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The epidemiologic transition to chronic diseases in developing countries: Cardiovascular mortality, morbidity, and risk factors in Seychelles (Indian Ocean)

Summary

The occurrence of cardiovascular diseases (CVD) and related risk factors was evaluated in Seychelles, a middle level income country, as accumulating evidence supports increasing rates of CVD in developing countries. CVD mortality was obtained from vital statistics for two periods, 1984–5 and 1991–3. CVD morbidity was estimated by retrospective review of discharge diagnoses for all admissions to medical wards in 1990–1992. Levels of CVD risk factors in the population were assessed in 1989 through a population-based survey. In 1991–93, standardized mortality rates were in males and females respectively, 80.9 and 38.8 for cerebrovascular disease and 92.9 and 47.0 for ischemic heart disease. CVD accounted for 25.2% of all admissions to medical wards. Among the general population aged 35–64, 30% had high blood pressure, 52% of males smoked, and 28% of females were obese. These findings substantiate the current health transition to CVD in Seychelles. More generally, epidemiologic data on CVD mortality, morbidity, and related risk factors, as well as similar indicators for other chronic diseases, should more consistently appear in national and international reports of human development to help emphasize, in the health policy making scene, the current transition to chronic diseases in developing countries and the subsequent need for appropriate control and prevention programs.

While cardiovascular diseases (CVD) decline in most Western countries[1], accumulating evidence supports increasing rates of CVD in developing countries[2–4]. Over half the deaths caused globally by CVD in the world already occur in developing countries (Fig. 1)[5] and the incidence of CVD and other chronic diseases in the developing world is expected to continue to rise. Indeed, improved sanitation and implementation of basic primary health care have dramatically reduced mortality due to infectious diseases. As more people survive to adulthood and as fertility rates decline ("demographic transition"), an increasing portion of the population becomes at risk for chronic, noncommunicable diseases[6,7]. In addition, many populations in the Third World tend to adopt westernized life-styles that may be detrimental to cardiovascular health ("epidemiologic transition") in terms of dietary habits, smoking, and physical exercise. Management of CVD is much demanding and dramatically challenges the limited resources of developing countries. Careful monitoring of CVD emergence throughout the developing world is therefore much needed for the development of effective public health interventions because of the limited availability of epidemiologic data, the unreliability of currently available primary data, the heterogeneous and rapidly changing pat-

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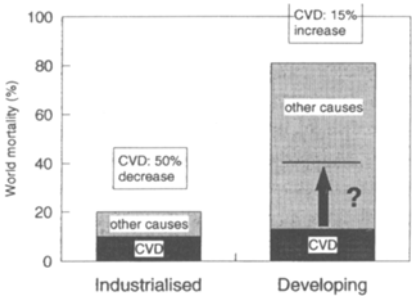

Figure 1. *Repartition of mortality attributable to cardiovascular disease (CVD) and other diseases in industrialized and developing countries (Data from World health statistics annual 1992).*

terns of morbidity, the uncertainty about the applicability in developing countries of prevention strategies experienced in Western countries, the lack of formulated strategies to achieve healthy life-styles that are culturally appealing and socially relevant, and the reluctance to allocate resources to CVD prevention in view of the on-going or resurgent infectious diseases and of the other high priority national development programs.

Since 1989, the Ministry of Health of Seychelles has monitored the CVD situation in the country and has subsequently initiated a national program of prevention and control of CVD. These activities were conducted with the support of the School of Medicine of the University of Lausanne, Switzerland, and of other international organizations such as the Swiss Jura Cooperation and the World Health Organization. The isolated location and small size of the Seychelles islands and the centralized national health system have much facilitated an effective collection of comprehensive epidemiologic data despite limited resources. These features and the rapid socio-economic development of the country make Seychelles an useful "epidemiologic laboratory" that well exemplifies current trends in health patterns in rapidly developing countries.

