running is significantly higher than that attained during a sECG. This finding is not sport-specific, nor is it related to the level of competitiveness of the athletes. Although no subjects in the study had ischaemic symptoms or exercise-induced sECG changes, it must be noted that the maximal HR attained during the sECG was lower than the maximal HR during the squash or running field tests. These data show that the routine sECG using a cycle ergometer is a submaximal test of exercise performance, and should be interpreted as such. Physicians should therefore be aware that veteran athletes participating in squash or running activities are exercising intermittently at higher maximal HR than during routine sECG testing.

References

1. Paffenbarger RS, Hyde RT, Wing AL, Hsich CC. Physical activity, all-cause mortality, and longevity of college alumni. *N Engl J Med*, 1986; **314:** 605-613.
2. Hardman AE. Exercise in the prevention of atherosclerotic, metabolic and hypertensive disease: A review. *J Sports Sci* 1996; **14:** 201-218.
3. Blanksby BA, Elliot BC, Bloomfield J. Telemetered heart rate responses of middle-aged sedentary males, middle-aged active males and 'A' grade male squash players. *Med J Aust* 1973; **2:** 477-481.
4. Winget JF, Capeless MA, Ades PA. Sudden death in athletes. *Sports Med* 1994; **18:** 375-383.
5. Noakes TD, Opie LH, Rose AG, Kleynhans PHT. Autopsy-proved coronary atherosclerosis in marathon runners. *N Engl J Med* 1979; **301:** 86-89.
6. Noakes TD, Rose AG. Exercise-related deaths in subjects with coexistent hypertrophic cardiomyopathy and coronary artery disease. *S Afr Med J* 1984; **66:** 183-187.
7. Northcote RJ, Evans AD, Ballantyne D. Sudden death in squash players. *Lancet* 1984; **1:** 148-150.
8. Northcote RJ, Flannigan C, Ballantyne D. Sudden death and vigorous exercise — a study of 60 deaths associated with squash. *Br Heart J* 1986; **55:** 198-203.
9. Maron BJ, Epstein SE, Roberts WC. Causes of sudden death in competitive athletes. *J Am Coll Cardiol* 1986; **7:** 204-214.
10. Noakes TD. Heart disease in marathon runners: a review. *Med Sci Sports Exerc* 1987; **19:** 187-194.
11. Noakes TD. Sudden death in athletes. *Continuing Medical Education* 1991; **9:** 958-969.
12. Cheitlin MD. Evaluating athletes who have heart symptoms. *The Physician and Sports Medicine* 1993; **21:** 150-162.
13. Alpert JS, Pape LA, Ward A, Rippe JM. Athletic heart syndrome. *The Physician and Sportsmedicine* 1989; **17:** 103-107.
14. Fuller CM, McNulty CM, Spring DA, *et al.* Prospective screening of 5 615 high school athletes for risk of sudden death. *Med Sci Sports Exerc* 1997; **29:** 1131-1138.
15. Pashkow FJ, Schweikert RA, Wilkoff BL. Exercise testing and training in patients with malignant arrhythmias. *Exerc Sport Sci Rev* 1997; **25:** 235-269.
16. American College of Sports Medicine. *Guidelines for Exercise Testing and Prescription 1991.* 4th ed. Philadelphia: Lea & Febiger, 1991.
17. Selley EA, Kolbe T, Van Zyl CG, Noakes TD, Lambert MI. Running intensity as determined by heart rate is the same in fast and slow runners in both the 10- and 21-km races. *J Sports Sci* 1995; **13:** 405-410.
18. Montpetit RR. Applied physiology of squash. *Sports Med* 1990; **10:** 31-41.
19. Durnin JVGA, Womersley J. Body fat assessed from total body density and its estimation from skinfold thickness. Measurements on 481 men and women aged from 16 to 72. *Br J Nutr* 1974; **32:** 77-79.
20. Léger L, Thivierge M. Heart rate monitors: Validity, stability and functionability. *The Physician and Sportsmedicine* 1988; **16:** 143-151.
21. Lambert MI, Mbambo ZH, St Clair Gibson A. Heart rate during training and competition for long-distance running. *J Sports Sci* 1998; **16:** S85-S90.
22. Digenio AG, Cantor A, Noakes TD, Cloete C, Mavunde D, Esser JD. Is severe left ventricular dysfunction a contraindication to participation in an exercise rehabilitation program? *S Afr Med J* 1996; **86:** 1106-1109.
23. Chaitman B. In: Braunwald E, ed. *Heart Disease: A Textbook of Cardiovascular Medicine.* 5th ed. Philadelphia: WB Saunders, 1997: 157.
24. Derman EW. The effects of B-blockade on the physiological response to physical exercise and exercise training in man. PhD thesis, University of Cape Town, 1995: 30-31.
25. Bogaty P, Dagenais GR, Cantin B, Alain P, Rouleau JR. Prognosis in patients with a strongly positive exercise electrocardiogram. *Am J Cardiol* 1989; **64:** 1284.
26. Mercier M, Beillot J, Gratas A, *et al.* Adaptation to work load in squash players: laboratory tests and on court recordings. *J Sports Med* 1987; **27:** 98-104.
27. Lynch T, Kinirons MT, O'Callaghan D, Ismail S, Brady HR, Horgan JH. Metabolic changes during serial squash matches in older men. *Canadian Journal of Sports Science* 1992; **17:** 110-115.
28. Jette M, Blumchen G, Treichel P, Landry F. Electrocardiographic responses to jogging in middle-aged and older men and women. *Clin Cardiol* 1993; **16:** 231-234.
29. Brady HR, Kinirons M, Lynch T, *et al.* Heart rate and metabolic response to competitive squash in veteran players: identification of risk factors for sudden cardiac death. *Eur Heart J* 1989; **10:** 1029-1035.

