

THE RELATIONSHIP BETWEEN BODY MASS INDEX, ENERGY INTAKE AND LEVEL OF PHYSICAL ACTIVITY OF HIV POSITIVE WOMEN (25-44 YEARS) IN MANGAUNG

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Abstract

Objective: To determine the relationship between body mass index (BMI), energy intake and levels of physical activity of HIV negative and HIV positive women. Design: Cross sectional study. Methodology: A random sample of 500 pre-menopausal women within the two age group categories of 25-34 and 35-44 years was selected. Data on physical activity was obtained using an adapted Baecke questionnaire and categorized into low, medium, and high levels of physical activity. Weight and height were used to calculate BMI. Dietary intake was determined by means of a standardized food frequency questionnaire. Results: Sixty-one percent of younger women and 38% of older women were HIV infected. The vast majority of women (91%) had low levels of physical activity, while only 9% of the sample had physical activity levels that fell within the normal to high category. More than 50% of respondents were either overweight or obese (BMI above 25 kg/m²). BMI of HIV positive younger women was, however, significantly lower than that of HIV negative women. Median energy intakes were high (more than 10 000 kJ) for both HIV positive and HIV negative women. Conclusions: Reverting to a more traditional lifestyle, including diet and physical activity, could assist in addressing unfavorable BMI parameters of these women and improve health status and quality of life of HIV infected women.

Key words: South Africa; HIV; BMI; energy intake; physical activity

1. INTRODUCTION

The major changes in diet and activity patterns encouraged by the technological revolution of the late 20th century have had a significant impact on body weight regulatory mechanisms. A decline in infectious diseases and an increase in the prevalence of chronic diseases of lifestyle have now become a global epidemic (Musaiger, 1992; Trowell, 1995). Obesity, hypertension, Type 2 diabetes mellitus and certain types of cancer are associated with a sedentary lifestyle and a high level of energy intake (Kumanyika et al., 1993; Seidell, 1999).

Urbanization is one of the major factors contributing to changes in lifestyle (Levitt et al., 1993). It usually includes major changes in diet and lower levels of physical activity compared with those of people in their traditional surroundings (Franz, 2000, p. 742). The patterns of change in structure of diet, physical activity and obesity are greater in developing countries (Popkin, 1994), and in South Africa morbidity and mortality from chronic diseases are more prevalent among African than Caucasian women (Walker, 1995).

Hays and Clark (1999) have reported that socio-demographic and health

characteristics such as low socio-economic status, older age, race and presence of chronic disease, tend to be associated with lower levels of activity. Various epidemiological studies have shown that a decrease in coronary heart disease, hypertension, obesity, stroke, colorectal cancer and osteoporosis is associated with increased physical activity (Paffenberger *et al.*, 1993; Kohl & McKenzie, 1994) and a healthy lifestyle (Hays & Clark, 1999).

Physical activity seems to be promising in various areas of HIV infection. Exercise is therefore increasingly being advocated as a beneficial addition to the health treatment of HIV-infected individuals (Jones *et al.*, 2001). Physical activity may be a therapeutic method capable of improving appetite and energy levels (United States Agency for International Development (USAID), 2001), which will in turn enhance overall physical, emotional and psychological well-being (Lox *et al.*, 1995; USAID, 2001), by neutralising the effects of anxiety and depression associated with HIV diagnosis (Birk, 1996; USAID, 2001). Physical activity may be useful to improve quality of life (Stringer *et al.*, 1998; Stringer, 1999; Yarasheski & Roubenoff, 2001), and to increase strength and functional capacity of the individual living with HIV (Evans *et al.*, 1998).

2. METHODOLOGY

A proportionally random sample of 500 African pre-menopausal women (25-44 years) was selected using township maps of Mangaung, an African residential area of Bloemfontein. The sample included respondents from two built-up areas, namely Pahameng (total of 1359 residences) and Botschabela (2308) and two informal settlements, namely Joe Slovo (1359) and Namibia (2995). Inclusion criteria were voluntarily participation, African female, age group 25 – 44 and non pregnant.

