

EDUCATION AND INCOME: DOUBLE-EDGED SWORDS IN THE EPIDEMIOLOGIC TRANSITION OF CARDIOVASCULAR DISEASE

The 2002 *World Health Report* warns that the allies of poverty and ignorance are joining forces with the new formidable enemies of health. This describes the epidemiologic transition of burden of disease from infectious and parasitic diseases to that of noncommunicable diseases. All parts of the world, with the possible exception of sub-Saharan Africa, have well-established epidemics of coronary heart disease and stroke. Hypertension contributes significantly to mortality everywhere and is a leading global problem. Education and wealth have strong influences on the epidemiologic transition and might serve as a double-edged sword of benefit and risk. While improved education and enhanced resources are necessary to reduce infectious, parasitic, and perinatal diseases, these factors are also associated with adoption of deleterious health behaviors, which lead to the atherosclerotic diseases. The diffusion of innovation theory describes the early adoption of unhealthy lifestyles in the educated and wealthy, who soon recognize the costs to their community and modify these lifestyles. The uneducated poor may adopt these unhealthy lifestyles later, but, once that occurs, are left with higher risk and burden of cardiovascular disease. One possible reason for this is that discretionary income and the desire for modern conveniences quickly attract unhealthy products (tobacco, high fat/high salt foods) and unhealthy behaviors (sedentary entertainment, transportation without physical exertion). The commercial interests of these products have been efficient and effective in delivering their messages to developing societies. Heart health organizations must be more aggressive in their assessment of needs for programs, education of people over a broad range of education levels, assurance of access to heart health services, alteration of the environment to facilitate heart health, and the development of policies and laws to limit deleterious products and behaviors. These late-adopter communities are assumed to require additional efforts and services to counterbalance deleterious influences. Sub-Saharan Africa is the only WHO region in which cardiovascular disease is not the leading cause of death. There is no precedent to support the notion that Africa will, without special efforts, avoid progression to later stages of the epidemiologic transition. The goal of improved education and eradication of poverty in Africa should not and need not carry the unhappy consequence of a cardiovascular disease epidemic. (*Ethn Dis.* 2003;13[suppl2]:S2-158-S2-163)

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“These are dangerous times for the well-being of the world. In many regions, some of the most formidable enemies of health are joining forces with the allies of poverty to impose a double burden of disease, disability, and premature death on many millions of people. It is time for us to close ranks against this growing threat.”

Gro Harlem Brundtland
2002 World Health Report

INTRODUCTION: CARDIOVASCULAR DISEASE IN THE EPIDEMIOLOGIC TRANSITION

In the 2002 *World Health Report*,¹ World Health Organization (WHO) Director General Brundtland alluded to 2 negative forces acting in today's world. She referred to the first of these as the allies of poverty and ignorance, which comprise inadequate nutrition, poor water quality, lack of hygiene, parasitic diseases, and lack of health care. The second of these, the new formidable enemies of health, includes deleterious health behaviors, such as tobacco use, poor nutrition, and physical inactivity. This force also describes the epidemiologic transition as seen in various stages between and within countries. The epidemiologic transition is the evolution of a population's predominant cause of

mortality from that of infectious and parasitic diseases to that of chronic, noncommunicable diseases.²⁻⁴ As shown in Table 1, which highlights cardiovascular diseases (CVDs),⁵ much of the world has already entered Stages III or IV, in which coronary artery disease (CAD) and stroke are the predominant causes of death. Sub-Saharan Africa is the only continental region that has not yet entered these later phases.

The epidemiologic transition suggests that countries with different levels of economy would be at different transition stages. Low- and middle-income countries are where the “allies of poverty” join forces with “the enemies of health.”¹ The convergence of these groups of diseases might be stratified by the income of the country (Table 2). In low-income countries, rheumatic heart disease and nutritional/infectious cardiomyopathy continue to be problematic. In middle-income countries, atherosclerotic diseases have already emerged, and coronary disease and stroke are the major causes of disability and death in high-income countries. An important observation in Table 2 is the ubiquitous role of hypertension in CVD for countries at all stages of development. This explains how high blood pressure can be the greatest actual cause of death in the world, according to the 2002 *World Health Report*¹ (Figure 1).