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WEIGHT AND HEALTH STATUS OF BLACK FEMALE STUDENTS

N P Steyn, M Senekal, S Brits, M Alberts, T Mashego, J H Nel

Objective. To examine black female students for the occurrence of risk factors associated with chronic diseases of lifestyle, namely obesity, hypertension, nicotine usage, dyslipidaemia and compromised mental health (depression).

Design. A cross-sectional analytical study design was used. All participants were examined within a period of 3 months during 1994. Weight, height, and hip and waist measurements were taken. Body mass index (BMI), waist-hip ratio (WHR) and waist circumference (WC) were calculated for each subject. Two systolic and diastolic blood pressure readings were taken for each participant. Questionnaires were used to determine specific risk factors related to lifestyle. The Beck Depression Inventory (BDI) was used to measure psychological well-being. Fasting blood samples were collected and analysed for serum lipids and iron status.

Setting. The University of the North in the Northern Province of South Africa.

Subjects. A complete data set of sociodemographic information, anthropometric measurements and blood pressure readings, as well as a psychological health test and a medical questionnaire, were obtained from 231 of the 431 first-year female students who attended the university orientation programme. Only students with a complete data set were included in the sample.

Results. Eighteen per cent of students were overweight (BMI 25 - 29.9), 6.5% were obese (BMI ≥ 30), and 26.8% were underweight. Mean blood pressure, BMI, WHR and WC increased significantly with age and were highest among the ≥ 24-year-olds. Only 1.6% of students had elevated blood pressure, 1.0% smoked and 4.4% took snuff. BMI, WC and WHR were positively correlated with blood pressure and age.

Departments of Human Nutrition, Kinesiology, Medical Sciences and Clinical Psychology and Research Administration, University of the North, Sovenga, Northern Province

N P Steyn, PhD

S Brits, PhD

M Alberts, DSc

T Mashego, MA

J H Nel, PhD

Department of Consumer Studies, University of Stellenbosch, Western Cape

M Senekal, PhD

Few students had dyslipidaemia (3.8% cholesterol > 5.2 mmol/l). However 14.5% were anaemic (Hb < 11.5 g/dl) and 24.6% had microcytosis (< 80 fl). Nearly one-fifth of students (17.7%) were classified as being moderately to severely depressed.

Conclusions. Black female students younger than 24 years exhibited few risk factors associated with chronic diseases of lifestyle. However in older women (≥ 24 years) there were significant increases in BMI, WHR, WC and blood pressure. A large number of students of all ages exhibited moderate to severe depression and anaemia was prevalent.

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Rapid changes are occurring in the lifestyle and health patterns of populations in developing countries, with chronic diseases of lifestyle becoming increasingly prevalent.[1] These changes are frequently ascribed to the large increase in people moving from rural to urban areas.[2] This is particularly marked in the South African black population. In 1991, 48% of the population lived in urban areas. This increased to 54% by 1996, and is projected to increase in the future.[3]

Obesity has been reported in 44% of urban black women in Cape Town.[4] Even in rural areas high prevalences of 28 - 32% have been reported in women.[5-7] In contrast, obesity is rare among black South African men.[8] Even though Walker *et al.*[9] have described 'benign' obesity in black women, it is still well documented that obesity favours the development of hypertension and related diseases such as coronary heart disease (CHD), gallbladder disease and certain cancers.[10-12] It has therefore become a priority in developing countries to address not only the problems of undernutrition, but also to monitor the weight and health status of the population in order to prevent a swing towards overnutrition and associated chronic diseases.[2]

The University of the North, which is situated near Pietersburg in the Northern Province, draws black students from both traditional rural and urban settings. Consequently, some students who arrive there for the first time come from a traditional cultural background, while others are at various stages of urbanisation. These students can therefore be described as individuals in a position of nutritional transition. This situation presents an ideal opportunity to study the effects of a more westernised lifestyle on weight and related health status. For this purpose a longitudinal study to monitor the weight, health status and associated factors of female students was initiated in 1994. This paper presents the baseline results of the longitudinal study.

