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Freely Available Online

OpenAccessPub

CLINICAL RESEARCH IN HIV AIDS AND PREVENTION
ISSN NO: 2324-7339

Research Article

DOI : 10.14302/issn.2324-7339.jcrhap-13-255

Physical Activity and Risk Factors Screening for Ischaemic Heart Disease in South African Individuals Living with HIV

Ronel Roos[1,*], Hellen Myezwa[1], Helena van Aswegen[1], Eustatius Musenge[2]

[1]University of the Witwatersrand, Faculty of Health Sciences, Department of Physiotherapy

[2]University of the Witwatersrand, Faculty of Health Sciences, School of Public Health, Division of Epidemiology and Biostatistics

Abstract:

People living with HIV (PLWH) are at risk of developing chronic lifestyle diseases such as ischaemic heart disease (IHD). Physical inactivity is a modifiable risk factor for IHD. The level of ambulation physical activity in individuals living with HIV in a South African context is unknown. The aim of this study was to assess the physical activity levels and other risk factors for IHD in PLWH on antiretroviral therapy (ARV). An observational study was conducted from October 2010 to June 2012 at an outpatient clinic in Johannesburg, South Africa. Two hundred and five individuals who were on ARV for 6-12 months were screened. Physical activity was measured with the Yamax SW200 pedometer over a seven day period. Physical activity of the sample was reduced at 7673.2 (±4017.7) steps/ day with women walking less than men [6993.3 (±3462.6) and 10076.3 (±4885.6)]respectively. Body mass index was increased to 25.6 (±5.4) kg/m^2 with women noted to be overweight [26.6 (±5.5) kg/m^2]. Independent predictors of being overweight were systolic blood pressure, waist and hip circumference, CD_4 count and daily fruit and vegetable intake. Smoking was less common in the study population with 16.1% of the sample being current smokers and 25.9% former smokers. Individuals' mean perceived stress levels were 19.9 (±7.8) on the Cohen's Perceived Stress Scale. The ambulation physical activity level of individuals living with HIV requires modification to assist with reducing risk factors of IHD.

Corresponding author:

Ronel Roos, Telephone: 00 27 11 7173723, Fax: 00 27 86 570 3644, E-mail address: ronel.roos@wits.ac.za

Keywords:

Physical activity level, HIV, ischemic heart disease

Received Apr 17, 2013; **Accepted** Jan 27, 2016; **Published** Feb 05, 2016;

Introduction

People living with the human immunodeficiency virus (HIV) (PLWH) are living longer since the introduction of antiretroviral therapy (ARV) [1]. South Africa's health care face a quadruple burden of disease between chronic lifestyle diseases, HIV, perinatal and maternal disease and violence related injuries [2, 3]. An estimated 17.3% of South Africans were living with HIV according to the 2011 World prevalence rates of HIV and only Swaziland, Botswana and Lesotho reported higher statistics [4]. South Africa has managed to increase the roll-out of ARV and two million individuals are on ARV currently [5]. This increase in ARV roll-out could alter the future causes of mortality in South Africa shifting the focus from communicable diseases to a more pronounced non-communicable diseases pattern such as ischaemic heart disease (IHD) and/or stoke.

Chronic lifestyle diseases are of concern as mortality in individuals living with HIV is slowly shifting to non-aids related illnesses such as cardiovascular disease [6, 7]. This shift could partially be explained by the prevalence of known risk factors of IHD such as smoking and obesity [8, 9] and specific HIV sequelae such as chronic inflammation, dyslipidemia and lipodystrophy [10-12]. Independent of IHD risk factors, HIV replication (Plasma HIV-1 RNA levels > 50 copies/mL) is also associated with an elevated risk of myocardial infarction (odds ratio 1.51 [95% confidence interval, 1.09-2.10]) [13].