The objective of this paper is to examine the roles of education and income in these dynamic global trends in CVD, with a focus on sub-Saharan Africa. The history of the CVD epidemic across education and income groups will be described and related to current theories of diffusion of ideas, technology, and commerce. Though income and education are generally considered beneficial, some deleterious consequences will

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Table 1. Deaths caused by cardiovascular disease at four different stages of the epidemiologic transition

| Stage of Development | Deaths From CVD (% of Total) | Predominant CVD's | Regional Examples |
|---|------------------------------|---|--|
| Age of pestilence and famine | 5–10 | Rheumatic heart disease, infectious and nutritional cardiomyopathies | Rural areas of sub-Saharan Africa, India, and South America |
| Age of receding pandemics | 10–36 | As above, plus hypertensive heart disease and hemorrhagic stroke | China, and urban Africa |
| Age of degenerative and man-made diseases | 35–55 | All forms of stroke and ischemic heart disease at relatively young ages | Urban Asia, Latin America, and Eastern Europe |
| Age of delayed degenerative diseases | <50 | Stroke and ischemic heart disease at older ages | Western Europe, North America, Australia, New Zealand, and Japan |

be highlighted. The discussion will then speculate on strategies to limit any detrimental outcomes of education and income. These lessons from other parts of the world then might be applied to African populations as that continent emerges from Phase II to potentially face a coronary and stroke epidemic coinciding with its preexisting burden of infectious and parasitic diseases. This discussion will provide insights on how to prevent “the most formidable enemies of health” from joining forces with “the allies of poverty,” especially in the African context.

PARADOXICAL TRENDS IN THE ROLE OF EDUCATION AND INCOME IN CARDIOVASCULAR DISEASES

One interesting historical feature of the cardiovascular epidemic in develop-

ing countries is the inverse association between educational attainment or income status and rates of coronary disease or stroke.^{6,7} Early in the 20th century, these diseases were thought to mainly afflict the educated and affluent of Western Europe and North America. Within these countries, groups with advanced education and higher income levels were regularly documented as having higher rates of myocardial infarction, compared to less educated, poorer groups. One interpretation of these data, as discussed later, might be that higher socioeconomic groups were experiencing their epidemiologic transition earlier than the lower socioeconomic groups, even within a country. In the 1960s and 1970s, the coronary disease mortality rates began to decline. The rates of groups with better educations and incomes likely started to decline earlier, and often, more rapidly.⁸ This resulted in increasingly wide disparities in CVD mortality rates by the 1980s, with groups with lower incomes and less

education having higher rates. These disparities persist today and continue to increase.^{9,10}

An example of this might be CAD mortality rates in urban vs rural populations in the United States. Coronary artery disease (CAD) was traditionally more common in cities, with the rural lifestyle that included high levels of physical activity being linked to lower heart disease risk.¹¹ As CAD mortality declined, regions within the United States that were largely urban initiated the decline earlier and declined more quickly, resulting in a cross-over of rates in 1979, after which CAD rates in rural areas actually were higher. Similar observations have been made in African Americans, with lower rates of CAD in the 1960s being replaced by higher rates in the 1990s, compared to White Americans.¹²

These trends might be explained by the diffusion of innovation theory proposed by Rogers and Shoemaker¹³ (Figure 2). Some populations, often because