METHODS

Sample

For the purposes of this study students coming from farms and villages were classified as being rural, and students coming from townships and cities were classified as being urban. In 1994 a total of 772 female students registered as first-year students at the University of the North. The original aim was to include all the students in the study, but only 431 attended the orientation programme, which is held for all first-year students during the first week of entry to the university. During this week the students completed a sociodemographic and psychological questionnaire. In the sessions during which these questionnaires were completed three further appointments were made with each student for the evaluation of dietary intake, the taking of anthropometric measurements and the drawing of blood. As not all students arrived for all their appointments, a complete set of data for the 431 students was not obtained. A complete data set of sociodemographic information, anthropometric measurements and blood pressure readings, as well as a psychological health test and a medical questionnaire, were obtained for 231 students and will be reported on here. It is possible that the absence of the non-responders could have caused a bias in the data. However, because there is a paucity of data on women of this age group in South Africa, we feel that these data contribute to the understanding of the health and weight status of black female students when interpreted and applied with caution. Permission for the study was obtained from the University Ethics Committee and informed consent was obtained from all participants before data collection.

Anthropometric measurements

Anthropometric measurements were taken by standardised fieldworkers who were trained according to the procedures described by Lee and Nieman.[13] The standing height of each subject was measured to the nearest 0.1 cm without shoes, using a stature meter. The weight of each participant — in light clothing — was measured to the nearest 0.01 kg on a load-cell-operated digital scale. Body mass index (BMI) was calculated for each person by dividing weight in kilograms by the square of height in metres.[14] Cut-off points recommended by Jéquier[15] were adopted: BMI < 20 = underweight; 20 - 24.9 = normal weight; 25 - 29.9 = overweight; 30 - 40 = obese. These comply with the latest recommendations of the US National Heart, Lung and Blood Institute.[16]

Waist and hip circumference measurements were taken for each participant using a non-stretchable tape measure, with the subject standing.[17] Waist circumference (WC) was measured around the waist through a point one-third of the distance between the xiphoid process and the umbilicus. Hip circumference was measured around the hips through a point 4 cm below the superior anterior iliac spine.[17] Waist-hip ratio (WHR) was calculated for each participant in order to assess body fat distribution. Subjects were then classified as ≥ or < 0.80. An increase in this ratio is associated with android obesity[18] and an increased risk for the development of cardiovascular disease.[19] Additionally, it was determined whether women had a WC ≥ 88 cm, which indicates excess fat in the abdominal area and is associated with an increased risk of cardiovascular disease and type 2 diabetes.[20]

Blood pressure

An average of two diastolic and systolic blood pressure readings were taken with the participant in a seated position according to World Health Organisation (WHO) procedures.[21] A diastolic reading of ≥ 90 mmHg and/or a systolic reading ≥ 140 mmHg were regarded as indicative of borderline hypertension.[22]

Psychological health

All students completed the Beck Depression Inventory (BDI)[23] which measures psychological well-being. Beck scores were calculated by a clinical psychologist and participants were ranked according to the following classification: normal = 0 - 9, mildly depressed = 10 - 15, mildly to moderately depressed = 16 -19, moderately to severely depressed = 20 - 29.

Health status

Blood samples collected from volunteers after a 12-hour fast (N = 62) were used for the determination of laboratory parameters. Full blood counts were determined using an automated blood cell counter (Sysmex K-100). Total cholesterol, triglycerides, high-density lipoprotein (HDL) cholesterol, total iron, transferrin and glucose were determined using assays commercially available from Boehringer Mannheim, Germany, in conjunction with a RA-XT autoanalyser. Ferritin was determined using an enzyme immunoassay (Ramco-Ferritin, AEC Amersham). Cut-off points were used to identify subjects with abnormal values.[24,25] A medical questionnaire was completed by the 231 participants. This included questions on smoking habits.

Analyses of data

Statistical analysis was done using the Statistical Analysis System (SAS) software. Data were expressed as means with standard deviations, or else as percentages falling within specific categories. The Bonferroni test was used to do a simultaneous comparison of pairs of means. Pearson's product-moment correlation coefficients were used to test for significant correlations between variables.

RESULTS

The majority of female students came from rural areas (63.6%) and were Northern Sotho-speaking (69.4%) (Table I). Almost half came from families with an income of less than R1 600 per month. Twenty-seven per cent of the participants had one or more children. Only a few participants reported smoking cigarettes (1.0%) or taking snuff (4.4%).

