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Noncommunicable Disease Conditions and HIV in Rural and Urban South Africa: 2005-2015

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Purpose: Hypertension, obesity, hyperlipidemia, and type 2 diabetes contribute primarily to noncommunicable disease deaths and together with human immunodeficiency virus contribute largely to mortality in South Africa. Our longitudinal study provides the necessary data and insights over a 10-year period to highlight the areas where improved management is required in urban and rural localities.

Methods: This study included 536 rural and 387 urban Black participants aged 32 to 93 years from the North-West province, South Africa. Disease prevalence, treatment, and control were determined in 2005 and were re-evaluated in 2015. Multiple measures analyses were used to determine the trends of blood pressure and waist circumference.

Results: The initial prevalence of hypertension was 53.2%, obesity was 23.6%, hyperlipidemia was 5.1%, diabetes was 2.9%, and human immunodeficiency virus was 10.7% in 2005. By 2015, the rural population had higher rates of hypertension (63.7% versus 58.5%) and lower rates diabetes (4.3% versus 7.9%) and hyperlipidemia (6.6% versus 18.0%) with similar obesity rates (41.7% versus 42.4%). The average blood pressure levels of urban hypertensives decreased ($P_{trend}<.001$), whereas levels were maintained in the rural group ($P_{trend}=.52$). In both locations, treatment and control rates increased from 2005 to 2015 for all conditions (all $\geq$6.7%), except for diabetes in which a decrease in control was observed. Waist circumference increased ($P_{trend}>.001$) in both sex and locality groups over the 10-year period.

Conclusion: Although average blood pressure of urban hypertensive individuals decreased, urgent measures focused on early identification, treatment, and control of the respective conditions should be implemented to decrease the burden of noncommunicable diseases. *Ethn Dis.* 2023;33(2/3):108–115; doi:10.18865/ed.33.2-3.108

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Introduction

In low- and middle-income countries, socioeconomic development, urbanization, and acculturation contribute to an increase in cardiovascular risk factors and noncommunicable disease (NCD) conditions, with known differences in risk factor prevalence between rural and urban settings.[1] Compared with high-income countries, cardiovascular disease occurs at a younger age in sub-Saharan Africa, where common NCDs, such as type 2 diabetes (T2DM), hyperlipidemia, and hypertension, are often underdiagnosed.[2–4]

Mortality data from South Africa show that the national contribution of deaths due to NCD was 42.9% in 2005 but gradually increased to 55.5% by 2015, while communicable disease mortality rates decreased from 48.1% to 33.1% over the same period.[5] This double burden of disease is a strain on the national health care system. Although publications exist indicating the estimated prevalence and treatment rates of hypertension,[6] T2DM,[7] hyperlipidaemia,[8] and human immunodeficiency virus (HIV)[9] in South Africa, we intend to provide additional insight on the matter. Longitudinal data on the prevalence and development of NCDs and HIV, which contribute significantly to disease-related mortality rates in South Africa, are limited.[8,10] The purpose of our study was to investigate changes in prevalence, treatment, and control rates of NCDs and HIV and the impact of treatment on these conditions within a Black rural and urban South African population over a 10-year period. This information will provide insight into the state of rural and urban community health, the rate of development of these conditions, and the management of these conditions in the respective areas.

Methods

Methodology

This study is part of the multinational Prospective Urban and Rural Epidemiological (PURE) study investigating the NCD risk of urban and rural populations.[11] As part of the South African leg of the international PURE study, Black rural and urban participants were recruited from the North West province. Details of the design and methods have been published previously.[12] Permission for the execution of the study was obtained from the North West Department of Health, the local authorities, and tribal Chief from each specific rural area included in the study. The study protocol was approved by the Health Research Ethics Committee of the North-West University in Potchefstroom, South Africa, and complied with the Declaration of Helsinki. Written informed consent was obtained from each participant before participating in any of the research activities.

