours (h)
- Microscope slide
- Light microscope
- Counter

Samples

- Fresh faecal sample (participant should hand in a fresh faecal sample; please refer to the SOP for stool collection).
- Comment: Faecal samples should be analysed on the day of stool production and collection.

Procedures

1. Place a standard Kato-Katz template on a microscope slide, which has been labelled with a participant number.
2. Scoop approximately 2-3 grams (g) of a fresh faecal sample onto a piece of aluminium foil and press a piece of wire or plastic mesh on top to sieve it.
3. Using a small plastic spatula, scrape the sieved material off the mesh and completely fill the hole in the Kato-Katz template. To remove excess faecal material, level the content of the hole with the spatula.
4. Vertically remove the template without disturbing the faecal material now adhering to the microscope slide. The template and spatula can be cleaned in water with detergent, rinsed in clean water, and re-used.
5. Place a piece of pre-soaked cellophane over the faecal sample on the microscope slide.
6. To spread the faecal material into a thick smear, gently press a clean microscope slide against the sample slide, evenly distributing the material within a circle of a diameter slightly smaller than the width of the microscopic slide.
7. Allow the slide to clear for 30-60 minutes (min), during which the slides must be kept away from direct sunlight. When hookworm is present in the community under

investigation (in all 4 study countries), it is essential to read the slides shortly after a clearing time of 30 min, with a maximum clearing time of 60 min. Examine the thick smear under a light microscope (40-100x magnification). Count the number of helminth eggs and record them for each helminth species separately.

8. To enhance the sensitivity of this technique, two Kato-Katz thick smears have to be prepared in parallel for each faecal sample. Whenever only one single helminth egg is detected on a Kato-Katz thick smear, this has to be confirmed by a second laboratory technician.

Duplicate Kato-Katz Smears: Two smears should be tested per sample.

Documentation of Results (scoring method):

The test should be recorded. If it is not performed, a reason for not doing one must be given. The result, whether positive or negative, must be recorded. If the result is positive, the number of helminth eggs on the slide according to species must be recorded. To determine the number of eggs per 1 g of stool (EPG), the following calculation is done: multiply the egg count from the slide by a factor of 24 (24 x 41.7 mg = 1 g). For example, if 600 eggs of hookworm are recorded, the calculation for the number of hookworm eggs per 1 g of stool is: 600 x 24 = 14,400 EPG. The Figure below shows the morphological differences of different eggs of STH.
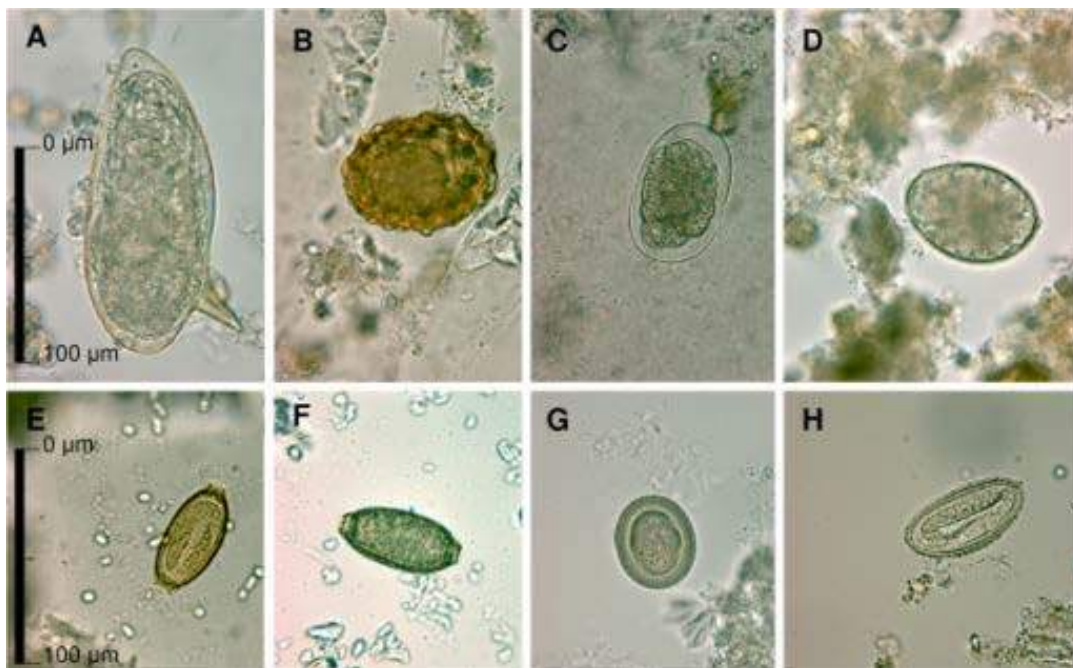

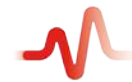Figure 12: Morphological differences of different STH eggs.

