

Injuries and noncommunicable diseases: emerging health problems of children in developing countries

Jacqueline L. Deen,¹ Theo Vos,² Sharon R.A. Huttly³ & James Tulloch⁴

The present article identifies, for children living in developing countries, the major causes of ill-health that are inadequately covered by established health programmes. Injuries and noncommunicable diseases, notably asthma, epilepsy, dental caries, diabetes mellitus and rheumatic heart disease, are growing in significance. In countries where resources are scarce it is to be expected that increasing importance will be attached to the development and implementation of measures against these problems. Their control may benefit from the application of elements of programmes directed against infectious, nutritional and perinatal disorders, which continue to predominate.

Voir page 523 le résumé en français. En la página 523 figura un resumen en español.

Introduction

Disease patterns have been changing in recent decades because of socioeconomic developments. Low-income countries have been moving into the middle-income category, where, as a consequence of increased life expectancy, reduced fertility, industrialization and a shift from rural to urban living, the age structure and health problems of populations have been altering. While continuing to cope with illnesses linked to poverty, these countries have to tackle increasing incidences of injuries and noncommunicable diseases. Infectious, perinatal and nutritional disorders continue to predominate in many countries with very low incomes, where, however, injuries and noncommunicable diseases are already presenting considerable public health problems.

People in developing regions experience 90% of the world's disease burden but have only 10% of global health care funds at their disposal. Strategies for improving health should therefore be selective and based on a rational setting of priorities. It is necessary to identify the principal problems, select appropriate, cost-effective interventions, and provide efficient

services. The formulation of responsive health policies requires that disease burdens be analysed critically and unremittingly (1). We review below the childhood burden of disease in developing countries, with particular reference to major causes of ill-health not covered by global public health strategies.

Materials and methods

Quantitative assessments in this review are taken from a set of death and disability estimates for 1990 and from baseline, optimistic and pessimistic projections for each ten-year period until 2020 (2). The data relate to:

- established market economies;
- former socialist economies of Europe;
- India;
- China;
- other Asian islands (i.e. developing countries in Asia other than India and China);
- sub-Saharan Africa;
- Latin America and the Caribbean;
- the Middle-Eastern Crescent.

The last six of these are classified as developing regions. Causes of death are categorized as:

- infectious, maternal, perinatal and nutritional conditions (group 1);
- noncommunicable diseases (group 2);
- injuries (group 3).

Each group is divided into broad disease categories and there is further subdivision into 110 specific diseases and injuries.

¹ Medical Research Council Laboratories, Farafenni Field Station, The Gambia (tel: 220 735 239; fax: 220 735 512; e-mail: jdeen@mrc.gm). Requests for reprints should be addressed to this author.

² Epidemiology Unit, Department of Human Services, Melbourne, Victoria, Australia.

³ Department of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, England.

⁴ Director, Child and Adolescent Health and Development, World Health Organization, Geneva, Switzerland.

Estimates of disease burden are reported as disability-adjusted life years (DALYs) (3), which are the sum of discounted and age-weighted years of life lost because of premature death and years lived with disability of specified severity. The principal contributors to childhood disease burden not covered by global public health strategies are determined by excluding infectious, perinatal and nutritional disorders from childhood death and disability estimates for 1990 and ranking the remaining conditions by number of DALYs. Comparisons of childhood disease burden in 1990 between regions, age groups and sex are made using DALYs per 1000 population; the DALY values for 1990 are also compared with baseline projections for 2020. A literature review covering the period 1980–1998 was conducted for each of the conditions discussed by means of the Medline and BIDS databases.

The broad picture

Table 1 indicates the pattern of disease and disability among the 86% of children under 15 years of age living in developing countries in 1990. Of the childhood disease burden, 72% was attributed to infectious, perinatal and nutritional disorders, 15% to noncommunicable diseases and 13% to injuries. All-cause DALY values were several times higher in developing regions than in developed regions. In regions with successful control of infectious, perinatal and nutritional disorders the percentage of childhood DALYs attributed to injuries and noncommunicable diseases was relatively high. Among the developing regions the percentages were highest in China, Latin America and the Caribbean, intermediate in other Asian islands (developing countries in Asia other than India and China), the Middle-Eastern Crescent, and India, and lowest in sub-Saharan Africa.