Table I. Socio-demographic and related characteristics of the sample of first-year female students (N = 231)

Characteristics	%
Age (yrs)	
≤ 18	42.9
19 - 23	39.8
≥ 24	17.3
Language	
Northern Sotho	69.4
Tshonga	7.4
Other	23.1
Residential area	
Rural	63.6
Urban	36.4
Family income (R/mo.)	
< 400	12.5
400 - 1 600	28.3
> 1 600	4.9
Don't know	54.3
Number of children	
None	72.3
One	17.6
≥ 2	10.1
Regular nicotine use	
Smoke cigarettes	1.0
Take snuff	4.4

Table II presents mean data on anthropometric status and blood pressure of the participants. With the exception of height, all mean values increased with age, with the ≥ 24-year-old group having the highest values, which were significantly greater than those of either one or both younger age groups.

Nearly half of students were classified as having a normal BMI, 18.2% were overweight and 6.5% were obese (Table III). Nearly one-third were classified as being underweight and a large percentage (20.8%) had a height for age less than the 5th percentile, which may be indicative of early stunting. Few students had elevated systolic or diastolic readings, smoked cigarettes or took snuff.

Significant differences were noted between the two BMI categories with regard to number of children, matric results, WC and WHR variables (Table IV). More students in the overweight category (BMI ≥ 25) had children, lower matric scores, a WHR ≥ 0.8, and a WC ≥ 88 cm. Although the difference was not significant, more older students fell in the overweight category.

Table II. Anthropometric and blood pressure values (mean ± SD) of first-year female students at the University of the North

	Age of students (yrs)			
Measure	≤ 18 (N = 99)	19 - 23 (N = 92)	≥ 24 (N = 40)	All ages (N = 231)
Weight (kg)*	56.1 ± 11.4	57.1 ± 10.2	61.1 ± 10.7	57.8 ± 11.3
Height (cm)	158.8 ± 5.9	159.8 ± 5.7	158.5 ± 5.4	159.1 ± 5.8
BMI†	22.4 ± 4.1	22.6 ± 3.5	24.3 ± 5.2	22.8 ± 4.1
Waist (cm)*	68.8 ± 8.5	69.1 ± 6.6	74.3 ± 10.3	69.9 ± 8.3
Hip (cm)†	91.8 ± 8.7	92.6 ± 7.1	95.9 ± 11.2	92.8 ± 8.7
Waist-hip ratio*	0.74 ± 0.05	0.75 ± 0.04	0.77 ± 0.05	0.75 ± 0.04
Systolic BP*	100.9 ± 9.0	103.0 ± 8.3	110.4 ± 18.5	103.5 ± 11.5
Diastolic BP* (mm/Hg)	66.4 ± 7.2	66.8 ± 6.8	72.8 ± 12.3	67.7 ± 8.5

* Age group ≥ 24 years differs significantly from other two groups (Bonferroni, $P < 0.05$).
† Age group ≥ 24 years differs significantly from ≤ 18-year-old group (Bonferroni, $P < 0.05$).

Table III. Percentage students falling within defined categories for BMI, WHR, WC, height and blood pressure

Categories	%
BMI	
< 20 (underweight)	26.8
20 - 24.9 (normal)	48.5
25 - 29.9 (overweight)	18.2
≥ 30 (obese)	6.5
WHR	
< 0.8 (normal)	87.0
≥ 0.8 (android)	13.0
WC	
< 88 cm	95.6
≥ 88 cm (excess fat)	4.4
Height (percentile)*	
< 5th	20.8
≥ 5th	79.2
< 95th	98.7
≥ 95th	1.3
Blood pressure (mmHg)	
Systolic < 140	88.4
Systolic ≥ 140	1.6
Diastolic < 90	88.4
Diastolic ≥ 90	1.6

*National Centre for Health Statistics percentiles (18 years).[44]
BMI = body mass index;[15] WHR = waist-hip ratio;[18] WC = waist circumference.[20]

Nearly one-fifth (17.7%) of students were classified as being moderately to severely depressed (Table V). Beck scores were positively (though weakly) related to matric results ($r = 0.187$, $P = 0.004$) and inversely related to socio-economic status ($r = -0.193$, $P = 0.006$) (Table VI). BMI and WC were positively correlated with blood pressure ($r = 0.320$, $P = 0.0001$) and age ($r = 0.344$, $P = 0.0001$). There was also a positive relationship between WHR and blood pressure (systolic: $r = 0.242$, $P = 0.0009$; diastolic: $r = 0.224$, $P = 0.002$) and with age ($r = 0.197$, $P = 0.002$).

