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**GLOBAL DATA ON BLINDNESS**  
**AN UPDATE**

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## PREAMBLE

It is estimated that there are 38 million persons blind globally. Moreover, a further 110 million have low vision and are at great risk of becoming blind.

The main causes of blindness and low vision are cataract, trachoma, glaucoma, onchocerciasis and xerophthalmia. Insufficient data on blindness from causes such as diabetic retinopathy and age-related macular degeneration do not permit specific estimations of their global prevalence.

Age-specific prevalence of the major causes that are aging-related points to a rising trend for blindness in the decades ahead, unless energetic efforts are made to tackle these problems.

More data collected through standardized methodologies, using internationally accepted (ICD-10) definitions, are needed. Data on incidence of blindness from common causes would be useful in calculating future trends more precisely.

### NOTE:

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See also: Thylefors, B., Négrel, A.-D., Pararajasegaram, R. & Dadzie, K. Y. "Available data on blindness (update 1994)" (Unpublished document WHO/PBL/94.38).

**Key words:** blindness, low vision, cataract, trachoma, glaucoma, onchocerciasis

## INTRODUCTION

The number of blind in the world is not accurately known, but it has been estimated, on some occasions by the World Health Organization (WHO). Thus, in 1972, it was reported that there might be some 10-15 million blind globally. The same year, when a Study Group on the Prevention of Blindness was convened,<sup>1</sup> this figure was recognized to be an underestimate even though based on information provided by Member States. This Study Group recommended and made a great contribution to the future collection of data on blindness, in working out uniform definitions on blindness and visual impairment, today included in the *International Classification of Diseases* (Tenth Revision).

When the WHO Programme for the Prevention of Blindness was established in 1978, its priority was to get more detailed knowledge about blindness and its causes worldwide. A Task Force on Data on Blindness was therefore convened in 1978, which developed an epidemiological model for blindness estimates in relation to the developmental stage of the country.<sup>2</sup>

The WHO Programme has, from its outset, developed a simplified population-based assessment methodology for visual loss and its causes;<sup>3</sup> this has resulted in a standard form and method for low-cost, small-scale field surveys, which can be conducted mainly by trained non-specialist staff. The application of this methodology, in an increasing number of countries, has led to a gradual accumulation of epidemiologically reliable data.

In addition to the WHO Global Data Bank on Blindness, for the collection and dissemination of epidemiological information and trends assessment, work was undertaken in 1993, in collaboration with the World Bank, to measure the burden of disease. For this purpose, the WHO Programme provided estimates of prevalence and incidence for the following blinding eye diseases: cataract, glaucoma, trachoma and onchocerciasis. The global burden of disease (GBD) combines the premature loss of life with the loss of healthy life years from disability. The GBD is measured in units of disability-adjusted life years (DALYs);<sup>4</sup> this is outside the scope of the present paper.

This paper reports on and discusses the available information on the prevalence, distribution and causes of blindness in the world. It also describes the trends in blindness prevalence over the last two decades. The paper draws attention to some of the assumptions made and the methodological issues involved in the computation of data. It also highlights the areas requiring further elucidation.

## MATERIALS AND METHODS

### 1. DEFINITIONS

In this paper, the definitions used for blindness and visual impairment follow those included in the Tenth Revision of the *International Classification of Diseases* (ICD-10).

- Blindness is defined as vision less than 3/60 (0.05) or corresponding visual field loss in the better eye with best possible correction (Categories 3, 4 and 5 in ICD-10). This corresponds to loss of walk-about vision.
- Low vision corresponds to vision less than 6/18 (0.3) but equal to or better than 3/60 (0.05) in the better eye with best possible correction (Categories 1 and 2 in ICD-10).

### 2. DATA COLLECTION

The background information for this paper came from selected epidemiologically sound data on blindness and visual impairment. Two main sources were used to identify relevant existing information on the subject:

2.1(a) Routine periodic computerized search of relevant information is carried out as part of an ongoing updating of the WHO/PBL Blindness Data Bank (BDB).