Among children aged 0–4 years, group 1 conditions predominated, whereas among those aged 5–14 years the distribution of DALY rates between the three disease groups was more even (Fig. 1). It is projected that DALY rates for children will decline by 2020 and that the greatest drop will be in group 1 conditions. This can be expected to result in an increase in the relative contribution of injuries and noncommunicable diseases to the childhood disease burden in developing regions from 28% in 1990 to 45% in 2020.

Table 2 indicates the contributors to childhood disease burden which are not covered by public health programmes. We focus below on injuries, asthma, dental caries, epilepsy, diabetes mellitus and rheumatic heart disease, bearing in mind the public health interventions that may be feasible on a large scale in developing countries.

Injuries

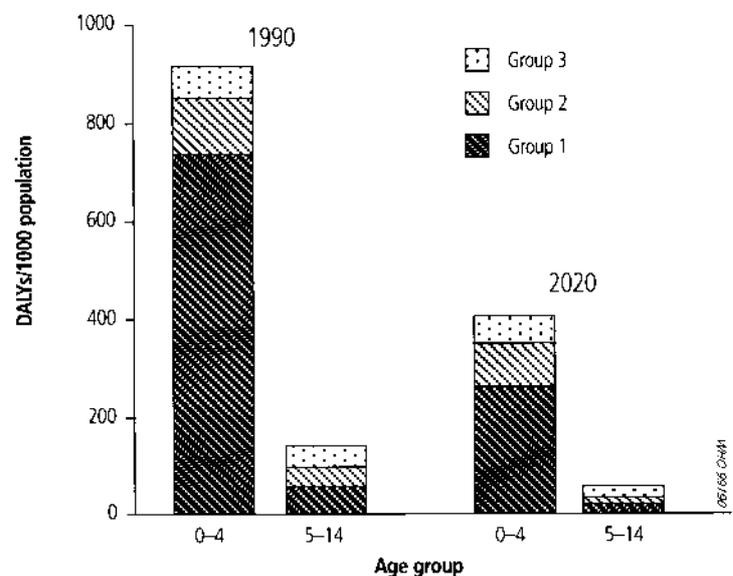
Childhood DALY rates attributable to injuries were highest in sub-Saharan Africa and India and were

Table 1. Global burden of disease of children under 15 years of age by region and disease group^a in 1990

Area (population in millions)	DALYs/1000 population				% DALYs contributed by groups 2 + 3
	All causes	Group 1	Group 2	Group 3	
Developing regions (1471)	434	312	67	56	28
India (314)	526	393	57	77	25
China (305)	205	111	52	42	46
Other Asian islands (250)	354	236	72	46	33
Sub-Saharan Africa (234)	820	666	70	84	18
Latin America and Caribbean (160)	249	157	58	34	37
Middle-Eastern Crescent (208)	439	298	100	41	32
Developed regions (235)	68	24	31	13	64

^a Disease groups: group 1 = infectious, maternal, perinatal and nutritional conditions; group 2 = noncommunicable diseases; group 3 = injuries.

Fig. 1. DALY rates of children under 15 years of age in developing countries by age and disease group^a for 1990 and projected to 2020



^a Disease groups: group 1 = infectious, maternal, perinatal and nutritional conditions; group 2 = non-communicable diseases; group 3 = injuries.

higher among males than females and among children aged 0–4 years than among those aged 5–14 years (Table 3). Falls, drownings and road traffic accidents were the main causes of unintentional injuries, while the largest number of intentional injuries was caused by war.

Males had more unintentional injuries than females, except for poisonings and burns. Poisonings occurred more frequently in children aged 0–4 years than in older children, irrespective of whether they

Table 2. **Noncommunicable diseases and injuries in children under 15 years of age in developing regions in 1990, ranked by number of DALYs**

Conditions/ circumstances	DALYs (1000s)	Conditions/ circumstances	DALYs (1000s)
Other unintentional injuries ^a	24 847	Dental caries	1884
Falls	16 524	Leukaemia	1734
Congenital heart anomalies	12 224	Epilepsy	1717
Drownings	10 730	Chronic obstructive pulmonary disease	1675
Road traffic accidents	10 441	Obsessive-compulsive disorder	1108
Fires	6885	Self-inflicted injuries	1013
War	5809	Diabetes mellitus	993
Anencephaly	4880	Rheumatic heart disease	858
Down syndrome	3887	Lymphomas	821
Spina bifida	3787	Cirrhosis of the liver	800
Asthma	3607	Degenerative central nervous system disorders	783
Inflammatory heart diseases	3473	Appendicitis	771
Violence	3080	Post-traumatic stress disorder	470
Nephritis	2981		
Poisonings	2613		
Cerebrovascular disease	2550		
Endocrine disorders	2397		

^a Other than falls, drownings, road traffic accidents, fires and poisonings, including injuries caused by natural calamities, man-made disasters, environmental factors, air or sea travel, animals, machinery, exposure to radiation, etc.