Study Population

In 2005, 2010 participants (rural n=1004, urban n=1006) aged 29 years and older participated in the study. During the 10-year period, 358 participants died, 923 (urban n=387, rural n=536 rural) returned for follow-up measurements, and 726 participants were lost to follow-up.

Blood Sampling and Biochemical Analyses

A registered nurse collected blood samples from the participants' antebrachial vein branches. Serum samples were used to determine total cholesterol (TC), triglycerides, and high-density lipoprotein (HDL) cholesterol with a Konelab20i autoanalyzer (Thermo Fisher Scientific Oy, Vantaa, Finland) in 2005 and a Cobas Integra 400 Roche Clinical System (Roche Diagnostics, Indianapolis, Indiana) in 2015. Low-density lipoprotein (LDL) cholesterol was calculated with the Friedewald formula.[13] By using whole-blood (EDTA) samples, glycated hemoglobin A1c (HbA1c) was determined with the D-10 Haemoglobin testing system from Bio-Rad (Bio-Rad Laboratories Ltd, Hercules, California, 220-0101). This method was based on ion-exchange high-performance liquid chromatography. Fasting glucose levels were determined from sodium fluoride samples by means of an enzymatic reference method with hexokinase using a Vitros DT6011 Chemistry Analyzer (Ortho-Clinical Diagnostics, Rochester, New York) in 2005 and the Cobas Integra 400 Roche Clinical System (Roche Diagnostics, Indianapolis, Indiana) in 2015.

HIV status was determined from whole-blood samples using the First Response rapid HIV card test (Premier Medical Corporation Ltd, Daman, India). When a positive result was observed, the test was confirmed with a Pareeshak card test (BHAT Bio-tech, India) in 2005, a SD BIOLINE HIV 1/2 3.0 card test (Standard Diagnostics, Inc, Korea) in 2010, and an ABON test kit (Biopharm Corporation, Ltd, Hangzhou, China) in 2015.

Anthropometric Measurements

Standardized procedures were used to obtain all anthropometric measurements (height, weight, and waist circumference [WC]).[14,15] Stature was measured with a stadiometer (Invicta Stadiometer, IP 1465, London, United Kingdom) in 2005 and a Leicester height measure (Seca, Birmingham, United Kingdom) in 2015, body mass was measured with a Precision health scale (A & D Company, Tokyo, Japan), and WC was measured with an unstretchable flexible metal tape (Holtain, Crosswell, Wales, United Kingdom [2005] and Lufkin, Cooper tools, Apex, North Carolina [2015]).[15,16] Body mass index (BMI) was calculated for each participant.

Cardiovascular Measurements

Trained observers measured seated brachial systolic blood pressure (SBP) and diastolic blood pressure (DBP) with the validated OMRON HEM-757 in 2005 and 2010 and the OMRON M6 (Omron Healthcare, Kyoto, Japan) in 2015. Participants were required to rest for 10 minutes before beginning the first measurement; measurements were repeated after a 5-minute rest. For statistical analyses, only the second blood pressure measurement was considered.

Questionnaires

Trained field workers collected information on socioeconomic and demographic information, current health status, and medication in the participant's native language using standardized questionnaires.

Classification of Hypertension, T2DM, and Obesity

The South African national hypertension,[17] T2DM,[18] and hyperlipidaemia[19] guidelines, corresponding with international guidelines,[20–22] were used to classify individuals into blood pressure, glucose, and lipids groups. Based on blood pressure, individuals were classified as hypertensive (SBP≥140 mmHg or DBP≥90 mmHg), prehypertensive (SBP≥130 to 139 mmHg or DBP≥85 to 89 mmHg), or normotensive (SBP≤129 mmHg and DBP≤84 mmHg). T2DM categories were determined using fasting glucose and/or HbA1c. Participants were classified as T2DM (glucose≥7.0 mmol/L and HbA1c≥7.0%), prediabetic (glucose≥6.1 mmol/L and HbA1c≤7.0 mmol/L), or desirable (glucose≤6.0 mmol/L). Individuals were classified with hyperlipidemia when they had elevated TC (≥5.0 mmol/L) and LDL (≥3.0 mmol/L) or elevated triglycerides (≥1.7 mmol/L) in combination with decreased HDL (men≤1.0 mmol/L and women≤1.2 mmol/L). Individuals already receiving medication for hypertension, T2DM,