This employs a three-step process. First, all abstracts are scanned to identify subject matter of interest to the BDB. Next, all relevant materials are reviewed in depth and a checklist is used for eligibility criteria for inclusion. Finally, an in-house discussion is held to arrive at a consensus for inclusion of the new data in the BDB.

For this purpose, the following inclusion criteria have been established:

- (i) Clear, unequivocal definitions of blindness and low vision used have to be stated (preferably according to ICD-10 categorization).
- (ii) Cross-sectional design (prevalence survey) ensuring
  - clear description of the sample design and sampling plan
  - random allocation of study sampling units

- large-enough sample to achieve a desired degree of precision
- fair assessment of non-sampling errors and a description of quality control measures used

2.1(b) The BDB receives unpublished information from national sources. A similar review process is applied to determine suitability for inclusion.

2.2 To overcome the paucity or lack of information from many parts of the world, a series of consultations was organized. This involved a consensus development on extrapolating available data to neighbouring areas or in countries sharing a similar sociocultural, economic and epidemiological environment. Where multiple sources of data were applicable for such extrapolation, agreement was reached on the most appropriate information for application in the model for a specific region or country or for some groups at risk.

### 2.3 Assessment of the magnitude of the problem

Five specific models/algorithms were developed in order to estimate the magnitude of blindness and severe visual impairment and the major causes of blindness, i.e., cataract, glaucoma, trachoma and onchocerciasis.

In relation to "other causes", defined as those causes of blindness and severe visual impairment unrelated to any of those listed above, the paucity of data available, particularly on diabetic retinopathy and aging-related macular degeneration, did not permit the direct estimation of the prevalence of visual loss due to these causes.

Although each of these five models presents a specific structure, they share a common framework. They permit estimates for defined regions, based on assessment of specific prevalences by age, sex and, where indicated, race.

As a first step, the 229 countries/territories/economies registered worldwide were grouped, as proposed in the *World Development Report (1993)*, into eight economic regions (Table 1). Next, the demographic structure of the year 1990 was taken as the population base, by country and for the age groups defined.<sup>5</sup> Regional totals were also calculated for those age groups and both sexes.

The selected parameters identified by the review process were applied for the five age groups (0-4, 5-14, 15-44, 45-59, 60 and over). Where appropriate, the sex, racial distribution (e.g. in glaucoma) and place of residence (e.g. for trachoma and onchocerciasis) were taken into account, as were urban/rural disparities. Projections of the number of people blind on a regional level were made by applying the "most valid" age/sex/race-specific rates to the demographic structure of the year 1990.

For estimating the magnitude of "low vision", as defined in ICD-10 (Categories 1 and 2), 17 relevant population-based surveys were analysed. This permitted, from the estimate of blindness, a rough assessment of low vision, using a corrective factor.

In view of the extensive work already done in onchocerciasis control and in new initiatives in ivermectin distribution, recourse was had to data from the Onchocerciasis Control Programme and Expert Committee reports. These are discussed later in this paper.

## RESULTS

### 1. GLOBAL MAGNITUDE OF BLINDNESS AND LOW VISION

According to the algorithm elaborated, there were (worldwide) in 1990 about 38 million blind people (Table 2).

The global prevalence of blindness is 0.7%, with a range from 0.3 for the established market economies and former socialist economies of Europe to 1.4% for sub-Saharan Africa.

Table 3 shows the relationship between blindness and low vision, based on surveys from 17 countries. Applying the multiplying factor 2.9 to the blindness estimate, the number of persons with "low vision" - as per the ICD-10 definition - is about 110 million.

Thus, the global burden of visual impairment (people blind or with significant visual loss) is estimated at about 148 million.