Table 3. **DALYs/1000 population of children under 15 years of age in developing regions in 1990 caused by injuries, asthma, dental caries, epilepsy, diabetes and rheumatic heart disease, by region, sex and age group**

Categories (population in millions)	DALYs /1000 population					
	Injuries	Asthma	Dental caries	Epilepsy	Diabetes mellitus	Rheumatic heart disease
Developing regions (1471)	56	2.5	1.3	1.2	0.7	0.6
India (314)	77	1.9	0.7	1.3	1.5	0.4
China (305)	42	2.7	1.4	0.7	0.2	0.3
Other Asian islands (250)	46	2.6	0.6	1.4	0.3	0.1
Sub-Saharan Africa (234)	84	2.9	0.8	1.0	0.6	1.4
Latin America and Caribbean (160)	33	2.5	3.3	1.5	0.5	0.2
Middle-Eastern Crescent (208)	41	2.1	1.8	1.3	1.0	1.3
Sex						
Male (751)	63	2.9	1.3	1.1	0.7	0.5
Female (720)	48	2.0	1.3	1.3	0.7	0.7
Age group						
0–4 years (553)	69	2.1	1.5	0.5	0.5	0.1
5–14 years (918)	48	2.7	1.1	1.6	1.3	0.9

were male or female. Burns were more common in females due to association with kitchen activities. Children in the lower age range had higher DALY

rates for most types of unintentional and intentional injuries than children aged 5–14 years.

The relative contribution to the disease burden of children under 15 years of age in developing regions is expected to increase from 13% in 1990 to 22% in 2020. It is predicted that in the next two decades the disease burden from injuries in many populations will equal or exceed that caused by infectious diseases; low-income and middle-income countries are expected to experience greater increases than industrialized countries (4).

Accidents in the home accounted for a significant number of DALYs. Initial interventions in developing countries may be most successful if they concentrate on domestic injuries. Primary preventive measures of proven effectiveness include the installation of window guards and bed rails, raising or enclosing cooking areas, using fire-resistant fabrics, and using child-proof caps for containers of pesticides, medicines and kerosene. Such interventions require legislation, enforcement of product standards, and financial outlays.

The prevention of unintentional injuries through health education of parents and children requires behavioural change that may be difficult to sustain. The effectiveness of measures such as the teaching of injury prevention and the conducting of campaigns in the mass media has not been adequately explored in developing countries.

Interventions against intentional injuries are comparatively difficult to achieve. Much of the maltreatment of children in developing countries is associated with poverty and inequality. Intervention strategies can gradually be developed once the nature of violence against children has been defined. Legislation and policies on child abuse are required; specific interventions dealing with child prostitution and child labour should be given priority. Schools of medicine, law and social work should include the subject of child abuse in their curricula. Health workers and police officers should be trained to identify and refer cases of child abuse. At the community level, the education of parents may be the most important preventive measure. A referral and support system involving government social welfare and nongovernmental organizations may be an option. Alternatively, neighbourhood programmes based in schools, churches or other local facilities may serve as centres for counselling and assistance.

In war situations, interventions have included international advocacy for the protection of children, banning the production of land mines, rehabilitation of child soldiers, prevention of the abandonment of children, assistance for unaccompanied children, and post-conflict reconstruction.

Asthma

In 1990 some 90% of asthma attacks in children occurred in developing regions and resulted in 2.5 DALYs/1000 population (Table 3). Males were more

often affected than females and children aged 5–14 years were more frequently affected than younger children.

The cost and effectiveness of preventive strategies should be evaluated. In order to prevent the development of the disease, it has been suggested that parental education would be of value in reducing childhood exposure to indoor pollutants (5). Secondary measures include improving the clinical detection of asthma and using preventive drug therapy. Tertiary strategies, which predominate, focus on the acute management of the disease and the provision of access to referral centres; they reduce mortality and increase life expectancy but do not improve the quality of life of asthmatic persons.