Morphological features of selected intestinal helminth eggs diagnosed using the formalin-ether concentration technique and standard light microscopy: A, *Schistosoma mansoni*; B, *Ascaris lumbricoides*; C, hookworm; D, *Diphyllobothrium latum*; E, *Trichuris trichiura*; F, *Capillaria spp..*; G, *Taenia spp.*; H, *Enterobius vermicularis*.

7.1.3. Classification of Soil-transmitted Helminths Measurement

Organism	Light Infection (EPG)	Moderate Infection (EPG)	Heavy Infection (EPG)
A. lumbricoides	1-4999	5000-49999	≥50000
Hookworm	1-1999	2000-3999	≥4000
T. trichiura	1-999	1000-9999	≥10000

All helminth eggs will be identified according to morphology as indicated above and infections will be categorized as indicated in the table below.

Cut-off criteria for categorization of STH infection according to WHO

7.1.4. Guidelines for Providing Soil-transmitted Helminths Classification to Participant

Not infected

- Explain that the stool sample was egg negative.
- Explain that the participant is not infected with soil-transmitted helminth species.
- Encourage the participant to continue leading a hygienic lifestyle.

Infected

- Explain that the stool sample was egg positive with the respective parasite species.
- Explain that the participant is infected with soil-transmitted helminthiasis.
- Refer the participant to a local clinic for respective treatment and encourage participant to follow a hygienic lifestyle.

7.1.5. Lifestyle Modifications to Decrease Soil-transmitted Helminths Result

- Avoid ingesting soil that may be contaminated with human faeces, including where human faecal matter ("night soil") or wastewater is used to fertilize crops.
- Wash your hands with soap and warm water before handling food.
- Teach children the importance of washing hands to prevent infection.
- Wash, peel, or cook all raw vegetables and fruits before eating, particularly those that have been grown in soil that has been fertilized with manure.
- The best way to avoid hookworm infection is not to walk barefoot in areas where hookworm is common and where there may be human faecal contamination of the soil. Also, avoid other skin contact with such soil and avoid ingesting it.
- Infection can also be prevented by not defecating outdoors and by effective sewage disposal systems.

7.2. Schistosoma mansoni / haematobium

7.2.1. Introduction

Schistosomiasis is also known as bilharzia and is a major intravascular infection that is caused by trematode parasites of the genus *Schistosoma. S. mansoni, S. japonicum* and *S. haematobium* which are the three major species that cause severe disease in humans[55]. Schistosomiasis is a disease of poverty that leads to chronic ill health. It mostly affects poor and rural communities, especially agricultural and fishing communities.

The infection is acquired when an individual comes into contact with fresh water infested with the larval forms (cercariae) of parasitic blood flukes. The microscopic worms live in the veins, drain the urinary tract and intestines and successfully evade the host's immune system[54, 56]. Worms excrete hundreds to thousands of eggs daily, which either leave the body in excreta or become trapped in nearby tissue. Trapped eggs cause distinct pathological effects including anaemia, growth stunting, impaired cognition and decreased physical fitness. They can also cause organ-specific effects such as severe hepatosplenism and periportal fibrosis.[56]

There are two major forms of schistosomiasis, namely intestinal and urogenital. The table below indicates the type of schistosomiasis, the species responsible for the disease as well as the geographical distribution of the disease.

Parasite Species and Geographical Distribution of Schistosomiasis[54]

	Species	Geographical Distribution
Intestinal Schistosomiasis	*S. mansoni*	Africa, the Middle East, the Caribbean, Brazil, Venezuela and Suriname
	S. japonicum	China, Indonesia, the Philippines
	S. mekongi	Several districts of Cambodia and the Lao People's Democratic Republic
	S. guineensis and related *S. intercalatum*	Rain forest areas of central Africa
Urogenital Schistosomiasis	*S. haematobium*	Africa, the Middle East, Corsica (France)

7.2.2. Equipment and Procedure

Stool and urine samples will be collected from the participant. The stool sample will be collected as described for soil-transmitted helminths and the Kato-Katz technique will be used for the identification and the determination of the presence of the *Schistosoma mansoni* species.

Collection of urine sample

A urine sample is required for the diagnosis of *S. haematobium* infection.