Demographic and socio-economic characteristics of Seychelles

The Seychelles consist of more than 114 islands lying 1800 km east to Kenya and 1800 km north to Mauritius. The total population was 70763 in 1992 with over 90% living on the main island, Mahé. Although a great deal of interracial marriage has blurred racial differences for many Seychellois, around 68% of the population are predominantly black, 22% mixed, 7% Caucasian, and 3% Chinese or Indian[8]. According to the vital statistics of 1992[9], 32% of the population was under 15 years, 52% under 25 years, 70% under 35 years, while only 7% of the population was aged 65 or more. The birth rate per 1000 population decreased from 41.1 in 1960 to 22.6 in 1992. The infant mortality rate per 1000 live births decreased from 57.8 in 1960 to 11.9 in 1992. Life expectancy was 67.2 years for males and 72.9 years for females, centered on 1987 population. The major tropical scourges such as malaria, yellow fever, leishmaniasis, and bilharziasis are unknown in Seychelles.

While production of copra and cinnamon bark has long been the main resources of Seychelles, tourism has become the major industry since the opening of the international airport in 1971. The standard of living has dramatically increased within the last decades with gross domestic product (GDP) per capita of population rising steadily from $925 in 1976 to $5850 in 1992 (real adjusted GDP per capita: $3683)[10]. On this basis, Seychelles ranks 39th out of 173 countries and Seychelles is considered a middle level invome country. The Human Development Index (HDI), a composite of three basic components of human development: life expectancy, adult literacy, and purchasing power parity, may better reflect the socio-economic development of a country than the GDP or the gross national product (GNP)[11]. With an HDI of 0.685, Seychelles ranks 83rd out of 173 countries and is considered as a country with medium human development (HDI between 0.5 to 0.8).

Methods and subjects

Cardiovascular mortality

CVD mortality for the period 1985–7 was compiled from data provided by the World Health Organization (WHO)[12]. Cause-specific mortality for the period 1991–1993 was computed using the routine annual vital statistics[9]. Diseases were classified using the 9th revision of the International Classification of Diseases (ICD-9). Several-year periods were pooled to estimate CVD mortality to smooth variation over time due to the small size of the population. All estimates were age-standardized to the world population to allow direct comparison with other countries[13]. Mortality rates can be considered as fairly reliable in Seychelles as, among all deaths in 1992, more than 90% were medically certified, more than 50% occurred in hospitals (most deaths occurring outside of hospitals are medically followed by clinic doctors), and 28% resulted in autopsy.

Hospital morbidity due to cardiovascular and other diseases

In order to get morbidity patterns related to CVD and other diseases in Seychelles, diagnoses were reviewed retrospectively for all adults aged more than 15 years admitted to the medical wards (including the intensive care unit) of the 2 hospitals of Mahé, i.e., a 250-bed General Hospital in Victoria and a small 24-bed county hospital

at Anse Royale between January 1990 and December 1991. Although there are smaller clinics in other islands of the country, which account for less than 10% of the total population, most CVD cases are transferred to the General Hospital in Victoria. Review of diagnoses applied to those written down by the nurses on the basis of the medical patient' records at the time patients are discharged or die at hospital. More than one diagnosis appeared in the notes in less than 20% of all admissions and the first diagnosis was selected as the 'main' diagnosis, unless clinically not relevant. The diagnosis review was done by one of us (PB) who had previously worked as a physician consultant at the Victoria hospital. Classification of diagnoses was performed with consideration of the clinical entities and available diagnostic resources found in the country. Classification of diseases within categories was done using the 10th version of the International Classification of Diseases (ICD-10). With regard to CVD diagnosis, electrocardiograms, and creatine phosphokinase measurements and X-rays were regularly available, echocardiography was occasionally available, while cardiac catheterism, Holter recordings, and CT-scan were not available.

Prevalence of cardiovascular disease risk factors

Levels of CVD risk factors (including diet patterns) were assessed in a sex- and age-stratified random sample of the whole population aged 25–64, conducted in 1989[8]. among the 1351 eligible participants, 1081 (86%) attended the survey. Data on smoking habits, blood pressure, and body mass index were collected through interview and physical examination carried out according the guidelines of the WHO-MONICA Project (MONItoring trends and determinants of CArdiovascular disease)[14]. Total blood cholesterol, HDL-cholesterol, triglycerides, apoprotein A-I, apoprotein B, and lipoprotein(a), fasting blood sugar, and insulin were also measured. Cardiovascular risk factors from the WHO-MONICA study in the area Vaud/Fribourg in Switzerland were determined in a similar fashion[15] and are provided to contrast levels in Seychelles with a Western country. All prevalence estimates are standardized to the world population to adjust for differences in population structures in both countries.