Dental caries

Bacteria on the teeth are the direct cause of dental caries, but increased sugar intake, plaque and insufficient fluoride are among many other contributory factors. Childhood dental caries in developing regions causes 1.3 DALYs/1000 population (Table 3).

Primary preventive measures include education on oral health and hygiene, reducing the amount of dietary sugars, and fluoridation. Secondary prevention slows the progression of caries by simple dental procedures. Tertiary measures include pain relief, emergency treatment, extraction, and antimicrobial and analgesic therapies. Education on oral health and the application of secondary measures by persons who have received basic training and who work under the guidance of dentists have been recommended as cost-effective strategies (6).

Epilepsy

About half of all epilepsy cases begin in childhood and early adolescence. The childhood burden of epilepsy in developing regions was estimated at 1.2 DALYs/1000 population; children aged 5–14 years were affected to a greater degree than younger children (Table 3).

Perinatal asphyxia, trauma and infections of the central nervous system are considered important risk factors for epilepsy in developing countries (7). Consequently, primary measures against the disease include safe delivery, prevention of brain trauma and control of infectious diseases. Locally defined causes of epilepsy have to be taken into consideration. For instance, public health measures against neurocysticercosis have included mass treatment of pigs and humans, augmented by public education campaigns.

Secondary interventions prevent recurrent seizures by means of antiepileptic medications. With phenobarbital treatment alone, about 50% of cases can be free of seizures (8), and the remaining 50% are likely to benefit from other anti-seizure medications. A large proportion of people with epilepsy in

developing countries are incorrectly treated or are not treated at all, because of a lack of training in the management of seizures, poor compliance with drug treatment, unavailability of antiepileptic drugs, and social prejudice.

Diabetes mellitus

Insulin-dependent diabetes mellitus is chronic and irreversible, requiring the injection of insulin in order to sustain life. The onset of the disease usually occurs in childhood, peak incidence being at puberty. The childhood burden caused by the disease in developing regions was 0.7 DALY/1000 population in 1990 (Table 3). The highest DALY rates were in India and the Middle-Eastern Crescent. In many countries the disease is responsible for case-fatality rates in the range 30–100% during the four to six years after diagnosis. Factors that increase mortality include failure or delay in diagnosis, limited contact of patients with the health system, scarcity of trained staff, and a lack of regular supplies of insulin and the equipment needed for its administration.

Primary preventive measures are unavailable because the precise etiology of the disease is unknown. The relatively low incidence and the short interval between the onset of pathology and clinical manifestations mean that population screening for early detection is unjustifiable. Priority should be given to case management in order to reduce mortality, relieve symptoms and avoid associated complications (9).

The cost of treating the disease is high. However, treatment postpones death for many years and consequently may well be more cost-effective than interventions against other chronic diseases. Each country has to determine how it should deal with diabetes mellitus in childhood, taking into consideration questions of priority and equity. Policy options for control of the disease include the development of standard case management protocols, the training of professional and community health personnel, increased education and follow-up of known diabetics, and the provision of insulin and the equipment needed for its administration (10).

Rheumatic heart disease

In 1990 the childhood burden from rheumatic heart disease in developing regions was 0.6 DALY/1000 population (Table 3). The DALY values were highest in sub-Saharan Africa and the Middle-Eastern Crescent. Females were more frequently affected than males and children aged 5–14 years were more often affected than younger children.

Since the clinical manifestations of rheumatic heart disease may not become apparent until adulthood, childhood DALY rates do not fully reflect the impact of the disease. DALY rates increase from 0.6 in childhood to 0.89 in persons

aged 15–44 years, and rise to 2.6 in persons aged 45 years and above.

Rheumatic heart disease begins with streptococcal pharyngitis, which can occur at any age but is commonest in persons aged 5–15 years. This is followed by episodes of rheumatic fever, 90% of which occur before the age of 15 years. About 30% of rheumatic fever cases recover completely with or without treatment, 12% develop mild carditis, 23% develop cardiomegaly, and in 35% there is progressive heart failure and early death (11).

Penicillin treatment of streptococcal pharyngitis is highly effective in the primary prevention of rheumatic fever/rheumatic heart disease (12). In countries with poor resources it is often impossible to obtain laboratory confirmation of streptococcal etiology. Without proper diagnosis, several hundred episodes of pharyngitis would have to be treated in order to prevent one death from cardiac failure.

