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# Prevalence of markers of hepatitis B virus infection in various countries: a WHO Collaborative Study*

O. SOBĚSLAVSKÝ [1]

*A WHO collaborative study on viral hepatitis B in which 21 laboratories in 20 countries participated is described. The aim of the study was to define the prevalence of hepatitis B surface antigen (HBsAg), its subtypes, and its antibody (anti-HBs) by age and sex and urban or rural residence in normal populations in different parts of the world. High-risk groups in the populations and patients with various diseases were also investigated. The results of the study confirmed that HBsAg and anti-HBs prevalence rates were higher in African and Asian countries than in the Americas, Australia, and northern and central Europe. Some eastern and southern European countries, however, were also shown to have high HBsAg and anti-HBs prevalence rates, comparable with those in Africa and Asia. In countries with low HBsAg and anti-HBs prevalence, there seems to be a gradual build-up during late childhood or early adolescence, whereas in countries with high HBsAg and its antibody prevalence, they were frequently detected in preschool children. Although the trend was towards a higher frequency of HBsAg and anti-HBs in urban than in rural and in male than in female populations, the differences were in most cases not significant. On the other hand, a significantly higher prevalence of markers of hepatitis B virus infection was seen in high-risk population groups than in normal populations. This was, however, clearly defined only in areas with low HBsAg and anti-HBs prevalence in the normal population. The geographical distribution of HBsAg subtypes showed a higher prevalence of the* ad *subdeterminant over* ay *in central European countries, whereas in eastern and southern Europe the* ay *subtype predominated. In West Africa,* ayw *was the only variant found, whereas in East Africa* ad *occurred more frequently than* ay. *In Australia, both* adw *and* ayw *subtypes were detected, whereas in the Far East and South-east Asia only* adw *and* adr *were seen.*

The relative prevalence of markers of hepatitis B virus infection in different parts of the world has been determined in a number of surveys. However, the techniques used in these studies often varied widely in sensitivity and specificity and consequently difficulties were encountered when attempts were made to compare and evaluate the results.

In 1975, the report of a WHO consultation on viral hepatitis therefore recommended that WHO organize an international collaborative study to assess the prevalence of hepatitis B surface antigen (HBsAg) and its antibody (anti-HBs) in different parts of the world using the WHO-recommended techniques, such as radioimmunoassay (RIA) and reverse passive haemagglutination (RPHA).

## MATERIALS AND METHODS

Sera for HBsAg and anti-HBs determination were collected from apparently healthy non-institutionalized individuals of both sexes and different age groups in urban and rural populations in various countries. In addition, sera were collected in several countries from populations at high risk, such as haemodialysis unit staff and patients, hospital and laboratory personnel, institutionalized persons, and from psychiatric and venereal disease patients, irrespective of sex and age.

HBsAg was determined by RIA and/or RPHA. Anti-HBs was also determined by RIA, except in Canada and Japan, where passive haemagglutination (PHA) was used. In the case of RIA, Ausria II and Ausab reagents (Abbott) were employed, whereas for RPHA the Hepatest reagent (Wellcome) was used. For comparative and quality control purposes, collections of sera were retested by RIA in the WHO Collaborating Centre for Reference and Research on Viral Hepatitis, CDC, Phoenix, Arizona, USA. In

* A list of participating scientists and laboratories is presented in the Annex.

[1] Institute of Sera and Vaccines, W. Pieck Street, Prague 10, Czechoslovakia.

addition, the Centre subtyped and/or confirmed the results of HBsAg subtyping from participating laboratories. Twenty-two laboratories in 20 countries took part in the study. Altogether 23 564 sera were examined.