Table 1. Change in the basic characteristics of the PURE South Africa cohort from 2005 to 2015

	Total group (N=2010)	Followed-up cohort (N=923)		
	2005	2005	2015	Mean change
Age, y	48 (14)	48 (14)	58 (13)	9.4
Women, n (%)	1253 (62.3)	648 (70.2)		—
Rural, n (%)	1006 (50.0)	536 (58.1)		—
Anthropometric measurements				
Body mass index, kg/m^2	23.0 (9.6)	23.9 (9.8)	25.0 (10.5)	3.35
Waist circumference men, cm	74.3 (11.5)	75.1 (21.9)	78.9 (19.0)	5.9
Waist circumference women, cm	81.0 (20.8)	80.8 (20.3)	91.2 (21.9)	12.1
Lipogram				
Total cholesterol, mmol/L	4.82 (1.86)	4.92 (1.87)	4.50 (1.53)	−0.46
High-density lipoprotein, mmol/L	1.42 (0.80)	1.42 (0.77)	1.25 (0.62)	−0.13
Low-density lipoprotein, mmol/L	2.78 (1.57)	2.87 (1.53)	2.57 (1.39)	−0.37
Triglycerides, mmol/L	1.08 (0.73)	1.09 (0.73)	1.09 (0.73)	0.03
Glycemic measures				
Glucose, mmol/L	4.8 (1.00)	4.8 (0.95)	5.1 (0.96)	0.47
Glycated hemoglobin A1c, mmol/L	5.5 (0.70)	5.6 (0.50)	5.6 (0.70)	0.19
Blood pressure measurements				
Systolic blood pressure, mmHg	130 (31)	130 (29)	131 (32)	1.9
Diastolic blood pressure, mmHg	87 (19)	88 (17)	84 (18)	−1.4
Prevalence rates of noncommunicable diseases				
Obesity (waist circumference), N (%)	415/2007 (20.7)	217/920 (23.6)	383/912 (42.0)	18.4
Hyperlipidemia, N (%)	87/1889 (4.6)	45/878 (5.1)	92/831 (11.1)	6.0
Type 2 diabetes, N (%)	53/1846 (2.9)	27/845 (3.2)	49/841 (5.8)	2.6
Hypertension, N (%)	1054/1997 (52.8)	487/916 (53.2)	554/901 (61.5)	8.3
Prevalence rates of communicable diseases				
Human immunodeficiency virus, N (%)	322/1998 (16.1)	99/918 (10.7)	166/921 (18.0)	7.3

Values reported are the median (interquartile range) or the number of participants (percentage)

and/or hyperlipidemia were classified as hypertensive, diabetic, or hyperlipidemic irrespective of their current blood pressure, glucose, or lipid results. The World Health Organization's[23] recommended BMI and WC cutoffs for men and women were used to classify the individuals as obese (a WC in men of ≥102 cm and in women of ≥88 cm or a BMI of ≥30.0 kg/m^2), overweight (a WC in men of ≥94.0 to 101.9 cm and in women ≥80.0 to 87.9 cm or a BMI of ≤29.9 to ≥25.0 kg/m^2), or desirable (a WC in men of <94 cm and in women of <80 cm or a BMI of ≤24.9 to 18.5 kg/m^2).

Treatment effectiveness was determined if the individual reported receiving treatment in the past month for a specific condition and was classified as controlled when they had a blood pressure of SBP<140 mmHg and DBP<90 mmHg while receiving antihypertensive medication, if they had an LDL level of less than 5.0 mmol/L while receiving statin medication, and if they had an HbA1c level of less than <7% while receiving diabetic medication.