Approval for the study was obtained from the Ethics Committee of the University of the Free State. Prior to the study, the approval of the community leaders of the four selected areas was obtained and written informed consent was signed by all participants.

A questionnaire based on the one developed by Baecke *et al.* (1982) and adapted by Kruger (1999), was used to develop a questionnaire measuring physical activity for occupation and leisure time in this sample. The questionnaire was completed in an interview situation. Three trained interpreters (Sotho and Xhosa) assisted. According to the answers obtained in the questionnaire, respondents were categorized into three activity levels, namely low, moderate or high. Ten percent of the sample was re-interviewed two weeks after the initial survey to determine reliability of answers obtained in the first interview. Anthropometric status and dietary intake were also determined, using standard methods reported elsewhere (Walsh *et al.*, 2004; Hattingh *et al.*, 2004).

HIV status was determined using a micro-particle enzyme Immunoassay.

3. STATISTICAL ANALYSIS

The data for all data sets were categorized into two age groups: 25-34 years, and 35-44 years. For each group, continuous variables were described by means and standard deviations, or medians and percentiles as applicable. Categorical variables were described by frequencies and percentages.

The questionnaire adapted for this study differed from the one used by Kruger (1999) in the Transition, Health and Urbanisation in South Africa (THUSA) study in the classification of time of the activity. In this study respondents were asked to specify the amount of time spent on an activity in minutes, while the THUSA study had a classification of time as “never, seldom, sometimes and always”. The amount of time for each activity was defined as never when a person spent 0 percent of their time at work or at home on that activity. Seldom was defined as less than 10 percent of the time and 10 percent to 50 percent was defined as sometimes. Fifty percent to less than 85 percent was defined as often and more than 85 percent as always. Questions related to activities at home and at work were included in the questionnaire. Work activity at home was considered as “work” when a person did not work out of the home. If a person worked out of the home, “work” was calculated as work activities at work plus work activities at home.

The physical activity index (PAI) was calculated and categorized as follows (Kruger, 1999):

$$\text{PAI} = 0.47 (\text{work index}) + 0.059 (\text{commuting index}) + 0.001 (\text{stair index}) + 0.47 (\text{sport index} + \text{leisure index}).$$

Due to the small numbers of respondents with normal and high levels of physical activity, these two categories were combined to make statistical analysis of data possible. If the PAI was lower than four, women were categorized as inactive while a PAI of four or higher was categorized as normal to high.

For each combination of age group, physical activity group and HIV-group, the physical activity questions were compared by means of chi-square test and Fisher’s exact test and 95 percent confidence intervals (CI) were calculated for the percentage difference. Medians were compared by 95 percent non-parametric CI’s and the Kruskal-Wallis test.

For each question, the answers obtained in the main survey and the reliability survey were compared by k*k tables and where the percentages who gave conflicting answers were more than 20 percent, the variables were considered as unreliable and ignored in further computations. For continuous variables, the difference between the two surveys was calculated and the number of non-zero differences reported.

Respondents could not accurately recall the time spent on the activities they performed which influenced the reliability of some of the questions answered in minutes and therefore they were omitted.

4. RESULTS

Results are shown in the accompanying table.

Table 1: BMI and energy intake (kJ) of HIV negative and HIV positive physically inactive and physically active women