Table IV. A comparison of female students with a BMI < 25 and students with a BMI ≥ 25

	BMI < 25	BMI ≥ 25	Chi-square P-value
Residence	%	%	
Urban	36.1	37.5	0.844
Rural	63.9	62.5	
No. of children			
0	77.2	57.2	0.002*
1	16.4	21.4	
≥ 2	6.4	21.4	
Age (yrs)			
≥ 18	45.4	35.1	0.099
19 - 23	40.2	38.6	
≥ 24	14.4	26.3	
Matric results (%)			
≥ 60	12.6	12.3	0.001*
50 - 60	55.2	29.8	
< 50	32.2	57.9	
Height (NCHS)			
< 5°	21.8	17.5	0.488
≥ 5°	78.2	82.5	
< 95°	98.8	98.3	0.726
≥ 95°	1.2	1.7	
WHR and WC			
< 0.8	92.0	71.9	0.000*
≥ 0.8	8.0	28.1	
WC < 88 cm	100.0	82.1	0.001*
WC ≥ 88 cm	0.0	17.9	
Diastolic BP (mmHg)			
< 90	98.5	98.0	0.817
≥ 90	1.5	2.0	
Systolic BP (mmHg)			
< 140	98.5	98.0	0.817
≥ 140	1.5	2.0	
Beck score			
0 - 15	67.2	66.7	0.408
≥ 16	32.8	33.3	

* $P < 0.01$.
BMI = body mass index; NCHS = National Centre for Health Statistics.

Table V. Psychological well-being of first-year female students using the BDI*

Beck* category	N = 231	%
Normal (0 - 9)	94	40.7
Mildly depressed (10 - 15)	61	26.4
Mildly to moderately depressed (16 - 19)	35	15.2
Moderately to severely depressed (20 - 29)	31	13.4
Severely depressed (≥ 30)	10	4.3

* Beck Depression Inventory.[23]

Few subjects had normal biochemical values (Table VII). Only 3.8% had a cholesterol value above 5.2 mmol/l. However, anaemia (haemoglobin concentration (Hb) < 11.5 g/dl) and microcytosis (mean corpuscular volume (MCV) < 80 fl) were prevalent in 15.4% and 24.6% of women, respectively. A large percentage of subjects had iron status indices below cut-off values: 38.5% had low serum iron and 27.3% had low ferritin values. Hyperferritinaemia, indicating iron overload, was not observed in this group. Mean values for haematocrit, ferritin and triglycerides were significantly greater in the older group but should be interpreted with caution because of the small sample size.

Discussion

There is a paucity of data on nutritional status and related health factors for young black women in South Africa. One of the most recent studies on urban black women reported that 12.9% of 15 - 24-year-olds and 30.6% of 25 - 34-year-olds had a

Table VI. Correlation matrices* for Beck scores, height, BMI, WC, WHR, blood pressure, matric scores, and age and socio-economic status of female students (N = 231)

	Beck score	Height	BMI	WC	WHR	Diastolic BP	Systolic BP	Matric score	Age	Socio-economic status
Beck score										
r	1.000	-0.056	0.001	0.002	-0.045	-0.083	-0.018	0.187	-0.107	-0.193
P	0.0	0.3928	0.9783	0.9694	0.4996	0.2570	0.8005	0.0042†	0.1037	0.0064†
Height										
r		1.000	0.011	0.160	0.026	0.070	0.061	0.095	0.001	-0.067
P		0.0	0.8634	0.0155	0.6909	0.3410	0.4055	0.1466	0.9828	0.3481
BMI										
r			1.000	0.876	0.311	0.302	0.320	0.117	0.344	-0.054
P			0.0	0.0001‡	0.0001‡	0.0001‡	0.0001‡	0.0764	0.0001‡	0.4506
WC										
r				1.000	0.615	0.328	0.324	0.170	0.378	-0.111
P				0.0	0.0001‡	0.0001‡	0.0001‡	0.0100†	0.0001‡	0.1221
WHR										
r					1.000	0.224	0.242	0.109	0.197	-0.084
P					0.0	0.0023†	0.0009‡	0.1014	0.0028‡	0.2385
Diastolic BP										
r						1.000	0.793	0.093	0.247	-0.066
P						0.0	0.0001‡	0.2027	0.0007‡	0.4118
Systolic BP										
r							1.000	0.136	0.280	-0.148
P							0.0	0.0635	0.0001‡	0.0678
Matric										
r								1.000	0.232	-0.121
P								0.0	0.0004‡	0.0881
Age										
r									1.000	-0.151
P									0.0	0.0332
Socio-economic status										
r										1.000
P										0.0

* Pearson's product-moment correlation coefficients.
† $P < 0.01$.
‡ $P < 0.001$.
BMI = body mass index; WC = waist circumference; WHR = waist-hip ratio; BP = blood pressure.