### 2. REGIONAL DISTRIBUTION AND REGIONAL BURDEN OF BLINDNESS

To address this issue and to provide an easy means of comparison, the proportion of the number of blind in the region in relation to the global number of blind was applied to the proportion of the regional population in relation to the world population; this ratio is referred to as the Regional Burden of Blindness (RBB) (Table 4).

Thus, if the region represents 0.1 (10%) of world blindness and 0.2 (20%) of the global population, the corresponding ratio is 0.5. In other words, if the region is characterized by a fair proportionate "share" of blindness in relation to its population, the RBB will be one. Every ratio higher than one will simply identify the regions where the burden of blindness is to be taken into urgent consideration in the setting-up of priorities on a global scale.

Three "regions" present a ratio greater than one, namely, "Sub-Saharan Africa" (1.93), "India" (1.46) and "Other Asian and Islands" (1.18).

### 3. DISTRIBUTION BY AGE

- Table 5 shows a breakdown of the global blind population by age. Fifty-eight per cent. (22 million) are in the 60 years and over age group, while at the other extreme of life - 0-14 years - blindness is estimated to affect 1 430 000, which is only 3.8% of global blindness. In the productive population (45-59 years) there is considerable blindness, affecting 12 million persons, or approximately one-third of world blindness.
- Table 6 shows a comparison between the developed and developing world of blindness prevalence for the population 60 years of age and over. In this table, the economic regions have been regrouped into two broad categories. The established market economies and former Socialist economies of Europe account for only 11.2% of the blind, despite having 41.5% of the population of 60 years and over (RBB = 0.27). The demographically developing world, with 58.5% of the population of 60 years and over, has 88.8% of the blindness in this age group (RBB = 1.51).

### 4. DISTRIBUTION BY CAUSE

Table 7 depicts regionwise estimates of blindness due to major causes for which specific models have been applied:

**Cataract** represents 41.8% of global blindness (15 829 000 persons), operable/curable cataract being the probable cause of the vast majority of this blindness.

**Trachoma** (15.5%) in developing countries and the various types of **glaucoma** worldwide (13.5%) represent two major conditions.

**Onchocerciasis** has recently (1993) been reassessed through a WHO Expert Committee; the number of blind is now estimated at 360 000,<sup>8</sup> including blindness due to restricted visual fields and taking into account the detection of new foci of disease in other parts of Africa.

Fig. 1 shows the relative importance of cataract, trachoma, glaucoma and other disorders, per demographic region. Cataract is the most important cause of blindness in all developing regions, whereas "Other disorders" (e.g. diabetes, macular degenerations, etc.) largely dominate in the "Established market economies" and in the "Former socialist economies of Europe".

### DISCUSSION

The present projections/estimations are based on an increasing amount of epidemiological data from certain parts of the world. There are, however, several shortcomings in the models developed for disease estimates due to paucity of population-based data on the prevalence of blindness, particularly for "Established market economies", "Former socialist economies of Europe" and "Latin America and Caribbean".

The estimates presented in this paper should be considered as highlighting trends between eight economic regions. Although attempts have been made to standardize the available information, it has not always been possible to do so between regions. This stemmed largely from variation in data collection procedures in the available studies: that is why the "regional burden of blindness" ratio has been introduced.

The application of the WHO simplified assessment methodology for blindness in more than 30 countries has led to a gradual accumulation of reliable data. This, in turn, was taken as the basis for a revision of the Blindness Data Bank with the 1984 global population. At this point in time, the estimated number of blind came to 31.2 million, based on a global population of 4760 million.\*

The three estimates of 1978 (28 million), 1984 (31 million) and the present one (38 million) are not directly comparable, as they represent the yield of three different methodological approaches. There has been an apparent increase of 10 million blind in the world from 1978 to 1990. The latest projection is based on an increased amount of data; this estimate can therefore be considered as the most accurate.