Equipment

- Single-use, plastic receptacle for urine
- Single-use, non-sterile gloves
- Marker

Procedure

- Put on single-use gloves.
- Write the participant number, the date and the hour on the receptacle.
- Give the receptacle to the participant.
- Explain to the participant how to obtain a midstream urine specimen.
- Ask the participant to produce a urine sample in a local rest room:
  - Minimum 50 ml
  - Midstream.
- Close the cap of the sampling container tightly to avoid any contamination.
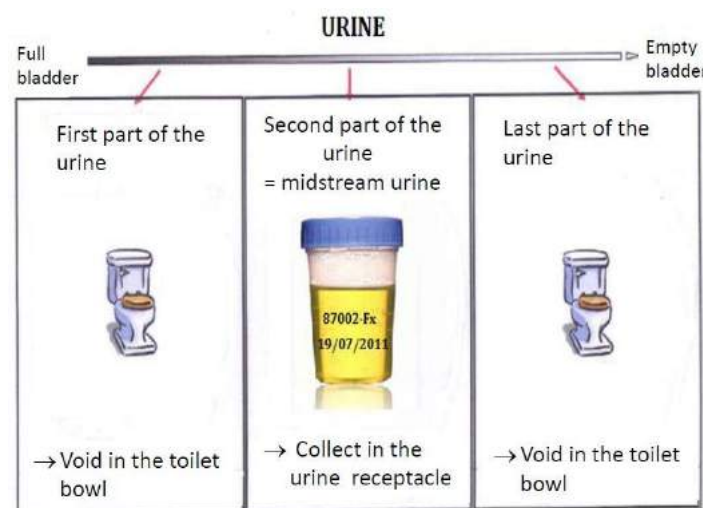- Use the urine within 4 hours after obtaining the sample.

Figure 13: Urine sample equipment and procedure

Safety

Handle all urine samples as potentially infectious and wear gloves at all times.

Detection of S. haematobium infection using the point-of care circulating cathodic antigen (POC-CCA) urine test

The detection of the schistosomal antigens in blood, urine and sputum is a proven and highly effective method for diagnosing *Schistosoma* infection[55]. Circulating cathodic antigen (CCA) and circulating anodic antigen (CAA) are *Schistosoma* markers that can be detected in the serum and urine of infected individuals, and the levels of these antigens represent sensitive and specific biomarkers for the intensity of infection.[57]

Equipment

- POC-CCA urine cassette test
- 3 mL bottle of buffer
- Urine collection device (plastic pipette)

Samples

- Urine sample should be examined on the day of collection

Procedures

1. Ensure that all reagents are brought to room temperature (20-25°C) before beginning the assay.
2. Ensure that the pouches containing the tests are not torn.
3. Remove the test cassette and collection device from their pouches just prior to use.
4. Homogenize the urine sample (shake it well).
5. Squeeze the pipette top and insert the tip into the urine sample.
6. Allow the sample to fill up by gently releasing the top.
7. Transfer 1 drop of urine to the circular well of the test cassette by gently squeezing the top.
8. Allow the sample to absorb entirely into the specimen pad within the circular well.
9. Hold the buffer bottle vertically, approximately 1 cm above the circular well.
10. Add 1 drop of buffer solution to the circular well.
11. Read the result exactly 20 min after adding buffer to the test cassette.
12. Any results read after ≥ 25 min should be considered to be invalid and must be repeated.
13. The blue control line must turn pink. If the control line stays blue, the test should be considered as invalid.
14. Any line in the test area should be considered as positive (see grading procedure below).
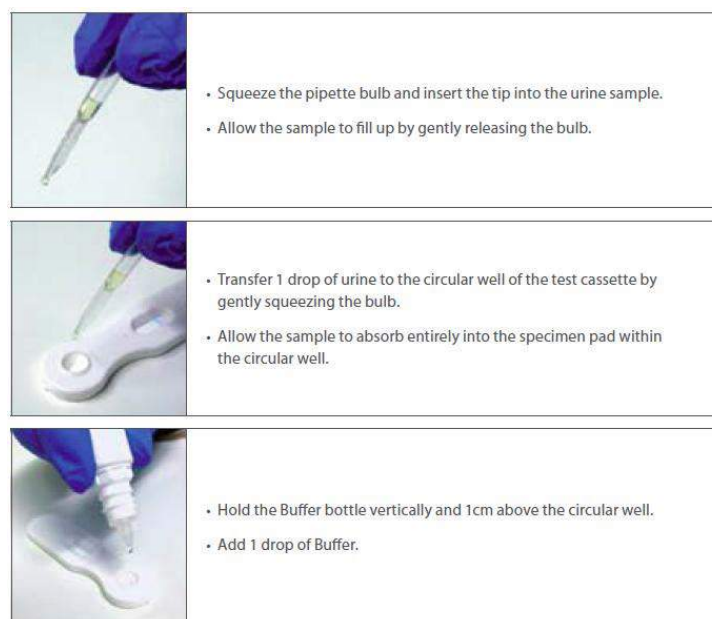
Visualized Procedure Summary

Figure 14: Detection of S. haematobium infection.