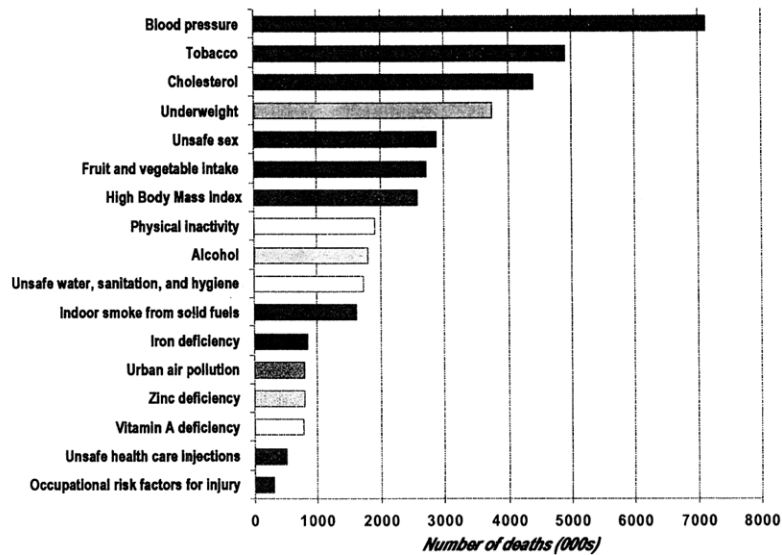
*The epidemiologic transition is the evolution of a population's predominant cause of mortality from that of infectious and parasitic diseases to that of chronic, noncommunicable diseases.*²⁻⁴

Table 2. The relative importance of cardiovascular diseases (CVDs) in low, middle, and high income countries

| Level of Development | Phase of Epidemiologic Transition and Predominant Cardiovascular Disease | | | |
|----------------------|--|-----------------|----------------------|---------------------|
| | I Infectious/Nutritional | II Hypertensive | III Early CAD/Stroke | IV Older CAD/Stroke |
| Low income | ++ | +++ | + | |
| Middle income | + | ++ | ++ | + |
| High income | | ++ | ++ | ++ |

+, ++, +++ = Relative contributions to country's total CVD burden.

World Deaths in 2000 attributable to selected leading risk factors



Source: WHR 2002



World Health Organization

Fig. 1. Numbers of deaths worldwide attributable to risk factors and behaviors, according to the World Health Report 2002

of better education and/or income, more readily adopt new ideas, products, and habits. Unhealthy habits (eg, tobacco) and products (high fat/salt foods) are also adopted earlier, with an earlier rise in CVD rates, and a rapid entry

into Phase III of the epidemiologic transition. The threat of CAD, the benefits of treating risk factors, and the adoption of heart healthy lifestyles, are likewise more quickly adopted, resulting in an earlier decline in CVD rates. The dy-

namic trends seen in the United States in urban vs rural lifestyles, or White vs African-American populations, are consistent with this theory.

The hypothesis here is that population groups of all sizes can have either early or late adoption characteristics, and their levels of education and/or income is a key determinant of that status. Residents of sub-Saharan Africa, along with other low-income populations, are likely to be late adopters. Similarly, the educated and wealthy groups residing in low-income countries would be early adopters, with a tendency to be afflicted with CVD earlier, and to experience a greater burden of stroke, compared to those groups with lower levels of education and income, residing in the same country.

The challenges for sub-Saharan Africa and other populations who have not yet entered Phase III are: 1) to encourage economic development and education as a proven strategy to reduce ma-

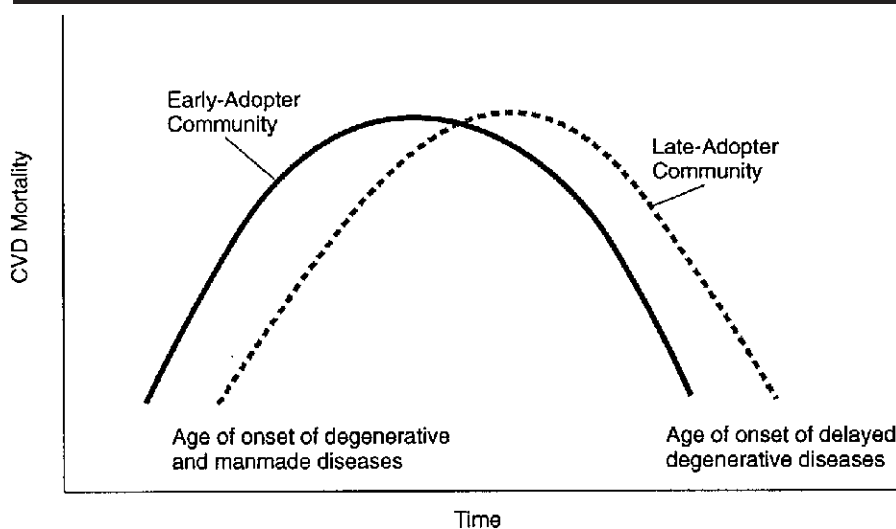


Fig. 2. Epidemiologic transition, Phase III and IV in early vs late adopter communities