Physical inactivity is a known modifiable risk factor for IHD and is estimated to account for 6% of the burden of disease related to IHD internationally [14]. In the South African context this burden is noted to be much higher at an estimated value of 30% in the general population [15]. Walking, as a form of exercise, is often suggested as a means of lowering and managing an individuals' risk for heart disease as it does not have cost implications or require specific skills. PLWH are encouraged to do regular exercise to manage their disease. Physical activity and ambulation behaviour have been well researched in the general population but is still poorly understood in an HIV population. This paucity in studies may be attributed to different measuring instruments being used to evaluate physical activity and researchers defining physical activity differently [16].

Considering the potential burden of IHD in a South African HIV context, it seems prudent to evaluate the level of physical activity and risk factors for IHD at a primary health care level. Such screening may inform the type of intervention programmes needed to influence the risk factors for IHD in this population. Therefore the aim of this study was to evaluate the ambulation physical activity level and other risk factors for IHD in PLWH initiated on ARV at an HIV clinic in Johannesburg, South Africa.

Materials and Methods

An observational study was carried out at an urban HIV outpatient clinic in Johannesburg South Africa from October 2010 to June 2012. Participants were sampled consecutively according to set inclusion and exclusion criteria. Individuals were included if they were between 20-65 years of age, on ARV for six to 12 months and ambulatory without an assistive device e.g. not using a walking frame or walking stick. They were excluded if they had a pre-existing history of angina, myocardial infarction, stroke or peripheral vascular disease; acute infection or active/current opportunistic AIDS-defining illness; pre-existing history of dementia, confusion, psychosis or current signs of emotional distress; known diagnosed peripheral neuropathy or a physical complaint of "sore" or "burning feet" influencing walking ability and pregnant or breast-feeding women. The study received ethical approval from The University of the Witwatersrand Human Research Ethics committee. Permission was received from the hospital and clinic

management and all participants gave informed consent prior to participating in the study.

The sample size was calculated at 195 participants using the prevalence rate for hypertension in the South African context as guide as no prevalence rates for IHD in South Africa were available at the start of the study [17]. The alpha level was set at 5% and power at 80%. The sample was increased with a factor of 100/95 to allow for any loss to follow-up of participants accounting for a final sample size of 205. Since completion of the current study, prevalence rates for IHD in individuals living with HIV in South Africa were published and indicated that the disease itself is still at a low prevalence level in this population [18].

The following risk factors for IHD were screened using a questionnaire and body measurements: smoking history (current and former), diet (vegetable and fruit intake), physical activity levels (walking behaviour), resting heart rate and blood pressure, self-reported hypertension and diabetes, body mass index (BMI), waist- and hip circumference and waist: hip ratio (WHR). The study participants' perception regarding their body shape and weight changes in the last six months was documented.

Physical activity was assessed using the Yamax SW200 pedometer to provide information on walking behaviour (daily step count). Participants were asked to wear a hip-mounted pedometer for seven consecutive days from getting up in the morning until going to bed at night and to document their daily steps on a physical activity log sheet. They were encouraged not to alter their normal physical activity routine. Reactivity related to the physical activity assessment was calculated following the pilot study. No significant alteration ($p = 0.4$) in physical activity level was observed between the first and last day of assessment in participants when wearing the hip-mounted pedometer and documenting their findings on a log sheet during the pilot study.

The participants' perceived stress levels were evaluated with the Cohen's Perceived Stress Scale-10 (PSS). The PSS is an instrument that measures the degree to which a person perceives their life as being stressful. The instrument consists of 10 questions that are rated on a 5-point Likert scale and range from "0 = never" to "4 = very often". Total PSS score is computed by summing across all ten questions. Scores range from 0 to 40 where a higher score reflects a higher degree of perceived stress [19-21]. The PSS has been used in South Africa [22] and in a HIV population [23, 24]. In the current study, the Cronbach's α for the PSS was 0.82 as evaluated during the pilot study.