Statistical Analyses

IBM SPSS Statistics version 23.0 (IBM Corporation, Chicago, Illinois) and GraphPad Prism version 5.03 (GraphPad Software, Inc, San Diego, California) were used for all statistical analyses and preparation of graphs. Group median, interquartile range, or frequency and percentage as well as mean change were determined and used for follow-up comparisons (2005 versus 2015). Repeated measures analyses were used to assess possible time trends for blood pressure and WC. Due to the small number of men classified as either obese or overweight, these individuals were grouped together for statistical analysis. Repeated measures analyses could not be performed in the glucose and hyperlipidemia groups due to the small number of participants classified as diabetic or hyperlipidemic. A two-sided P-value of <.05 was considered statistically significant.

Results

Table 1 reports the basic characteristics of the participants, which include the prevalence rates of the total group and followed-up participants with the mean changes observed in the respective variables over the 10-year period.

Table 2. Change in the prevalence, treatment, and regulation of the conditions for PURE South Africa study participants from 2005 to 2015 by locality

	Rural (N=536)			Urban (N=387)		
	2005	2015	Change	2005	2015	Change
Obesity						
Overweight (BMI), N (%)	103/536 (19.2)	121/529 (22.9)	3.7	78/387 (20.2)	79/377 (21.0)	0.8
Obese (BMI), N (%)	118/536 (22.0)	142/529 (26.8)	4.8	104/26.9 (26.9)	113/377 (30.0)	3.6
Abdominally overweight (WC), N (%)	76/533 (14.3)	86/532 (16.2)	1.9	65/387 (16.8)	67/387 (17.6)	0.8
Abdominal obesity (WC), N (%)	119/533 (22.3)	222/533 (41.7)	19.4	98/380 (25.3)	161/380 (42.4)	17.1
Hyperlipidemia						
Hyperlipidemia, N (%)	26/510 (5.1)	33/503 (6.6)	1.5	19/368 (5.1)	59/328 (18.0)	12.9
Statin medication, N (%)	0/26 (0.0)	10/33 (30.3)	30.3	1/19 (5.2)	33/59 (55.9)	50.7
Controlled hyperlipidemia, N (%)	—	7/10 (70.0)	70.0	0/1 (0.0)	19/33 (57.6)	57.6
Diabetes						
Prediabetic range, N (%)	19/503 (3.7)	54/487 (11.0)	7.3	29/342 (13.2)	33/354 (17.2)	4.0
Diabetic range, N (%)	11/503 (2.1)	21/487 (4.3)	2.2	16/342 (4.7)	28/354 (7.9)	3.2
Diabetic medication, N (%)	1/11 (9.1)	17/21 (80.9)	71.8	8/16 (50.0)	23/28 (82.1)	32.1
Controlled diabetes, N (%)	1/1 (100)	4/17 (23.5)	−76.5	5/8 (62.5)	7/23 (26.9)	−35.6
Hypertension						
Prehypertensive, N (%)	84/531 (15.7)	49/523 (9.4)	−6.3	50/385 (13.0)	30/378 (7.9)	−5.1
Hypertension, N (%)	251/531 (47.3)	333/523 (63.7)	16.4	236/385 (61.3)	221/378 (58.5)	−2.8
Hypertension medication, N (%)	69/251 (27.5)	165/333 (49.5)	22.0	69/236 (29.2)	119/221 (53.8)	24.6
Controlled hypertension, N (%)	23/69 (33.3)	66/165 (40.0)	6.7	21/69 (30.4)	77/119 (64.7)	34.3
Human immunodeficiency virus						
Human immunodeficiency virus, N (%)	56/535 (10.5)	95/535 (17.8)	7.3	43/383 (11.2)	71/386 (18.4)	7.2
Antiretroviral treatment, N (%)	0/56 (0)	64/95 (67.4)	67.4	0/43 (0)	49/71 (69.0)	69.0