Results

Cardiovascular mortality

In 1992, 38.9% of all deaths were attributable to CVD, 14.0% to cancer, and 5.6% to infectious disease (Table 1). Mortality rates for ischemic heart disease and cerebrovascular for the period 1985–7 (Table 2) as well as for the period 1991–3 (Table 3) show high rates of cerebrovascular disease and intermediate rates of ischemic heart disease, by Western standards. Ischemic

Cause of death	Number	Percent	Mortality*
All cardiovascular diseases (ICD-9: 25–30)	203	38.9	287
Neoplasms (ICD-9: 08–17)	73	14.0	103
Infectious diseases (ICD-9: 01–07)	29	5.6	41
All causes	522	100.0	738

* Crude mortality per 100000 population and per year. Source: vital statistics[9].

Table 1. *Mortality by broad disease category, Seychelles, 1992.*

Country (year)	Ischemic heart disease (ICD-9: 27)		Cerebrovascular disease (ICD-9: 29)	
	Males	Females	Males	Females
Seychelles (1985–7)	103.7	96.8	117.9	68.9
Sao Tome (1984–5)	16.0	18.4	44.6	53.5
Barbados (1984)	62.9	41.4	107.8	66.2
Trinidad & Tobago (1983)	199.3	135.7	136.3	110.5
Mauritius (1987)	194.6	95.4	150.5	93.3
United Kingdom (1987)	218.1	94.7	60.2	53.3
United States (1986)	172.0	85.8	35.4	31.0
Switzerland (1987)	105.2	39.6	40.1	29.8
Japan (1987)	31.8	17.4	72.2	51.3

Rates standardized to the world population. Source: World health statistics annual 1988.

Table 2. *Age-standardized death rates for ischemic heart disease and cerebrovascular disease in various countries.*

Age	Population		Cerebrovascular disease (ICD-9: 29)				Ischemic heart disease (ICD-9: 27)			
	Males	Females	Males		Females		Males		Females	
	No.	No.	No.	Rate	No.	Rate	No.	Rate	No.	Rate
< 35	24723	24761	6	8	1	1	0	0	0	0
35–44	3899	3192	5	43	0	0	2	17	1	10
45–54	2430	2440	6	82	0	0	9	123	3	41
55–64	2010	2280	10	166	4	58	20	332	9	132
65–74	1304	1725	22	562	13	251	20	511	16	309
75+	689	1310	25	1209	42	1069	26	1258	30	763
35–74	9643	9637	43	148.6	17	58.8	51	176.3	29	100.3
Total	35055	35708	68	64.7	59	55.1	77	73.2	59	55.1
Age-standardized to world population				*80.9*		*38.8*		*92.9*		*47.0*

Rates per 100 000 population per year. Population in 1992. Source: vital statistics[9].

Table 3. *Mortality attributable to ischemic heart disease and cerebrovascular; 1991–3.*

Diseases	ICD-10 code	Admissions		Total days	
		No.	(%)	No.	(%)
Certain infectious diseases	A00-B09	529	(10.5)	4755	(14.8)
Neoplasms	C00-D48	134	(2.7)	1085	(3.4)
Blood and blood forming organs	D50-D89	75	(1.5)	564	(1.8)
Endocrine diseases	E00-E90	235	(4.7)	1491	(4.6)
Mental and behavioral disorders	F00-F99	49	(1.0)	152	(0.5)
Nervous system	G00-G99	345	(6.9)	1803	(5.6)
Circulatory system	I00-I99	1263	(25.2)	8720	(27.1)
Respiratory system	J00-J99	645	(12.9)	4235	(13.1)
Diseases of the digestive system	K00-K03	424	(8.5)	2213	(6.9)
Skin and subcutaneous system	L00-L99	198	(3.9)	1626	(5.0)
Musculoskeletal system	M00-M25	107	(2.1)	608	(1.9)
Genitourinary system	N00-N99	213	(4.2)	1406	(4.4)
Symptoms, signs, abnormal findings	R00-R99	400	(8.0)	1625	(5.0)
Poisoning, certain external causes	S00-Y98	287	(5.7)	1153	(3.6)
Investigation, health services	Z00-Z13	111	(2.2)	781	(2.4)
Total		5015	(100.0)	32218	(100.0)

Table 4. *Adult admissions to all medical wards by disease category, Seychelles, 1990–1.*

heart disease mortality rates were comparable in males and females in 1985–7 while higher rates were found in males in 1991–3. Age-standardized mortality rates did not substantially differ when comparing the two periods.