Resting heart rate and blood pressure were evaluated with an automated sphygmomanometer on both of the participant's arms twice after sitting quietly for a minimum of five minutes. The average of these four measurements was calculated and recorded. Anthropometric measurements were done according to the American College of Sports Medicine Guidelines [25]. BMI was calculated in kg/m^2 and WHR as the ratio of the waist to the hip circumference. WHR values of > 0.95 in men and > 0.85 in women were considered abnormal. A waist circumference of ≥ 88 cm in women and ≥ 102 cm in men were considered as an increased risk for IHD [26]. Information regarding time spent on ARV and type was gathered from each participant and from his/her clinic file. The latest CD_4 and viral load counts of participants were collected from their clinic file or laboratory data base.

The participants attended two sessions with the researcher. On the first visit all questionnaires were completed, the pedometer and pedometer log sheet was explained and an accuracy test of the pedometer was carried out. The second visit occurred approximately 10 to 14 days following the first visit where body measurements were taken and the pedometer with log sheet returned.

Statistical Methods

Data analysis was done with STATA 12 [27] and IBM SPSS 20 [28]. Data were evaluated for normal distribution. Continuous data e.g. pedometer step count were summarised as means and standard deviations. Percentiles of the means were reviewed to evaluate the presence and percentage of risk factors. Categorical data e.g. gender were summarised as frequencies and percentages. Demographic data of the study sample were assessed as a whole but smoking status, physical activity levels, perceived levels of stress and body measurements were also reviewed in gender groups. Bivariate analysis was carried out to determine with which independent variables physical inactivity (step count ≤ 9999 steps/day) and overweight/obesity (BMI ≥ 25 kg/m^2) had an association as abnormal values were noted in physical activity and body mass index. Having a step count ≥ 10000 steps/day one is considered 'active' [29] and a BMI value between 18.5 – 24.9 kg/m^2 is considered a normal BMI range [25]. A univariate logistic regression analysis was then done to explain the odd ratios between the physical inactivity and increased body mass index and their independent variables. The odds ratios were adjusted for age and gender in further multiple variable logistic regression. Findings were statistically significant if $p < 0.05$.

Results

Two hundred and ninety six participants who were on ARV treatment for six to twelve months indicated interest in participating in the study. Fourteen individuals were excluded due to not meeting all the inclusion criteria. Two hundred and eighty two participants consented to participate in the study. Seventy seven individuals recruited did not attend their first scheduled session due to work obligations, financial difficulties, travelling outside the Gauteng province and/ or were not able to be contacted telephonically. Two hundred and five participants attended their first session and eleven of these individuals did not attend their second session due to the same barriers identified following recruitment. One hundred and ninety four individuals' data were complete and used during data analysis. Physical activity data for 195 participants were available for analysis due to the following reasons: three participants' data were excluded during analysis due to not completing seven days of pedometer assessment, seven participants did not attend their second visit or return their pedometer and pedometer log sheet and three participants send a friend/family member to return their pedometer and physical activity log sheet if they could not attend their second session.

Table 1 describes the demographic information of the study participants. The mean age of the sample was 38 (±9.8) years and consisted mostly of women (77.1%; n=158). The majority of the sample was employed (56.1%; n=115), had a secondary educational level (46.3%; n=95) and was supporting dependents (85.4%; n=158). The participants perceived their health as good (58.5%; n=120) and the mean time spend on ARV treatment was 8.7 (±2.3) months. The majority of study participants were on the current first line ARV regimen of South Africa; Lamivudine, Efavirenz and Tenofovir (76.8%; n=139).

The mean ambulation physical activity level of the study sample was 7673.2 (±4017.1) steps/day. Male participants were more active than female participants [men 10076.3 (±4885.6) and women 6993.3 (±3462.6)]. Seventy three percent of the cohort walked less than the 10 000 steps/day (active category): 25. 4% walked less than 5000 steps/day (sedentary), 27.8% between 5000-7499 steps/day (light active category) and 20% between 7500-1000 steps/day (somewhat active category).

