

Circulation

JOURNAL OF THE AMERICAN HEART ASSOCIATION



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Circulation 2008;118:2323-2325

DOI: 10.1161/CIRCULATIONAHA.108.819821

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75214

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Heart Failure in the Urban African Enclave of Soweto A Case Study of Contemporary Epidemiological Transition in the Developing World

Michelle Asha Albert, MD, MPH

Located in the Gauteng Province of South Africa (SA), Soweto is home to at least 1.1 million blacks and represents the largest black community in this sub-Saharan nation. Historically, its townships, spread over ≈ 40 sq miles of territory located to the southwest of Johannesburg, were created as a result of the residential segregation of blacks relocated to the area to work as cheap labor in the gold mines. Soweto has a history of poverty, overcrowding, and limited water supply, resulting in lifestyle factors such as communal toilets, along with a record of producing leaders of the international movement for sociopolitical transition in SA. Accordingly, any examination of the determinants, effects, prevention, and treatment of cardiovascular disease (CVD) must be framed within this sociopolitical context. Thus, the concept of “epidemiological transition,” which refers to a switch in disease prototype and the interrelations of the latter with the socioeconomic and demographic environment, applies to heart failure epidemiology in Soweto to the extent that the change in heart failure pattern is a result of evolving socioeconomic, cultural, technological, and other transitions.

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In this issue of *Circulation*, Stewart et al¹ provide data about the epidemiology of heart failure in Soweto among persons who presented to the Cardiology Unit of Chris Hani Baragwanath Hospital in 2006. Among 844 de novo presentations of heart failure and cardiomyopathy, hypertensive cardiomyopathy and idiopathic dilated cardiomyopathy represented $>60\%$ of the cases, a finding that is out of proportion to other causes of heart failure in the region. Moreover, the authors note that unlike the West, where ischemic heart disease is a major cause of heart failure, coronary artery disease accounted for only 9% of the causes of cardiomyopathy. Additionally, in this predominantly black population, young black women who tended to be obese made up a majority of heart failure cases. These results further characterize the data on heart failure previously published in *The Lancet* that noted that the “strong evidence of epidemiological

transition in Soweto has broadened the spectrum of complexity of this disease in this community.”² Therefore, of conceptual relevance to the above is a discussion of this article within the context of the 5 propositions of epidemiological transition outlined by Omran.³

Mortality Is a Fundamental Factor in Population Dynamics

As is the case with many developing nations, life expectancy is lower in SA than in more developed nations; that is, the average estimated life expectancy (2005 to 2010) of men and women is 47.5 and 49.3 years of age, respectively.⁴ These statistics are on average 20% lower than the world average and are dictated by fertility, mortality, and particularly the extremely high prevalence of HIV/AIDS cases in SA. Although research from the 1980s and 1990s indicates that CVD represents up to 10% of hospitalizations in Africa, with heart failure making up 3% to 7% of admissions,⁵ these statistics have likely increased in magnitude in the contemporary setting, highlighting the notion that population dynamics in Soweto will be greatly influenced by the rising heart failure epidemic, similar to observations in Western nations. As evidenced by the mean age of study participants of 55 ± 16 years, heart failure in Soweto appears to be a disease associated with older age, taking into consideration the lower average life expectancy of South Africans and the fact that population growth is slower in part because of the HIV epidemic.⁴ However, it is noteworthy that the mean age of the study participants is still lower than the average age for heart failure patients in developed countries, suggesting that prevention of heart disease and early identification of persons at risk for disease are imperative.

Epidemiological Transition Is Characterized by Shifts in Disease Patterns, for Example, From Infectious Diseases to Chronic Manmade Diseases

Tempered by the HIV/AIDS crisis, improvements in housing conditions and the water supply and evidence of an emerging black middle class likely contribute to demographic shifts in the etiology of heart failure in Soweto so that communicable/immune-mediated illnesses that contribute to conditions such as endomyocardial fibrosis (albeit more common in subtropical/tropical regions) and rheumatic heart disease are less common causes for heart failure than hypertension and idiopathic dilated cardiomyopathy. Certainly, the prevalence of hypertension of almost 60% in this urban black heart failure cohort is similar to the prevalence of hypertension in black Americans.⁶ Black Americans develop hypertension decades earlier than their white counterparts regardless of body mass index, thereby predisposing them to heart disease, predom-

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.

From the Center for Cardiovascular Disease Prevention, Donald W. Reynolds Center for Cardiovascular Disease Research, Divisions of Cardiovascular Diseases and of Preventive Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, Mass.

Correspondence to Dr Michelle A. Albert, Cardiovascular Division, Brigham and Women's Hospital, 75 Francis St, Boston MA 02115. E-mail maalbert@partners.org

(*Circulation*. 2008;118:2323-2325.)