Hospital morbidity due to Cardiovascular and other diseases

CVD were the first cause of adult medical admissions to hospital and accounted for 1263 (25.2%) out of total of 5015 admissions to medical wards during the 2-year period under study (1990–1991) (Table 4). Acute and chronic ischemic heart disease (21.0%), congestive heart failure (19.6% of all CVD admissions), hypertension (18.8%), and cerebrovascular disease (18.2%)

accounted for most (78%) of the 1263 CVD cases (Table 5). Alcohol-related cardiomyopathy is frequent in Seychelles[16] and accounted for 121 (18.1%) out of the 667 male CVD patients (but only 3 out of 596 in females). Rheumatic fever and valvular heart disease accounted for 0.5% and 2.4% of all CVD admissions, respectively. Mean age of CVD admissions (60 years) was higher than mean age of all other non CVD cases (47 years). High case-fatality (8.8%) was found for CVD patients, especially for cerebrovascular disease (20.4%), myocardial infarction (13.8%), and congestive heart failure (10.1%), compared to the overall case-fatality for all non CVD cases (3.0%).

Other chronic diseases accounting for frequent medical admissions were diabetes (4.5% of all medical admissions) and neoplasms (2.7%). Large proportions of medical admissions were attributable to alcohol-related diseases other than the aforementioned alcohol-related cardiomyopathy, such as convulsions (4.8%), acute intoxication of alcohol (2.4%), alcohol gastritis (2.3%), pancreatitis (0.9%), cirrhosis (0.4%). Gastroenteritis (4.0%), leptospirosis (2.7%), and amoebic liver abcess (1.2%) were the most frequent admissions in the category "certain infectious diseases" (A00-B09), but it should be acknowledged that other ICD-10 disease categories also include infectious diseases (such as pneumonia: 4.7%, cellulitis: 1.8%, meningitis: 0.3%).

Prevalence of cardiovascular risk factors

High prevalence of high blood pressure, elevated serum lipoprotein(a) concentration, diabetes, obesity (females), and smoking (males) were found in the adult population of Seychelles (Table 6). Serum total cholesterol concentra-

	Males		Females		Total	
	No.	(%)	No.	(%)	No.	(%)
Congestive heart failure	148	(22.2)	100	(16.8)	248	(19.6)
Hypertension	72	(10.8)	165	(27.7)	237	(18.8)
Cerebrovascular disease	123	(18.4)	107	(18.0)	230	(18.2)
Ischemic heart disease	128	(19.2)	137	(23.0)	265	(21.0)
Alcohol-related cardiomyopathy	121	(18.1)	3	(0.5)	124	(9.8)
Valvular heart disease	13	(1.9)	17	(2.9)	30	(2.4)
Rheumatic fever	3	(0.4)	3	(0.5)	6	(0.5)
Other	59	(8.8)	64	(10.7)	123	(9.7)
Total	667	(100.0)	596	(100.0)	1263	(100.0)

Table 5. *Adult admissions to all medical wards due to cardiovascular diseases, Seychelles, 1990–1.*

Risk Factors	Seychelles (1989)		Switzerland (1988–89)	
	Males	Females	Males	Females
Blood pressure ≥160 or ≥95 or under medication	35	30	15	14
Smoking ≥1 cigarette per day	53	13	34	24
Blood total cholesterol ≥6.5 mmol/l	11	20	46	39
Blood HDL-cholesterol <0.9 mmol/l	11	8	12	2
Blood lipoprotein(a) ≥300 mg/l	33	35	10	13
Body mass index ≥30 kg/m²	5	28	11	12
Diabetes using NDDG criteria	7	7	–	–

Prevalence (%) standardized to the world population.