Secondary prophylaxis prevents the development or progression of cardiac disease when rheumatic fever/rheumatic heart disease is diagnosed. Monthly or three-weekly penicillin injections are given for five years after the last attack of rheumatic fever, or until the age of 18 years if carditis is present, or throughout life in the presence of valvular disease (12). In order to conduct effective secondary prevention it is necessary to have health workers who are skilled in the diagnosis of rheumatic fever/rheumatic heart disease and patients who are compliant with prolonged antibiotic prophylaxis. Patients are diagnosed as having rheumatic fever/rheumatic heart disease when they seek care, or diagnosis may take place during active case-finding. Secondary prophylaxis targets a much smaller population than primary prophylaxis; the estimated cost of averting one death is US\$ 5520 for secondary prophylaxis and US\$ 40 920 for primary prophylaxis (11).

Financial considerations have made secondary prophylaxis predominant in developing countries. It does not reverse cardiac compromise, however, and consequently primary prevention has been increasingly advocated, although this may not be feasible in all such countries. Data are needed on the cost and effectiveness of streptococcal screening techniques incorporated into the primary prevention of rheumatic heart disease in developing countries.

Conclusion

Infectious, perinatal and nutritional disorders are still the main causes of childhood death and disability in developing regions, where, however, there is clear evidence that injuries and noncommunicable diseases are becoming significant health problems among children. In 1990, DALY rates attributable to injuries and noncommunicable diseases taken together among children aged 5–14 years had already exceeded those attributable to infectious, perinatal and nutritional conditions. The predicted pattern for

2020 is one of an increased relative burden from injuries and noncommunicable diseases.

The principal factor responsible for the recognition of the importance of injuries and noncommunicable diseases has been the inclusion of disability in the calculation of global disease burden in DALYs. The estimates of global disease burden give an idea of the patterns of childhood disease and disability and provide a basis for general prioritization.

In order to combat infectious, perinatal and nutritional problems, international development assistance has focused primarily on health services. Tackling the range of other health problems discussed in the present paper requires a broader, more diversified approach, involving:

- research into local patterns of health and available resources;
- identification of cost-effective interventions;
- planning actions that are adapted to each context.

Nevertheless, lessons learnt about surveillance, integration and community participation from programmes dealing with infectious, perinatal and nutritional problems may be applicable to the control of injuries and noncommunicable diseases.

Surveillance of injuries and noncommunicable diseases can be incorporated into national data reporting systems. The quantification of these problems makes it possible to determine priorities for action, to establish targets for control, and to generate political will. The identification of high-risk populations or behaviours allows focused interventions to be developed and implemented. The monitoring of changes in incidence or prevalence over time permits the effectiveness of control programmes to be determined and the detection of new areas of concern.

The integration of strategies for dealing with injuries and noncommunicable diseases into health frameworks is likely to make them more feasible and cost-effective than they would otherwise be. Thus dental care and the prevention of injuries in the home could be incorporated into child survival and development programmes, while interventions against road traffic accidents, asthma, epilepsy and rheumatic heart disease could be integrated into school health programmes.

The incorporation of control measures against injuries and noncommunicable diseases into behaviour patterns is probably best achieved through community involvement. Family education and social marketing in respect of specific practices in the field of child care could be effective. It is also worth considering expansion of the traditional role of community health workers to include the dissemination and feedback of information on injuries and noncommunicable diseases.

In the developing world there are increasingly important childhood conditions that are not being adequately tackled by public health programmes. Estimates of global disease burdens give an idea of the patterns of childhood disease and disability in

developing regions. However, country-specific data are essential, and there is also a need for more research into the cost and effectiveness of intervention strategies. It is to be hoped that a growing awareness of the significance of injuries and non-communicable diseases in developing countries will encourage studies in these fields. ■

Acknowledgements

The authors wish to thank WHO medical officers Drs Carol Djeddah, Monica Goracci, N. Khaltaev, Porfirio Nordet and Claude J. Romer for all their help.

Résumé

Traumatismes et maladies non transmissibles : des problèmes de santé émergents chez les enfants des pays en développement.

Il est essentiel de procéder à une analyse critique et continue du schéma de la morbidité pour une détermination rationnelle et responsable des priorités. Les auteurs du présent article se sont attachés à recenser, chez les enfants vivant dans des pays en développement, les causes majeures de morbidité auxquelles les programmes de santé existants n'accordent pas suffisamment d'importance.