ternal, prenatal, infectious, and nutritional diseases; and 2) to avoid the adoption of deleterious behaviors and products which play a major role in extending the CVD epidemic to those populations. Historically, these efforts have not been widely successful; however, insights from developed and developing countries who have preceded Africa in the epidemiologic transition would likely be beneficial.

EDUCATION AND INCOME AS THE DOUBLE-EDGED SWORD IN THE EPIDEMIOLOGIC TRANSITION

Economic development and education are, without question, cornerstones to any effort to improve health. The problem, it seems, is that discretionary income and the desire for modern conveniences quickly attract unhealthy products (tobacco, high fat/salt foods), and unhealthy behaviors (sedentary entertainment, transport without physical activity). Why does this happen with such regularity, as a community or nation reaches higher levels of development? The hypothesis is that commercial interests have, by a great margin, been more efficient and effective in delivering their messages to emerging societies.

Much is known about altering a population's knowledge and attitudes about health-related issues.^{14,15} Surveillance is required to identify a need, with the public then being made aware of the health issue through health education. This may be sufficient to encourage an early adopter community to change its behavior relating to a health issue (Figure 3).¹⁶ However, it is hypothesized that a late adopter community will not respond in a like manner, requiring additional efforts to organize the community, to assure access to the new health benefits, and to create an environment conducive to the health inter-