Values are reported as number of participants (percentage). The following classifications were used: hypertensive (systolic blood pressure≥140 mmHg or diastolic blood pressure≥90 mmHg) or prehypertensive (systolic blood pressure≥130 to 139 mmHg or diastolic blood pressure≥85 to 89 mmHg); diabetic (glucose≥7.0 mmol/L and glycated hemoglobin A1c≥7.0%) and prediabetic (glucose≥6.1 mmol/L and glycated hemoglobin A1c≤7.0 mmol/L); and hyperlipidemic with elevated triglycerides (≥5.0 mmol/L) and low-density lipoprotein (≥3.0 mmol/L) or elevated triglycerides (≥1.7 mmol/L) in combination with decreased high-density lipoprotein (men≤1.0 mmol/L and women≤1.2 mmol/L). Individuals already receiving medication for hypertension, diabetes, and/or hyperlipidemia were classified as hypertensive, diabetic, or hyperlipidemic irrespective of their current blood pressure, glucose, or lipid results. Body mass index and waist circumference cutoffs for men and women were used to classify the individuals as obese (waist circumference: men≥102 cm and women≥88 cm or body mass index≥30.0 kg/m^2) or overweight (waist circumference: men≥94.0 to 101.9 cm and women≥80.0 to 87.9 cm or body mass index≤29.9 to ≥25.0 kg/m^2)

BMI, body mass index; WC, waist circumference

Total Group versus Followed-Up Participants at Baseline (2005)

Compared with the total group, the baseline (2005) values of the followed-up participants included a larger percentage of women (62.3.1% versus 50.0%) and participants from the rural area (58.1% versus 50.0%). The median values of the anthropometric, lipogram, glycemic, and blood pressure variables as well as the prevalence of T2DM (2.9% versus 3.2%), hypertension (52.8% versus 53.2%), and hyperlipidemia (4.6% versus 5.1%) were relatable (less than 1% difference in prevalence) between the groups. However, the percentage of obese individuals (20.7% versus 23.6%) was lower in the total group, and a larger percentage of HIV-positive individuals was reported in the total group (16.1% versus 10.7%) than in the followed-up baseline participants.

Changes from 2005 to 2015 in the Followed-Up Participants

The SBP, triglycerides, anthropometric (BMI and WC), and glycemic (glucose and HbA1c) variable median values increased, whereas the median DBP and median levels of the majority of lipids (TC, HDL, and LDL) decreased from 2005 to 2015. The observed change in hyperlipidemia (baseline prevalence 5.1%, percentage change 6.0%) was more than the reported baseline prevalence, while obesity, hypertension, HIV, and T2DM prevalence increased by 18.4%, 8.3%, 7.3%, and 2.6% respectively.

When the basic characteristics of the followed-up participants were investigated by locality (data not shown). Similar observations to the total followed-up participants are reported for both areas apart from the blood pressure results, where an increase in SBP (126 to 133 mmHg; mean change 5.5 mmHg) was observed in the rural cohort, while SBP (134 to 128 mmHg; mean change −3 mmHg) and DBP (89 to 82 mmHg; mean change −6.3 mmHg) decreased in the urban cohort.