Sixty percent of participants (n=123) perceived a change in their body shape in the last six months. Changes in body shape were explained by participants in the following ways: general weight gain or general weight loss or gaining weight centrally (around their

Table 1: Demographic information of study population (n = 205)

Variable	Percentage (n)/ Mean (±SD)
Age (years)	38.2 (±9.5)
Gender Male Female	 22.9% (47) 77.1% (158)
Educational level No education Primary school education Secondary school education Post-secondary school education	 2.9% (6) 24.4% (50) 46.3% (95) 26.3% (54)
Employment status Unemployed Employed Self-employed	 40.5% (83) 56.1% (115) 3.4% (7)
Participants who had dependents No Yes	 14.6% (30) 85.4% (158)
ARV categories Lamivudine, Efavirenz, Tenofovir Lamivudine, Efavirenz, Stavudine Other	 67.8% (139) 18.5% (38) 13.6% (28)
Time on ARVs (months)	8.7 (± 2.3)
CD_4 count (cells/mm^3)	285.1 (± 157)
Viral load < 400 (copies/ml)	64.9% (133)

abdomen, or at their breasts, or at their abdomen and breasts, or around their hips and buttocks, or at their breasts and buttocks). Sixty four percent (n=132) felt that they had gained weight and twenty three percent (n=49) felt that they had lost weight in the last six months. Table 2 is a representation of the risk factors for IHD that was measured during this study.

Men were more likely to smoke than female participants. One participant had a past medical history of diabetes and 19 participants were hypertensive and on treatment. Daily intake of vegetables and fruit was not regular (46.3%) and few individuals (33.2%) were able to partake in 3-5 vegetables/fruit per day. Female participants perceived higher levels of stress compared to their male counterparts. The mean resting heart rate was 82.7 (±11.4) beats/minute and BMI 25.6 (±5.4) kg/m^2 was increased in the sample as a whole but more so in female participants. Waist circumference and WHR means were within the gender specific ranges [25]. As such attention should be paid to the results where 5% of men and 25% of women had increased waist circumferences and 10% of men and 25% of women had increased WHR. Both these parameters indicate the presence of abdominal obesity in part of the study cohort. The mean systolic and diastolic blood pressure values were within the normal ranges (systolic 95-140 mmHg and diastolic 60-90 mmHg). Table 3 is a representation of the independent variables significantly influencing the risk of being overweight/obese and/or physically inactive.

Being overweight/obese was inversely related to physical activity level. Individuals with a higher CD_4 count, systolic blood pressure, waist and hip circumference and daily intake of vegetables/fruit were

Table 2: Non-invasive risk factors for ischemic heart disease in study population

Risk factors	n	Percentage (n) / Mean (SD)
Current smokers • Male • Female	205	16.1% (33) 40.4% (19) 8.9% (14))
Former smokers • Male • Female	205	25.9% (53) 59.6% (28) 15.8% (25)
Diabetes	205	0.005% (1)
Hypertension	205	0.09% (19)
Daily intake of vegetables/fruits	205	46.3% (95)
Daily intake of 3-5 vegetables/fruit per day	205	33.2% (68)
Perceived stress levels • Male • Female	205 47 158	19.9 (7.8) 16.8 (9.1) 20.8 (7.1)
Body & Anthropometric measurements *Resting heart rate (beats/minute)* • Male • Female	194 44 150	82.7 (11.4) 79.4 (10.7) 83.7 (11.5)
Systolic blood pressure (mmHg) • Male • Female	194 44 150	118.6 (13.0) 121.7 (13.4) 117.7 (12.8)
Diastolic blood pressure (mmHg) • Male • Female	194 44 150	77.8 (9.9) 82.0 (17.0) 77.1 (9.9)
Body Mass Index (kg/m^2) • Male • Female	194 44 150	25.6 (5.4) 22.3 (3.1) 26.6 (5.5)
Waist circumference (cm) • Male • Female	194 44 150	84.9 (11.1) 82.7 (9.6) 85.6 (11.5)
Hip circumference (cm) • Male • Female	194 44 150	103.5 (11.6) 95.8 (6.0) 105 (11.9)
Waist: hip ratio • Male • Female	194 44 150	0.8 (0.1) 0.9 (0.1) 0.8 (0.1)