Table 6. *Age-standardized prevalence of cardiovascular risk factors in the population aged 35–64, Seychelles and Switzerland, 1988–9.*

tions were intermediate, by Western standards. Age-standardized levels of several cardiovascular risk factors in the adult population of Seychelles were therefore as high as, or higher than, in the Swiss population. Specific publications have previously detailed findings in Seychelles[8, 17–20] and in Switzerland[15].

Discussion

Mortality and morbidity findings from the various sources of data used to assess CVD occurrence are consistent with a very high occurrence of cerebrovascular disease and a fairly high occurrence of ischemic heart disease in the population of Seychelles. The finding of high levels of CVD risk factors in the population, especially very high prevalence of hypertension, is in accordance with these results[21]. Although no specific trend data is available yet, contrasts between a health survey carried out in 1956–57[22] and current data provide some evidence that cardiovascular diseases have been dramatically rising lately. In the former survey, the main concerns were intestinal diseases (CVD were not mentioned) whereas current surveys were undertaken because CVD had become common.

Validity of CVD mortality and morbidity data is a legitimate concern due to the many factors that may bias such estimates[23]. Mortality estimates provided for Seychelles are however expected to be fairly valid as around half of all deaths occur in hospitals, hospitals benefit from fairly good diagnostic resources, medical certificates are provided for almost all deaths, one out of four deaths undergo autopsy, and less than half of all deaths occur outside of hospitals. Furthermore, hospital-based data on CVD morbidity are expected to provide fairly reliable information. Diagnostic of broad categories of CVD is clinically relatively simple, and Seychelles benefit of a good referral health system (health care free of charge to the whole population, single health care provider, and ambulance transport to hospital generally managed within less than one hour throughout the country). With respect to risk factors levels in the population, data were collected following the standardized guidelines used in the multicentric WHO-MONICA-study and accuracy of estimates is likely to be comparable to those obtained in other settings. Our data support the view that adult health has become a legitimate concern for developing countries as illness due to chronic disease imposes a major burden on health and have large negative consequences on individuals, families, communities, and societies[24].

From a public health standpoint, such epidemiologic data are of paramount importance to design appropriate control and prevention programs in Seychelles and possibly in many other developing countries. In Seychelles, epidemiologic data substantiating transition to chronic disease has been crucial to initiate and back up a national multisectorial long term program of reduction of cardiovascular risk factors targeting the whole population and specific high risk groups[25,26]. These data have also been instrumental to elicit appropriate support from local and international public as well as private institutions. Additional epidemiologic information is however required and the prevention program, initiated in 1990, includes ongoing evaluation through surveillance of CVD frequency (e.g., hospital-based register of CVD) and repeated health surveys to monitor the impact of the campaign and trends in risk factors over time (e.g., community-based survey of cardiovascular risk factors and related knowledge, attitudes and behaviours in 1994).

CVD may be prevented to a large extent by adopting healthy life-styles[27]. In this view, the still relatively low overall prevalence of CVD in developing countries (around 17%), in comparison to the correspondingly much higher rates in Western countries (around 50%), suggest a large potential impact of primary prevention of CVD in developing countries (Fig. 1). Indeed, prevention of chronic diseases, especially CVD, is likely to be more effective and less demanding on the limited resources of developing countries than a solely therapeutic approach[28]. Furthermore, prevention actions are expected to be most cost-effective when introduced early so as to avoid the widespread adoption of unhealthy lifestyles and patterns of consumption[29].

Practically, cause-of-death statistics are a cornerstone for monitoring health progress and determining health priorities[30]. Monitoring of all serious diseases of global importance is therefore needed universally, including in developing countries in view of the rapid emergence of CVD in the developing world[24, 31–33]. While it is recognized that cause-of-death statistics based on vital registration may be difficult to collect at national levels for a number of developing countries (e.g., only the three African countries listed in Table 3 have provided cause-specific mortality data to WHO), alternative simpler approaches to collect cause-of-death data have been formulated, such as lay reporting schemes to determine the approximate causes of death using verbal autopsy, surveillance systems in specific populations, or hospital/clinic-based data[34].