Prevalence, Treatment, and Control of the Disease Conditions by Locality

For most disease conditions, an increase in prevalence (Table 2) was

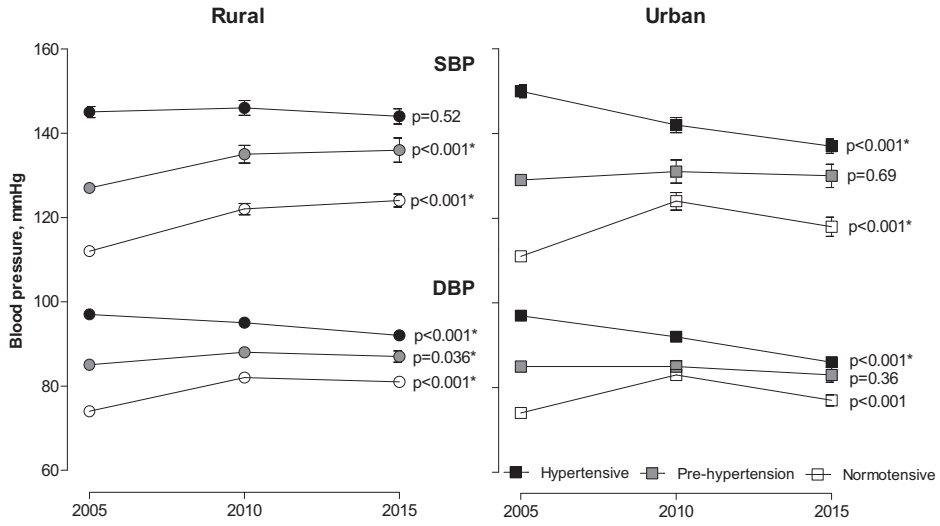

Figure 1. Average trend of systolic and diastolic blood pressures for 2005, 2010, and 2015 for hypertensive, prehypertensive, and normotensive groups, as classified at baseline by locality. Values are shown as group mean and standard error. P denotes the trend within participants; *P ≤.05 (2005 versus 2015)

observed from 2005 to 2015, except for the prevalence rates of prehypertension (13.0% versus 7.9%) and hypertension (61.3% versus 58.5%) in the urban area that decreased from 2005 to 2015. The biggest changes observed were in terms of the treatment rates observed for all conditions, with the smallest change being a 22% increase in blood pressure treatment in the rural cohort and the biggest change being a 69% increase in HIV treatment in the urban cohort. The percentage of individuals who reported using medication for their condition and presented with normal/controlled levels of the respective variables also increased from 2005 to 2015 in all conditions except for T2DM. Individuals reporting receiving treatment for T2DM increased, whereas the percentage of individuals with controlled glycemic levels (HbA1c≤7%) decreased (rural: 100% versus 23.5%; urban: 62.5% versus 26.9%) from 2005 to 2015 in both locations.

Trend in blood pressure and WC from 2005 to 2015 by locality

Figure 1 shows the blood pressure trend per blood pressure category (as determined at baseline) by locality from 2005 to 2015. In the rural cohort, only the DBP of hypertensives significantly decreased from 2005 to 2015, whereas a significant downward trend for both SBP and DBP was observed in the hypertensives from the urban areas. Figure 2 shows the trends for the different WC groups (as determined at baseline). An increase trend in WC was observed for all WC groups from 2005 to 2015, irrespective of locality. However, in the rural cohort, the trend incline was much steeper between 2010 and 2015.

Discussion

Rural and urban disparities regarding the prevalence of obesity, hyperlipidemia, T2DM, and hypertension were evident at study baseline in 2005. As expected, the prevalence rates increased over the 10-year study period with noteworthy changes in the rural area that led to obesity and hypertension prevalence being similar in both areas by 2015. Treatment and control rates for hyperlipidemia, hypertension, and HIV also improved substantially in both areas over the 10 years, which most likely contributed to the lower blood pressure and lipid values observed in 2015.

Change in Prevalence

As expected, the prevalence rates increased with aging in our participants over the 10 years. Weight gain and WC trends showed a steeper incline in the rural areas. This incline coincides with the opening of a large supermarket in the area, providing the community with much needed access to essential products but increasing the exposure to energy-dense, processed foods and items high in sugar, salt, and fat, such as sugar-sweetened beverages shown to be related to an increase in WC in our study population.[24] The increasing trend of mean WC observed across all the groups is of concern seeing that obesity is considered a primary risk factor for the development of T2DM[7,25] and hyperlipidemia.[8] Indeed, in our cohort, the majority of individuals that were classified with a diabetic (95%) or hyperlipidemic (85%) profile at follow-up were either overweight or obese. Excessive weight gain could therefore be regarded as a possible cocontributor