There can be no doubt that the number of blind in the world is increasing, and the present estimate is indicating the accelerated growth that will take place in the absence of sufficient resources for blindness prevention. The increase is taking place almost exclusively in Africa and in Asia. In fact, 75% of world blindness is presently found in those two continents, where the high population growth and the rapid increase in the number of elderly take their toll in pushing blindness figures upwards. This will be even more so in those countries where eye care services are particularly scarce.

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\* Unpublished document WHO/PBL/87.14.

More attention needs to be given to the issue of low vision, in view of its importance as a cause of disability, and the potential for remedial measures. As



shown in this paper, available data indicate that for each blind person there are three people with low vision. This is of great socioeconomic and public health significance, and more data should be collected on low vision and its causes, to allow for proper national programme planning.

The three main causes of blindness in the world, namely, cataract, trachoma and glaucoma, together account for more than two-thirds (71%) of all blindness. The relative importance of each of these three diseases varies greatly by region. This is a consequence of the demographic structure, and differences in disease incidence and availability/accessibility of eye care services.

- **Cataract** remains the single largest cause of blindness (15 800 000 persons). The backlog of unoperated cataracts is on the increase, according to the present projection, compared to that which was estimated in 1990 in a WHO Consultation (13 600 000 persons).<sup>7</sup> This may be a reflection of more and better data included in the cataract burden projection, which pays more attention to the effects of aging in developing countries.
- **Trachoma** is still an important global cause of blindness, responsible for approximately 15% of world blindness. There are indications from several countries of trachoma gradually coming under control,<sup>8</sup> but there are still large pockets of severe blinding disease in many of the least developed countries. The remaining high toll of trachomatous blindness should be seen in the perspective of neglected, underserved rural populations in those countries where the link to poverty makes it difficult to achieve sustainable disease control.
- **Glaucoma** has been only summarily alluded to in previous blindness estimates; a detailed review of available data and disease projections in 1993 revealed a greater magnitude of the problem than previously thought.<sup>9,10</sup> Effective intervention to prevent blindness from glaucoma is quite difficult, and particularly so in developing countries, where the early detection and management of the disease pose great problems. The likely future scenario is therefore that glaucomatous blindness will continue to increase globally, reflecting the aging of populations together with insufficient eye care resources for effective intervention against the disease.

**Vitamin A deficiency (xerophthalmia)** is still the leading cause of childhood blindness; in a recent analysis of data, it was estimated that there is an annual incidence of 500 000 children becoming blind, 70% of which cases are due to xerophthalmia.<sup>11</sup> This would correspond to roughly one million blind children in terms of prevalence, given the high mortality of affected children.

The lack of relevant epidemiological data makes it impossible to present separate specific statistics for a number of well-known causes of blindness such as **diabetic retinopathy** - generally recognized as the leading cause of blindness in the working age group in the developed economies, and rapidly emerging in the

urban areas of the developing world - and **aging-related macular degeneration**, which will be increasingly prevalent with the "greying" of the world population. Other causes to consider include **ocular trauma**, estimated to be responsible for about 500 000 cases of blindness,<sup>12</sup> and **ocular leprosy** (some 250 000 cases).<sup>13</sup>

The elderly population is commonly defined as "persons aged 60 and over". Table 8 summarizes the evolution (starting in 1980) and future trends of this population by the year 2020.

To date, population aging represents a prominent issue in the "Established market economies" and the "Former socialist economies of Europe". In these countries, the projected increase in the population aged 60 and over, for the period 1980 to 2020, is 186%. Nevertheless, population aging is occurring in developing countries as well. The pace of demographic changes has been - and is expected to continue to be - faster in the developing world. Thus, in these countries, the projected increase for the considered age group from 1980 to 2020 is 356% (Table 8).

Considering the very strong correlation between aging and the incidence of blindness, eye health services must cope with aging-related causes of blindness.

In this context, applying the age-specific prevalences for the elderly in this paper (Table 6) - 1.2% for the most developed countries versus 6.8% for the rest of the world - and assuming there will be no additional resources to reduce the expected burden of unnecessary blindness among the elderly, there will be about **54 000 000** blind people aged 60 and over by the year 2020, of whom more than 50 million will be in the developing countries.