Table VII. Haematology and biochemistry of blood samples of first-year female students

	Age (yrs)					
	All (N = 62)	≤ 18 (N = 27)	19 - 23 (N = 26)	≥ 24 (N = 9)	Cut-off points*	%
Red blood cells (x 10^{12}/l)	4.7 ± 1.1	4.5 ± 0.9	4.8 ± 1.3	5.0 ± 1.6	< 3.9	9.7
Haemoglobin (g/dl)	13.1 ± 2.4	13.2 ± 1.9	13.3 ± 2.9	12.4 ± 1.8	< 11.5	14.5
Haematocrit (%)†	44.5 ± 42.0	38.7 ± 4.8	39.5 ± 8.4	76.7 ± 108	< 36.0	28.1
					> 48.0	8.8
MCV (fl)	83.6 ± 7.6	84.4 ± 7.3	83.3 ± 7.1	82.1 ± 9.9	< 80.0	24.6
MCH (pg)	27.2 ± 6.3	27.6 ± 6.3	27.0 ± 6.3	26.5 ± 6.9	< 27.0	29.8
MCHC (g/dl)	33.5 ± 2.9	33.9 ± 1.6	33.7 ± 2.2	31.7 ± 5.9	< 20.0	1.8
Serum iron (μmol/l)	13.3 ± 6.9	13.0 ± 6.9	14.1 ± 7.5	11.4 ± 5.3	< 10.0	38.5
					> 30.0	0.0
Ferritin (μg/l)†	28.4 ± 22.2	21.7 ± 19.0	29.7 ± 21.8	44.1 ± 31.5	< 15.0	27.3
					> 150.0	0.0
Transferrin (g/l)	2.9 ± 0.6	2.8 ± 0.6	2.9 ± 0.7	2.9 ± 0.8	< 2.0	5.0
					> 4.0	7.3
Total cholesterol (mmol/l)	3.5 ± 0.8	3.3 ± 8.8	3.5 ± 0.7	4.0 ± 0.8	> 5.2	3.8
Triglycerides (mmol/l)†	0.6 ± 0.2	0.6 ± 0.2	0.6 ± 0.1	0.9 ± 0.3	> 1.8	0.0
Glucose (mmol/l)	4.1 ± 0.6	4.0 ± 0.7	4.0 ± 0.5	4.3 ± 0.4	> 6.0	0.0

* References 23 and 24 were used.
† Age group ≥ 24 years differs significantly from other two groups (Bonferroni, $P < 0.05$).
MCV = mean corpuscular volume; MCH = mean corpuscular haemoglobin; MCHC = mean corpuscular haemoglobin concentration.

BMI ≥ 30.[4] In the present study only 6.5% of women were found to be obese. However, nearly double the number of subjects in the older group (≥ 24 years) were overweight. Mean values for BMI were also significantly greater in the older group.

In the USA obesity has been reported in 25% of black girls aged 12 - 17 years and super-obesity in 12%.[26] Obesity in this age group has increased by 120% in less than a decade.[27] Bellisle *et al.*[28] reported on the weight status of 16 486 university students in 21 European countries in 1995. Average BMI values for women ranged from 20.2 (Switzerland) to 21.3 (Scotland). Only 8% of European students were classified as overweight (BMI ≥ 25), compared with 24.7% in this study. It would appear, therefore, that the prevalence of overweight in black South African women is higher than in their European counterparts, but has not yet reached the endemic proportions of the USA.

Obesity is known to be one of the most important risk factors contributing to hypertension.[29] Individuals with hypertension have 2 - 3 times the risk of CHD and 7 times the risk of stroke.[30] It has been reported that hypertension is prevalent in 25% of black adults in Durban,[31] and that stroke has been reported in 4% of all hospital admissions in Africa.[32] In the present study there was a significant increase in obesity and increased blood pressure with age. In addition there was a positive correlation between BMI, which reflects general obesity, and blood pressure (diastolic and systolic).

Android obesity is generally evaluated by WHR and WC. A high WHR is associated with increased mortality due to cardiovascular disease or diabetes and high levels of blood pressure, insulin and lipids.[33-35] However, this evidence is based primarily on epidemiological studies of white populations and the use of WHR and WC as risk factors for cardiovascular disease in black women has been questioned.[36] In the present study there was a positive, though weak, correlation between WHR and WC with blood pressure. Although few subjects were hypertensive this finding is significant, particularly in view of the fact that hypertension and stroke are prevalent in the black population.[36]

Nearly one-fifth of students in the present study appeared to be moderately to severely depressed. This finding has also been reported in freshmen from 600 institutions in the USA.[37] Women reported more stress and depression than men; 12% reported frequent depression and 33% reported frequently feeling overwhelmed.[37] It was also interesting to note that in the present study Beck scores were inversely related to socio-economic status.