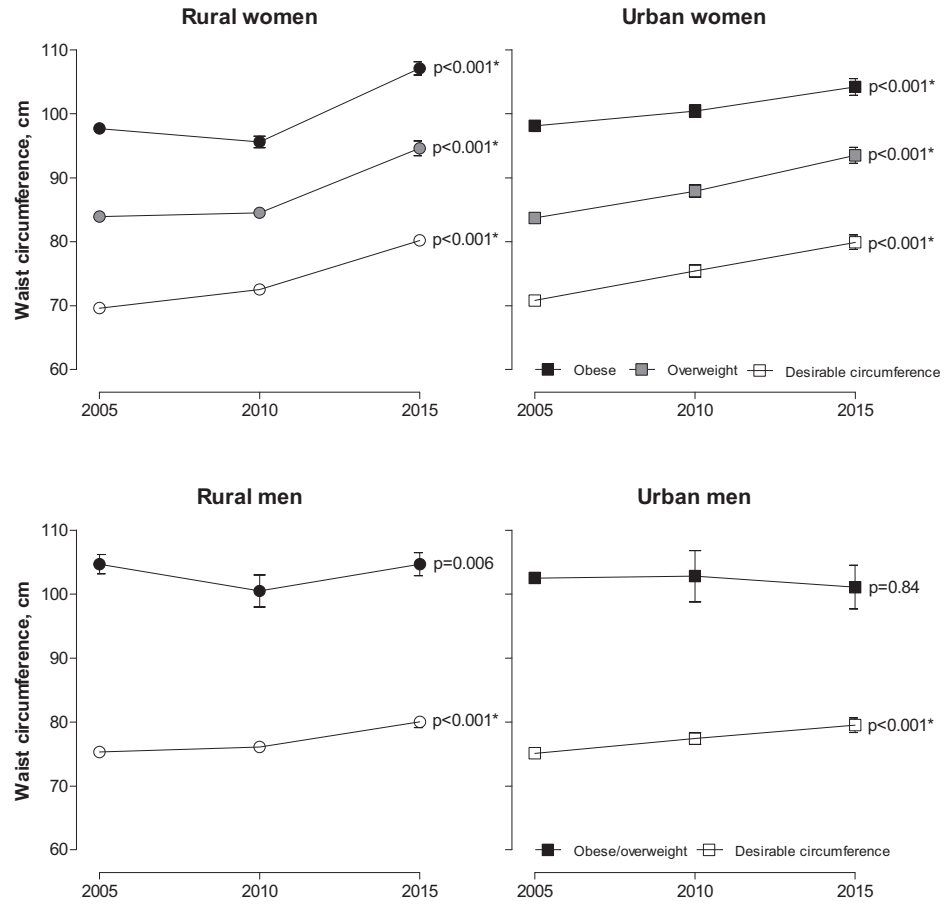

Figure 2. Mean waist circumference for abdominal fat categories as classified in 2005 stratified by locality and gender. Men were stratified into only two groups due to the small number of men classified as obese or overweight. Values are shown as group mean and standard error. The P value denotes a trend within participants; *P ≤.05 (2005 versus 2015)

for the increased prevalence seen in both T2DM and hyperlipidemia over the 10-year period. The reason for the large change (12.9%) observed for prevalence of hyperlipidemia in the urban population compared with the rural population (change of 1.5%) with similar obesity rates is unclear and requires additional investigation. Furthermore, the high hypertension prevalence observed at baseline and only 8% change indicate that hypertension development occurred earlier in our study cohort and often preceded the development of other conditions, with 49% of the hypertensive (baseline) individuals having no other co-occurring condition.

Treatment and Control

During the 10-year study observation period, several national policy changes were implemented regarding the treatment of the different conditions, with the most notable change observed in HIV treatment and rollout of HIV treatment. In 2005, antiretroviral treatment was recommended for all individuals that tested positive irrespective of their CD4 lymphocyte count,[26] which most likely contributed to the significant increase in HIV treatment observed from baseline to follow-up. In addition, cohort studies performed at health centers in rural Limpopo[27] and in periurban centers in Cape Town,[28] South Africa, found that community-based antiretroviral treatment programs held additional health benefits for HIV-infected persons. Both studies reported that HIV-infected persons receiving treatment were also more likely to use diagnostic testing and receive treatment as well as counselling regarding lifestyle modifications for T2DM, hypertension, and other chronic diseases due to regular health care visits.