## REFERENCES

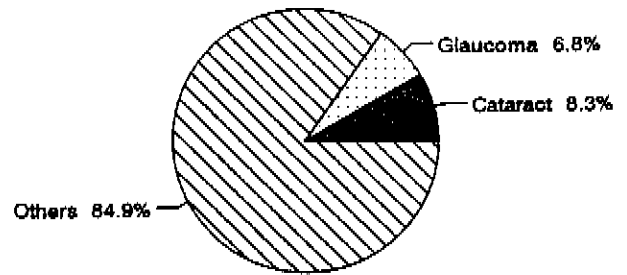
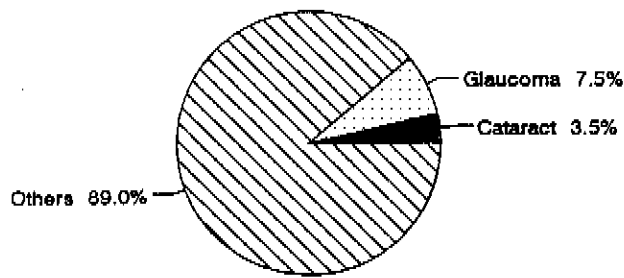
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Fig. 1

# Major Causes of Blindness per Demographic Region

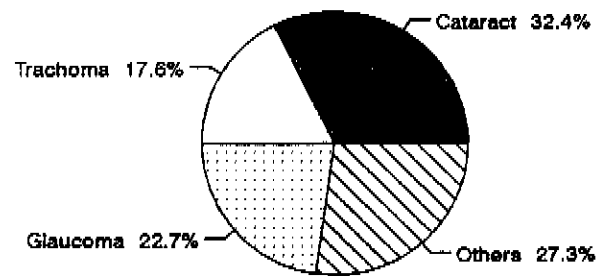
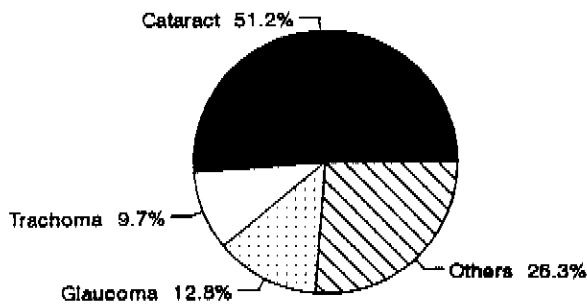
Established Market Economies

Formerly Socialist Economies of Europe



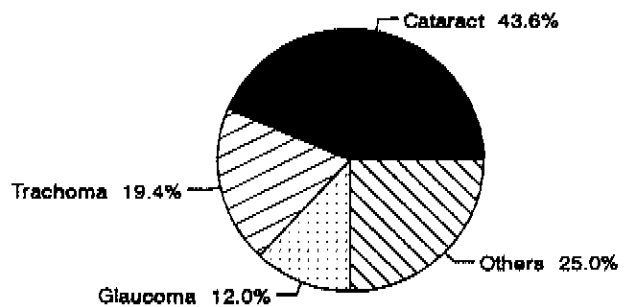
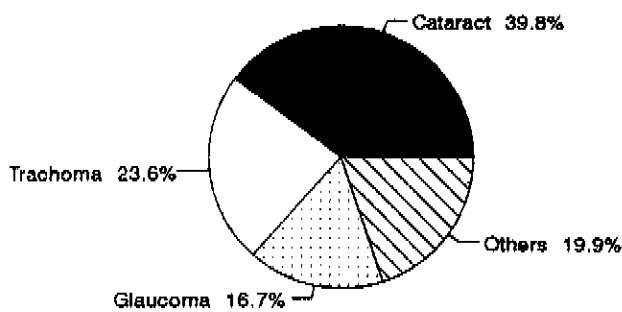
India