	Median intake	Median BMI	BMI categories (kg/m ²)					
			<18.5 Underweight		18.5<25 Normal weight		≥25 Overweight & obese	
			N	%	N	%	N	%
Group 1: 25-34 years; HIV-; Low PA (n = 88)	10 349	27.18*	2	2.27	31	35.23	55	62.50
Group 2: 25-34 years; HIV+; Low PA (n = 151)	12 072	24.87*	5	3.31	72	47.68	74	49.01
Group 3: 35-44 years; HIV-; Low PA (n = 128)	10 847	24.98	4	3.13	60	46.88	64	50.0
Group 4: 35-44 years; HIV+; Low PA (n = 76)	10 090*	25.58	5	6.58	28	36.84	43	56.58
Group 5: 25-34 years; HIV-; Normal to High PA (n=18)	10 927	27.81	0	0.00	7	38.89	11	61.11
Group 6: 25-34 years; HIV+; Normal to High PA (n = 15)	11 074	22.12	0	0.00	11	73.33	4	26.67
Group 7: 35-44 years; HIV-; Normal to High PA (n = 5)	11 771	27.02	0	0.00	2	40.00	3	60.00
Group 8: 35-44 years; HIV+; Normal to High PA (n = 6)	14 519*	22.41	0	0.00	5	83.33	1	16.67

PA: physical activity

*Statistically significant

The results of four subjects that were found to be pregnant during the medical examination were excluded and blood samples could not be obtained in eight subjects. Sixty-one percent of younger women and 38 percent of older women were HIV infected.

Women were divided into eight groups, according to age, level of physical activity and HIV status. Groups 1 – 4 represent women with low levels of physical activity, while groups 5 – 8 represent women with normal to high levels of physical activity. In the groups with low levels of physical activity and normal to high levels of physical activity, women were categorized according to age (25 – 34 years, and 35 – 44 years) as well as HIV status.

Two hundred and thirty nine women were HIV negative. Of these, 106 (88 +18) were between 25 and 34 years old and 133 (128 + 5) were between 35 and 44 years old. The majority of HIV negative women were physically inactive with only 23 women (10 percent) falling in the normal to high physical activity category. Of the younger, physically inactive women without HIV (n=88), 62.5 percent had a BMI > 25 kg/m² indicating that they were overweight or obese. Of the younger physically active women (n=18) without HIV, 61 percent also had a BMI > 25 kg/m². In the older HIV negative group that were inactive (n=128), 50.0 percent had a BMI > 25 kg/m², while three (60 percent) of the physically active older women without HIV had a BMI > 25 kg/m².

Two hundred and forty nine women were HIV positive. Of these, 167 (152 + 15) were between 25 and 34 years old and 82 (76 + 6) were between 35 and 44 years old. As in the HIV negative group, the majority of HIV positive women were physically inactive with only 21 women (8 percent) falling in the normal to high physical activity category. Of the younger physically inactive women with HIV (n=151, one women's BMI was not recorded), 49.0 percent had a BMI > 25 kg/m² indicating that they were overweight or obese. Fewer HIV positive younger women that were physically active (n=15) were overweight, with only 26.7 percent having a BMI > 25 kg/m². In the older HIV positive group that were inactive (n=76), 56.6 percent, had a BMI > 25 kg/m², while only one physically active older women with HIV had a BMI > 25 kg/m².

The median BMI of the younger HIV negative women in group 1 (low physical activity) was 27.18 kg/m², thus falling within the overweight BMI category. In contrast, the BMI of the same group with HIV (group 2) was 24.87 kg/m², thus falling within the normal weight BMI category. This difference was significant (95 percent CI for the median difference: [0.91; 3.78]), indicating that the presence of HIV infection has a significant effect on BMI. Although no significant associations could be found between the BMI of the other groups (possibly due to the small number of respondents in the physically active groups 5-8), close to significant differences were found between groups 2 and 6 (CI [-0.55; 3.86]), and groups 5 and 6 (CI [-0.14; 7.19]).

The median energy intake of HIV negative and HIV positive physically inactive and physically active women showed that, in all 8 groups, the median intake was higher than the RDA for this age group of 9 196 kJ, ranging from 10 090 kJ in group 4, to 14 519 kJ in group 8. The energy intake of the women in group 4 (35-44 years, HIV + low physical activity) was significantly lower than that of the women in group 8 (35-44 years, HIV + normal to high physical activity) (CI for the median difference [-7857; -457]). Since the women in these groups were both older and HIV positive, the only difference was their level of physical activity. Thus the more physically active women had a higher energy intake than the physically inactive women. No significant associations could be found between the energy intake of the other groups (possibly due to the small number of respondents in the physically active groups 4-8).