Les cas de morbidité et d'incapacité chez les enfants des pays en développement sont présentés à partir des données fournies par l'étude sur la charge mondiale de la morbidité. Si les maladies infectieuses, nutritionnelles et périnatales continuent de prédominer, les maladies non transmissibles et les traumatismes commencent à poser de sérieux problèmes de santé chez

les enfants. Les traumatismes, l'asthme, l'épilepsie, les caries dentaires, le diabète sucré et les cardiopathies rhumatismales en particulier apparaissent comme de nouvelles priorités potentielles, compte tenu de leur contribution à la charge de la morbidité chez les enfants des pays en développement et des interventions qui peuvent être envisagées.

L'élaboration et la mise en œuvre de mesures contre les maladies non transmissibles et les traumatismes vont revêtir une importance croissante dans les pays démunis. Des éléments des programmes de lutte contre les pathologies infectieuses, périnatales et nutritionnelles devraient pouvoir être appliqués à la lutte contre les maladies non transmissibles et les traumatismes.

Resumen

Traumatismos y enfermedades no transmisibles: problemas de salud emergentes en la población infantil de los países en desarrollo

Es fundamental llevar a cabo un análisis crítico y continuado de las pautas de morbilidad para poder establecer las prioridades racionalmente y en función de las necesidades. El objetivo de esta revisión consiste en identificar, en lo que atañe a los niños que viven en los países en desarrollo, las principales causas de morbilidad que los programas de salud establecidos no abordan en la medida necesaria.

A partir de los datos aportados por el estudio sobre la Carga Mundial de Morbilidad, se describen las enfermedades y discapacidades que aquejan a los niños en los países en desarrollo. Aunque siguen predominando los trastornos infecciosos, nutricionales y perinatales, las enfermedades no transmisibles y los traumatismos están emergiendo como problemas

importantes de salud infantil. Se identifican concretamente los traumatismos, el asma, la epilepsia, la caries dental, la diabetes mellitus y la cardiopatía reumática como posibles nuevas prioridades; así se deduce de su contribución a la carga de morbilidad infantil en los países en desarrollo y de la disponibilidad de intervenciones viables.

El desarrollo y la aplicación de medidas contra las enfermedades no transmisibles y los traumatismos adquirirán cada vez más importancia en los países con recursos escasos. Es posible aplicar elementos de los programas establecidos contra las enfermedades infecciosas perinatales y nutricionales para combatir las enfermedades no transmisibles y los traumatismos.

References

1. **Mooney G, Creese A.** Priority setting for health service efficiency: the role of measurement of burden of illness. In: Jamison DT et al., eds. *Disease control priorities in developing countries*. Washington DC, Oxford University Press, 1993.
2. **Murray CJL, Lopez AD.** *The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020*. Cambridge MA, Harvard University Press, 1996.
3. **Murray CJL.** Quantifying the burden of disease: the technical basis for disabled-adjusted life years. *Bulletin of the World Health Organization*, 1994, **72**: 429–445.
4. **Ad Hoc Committee on Health Research Relating to Future Intervention Options.** *Investing in health research and development*. Geneva, World Health Organization, 1996 (document TDR/Gen/96.1).
5. **National Institutes of Health.** *Global initiative for asthma: global strategy for asthma management and prevention*. Proceedings of an NHLBI/WHO workshop, National Heart, Lung and Blood Institute publication no. 95-3659, January 1995.
6. **Valentine AD.** A community approach to the prevention of dental disease in the children of developing countries. *International dental journal*, 1981, **31**: 23–28.

7. **Sandmann MC, de Bittencourt PRM.** Epilepsy. In: Shakir RA, Newman, PK, Poser CM, eds. *Tropical neurology*. London, WB Saunders & Co, 1996.
8. **Hosking G.** Epilepsy. *Tropical doctor*, 1990, **20**: 49-51.
9. **Vaughan JP, Gilson L, Mills A.** Diabetes. In: Jamison DT et al., eds. *Disease control priorities in developing countries*. Washington, DC, Oxford University Press, 1993.
10. **World Health Organization.** *Guidelines for the development of a national programme for diabetes mellitus*. Geneva, World Health Organization, 1991.
11. **Michaud C et al.** Rheumatic heart disease. In: Jamison DT et al., eds. *Disease control priorities in developing countries*. Washington DC, Oxford University Press, 1993.
12. **Snitcowsky R.** Rheumatic fever prevention in industrializing countries: problems and approaches. *Pediatrics*, 1996, **97**: S997–S998.