Number of tests: One

Documentation of results (scoring method):

- Record whether the test was done or not and provide a reason if it was not done.
- Record whether the result is POSITIVE or NEGATIVE.
- In case of an invalid test result, repeat the test.
- Record the line intensity of the test line (e.g. trace; 1+ (clearly positive, but faint line); 2+ (clearly positive with strong line); 3+ (strongly positive with very strong line).

Results for POC-CCA test using urine sample

The line intensity of the test strongly correlates to the intensity of the infection, thus the infection is rated accordingly, as indicated below.

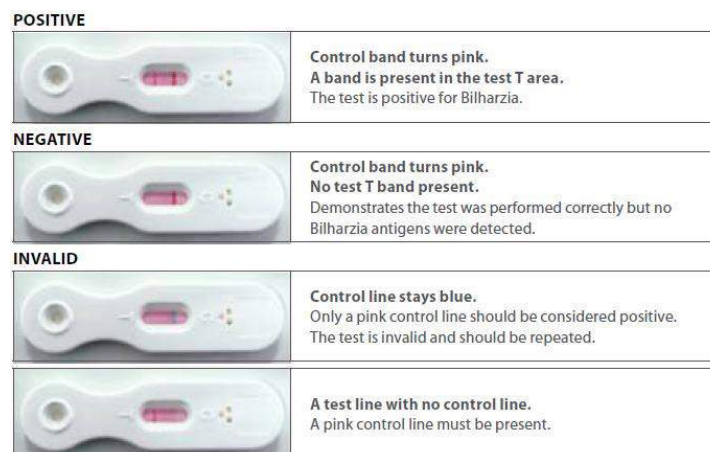|	
0	clearly negative
1+	clearly positive, but faint line
2+	clearly positive with strong line
3+	strongly positive with very strong line

Figure 15: Results for POC-CCA test.

Results for Kato-Katz test using stool sample:

All blood fluke eggs will be identified according to morphology and infections will be categorized as indicated in the table below using the Kato-Katz technique.

7.2.3.   Classification of Schistosomiasis Measurement

Cut-off criteria for categorization of *Schistosoma* infection according to WHO

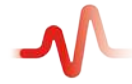| Organism	Light infection (EPG)	Moderate infection (EPG)	Heavy infection (EPG)
S. mansoni	1-99	100-399	≥400
S. haematobium	<50/10 mL	-	≥50/10 mL or visible haematuria

7.2.4.   Guidelines for Providing Schistosomiasis Classification to Participant

Not infected

- Explain that the stool or urine sample was egg negative.
- Explain that the participant is not infected with the respective (*S. mansoni* or *S. haematobium)* species.
- Encourage the participant to continue with a hygienic lifestyle.

Infected

- Explain that the stool or urine sample was egg positive with the respective (S. mansoni or S. haematobium) species.
- Explain that the participant is infected with schistosomiasis.
- Refer the participant to a local clinic for respective treatment, encourage participant to follow a hygienic lifestyle and remind the participant not to swim in stagnant water.

7.2.5. Lifestyle Modifications to Decrease Schistosomiasis Result

The best way to prevent schistosomiasis is to take the following steps if you are visiting or live in an area where schistosomiasis is transmitted:

- Avoid swimming or wading in freshwater when you are in countries in which schistosomiasis occurs. Swimming in the ocean and in chlorinated swimming pools is safe.
- Drink safe water. Although schistosomiasis is not transmitted by swallowing contaminated water, if your mouth or lips come in contact with water containing the parasites, you could become infected. Because water coming directly from canals, lakes, rivers, streams, or springs may be contaminated with a variety of infectious organisms, you should either bring your water to a rolling boil for 1 minute or filter water before drinking it. Bringing your water to a rolling boil for at least 1 minute will kill any harmful parasites, bacteria, or viruses present. Iodine treatment alone will not guarantee that water is safe and free of all parasites.
- Water used for bathing should be brought to a rolling boil for 1 minute to kill any cercariae, and then cooled before bathing to avoid scalding. Water held in a storage tank for at least 1 - 2 days should be safe for bathing.
- Vigorous towel drying after an accidental, very brief water exposure may help to prevent the Schistosoma parasite from penetrating the skin. However, do not rely on vigorous towel drying alone to prevent schistosomiasis.