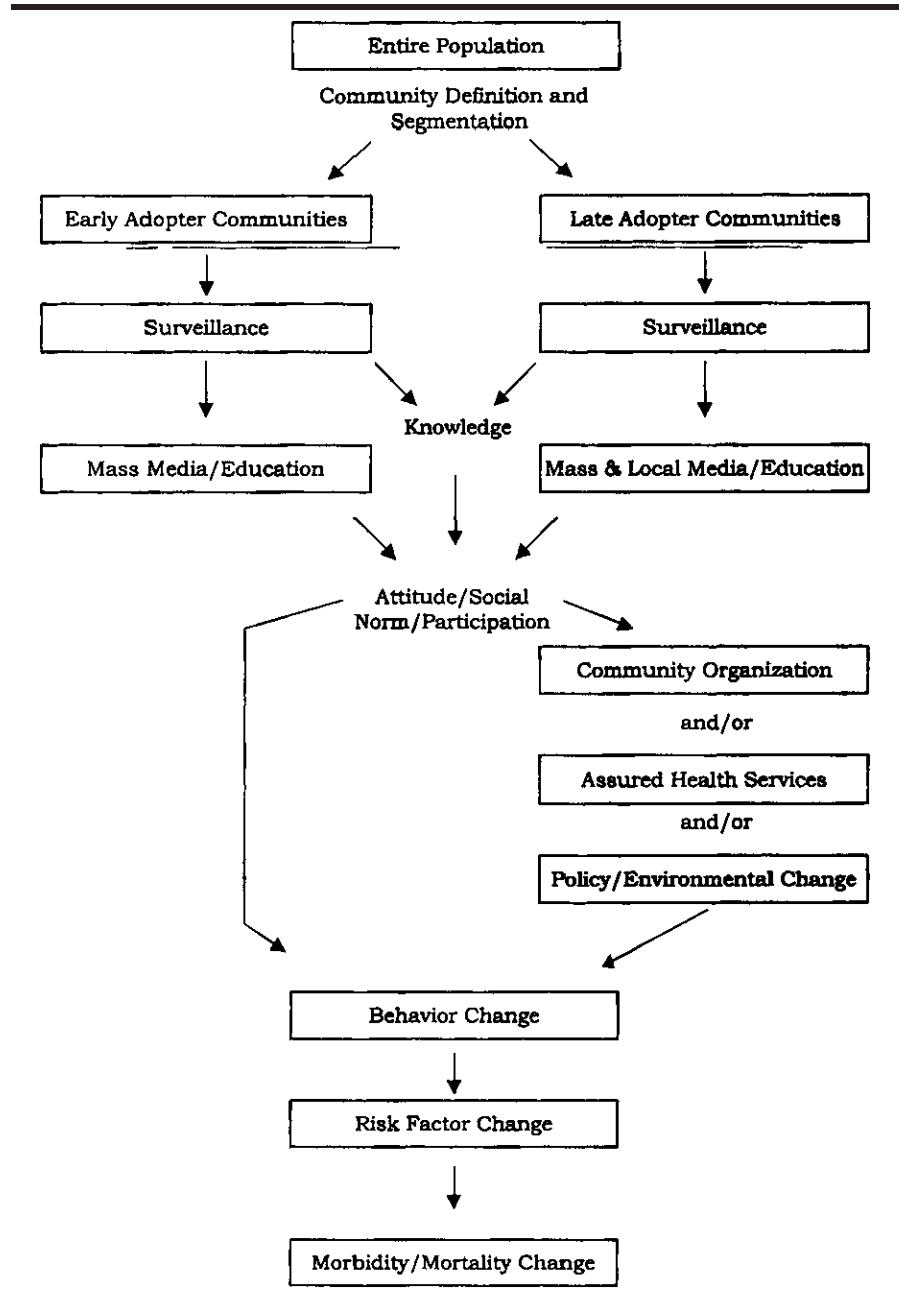


Fig 3. A model for segmentation of a community to allow stratification of community intervention strategies. The model suggests that segmentation into early- and late-adopter communities allows surveillance and media programs to be sufficient for early-adopter communities to effect change in social norms and behaviors. Late-adopter communities, however, may require additional community organization, assured health services, or policies leading to environmental change¹⁶

vention's effectiveness. In a public health model, the latter may include policy changes. These late adopter communities then would have both necessary and sufficient means to change behaviors, risk factors, and disease risk.

Is the commercial sector really different in its approach to a new market for products? Consider the marketing of tobacco, high fat Western foods, etc. Some investigation would be conducted to determine the size of the market,

market segments, and potential competitors (ie, market research). Prior to, or coinciding with, the product's launch, marketers communicate the virtues of the product (real or not) to the target population. This is called advertising. Marketers are well aware of the need for a local promoter, and may seek partnerships with local organizations. Co-marketers or wholesalers may be involved in ensuring the population's access to the new product (ie, retail distribution). There might be co-marketers or wholesalers. Finally, marketers may alter the environment to make the product appear more attractive, by such means as enlisting celebrities to use the product, supporting sports events, distributing promotional hats, shirts, etc. Efforts might be made to protect the product's use through legislation, a standard approach to entering an untapped market. Unfortunately, the tobacco, high fat food, and sedentary entertainment industries are extraordinarily effective at capturing the discretionary income of new markets in ways deleterious to heart health. These late adopter societies will require more than messages about the increasing burden of CVD to persuade them to change their behavior. Marketers of deleterious products have been willing and able to partner, provide access, and alter the environment to ensure dissemination of their new products. Heart health programs usually have not been as aggressive or efficient.

This pessimistic view does, however, provide a perspective as to approaches to improve this situation. Can heart health proponents rival commercial interests in their marketing of opposing ideas? Table 3 describes the analogous heart health programs that might compete with commercial interests. It is speculated that the magnitude of the risk factor burden often remains undefined by these programs, and certainly is not communicated to the population. Many countries do not have heart foundations or professional societies with which to organize or market local pro-

Table 3. Analogous actions of commercial and heart health organizations targeting population-wide behaviors

| Population Approach | Commercial Interest | Heart Health Program |
|--|--|--|
| Surveillance Awareness Organization/partnering | Market research Advertising Wholesalers, sponsorship of local groups | Surveillance Health education Voluntary health agencies, foundations, healthcare systems |
| Assuring access | Retail network | Dissemination via healthcare facilities, schools, religious organizations, worksites |
| Environmental/policy change | Protection of product use | Policies and laws to limit access and use |

grams. Healthcare systems may be overrun with acutely ill patients, therefore being unable to provide preventive programs. Public health systems are underfunded and understaffed in many parts of the world. Access to heart health messages and programs might be offered through healthcare facilities, schools, work sites, or religious organizations. A strategy which may be especially supportive of heart health policies is that of environmental or policy change, with limitations, or even prohibitions, being placed on access to, and use of, certain deleterious products and behaviors. Marketers of deleterious products are willing and able to exert additional efforts to alter a community's behavior; heart health advocates must also be willing and able, *especially* in late adopter communities.