5. DISCUSSION

In this study of a community undergoing rapid epidemiological and demographic transition, prevalence of HIV was very high. In addition, high rates of physical inactivity and obesity were identified. The effect of the nutrition transition is also reflected in the diet with a high energy intake.

The study population in Mangaung is considered to be an example of a typical developing community in transition from a traditional to an urban lifestyle. It is estimated that by 2010 more than 75 percent of South Africa's population will be urbanized which will mainly affect the African population (Bourne et al., 1993; Mollentze et al., 1995; Lambert et al., 2001a).

Compared to women with normal to high levels of physical activity, low levels of physical activity in this sample were ascribed to lower participation in sporting activities, not climbing stairs, television watching and walking and cycling less often. According to Hays and Clark (1999), there is a vast shift in the structure of employment, with a movement towards more capital-intensive and knowledge-based employment that relies far less on physical activity. The rapid decline in physical activity at work is significantly associated with increased adult BMI and obesity. The shift in activity is also due to the increased use of transport to get to work or school and more passive leisure time activities such as watching television at home.

Although not underweight, most HIV positive women in this sample had a lower BMI compared to their HIV negative counterparts. Loss of muscle mass early in HIV disease progression may result from low levels of physical activity. There is thus potential in exercise to treat losses of muscle size (Evans et al., 1998). Resistance exercise in particular may be important in maintaining body mass (Birk, 1996), and increasing lean body mass (Roubenoff et al., 1999), in HIV-infected patients with or without wasting. Although exercise *per se* may not significantly retard AIDS progression and the subsequent onset of AIDS, it does not appear to intensify HIV (Birk, 1996). The ability to exercise may however be compromised by deteriorations in cardio respiratory and neuromuscular function of patients with fully-developed AIDS (Shephard, 1998).

Aerobic exercise as part of social and everyday activities such as walking, cleaning and collection of firewood or water is considered important for the HIV-infected individual, and should be sustained as long as patients are physically able to do so (USAID, 2001). Aerobic exercise training *per se* has also indicated to be an effective non-pharmacological treatment to manage HIV-related complications such as alterations in body composition and metabolism (Yarasheski & Roubenoff, 2001).

6. CONCLUSION

Prevalence of HIV infection in this sample was very high, especially in the younger age group (25-34 years). Although the prevalence of overweight and obesity was an outstanding feature of the sample, BMI of HIV positive younger women was significantly lower than that of HIV negative women. In all groups, mean energy intake was high.

As both lack of physical activity and obesity are now recognized as risk factors for several chronic diseases, it is obvious that activity and dietary recommendations should complement one another (United States Department of Health and Human Services, 1996; Colditz *et al.*, 1998; Macera & Pratt, 2000). The focus should fall on changes in the food supply in the local area and a supportive environmental physical activity programme (Egger & Swinburn, 1997).

Guidelines for exercise in HIV lack scientific support (Terry *et al.*, 1999), as studies on the effect of exercise training on immunologic markers (CD4, CD8 and CD4:CD8 ratio), and anthropometric measures have shown conflicting results. It has been suggested that HIV seropositive individuals that participate in moderate and high intensity exercise programmes can increase their functional capacity (Stringer, 1999; Terry *et al.*, 1999), without any obvious changes in immunological indices (Birk, 1996; Stringer *et al.*, 1998; Shephard, 1998; Terry *et al.*, 1999), viral replication (Stringer *et al.*, 1998), or anthropometric measurements (Terry *et al.*, 1999). In addition, physical activity can increase quality of life in HIV positive individuals.

Lifestyle modification on a population level requires a comprehensive, community-based, integrated, multidisciplinary and multi-sectorial strategy. The success of a community-based lifestyle intervention programme is dependent on its acceptability, individualization, sensitivity, and sustainability and the degree to which the community adopts it (Levitt *et al.*, 1999; McCarthy *et al.*, 2002; Lambert, 2001b).