Table 3: Risk of being overweight and/or physically inactive associated with individual IHD risk factors

Risk factor	n	Odds Ratio (95% CI) *Adjusted for Age , Sex*	p-value
Overweight/Obese			
▪ Systolic blood pressure	194	1.07 (1.04-1.10)	0.00
▪ Waist circumference	194	1.33 (1.23-1.46)	0.00
▪ Hip circumference	194	1.53 (1.34-1.75)	0.00
▪ Physical activity	195	0.99 (0.99-0.99)	0.05
▪ CD_4 count	205	1.00 (1.00-1.00)	0.01
▪ Daily fruit/vegetable intake	205	1.80 (0.99-3.27)	0.05
Physical inactive			
▪ Waist circumference	194	1.04 (1.00-1.08)	0.03

also more likely to have a BMI ≥ 25 kg/m^2. Waist circumference was significantly related to a physical activity level less than 10000 steps per day.

Discussion

Our findings build on international data that are available concerning the ambulation physical activity levels of PLWH and provide information regarding the South African context.

Pedometer step count physical activity categories were first described by Tudor-Locke and Bassett [29] to assist with reference ranges for objective physical activity walking behaviour. A person is said to follow an "active" lifestyle if he/she accumulates more than 10000 steps/day; be "somewhat-active" if taking more than 7500 steps/day; "light active" between 5000 and 7499 steps/day and "sedentary" if accumulating less than 5000 steps/day. The physical activity level of the sample could be considered "somewhat active" when considering the average pedometer steps/ day. However, male participants were "active" while their female counterparts were "light active". This pedometer step count finding was less than that reported in a study conducted by Cook et al [30] in adolescent and adult South African individuals living in a rural area. The average step count in their sample was 12471 steps/day. The difference in physical activity level between the current urban HIV cohort and the previously stated rural study could possibly be firstly explained by differences in transportation. The urban population might rely more on public transportation whereas the rural population could walk more and accumulated more steps/day. Secondly, individuals living in a rural South African community often have to walk long distances to collect water and firewood. This could result in more walking activity and higher daily step counts than the urban group. Thirdly, study participants in this study were living with HIV whereas the HIV status of the rural participants was not known. Physical symptoms such as shortness of breath and fatigue were often reported by study participants. Immune status with accompanied physical symptoms might have resulted in these individuals resting more often during daily activity in an attempt to conserve energy resulting in fewer steps per day.

The physical activity findings from the South African HIV cohort had similarities with a study conducted by Ramirez-Marrero in Hispanic adults living with HIV in San Juan, Porto Rico [31]. Their research indicated a mean of 7418 (±2714) steps/day with men accumulating slightly less than the South African males at 7594 (±2817) steps/day and women slightly more at 7151 (±2589) steps/ day.

The current study demonstrated a significant relationship between waist circumference and physical

inactivity in study participants. This finding is consistent with research done by Saunders et al [32] that found a 0.15cm increase in waist circumference if sedentary behavior increased with 15 minute in study participants.

Being physically active has many health benefits and a 10000 steps/day aim is suggested as a reasonable target for healthy individuals to reach to increase the health benefits related to activity [33]. Physical activity levels of more than 10000 steps/ day are said to assist with reducing the risk for obesity [34] and reducing waist circumference and fasting glucose levels in the general population [35]. In an HIV context, studies have demonstrated that physical activity programmes such as structured exercise may address risk factors for IHD such as BMI, waist circumference and WHR [36, 37]. This study demonstrated that the ambulation physical activity levels of South African PLWH attending an urban HIV clinic could be improved. Implementing a physical activity modification programme as part of their clinic management early could potentially assist in reducing their risk for IHD in the long term. If the 10000 steps per day guideline is to be used in PLWH, it is however suggested that an incremental increase in their step count and regular monitoring of individuals be encouraged to evaluate how individuals react to such a programme given that there is no previously known data.