Compared with the South African Demographic Health Survey,[29] our reported hypertension treatment rates (all <53.8%) were lower than their observed (82% to 87%) rates, while our control rates (all >30.4%) were much higher than the 10% at both baseline and follow-up. After further

investigation of the mean blood pressure trends of the participants classified as hypertensive at baseline, a clear downward trend was observed for both SBP and DBP in the hypertensive groups from the urban area only. This observation shows the beneficial impact of high treatment and control rates on the average blood pressure levels of hypertensive individuals in the urban area. There are many factors that could influence disparities in hypertension treatment and control rates between the areas under investigation. One of the drivers in our study cohort could have been the healthcare-seeking behavior of the urban participants, as van der Hoeven et al[30] pointed out that our urban study participants preferred visiting a medical practitioner in private practice instead of community health clinics, when possible, as they perceived the quality of care to be higher in these settings. Further investigation is, however, needed to determine if the observed increase in treatment and control of hypertension and hyperlipidemia in our urban areas was in fact due to this preference.

Additionally, our study reported high treatment rates ($\geq$80.9%) with poor control rates ($\leq$26.9) for individuals classified with T2DM at follow-up. Our treatment rates are lower and the control rates are higher than the 86% to 89% treatment and 15% control rates observed in the national survey conducted in 2016, which based diabetes classification mainly on HbA1c measurements.[29] The very low control rates observed at follow-up are not uncommon, as most studies conducted in South Africa report poor glycemic control among individuals with T2DM.[31,32] To better understand the poor diabetes control rates reported in T2DM patients, Mutyambizi et al[33] investigated diabetes self-care behaviors at two urban diabetes care clinics in Gauteng. They observed that adherence to physical activity, dietary diversity, and medication recommendations for management of glucose levels was suboptimal and varied significantly between socioeconomic groups. Therefore, they suggest that targeted approaches should be developed for different socioeconomic groups to ensure the development of healthier self-care habits by individuals with T2DM. James et al[34] investigated the effect of using trained community-based caregivers and several home-based screening methods on the management of hypertension and diabetes in a rural district of Kwazulu-Natal. In total, 10,832 individuals were screened. Of the individuals previously diagnosed with hypertension, 49.6% still had elevated blood pressure, while only 28.2% of individuals with diabetes had an elevated blood glucose level $\geq$11.0 mmol/L. Of the screened individuals, 21% and 1.5% of individuals were newly identified with elevated blood pressure and glucose levels. More than 90% of the individuals that reported to a health facility after receiving a referral letter by a community caregiver either started or continued with treatment for hypertension and/or diabetes. The community-based approach aided in the early detection and continued treatment of hypertension and T2DM. Furthermore, the caregivers reported a need for hypertension and diabetes education regarding care and management for individuals diagnosed.

Although our study is not without limitations and cannot be seen as representative of the national population, it is unique due to the fact that it provides insight into the extent that socioeconomic transitioning and development of a rural area into a periurban area can impact the development rates of cardiometabolic diseases. Compared with other epidemiological studies performed in high-income countries, our sample size of 923 participants may seem small, but it is one of the largest sample sizes available for studies of this nature performed in Africa.

Conclusion

The prevalence of obesity and hypertension was high in our study cohort both at baseline and at the 10-year follow-up. Distinct differences in the prevalence of NCDs in urban and rural areas have decreased over the 10-year period as development occurred in the rural area. Although there are improvements in the number of patients receiving treatment and showing promise regarding control of these NCDs over the 10-year period, more needs to be done to increase awareness of how to prevent and manage these conditions. Targeted community-based programs aimed at improving early detection, management, and control may assist in improving community health.

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Conflict of Interest

All authors declare no conflicts of interest.

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