China



Other Asian and Islands

Sub-Saharan Africa



Latin America and the Caribbean

Middle-Eastern Crescent

(including newly independent states in Asia)

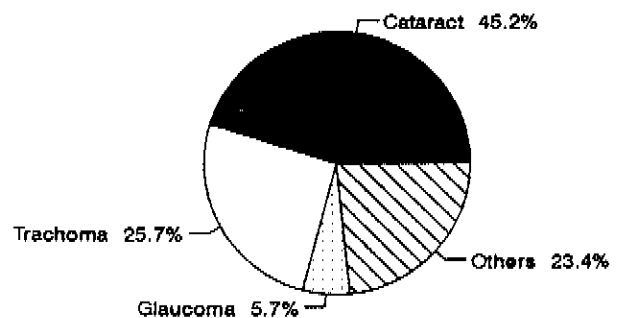
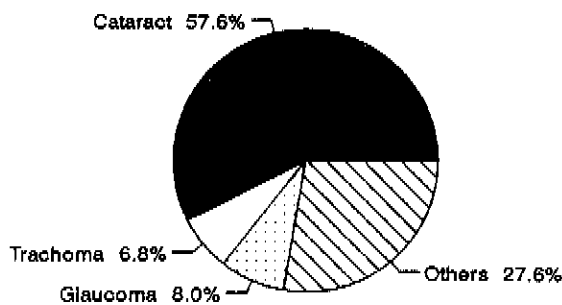


TABLE 1. GROUPING OF COUNTRIES AND ECONOMIES, 1990

Region	No. of countries or economies	Population (x10 <sup>3</sup> )
1. Established market economies (Western Europe, North America, Australia, Japan and New Zealand)	35	797 788
2. Former socialist economies of Europe	14	346 237
3. India	1	849 515
4. China	1	1 133 698
5. Other Asian and islands	49	682 533
6. Sub-Saharan Africa	49	510 271
7. Latin America and the Caribbean	46	444 297
8. Middle-Eastern Crescent (including newly independent states in Asia)	34	503 075
<b>Total</b>	<b>229</b>	<b>5 287 414</b>

TABLE 2. GLOBAL DISTRIBUTION BY ECONOMIC REGION

Region	Reference population (x10 <sup>3</sup> )	Number of blind (x10 <sup>3</sup> )	Prevalence of blindness (%)
Established market economies	797 788	2 400	0.3
Former socialist economies of Europe	346 237	1 100	0.3
India	849 515	8 900	1.0
China	1 133 698	6 700	0.6
Other Asian and Islands	682 533	5 800	0.8
Sub-Saharan Africa	510 271	7 100	1.4
Latin America and Caribbean	444 297	2 300	0.5
Middle-Eastern Crescent	503 075	3 600	0.7
<b>Total</b>	<b>5 267 414</b>	<b>37 900</b>	<b>0.7</b>

**TABLE 3. ESTIMATE OF RELATIONSHIP BETWEEN BLINDNESS AND LOW VISION<sup>a</sup>  
(ICD-10 definitions)**

<b>Countries</b>	<b>Blindness range (%)</b>	<b>Low vision range (%)</b>	<b>Multiplying factor</b>
9 African (sub-Saharan)	0.3-1.3	1.4-3.6	x2.0-7.0
6 Middle-Eastern Crescent	0.4-1.5	1.3-7.8	x2.5-5.2
1 Established market economy	0.5	1.3	x3.3
1 Other Asian and Islands	0.8	1.9	x2.3
<b>Total: 17 countries</b>			<b>2.9 (geometric mean)</b>

<sup>a</sup> Based on data available in WHO/PBL Blindness Data Bank from population-based surveys.