IMPLICATIONS FOR THE IMPENDING CARDIOVASCULAR DISEASE EPIDEMIC IN SUB-SAHARAN AFRICA

As stated previously, sub-Saharan Africa is the only WHO region in which CVD has not exceeded infectious and parasitic diseases as the leading cause of death.⁵ This is due to various social determinants, including delays in economic development and lower levels of education. While the burdens of HIV, in-

fectious and parasitic diseases, and undernutrition are disproportionately concentrated in Africa at present, an epidemic of CVD is predicted, nonetheless. The opportunity to influence its course earlier than in other world regions remains intriguing.

As Africa develops, increases in education and income levels provide both opportunities and dangers. There is *no* precedent to support the notion that Africa will, without special effort, avoid Stage III of the epidemiologic transition. The diffusion of innovation theory supports the initiation of the epidemic among those with higher educational attainment and more discretionary income.¹³ However, even if its initial stages affect the rich and privileged, the later stages will involve all strata of society. Lessons from North America and Europe document the tendency for the uneducated and low-income segments of a society to retain their predisposition for early coronary disease and stroke, even after the rest of the population has benefited from reductions in the rates of these afflictions.⁶⁻¹⁰ Africa may be the last opportunity to alter what has been a repeated pattern of epidemiologic transition within and between societies.

The role of hypertension in the epidemiologic transition deserves emphasis. A health burden from hypertension is already being realized in Africa, and will remain a major contributor through later stages of the epidemiologic transi-

tion. Given the increased prevalence and greater end-organ disease in populations of African origin living outside Africa, targeting this risk factor and its determinants is worthwhile.

It is hoped that strategies to improve Africa's chances to ameliorate a CVD epidemic will profit from lessons learned in other regions of the world where CVD is now the leading cause of death. Using the strategy of matching commercial interests' marketing at every opportunity, some requirements become apparent. Data on the current prevalence of CVD and its risk factors are needed to emphasize the need for action. Effective and culturally appropriate health education messages are needed to activate and motivate communities and their leaders. Partners with interests in heart health need to be identified. Since African countries frequently do not have heart foundations or cardiovascular medicine societies to serve as international, national, and community leaders in this struggle, it will be necessary to identify and form partnerships with organizations with interests in heart health. International support for these foundations and societies is warranted. Local healthcare providers will need training in diagnostic methods, and an essential group of drugs needs to be available to the primary healthcare systems. Policies must be enacted early on to restrict access to, and use of, known causes of CVD, and communities need to enforce these. Heart health needs to be considered seriously during the prioritization of resources allocated for health.

CONCLUSIONS

Africa epitomizes the WHO Director General's depiction of "the most formidable enemies of health joining forces with the allies of poverty," and a cardiovascular epidemic is well on its way. Hypertension is already a major contribu-

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tor to poor health and will remain so. Education and economic development provide the last opportunity for better health, yet pose short-term risks, unless the increased awareness of and desire for tobacco, poor dietary priorities, and sedentary pursuits can be avoided. Those with commercial interests in these products and behaviors have consistently applied strategies of population behavior change earlier, more widely, and more effectively, than have disease prevention programs. Our understanding of diffusion of ideas needs to be used to initiate effective programs early, that have equal reach, and are reinforced by legislative policies. Given our current experience with the global CVD epidemic, it is impossible to invoke the excuses that the African CVD epidemic is a surprise, or that strategies and policies for action are unknown. The goal of improved education and eradication of poverty in Africa should not, and need not, result in the unhappy consequence of a CVD epidemic.

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