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Circulation is available at <http://circ.ahajournals.org>
DOI: 10.1161/CIRCULATIONAHA.108.819821

inantly heart failure and stroke, in disproportionate numbers.⁶ Although urbanization and the adoption of a Western diet contribute to the prevalence of hypertension and heart failure among blacks in both continents, the reason(s) why blacks have higher hypertension rates remain uncertain. Although ischemic heart disease currently remains a less prevalent cause of heart failure in Africa than in developed nations, the burden of hypertension, diabetes (noted in 16% of this cohort), smoking, and other traditional risk factors for coronary artery disease will continue to rise as the society transitions to more Western lifestyles, making it more likely that coronary artery disease will increase in stature as a cause of heart failure in Africa. Indeed, 90% of patients had >1 CVD risk factor. Despite this finding, it is important to take lessons from autopsy, angiographic, and calcium score data that show that black Americans tend to have less significant coronary artery disease burden than similar white populations, leaving the likelihood that hypertension will continue to be a major etiological determinant of heart failure in Soweto and other parts of Africa.⁷

As the second major cause of heart failure in Soweto, the cause of idiopathic cardiomyopathy (28%) by definition is unknown; notably, idiopathic cardiomyopathy was more prevalent than hypertension-related cardiomyopathy in blacks compared with other race/ethnic groups. However, this entity probably represents multiple conditions, including infectious, nutritional, immune, toxic, hemodynamic, and genetic causes.⁸ From the perspective of genetic causes, it is interesting to note that 25% of subjects reported a family history of heart failure, a statistic that encompasses familial forms of heart failure of which most identified cases to date have an autosomal-dominant inheritance pattern spanning the spectrum of contractile and immune factors to mitochondrial DNA.^{9–11} Also of potential interest to the etiology and adjunctive therapy for heart failure is the finding that mean resting heart rates were significantly higher in blacks. Although advanced heart failure in itself is associated with heightened sympathetic drive, available data suggest that resting heart rate, heart rate in response to acute stress, and heart rate variability differ between blacks and whites, favoring higher adrenergic outflow at baseline among blacks; purported reasons for these observations remain uncertain but include psychosocially mediated stress.¹²

As highlighted by the authors, an astonishing 27% of subjects, including 13% of black participants, had right heart failure. This finding raises questions about the potential effect of lung disease related to environmental exposures, including smoking or other as-yet unidentified factors of right heart failure, offering potential opportunities for intervention at a public-policy level. Similarly, HIV/AIDS in SA negatively affects not only life expectancy but also the development of heart failure related to tuberculosis and HIV. Thus, Soweto perhaps finds itself caught between the epidemiological transition stages of “the age of pestilence and famine” in which mortality rates are still high and unstable and “the age of receding pandemics” in which traditional infectious causes of death such as diarrhea and acute rheumatic fever are on the decline, initially contributing to a slight increase in life expectancy, which has, in turn, been affected by the HIV/AIDS crisis, casting a shadow on the evolutionary framework of epidemiological transition.

Epidemiological Transition Is Accompanied by Profound Changes in Health and Disease Patterns Among Children and Young Women

Women and children are critical components of the “epidemiological transition” population theory because they are front-line indicators of fertility, birth rates, and mortality and thus determine population stability or growth. Not unlike the demographics of the Gauteng Province to which it belongs, women outnumber men in Soweto. Therefore, at the surface, it is not immediately surprising that 57% of the heart failure patients are women. The vulnerability of younger and particularly black women to heart failure is driven in part by the rates of obesity and accompanying hypertension in the latter group. According to Stewart and colleagues, 87% and 88% of blacks were obese and hypertensive, respectively; black women account for a majority of cases. Urbanization and a more sedentary lifestyle certainly drive the overweight/obesity epidemic as it does in the United States, where at least 70% of black women are either overweight or obese.⁶ Indeed, some data suggest that although obesity and hypertension are linked in South African women, obesity was associated more with insulin resistance.¹³ From a cellular perspective, obesity and associated glucose intolerance can lead to toxic exposure of the heart to free fatty acids and to the emergence of toxic nonglycolytic glucose metabolism, both processes that could contribute to the development of heart failure.¹⁴ Additionally, the shift in the prominence of rheumatic heart fever and endomyocardial disease as causes of heart failure in Africa to hypertension suggests improvements in environmental circumstances, leading to lower infant and maternal mortality rates.