From an operational standpoint, epidemiologic surveillance of CVD is central to emphasize, in national and international health organizations, the need for further studies and subsequent implementation of prevention programs of CVD. To this end, reports of human development of nations, which are working documents for policy-makers

and resource providers, should more systematically include indices on frequency of CVD and related cardiovascular risk factors. Interestingly, no data pointing to health transition and emergence of CVD appear in major recent national development reports such as, for example, the Human Development Report 1994, elaborated by the United Nations Development Program and which aims at providing a new concept of human security and discuss key issues to be taken up at the World Summit for Social Development in Copenhagen in 1995[11]. Legitimate validity concerns should not offset the potentially most important information conveyed by health indices such as the mortality due to CVD, the proportion of admissions to hospital accounted for by CVD, the prevalence in whole or specific populations of smoking, high blood pressure, or elevated blood cholesterol.

Zusammenfassung

Epidemiologische Entwicklungen von chronischen Krankheiten in der 3. Welt: Kardiovaskuläre Mortalität, Morbidität und Risikofaktoren auf den Seychellen (Indischer Ozean)

Während zwei Perioden wurden in den Seychellen Daten über Herzkreislaufkrankheiten (HKK) erhoben. Die Mortalitätsdaten stammen von den Mortalitätsstatistiken. Morbiditätsdaten wurden mittels einer retrospektiven Studie der Spitalaustrittsdiagnosen erfasst. Den Risikofaktoren für HKK wurde in einer Bevölkerungserhebung nachgegangen. 1991 bis 1993 betrugen die standardisierten Mortalitätsraten für zerebrovaskuläre Krankheiten 80,9 (Männer) und 38,8 (Frauen), für die koronare Herzkrankheit 92,9 (Männer) und 47,0 (Frauen). HKK machten 25,2% aller Spitaleinweisungen aus. In der 35 bis 64jährigen Bevölkerung wiesen 30% eine Hypertonie auf; 52% der Männer waren Raucher und 28% der Frauen waren übergewichtig. Aus den erhobenen Daten geht hervor, dass sich in den Seychellen ein Übergang zur HKK abspielt. Generell sollte dieser epidemiologische Übergang zu chronischen Krankheiten, wie man sie in den Entwicklungsländern sieht, vermehrt in Betracht gezogen werden, wenn auf nationaler und internationaler Ebene die Gesundheitspolitik entschieden wird.

Résumé

Transition épidemiologique vers les maladies chroniques dans les pays en voie de développement: Mortalité cardiovasculaire, morbidité et facteurs de risque aux Seychelles (Océan Indien)

L'apparition des maladies cardio-vasculaires (MCV) et leurs facteurs de risque ont été évalués aux Seychelles, pays à niveau de revenu intermédiaire entre les pays en voie de développement (PVD) et les pays industrialisés. En effet, des éléments de plus en plus nombreux attestent d'une augmentation de l'incidence des MCV dans certains pays en développement. La mortalité par maladies cardio-vasculaires a été mesurée à partir des statistiques vitales pour les périodes 1984–85 et 1991–93. La morbidité a été estimée rétrospectivement sur la base des lettres de sorties de toutes les admissions des hôpitaux de 1990–92. Le niveau des facteurs de risque dans la population a été évalué en 1989 dans le cadre d'une étude spécifique. Durant la période 1991–93, les taux de mortalité standardisés étaient de 80.9 et 38.8 pour les maladies cérébrovasculaires et de 92.9 et 47.0 pour les MCV chez les hommes et les femmes respectivement. Les MCV représentaient 25.2% des admissions hospitalières. Pour les facteurs de risque dans la population générale de 35–64 ans, on comptait 30% d'hypertension artérielle, 52% de fumeurs chez les hommes, alors que 28% des femmes étaient obèses. Ces chiffres vont dans le sens d'une situation dite de transition pour les MCV aux Seychelles. Plus généralement, les données épidémiologiques concernant la mortalité, la morbidité et les facteurs de risques cardiovasculaires ainsi que des éléments concernant les autres maladies chroniques, devraient apparaître plus systématiquement dans les rapports statistiques nationaux et internationaux. On pourrait de cette façon mieux mettre en évidence la transition épidémiologique vers les maladies chroniques dans les PVD et défendre la nécessité d'en tenir compte dans les politiques de santé ainsi que dans les programmes de prévention.

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