Socio-economic status has been found to play a significant role in the weight status of black women.[38] Those at greatest risk of obesity in the USA are reported to be poor black women and teenage girls.[38] Similar findings have been reported in developing countries such as Curacao[39] and Brazil.[40] In Curacao women of low socio-economic status were found to be at the greatest risk of an increased BMI, WHR and WC. It was difficult to determine a relationship with income in this study as many of the girls reported that they did not know their household income. However it would appear that the majority of students had a family income of less than R1 600 per month. According to Kumanyika,[41] multiple pregnancies in black women of low socio-economic status, particularly teenagers, also contribute to the prevalence of obesity in this population. In this study there was a significant positive relationship between weight status and parity. Twenty-one per cent of women who had two or more children were overweight. The large percentage of overweight among women with the lowest matric results is difficult to explain, but could be associated with poverty and poor socio-economic conditions.

Few students in the present study had abnormal cholesterol, triglyceride, or glucose values. However, anaemia was present in 15% of the subjects. Iron deficiency was probably the main reason for anaemia in this group since a large percentage had biochemical evidence of low iron status: low serum ferritin values reflecting depleted iron stores, low serum iron values reflecting latent iron deficiency erythropoiesis, and microcytosis indicating characteristic later stage changes of erythrocytes.[42] These results are similar to those for 11 - 14-year-old black girls examined in a rural area of the Northern Province.[43]

Positive health findings among this population in terms of chronic diseases of lifestyle (particularly CHD) were low prevalence of hypertension, low reported nicotine usage and absence of dyslipidaemia. Risk for CHD is known to be increased by high blood pressure, high serum cholesterol and cigarette smoking.[2] Negative findings, however, were the high prevalence of overweight, particularly central abdominal adiposity, and high prevalence of depression, which may be indicative of stress.

In conclusion, we found that black female students younger than 24 years of age exhibited few risk factors associated with chronic diseases of lifestyle. However in the older women (≥ 24 years) there were significant increases in BMI, WHR, WC and blood pressure. A large number of students of all ages exhibited moderate to severe depression and anaemia was prevalent.