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7. REFERENCES

- Baecke, J.A., Burema, J. & Frijters, E.R. 1982. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *American Journal of Clinical Nutrition*, 36(5):936-942.
- Birk, T.J. 1996. HIV and exercise. *Exercise Immunology Review*, 2(1):84-95.
- Bourne, L.T., Langenhoven, M.L., Steyn, K., Jooste, P.L., Laubscher, J.A., & van der Vyver, E. 1993. Nutrient intake in the urban African population of the Cape Peninsula, South Africa. The BRISK study. *Central African Journal of Medicine*, 3(4):238-246.
- Colditz, G.A., Willet, W.C., Rotnitzki, A. & Manson, J.E. 1998. Weight gain as a risk factor for clinical diabetes in women. *Annals of Internal Medicine*, 122(7):481-486.
- Egger, G. & Swinburn, B. 1997. An "ecological" approach to the obesity pandemic. *British Medical Journal*, 315(7106):477-480.
- Evans, W.J., Roubenoff, R. & Shewitz, A. 1998. Exercise and the treatment of wasting: aging and Human Immunodeficiency Virus infection. *Seminars in Oncology*, 25: (2 Suppl. 6) 112-122.
- Franz, M.J. 2000. Medical nutrition therapy for diabetes mellitus and hypoglycemia of nondiabetic origin. In: Mahan, L.K. & Escott-Stump, S. (ed.). *Krause's food, nutrition & diet therapy*. Tenth edition. Philadelphia: W.B. Saunders Company. pp. 742-780.
- Hattingh, Z., Walsh, C., Veldman, F.J. & Bester, I. 2004. Macronutrient intake of HIV seropositive women (25-44 years) living in Mangaung, South Africa. In press.
- Hays, L.M. & Clark, D.O. 1999. Correlates of physical activity in a sample of older adults with type 2 diabetes. *Diabetes Care*, 22(5): 707-712
- Jones, S.P., Doran, D.A., Leatt, P.B., Maher, B. & Pirmohamed, M. 2001. Short-term exercise training improves body composition and hyperlipidemia in HIV positive individuals with lipodystrophy. *AIDS*, 15(15):2049-2051.
- Kohl, H.W. & McKenzie, J.D. 1994. Physical activity, fitness and stroke. In : Bouchard, C., Shephard, R.J. & Stephens, T. (ed). *Physical activity, fitness and health*. Champaign, I.L. : Human Kinetics. pp 609 – 621.
- Kruger, H.S. 1999. The puzzle of obesity in African women: contributing factors and associated risk factors (Thesis) Potchefstroom PU for CHE, 1-210.

Kumanyika, S., Wilson, J.F. & Guildford-Davenport, M. 1993. Weight-related attitudes and behaviours of Black women. *Journal of the American Dietetic Association*, 93 : 416 – 422.

Lambert, E.V., Bohlmann, I. & Hudson, K. 2001a. Physical activity for health: understanding the epidemiological evidence for rest benefits. *International Sport Medical Journal*, 2:1-5.

Lambert, E.V., Bohlmann, I. & Ko be-Alexander, T. 2001b. 'Be active' – Physical activity for health in South Africa. *South African Journal of Clinical Nutrition*, 14(3):(Suppl.) S12-16.

Levitt, N.S., Katzenellenbogen, J.M., Bradshaw, D., Hoffman, M.N. & Bonnici, F. 1993. The prevalence and identification of risk factors for NIDDM in urban Africans in Cape Town, South Africa. *Diabetes Care*, 16 (4):601-607.

Levitt, N.S., Steyn, K., Lambert, E.V., Reagon, G., Lombard, C.J., Fourie, J.M., Rossouw, K. & Hoffman, M. 1999. Modifiable risk factors for Type 2 diabetes mellitus in a peri-urban community in South Africa. *Diabetic Medicine*, 16(11):945-950.