Shifts in Disease Patterns That Characterize Epidemiologic Transition Are Associated With Demographic and Socioeconomic Transitions That Constitute the Modernization Complex

Convergence of the remnants of the apartheid system, modernization, and low socioeconomic status for blacks in Soweto (95% blacks in this study had no education/standard education) reinforces the challenges involved in the prevention and treatment of heart failure in this developing society. Although some suburban enclaves are present within Soweto, a majority of homes remain small shacks or houses that perpetuate overcrowding. Crucial to the prevention of illness are programs designed to improve the educational level, healthcare access, and living standards of the community. Because the area is largely geographically localized, low-cost preventive education tailored toward understanding of the relevance of family history of heart disease, recognizing symptoms of heart failure, and screening for and treating hypertension and diabetes, as well as early family screening for clinically silent or mild forms of heart failure, is prudent. In particular, the prevention of obesity must be couched within a cultural context with respect for cultural norms to achieve any level of effectiveness. Hence, a multiple risk factor approach to risk reduction is warranted and estimated to be more cost effective in sub-Saharan Africa.¹⁵

This study used echocardiograms on all subjects to assist in disease classification, an important advance for studies of this kind in Africa. One potential approach to screening in this

setting might be the use of portable handheld echocardiography machines by local nonspecialized centers or perhaps even roving medical vehicles assigned to specific townships. Moreover, use of handheld ultrasound devices would assist in the recognition of less advanced cases of heart failure/cardiomyopathy such as might be the case in early valvular disease, hypertrophic cardiomyopathy, familial cardiomyopathy, and early right ventricular dysfunction. Because the Chris Hani Baragwanath Hospital is a specialized hospital, only severe cases of heart failure would tend to be captured, as evidenced by the advanced New York Heart Association class of a large proportion of the patients. Alternatively, the entry point for educational and job services might also provide an important opportunity for hypertension screening. At a public-policy level, stricter regulation of smoking and limitation of known environmental toxins are prudent because most patients are long-term residents of Soweto. Additionally, in the hospital setting, improvements in the underutilization of standard heart failure therapy, evidenced by the only 70% and 64% usage of angiotensin-converting enzyme inhibitors and β -blockers, respectively, must be made. Admittedly, ensuring appropriate medication use for heart failure by patients, including compliance, will be challenging.

Basic Models of Epidemiological Transition Include the Classical/Western, Accelerated, and Contemporary/Delayed Models, Which Are Determined in Part by Pattern Variation and the Pace of Change

Epidemiological transition remains in progress in Soweto. Because women with heart failure are of younger age than their male counterparts, their risk for mortality remains relatively high without adequate prevention and therapy. Similarly, infant and childhood mortality rates also remain high, perhaps placing the epidemiology of heart failure in urban Soweto in the category of "yet-to-be-completed transition."³

The authors must be commended for ambitiously undertaking a study of CVD in Soweto to rigorously evaluate the risk factors and clinical presentations of CVD among residents. Although this project gives us valuable information about heart failure in Soweto, limitations of this study include its geographic localization and the fact that asymptomatic cardiomyopathy or milder forms of heart failure might not be captured in the hospitalized setting. In addition, the number of persons with ischemic heart failure could have been underestimated as a result of reliance on clinical suspicion to prompt definitive testing. In particular, women might present with atypical symptoms. For example, despite having a higher prevalence of most CVD risk factors, women in this study were half as likely to have ischemic cardiomyopathy as a cause of their heart failure. Similarly, the role of HIV/AIDS as a cause of heart failure may have been underestimated because of the need for consent to perform screening. Additionally, no data are given regarding whether reported blood pressures were taken while patients were being treated with medication, a factor that might lead to underestimation of the contribution of hypertension. It is surprising that stroke was documented in a relatively smaller number of patients than one might expect in this cohort with hypertension and heart failure, and that the contribution of renal dysfunction

(20% of the cohort) to overall morbidity and its impact on therapy were not addressed by the authors. Finally, as noted by the research team, because these data are from a registry, the results are observational, do not include subjects who died out of hospital, and have limited ability to adequately assess patient outcome and outpatient follow-up.

In summary, Stewart et al provide crucial information about the pattern of heart failure in hospitalized Soweto residents, a disease process with an effect on population dynamics that is linked in part to the demographics of the HIV/AIDS epidemic in SA. Thus, the major challenges for improving CVD health in Soweto revolve around the elimination of poverty, early prevention and treatment of HIV infection, early CVD risk factor and disease identification, development of low-cost community-based screening and intervention programs, and development of a research infrastructure to characterize contemporary CVD patterns and responses to treatment to identify evidence-based strategies for primary and secondary prevention of CVD.

Disclosures

Dr Albert is funded by the Doris Duke and Donald W. Reynolds Foundations, and by a Learner Cardiovascular Award.

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KEY WORDS: Editorials ■ heart failure ■ South Africa