References

1. Murray CJL, Lopez AD. *The Global Burden of Disease.* Cambridge, Mass.: Harvard School of Public Health, Harvard University Press, 1996.
2. World Health Organisation Study Group. *Diet, Nutrition, and the Prevention of Chronic Diseases.* Geneva: WHO, 1990: 46-47.
3. Central Statistical Services. *The People of South Africa.* Population Census, 1996. Census in Brief. Report No 1: 03-01-11. Pretoria: Government Printer, 1996.
4. Steyn K, Jooste PL, Bourne L, *et al.* Risk factors for coronary heart diseases in the black population of the Cape Peninsula. The BRISK Study. *S Afr Med J* 1991; **79:** 480-485.
5. De Villiers MA, Albertse EC, McLachlan MH. The prevalence of obesity and hypertension in a remote rural area. *S Afr J Sci* 1988; **84:** 601-602.
6. Walker ARP, Walker BF, Walker AJ, Voster HH. Low frequency of adverse sequelae of obesity in South African rural black women. *Int J Vitam Nutr Res* 1989; **59:** 224-228.
7. Steyn NP, Nel JH, Tichelaar HY, *et al.* Malnutrition in Pedi preschool children, their siblings and caretakers. *S Afr Med J* 1994; **7:** 12-18.
8. Walker ARP. Obesity — anything new? *S Afr Med J* 1997; **87:** 583-584.
9. Walker ARP, Walker BF, Manetsi B, Tsotetsi NG, Walker AJ. Obesity in black women in Soweto, South Africa: minimal effects on hypertension, hyperlipidaemia and hyperglycaemia. *J R Soc Health* 1990; **110:** 101-103.
10. Flynn MAT, Gibney MJ. Obesity and health: why slim? *Proc Nutr Soc* 1991; **50:** 413-432.
11. Bray GA, York B, De Lany J. A survey of the opinions of obesity experts on the causes and treatment of obesity. *Am J Clin Nutr* 1992; **55:** 1515-1545.
12. Pi-Sunyer FX. Medical hazards of obesity. *Ann Intern Med* 1993; **119:** 655-660.
13. Lee RD, Nieman DC. *Nutritional Assessment.* Oxford: Brown and Benchmark, 1993: 121-164.
14. Bastow MD. Anthropometrics revisited. *Proc Nutr Soc* 1982; **41:** 381-388.
15. Jéquier E. Energy, obesity and body weight standards. *Am J Clin Nutr* 1987; **45:** 1035-1047.
16. D'Arrigo T. New obesity guidelines reclassify 29 million Americans as overweight. *Diabetes Forecast* 1998; September: 60-61.
17. Krotkiewski M, Björntorp P, Sjoström L, Smith U. Impact of obesity on metabolism in men and women. *J Clin Invest* 1983; **72:** 1150-1162.
18. Bray GA, Gray DS. Obesity. Part 1. Pathogenesis. *Western J Med* 1988; **149:** 429-441.
19. Division of Noncommunicable Diseases. *Obesity — Preventing and Managing the Global Epidemic.* Geneva: World Health Organisation, 1997: 48-49.
20. Vanltallie TB. Waist circumference: A useful index in clinical care and health promotion. *Nutr Rev* 1998; **56:** 300-302.
21. World Health Organisation. Arterial hypertension. Report of a WHO expert committee. *World Health Organ Tech Rep Ser* 1978; No. 628.
22. Opie LH. Hypertension. In: Fourie J, Steyn K, eds. *Chronic Diseases of Lifestyle in South Africa.* Cape Town: MRC, 1995: 37-50.
23. Beck AT, Beamesderfer A. Assessment of depression: The Depression Inventory. In: Pichot P, ed. *Modern Problems in Pharmacopsychiatry.* Basel: Karger, 1974: 151-169.
24. Marshall WA. *Clinical Chemistry.* London: Mosby, 1995.
25. Hoffbrandt AV, Pettit GE. *Essential Haematology.* 3rd ed. London: Blackwell, 1993.
26. Gortmaker SL, Dietz WH, Sobal AM, Wehler CA. Increasing pediatric obesity in the United States. *Am J Dis Child* 1987; **141:** 535-540.
27. Melnyk MG, Weinstein E. Preventing obesity in black women by targeting adolescents: a literature review. *J Am Diet Assoc* 1994; **94:** 536-540.
28. Bellisle F, Monneuse M-O, Steptoe A, Wardle J. Weight concerns and eating patterns: A survey of university students in Europe. *Int J Obes* 1995; **19:** 723-730.
29. Beilin LJ. Non-pharmacological management of hypertension: optimal strategies for reducing cardiovascular risk. *J Hypertens* 1994; **12:** suppl 10, 571-581.
30. Castelli WP. Cardiovascular disease and multifactorial risk: challenge of the 1980s. *Am Heart J* 1983: **106:** 1191-1200.
31. Seedat YK, Seedat MA. An inter-racial study of the prevalence of hypertension in an urban South African population. *Trans R Soc Trop Med Hyg* 1982; **76:** 62-71.
32. Osuntokun BO. Stroke in the Africans. *Afr J Med Med Sci* 1997: **6:** 39-53.
33. Kannel WB, Cupples LA, Ramaswami R, Stokes J, Kreger BE, Higgins M. Regional obesity and risk of cardiovascular disease; the Framingham Study. *J Clin Epidemiol* 1991; **44:** 183-190.
34. Higgins M, Kannel W, Garrison R, Prinsky J, Stokes J. Hazards of obesity — the Framingham experience. *Acta Med Scand Suppl* 1988; **723:** 23-26.
35. Björntorp P. The associations between obesity, adipose tissue distribution and disease. *Acta Med Scand Suppl* 1988; **723:** 121-134.
36. Croft JB, Keenan NL, Sheridan DP, Wheeler FC, Speers MA. Waist-to-hip ratio in a biracial population: Measurement, implications, and cautions for using guidelines to define high risk for cardiovascular disease. *J Am Diet Assoc* 1995; **95:** 60-64.
37. Sax LJ. Health trends among college freshmen. *Health Trends* 1997; **45:** 252-262.
38. Sobal J, Stunkard AJ. Socioeconomic status and obesity: a review of the literature. *Psychol Bull* 1989; **22:** 89-96.
39. Grol MEC, Eimers JM, Alberts JF, *et al.* Alarmingly high prevalence of obesity in Curacao: data from an interview survey stratified for socio-economic status. *Int J Obes* 1997; **21:** 1002-1009.
40. Monteiro CA, Mondini L, Medeiros de Souza AL, Popkin BM. The nutrition transition in Brazil. *Eur J Clin Nutr* 1995; **49:** 105-113.
41. Kumanyika S. Obesity in black women. *Epidemiol Rev* 1987; **9:** 31-50.
42. Bothwell TM, Charlton RW, Cook JD, Finch CA. *Iron Metabolism in Man.* Oxford: Blackwell Scientific Publications, 1979.
43. Badenhorst CJ, Steyn NP, Jooste PL, Nel JH, Kruger M, Oelofse A, Barnard C. Nutritional status of Pedi schoolchildren aged 6 - 14 years in two rural areas of Lebowa: a comprehensive nutritional survey of dietary intake, anthropometric, biochemical, haematological and clinical measurements. *S Afr J Food Sci Nutr* 1993; **5:** 112-119.
44. Hamill PW, Drizd TA, Johnson CL, Reed PB, Roche AF, Moore WM. Physical growth: National Center for Health Statistics percentiles. *Am J Clin Nutr* 1979; **32:** 607-629.

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