Lox, C.L., McAuley, E. & Tucker, R.S. 1995. Exercise as an intervention for enhancing subjective well-being in an HIV-1 population. *Journal of Sport and Exercise Psychology*, 17(4):345-362.

Macera, C.A. & Pratt, M. 2000. Public health surveillance of physical activity. *Research Quarterly for Exercise and Sport*, 71(2):97-103.

McCarthy, S.N., Gbney, M.J. & Flynn, A. 2002. Overweight, obesity and physical activity levels in Irish adults: evidence from the North/South Ireland food consumption survey. *Proceedings of the Nutrition Society*, 61(1):3-7.

Mollentze, W.F., Moore, A.J., Steyn, A.F., Joubert, G., Steyn, K., Oosthuizen, G.M. & Weich, D.J.V. 1995. Coronary heart disease risk factors in a rural and urban Orange Free State Black population. *South African Medical Journal*, 85(2):90-96.

Musaiger, A.O. 1992. Diabetes mellitus in Bahrain: an overview. *Diabetic Medicine*, 9(6): 574-578.

Paffenberger, R.S., Hyde, R.T., Wing, A.L., Lee, I.M., Jung, D.L. & Kampert, J.B. 1993. The association of changes in physical activity level and other lifestyle characteristics with mortality among men. *New England Journal of Medicine*, 328 : 538 – 545.

Popkin, B.M. 1994. The nutrition transition in low-income countries: an emerging crisis. *Nutrition Reviews*, 52(9):285-298.

Roubenoff, R., McDermott, A., Weiss, L., Suri, J., Wood, M., Bloch, R. & Gorbach, S. 1999. Short-term progressive resistance training increases

strength and lean body mass in adults infected with Human Deficiency Virus. *AIDS*, 13(2):231-239.

Seidell, J.C. 1999. Obesity, insulin resistance and diabetes – a worldwide epidemic? Paper presented at the 21st International Symposium of the Swedish Nutrition Foundation, August 26-28, Ystad, Sweden.

Shephard, R.J. 1998. Exercise, immune function and HIV infection. *Journal of Sports Medicine and Physical Fitness*, 38(2):101-110.

Stringer, W.W., Berezowskaya, M., O'Brien, W.A., Beck, C.K. & Casaburi, R. 1998. The effect of exercise training on aerobic fitness, immune indices, and quality of life in HIV positive patients. *Medicine and Science in Sports and Exercise*, 30(1):11-16.

Stringer, W.W. 1999. HIV and aerobic exercise: current recommendations. *Sports Medicine*, 28(6):389-395.

Terry, L., Sprinz, E. & Ribeiro, J.P. 1999. Moderate and high intensity exercise training in HIV-1 seropositive individuals: a randomized trial. *International Journal of Sports Medicine*, 20(2):142-146.

Trowell, H. 1995, as cited by Walker, 1995. Obesity in the western world. *Plant foods for Man*, 1:157-168.

United States Department of Health and Human Services 1996. Physical activity and health. A report from the Surgeon General. Department of Health and Human Services, Gentec for Chronic Disease Prevention and Health Promotion. Atlanta, GA Authors.

United States Agency for International Development (USAID), 2001. HIV/AIDS: a guide for nutrition, care and support. Washington DC: Food and Nutrition Technical Assistance Project, Academy for Educational Development.

Walsh, C., Hatting, Z., Bester, I. & Veldman, F.J. 2004. Anthropometric nutritional status of HIV positive women in Mangaung. In press.

Walker, A.R.P. 1995. Epidemiology and health implications of obesity in Southern Africa. In: Fourie, J. & Steyn, K. (ed.). *Chronic Diseases of Lifestyle in South Africa*. Tygerberg South Africa: Medical Research Council.

Yarasheski, K.E. & Roubenoff, R. 2001. Exercise treatment for HIV-associated metabolic and anthropomorphic complications. *Exercise & Sport Sciences Reviews*, 29(4):170-174.