TABLE 4. REGIONAL BURDEN OF BLINDNESS (RBB)

Region	(A) % of global population	(B) % of global blindness burden	(B/A) RBB
Established market economies	15.1	6.3	0.41
Former socialist economies of Europe	6.6	2.9	0.44
India	16.1	23.5	1.46
China	21.4	17.6	0.82
Other Asian and islands	13.0	15.3	1.18
Sub-Saharan Africa	9.7	18.8	1.93
Latin America and Caribbean	8.4	6.1	0.72
Middle-Eastern Crescent	9.6	9.5	0.99



TABLE 5. GLOBAL DISTRIBUTION BY AGE

Age	Reference population (x10 <sup>3</sup> )	Number of blind (x10 <sup>3</sup> )	Prevalence
0-14	1 710 000	1 430 (3.8%)	8/10 000
15-44	2 445 000	2 470 (6.5%)	1/1000
45-59	623 000	12 000 (31.7%)	1.9%
60+	488 000	22 000 (58.0%)	4.4%
<b>Total</b>	<b>5 267 000</b>	<b>37 900 (100%)</b>	<b>0.7%</b>

TABLE 6. POPULATION OVER 60 YEARS OF AGE: DISTRIBUTION OF BLINDNESS

Region	Total population (x10 <sup>3</sup> )	Population > 60 (x10 <sup>3</sup> )	Blind > 60 (x10 <sup>3</sup> )	Prevalence (%)
Established market economies & Former socialist economies of Europe	1 144 027 (21.7%)	202 470 (41.5%)	2 450 (11.2%)	1.2
Demographically developing world	4 123 385 (78.3%)	285 602 (58.5%)	19 550 (68.8%)	6.8
<b>Total</b>	<b>5 267 414</b>	<b>488 072</b>	<b>22 000</b>	<b>4.4</b>

TABLE 7. GLOBAL DISTRIBUTION BY BLINDING DISEASE AND REGION  
(in thousands)

Region	Cataract	Trachoma	Glaucoma	Onchocerciasis	Others*	Total
Established market economies	84	-	180	-	2 136	2 400
Former socialist economies of Europe	91	-	74	-	935	1 100
India	5 120	865	1 141	-	1 774	8 900
China	2 166	1 174	1 514	-	1 846	6 700
Other Asian and Islands	2 314	1 362	973	-	1 151	5 800
Sub-Saharan Africa	3 101	1 380	853	358.5	1 407.5	7 100
Latin America and Caribbean	1 326	158	183	1.5	631.5	2 300
Middle-Eastern Crescent	1 627	927	205	-	841	3 600
<b>Total</b>	<b>15 829</b>	<b>5 866</b>	<b>5 123</b>	<b>360</b>	<b>10 722</b>	<b>37 900</b>
	<b>41.8%</b>	<b>15.5%</b>	<b>13.5%</b>	<b>0.9%</b>	<b>28.3%</b>	<b>100%</b>

TABLE 8. POPULATION GROWTH ( $\times 10^3$ ) AND AGING IN DEVELOPED VERSUS DEVELOPING COUNTRIES FROM 1980 TO 2020

Region	1980 <sup>a</sup>		1990 <sup>b</sup>		2020 <sup>c</sup>	
	Total population	Population > 60 years	Total population	Population > 60 years	Total population	Population > 60 years
Established market economies and Former socialist economies of Europe	1 136 668	173 325 (15.2%)	1 144 027	202 470 (17.7%)	1 376 686	321 930 (23.4%)
Others	3 312 899	207 880 (6.2%)	4 123 385	285 602 (6.9%)	6 445 507	739 710 (11.5%)
<b>Total</b>	<b>4 449 567</b>	<b>381 205 (8.6%)</b>	<b>5 267 412</b>	<b>488 072 (9.3%)</b>	<b>7 822 193</b>	<b>1 061 640 (13.6%)</b>

<sup>a</sup> United Nations. *Global Estimates and Projections of Population by Sex and Age: The 1984 Assessment.*

<sup>b</sup> World Bank. *World Development Report 1993: Investing in Health.*

<sup>c</sup> US Department of Commerce, 1991.

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