Smoking was present in the study population but was not as prevalent as noted by international authors in HIV populations [9, 38, 39]. A possible reason to explain the level of smoking is that the study population consisted mostly of women and individuals of black ethnic origin. Peer et al [40] reported that South African women are less likely to smoke than their male counterparts and that black men and women smoke significantly less than other population groups in South Africa. In the South African context where HIV prevalence remains disproportionally high in females in comparison to males [41] it might be suggested that more focus is needed on education and exercise programmes to address physical inactivity and overweight/ obesity compared to smoking cessation. Anthropometric abnormalities were noted in part of the study population at this early stage of their ARV treatment. This was partly consistent with findings noted in longitudinal studies conducted in South African PLWH initiated on ARV that consisted of the Stavudine containing regimen [10, 26]. In this study, the main ARV regimen identified did not contain Stavudine but Tenofovir. It should however be emphasised that analysis did not reveal an association between BMI and ARV therapy and that such an investigation was not one of the aims of the current study. The association of increased BMI with other anthropometric measurements such as waist and hip circumference, may suggest that waist and hip circumference measurements and WHR calculation should be included in general HIV management to monitor individuals at risk of IHD due to the development of abdominal obesity. Education programmes that focus on what normal healthy weight is should also be encouraged. Hurley et al [26] noted that individuals in a South African HIV context often perceive their weight different to the measured reality and this might potentially hinder weight reduction programmes. Daily fruit and vegetable intake increased the possibility of being overweight in this population. This was a rather interesting finding as one would anticipate the opposite to be true. Body mass index provides information regarding the general nutritional status of individuals and could therefore indicate that participants that fell into the overweight/obese category had sufficient nutrition that allowed them to also partake in daily fruit and vegetable intake. The focus of the study was to screen diet as risk factor for IHD and not general diet. It is reported that a daily diet low in fruit and vegetable is considered a risk factor for IHD [42]; hence the inclusion of investigation of fruit and vegetable intake in the current study. The majority of participants were unable to partake in daily fruit and

vegetable intake. A frequent reason provided by participants for this finding was financial constraints due to unemployment. A solution for this risk factor would therefore require education regarding diet in relation to risk for IHD but more importantly as part of the wider response addressing social problems facing South Africa that includes unemployment.

The perceived level of stress experienced by the study participants was slightly higher when compared to a low-income general South African cohort [mean 18.6 (±6.7)] [22] and this is to be expected as the participants in the current study had to cope with the stigma that surrounds HIV and the difficulties associated with employment and participation in the wider community.

A limitation of the study was that only ambulation physical activity level was formally screened in study participants. How much time participants participated in other forms of physical activity e.g. domestic activities were not the specific aim of the study. It should thus be emphasized that the current manuscript provides information of participants walking level.

In conclusion, risk factors of IHD were identified in PLWH initiated on ARV between 6 and 12 months. The risk factors included physical inactivity, presence of diabetes and hypertension, increased BMI, presence of abdominal obesity, diet that does not include daily fruit and vegetable intake and a small proportion of participants smoked. Education and specific intervention programmes focusing on promoting and increasing physical activity would be a means of addressing a number of these risk factors and could be included in the prevention, treatment, care and support programmes.

Acknowledgement

This study was possible due to support received from the Themba Lethu HIV clinic, Clinical HIV Research Unit, Right to Care and the Department of Medicine at Helen Joseph Hospital in Gauteng, South Africa. This study was supported by grants received from the University of the Witwatersrand (Medical Endowment and Faculty Research Committee grants), South African Society of Physiotherapy (Research Foundation grant), National Research Foundation (NRF) Thuthuka grant and Medical Research Council (MRC). Any opinion, findings and conclusions or recommendations expressed in this material are those of the author(s) and therefore the NRF does not accept any liability in regard thereto. The views and opinions expressed are not those of the MRC but of the author (s) of the material produced or publicized.

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