## RESULTS

### *Prevalence of HBsAg*

Table 1 summarizes the age-specific prevalence of HBsAg in normal populations in various parts of the world. Low HBsAg prevalence rates (0.1–1.5%) were detected in specimens collected in Argentina, Australia, Canada, the USA, and in some European countries, such as Czechoslovakia, the German Democratic Republic, the Federal Republic of Germany, and the United Kingdom. In other European countries, however, the rates were higher, reaching from 4.2 to 10.8% in Greece, Poland, Romania, Turkey, and the USSR. High HBsAg prevalence was also detected in African and Asian countries such as Egypt, India, Senegal, Thailand, and Uganda. As to age distribution, it should be noted that in countries

Table 1. Age-specific HBsAg prevalence among normal urban and rural populations as determined by radioimmunoassay

| Laboratory location | Age group (years) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0–4 | | 5–9 | | 10–14 | | 15–19 | | 20–29 | | 30–39 | | 40–49 | | ⩾50 | | Total | |
| | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive |
| Cairo (Egypt) | 183 | 23.0 | 70 | 4.0 | 469 | 5.1 | 427 | 3.7 | 200 | 4.0 | 381 | 3.9 | 89 | 5.6 | — | — | 1819 | 6.2 |
| Dakar (Senegal)[a] | 173 | 4.0 | 203 | 14.3 | 169 | 14.2 | 147 | 19.0 | 371 | 15.0 | 213 | 9.4 | 186 | 5.9 | 317 | 5.4 | 1778 | 10.8 |
| Entebbe (Uganda) | 29 | 3.4 | 32 | 6.3 | 28 | 0 | 98 | 10.2 | 212 | 7.5 | 91 | 4.4 | 27 | 11.1 | 24 | 12.5 | 541 | 7.2 |
| Rabat (Morocco) | 109 | 1.8 | 71 | 1.4 | 49 | 3.8 | 53 | 6.1 | 37 | 8.1 | 14 | 0 | — | — | — | — | 333 | 3.3 |
| Houston (USA) | | | | | | | | | | | | | | | | | 784 | 0.9 |
| Ottawa (Canada)[b] | 43 | 2.3 | 99 | 1.0 | 180 | 0 | 296 | 0.7 | 439 | 0.2 | 238 | 0.8 | 204 | 1.0 | 611 | 0.8 | 2110 | 0.7 |
| Phoenix (USA) | 50 | 0 | 50 | 0 | 50 | 0 | 93 | 0 | 189 | 0.5 | 94 | 0 | 95 | 0 | 99 | 0 | 720 | 0.1 |
| Buenos Aires (Argentina)[a] | 16 | 0 | 34 | 0 | 54 | 0 | 145 | 1.4 | 204 | 1.6 | 238 | 0.4 | 158 | 0 | 177 | 0 | 1026 | 0.6 |
| Bangkok (Thailand) | 19 | 10.5 | 62 | 3.2 | 97 | 14.4 | 84 | 9.5 | 184 | 10.9 | 83 | 7.2 | 53 | 5.7 | 23 | 4.3 | 605 | 9.3 |
| Poona (India) | 6 | 0 | 50 | 2.0 | 88 | 6.8 | 107 | 6.5 | 130 | 3.8 | 122 | 7.4 | 101 | 8.9 | 96 | 6.3 | 700 | 5.9 |
| Tokyo (Japan)[a] | 145 | 0 | 203 | 2.5 | 204 | 3.4 | 200 | 4.5 | 367 | 2.5 | 202 | 1.0 | 199 | 2.0 | 389 | 1.3 | 1909 | 2.1 |
| Fairfield (Australia) | 67 | 0 | 92 | 0 | 96 | 0 | 83 | 0 | 173 | 0.6 | 87 | 1.1 | 92 | 0 | 168 | 0.6 | 858 | 0.3 |
| Athens (Greece) | 44 | 18.2 | 282 | 3.9 | 144 | 10.4 | 120 | 10.8 | 367 | 13.6 | 321 | 13.4 | 416 | 9.4 | 926 | 7.3 | 2620 | 9.4 |
| Berlin (GDR)[a] | 94 | 0 | 100 | 1.0 | 100 | 1.0 | 100 | 2.0 | 139 | 2.2 | 99 | 1.0 | 100 | 1.0 | 188 | 1.6 | 920 | 1.3 |
| Göttingen (FRG) | 35 | 0 | 40 | 0 | 40 | 0 | 39 | 0 | 40 | 0 | 40 | 0 | 40 | 0 | 80 | 0 | 354 | 0 |
| Munich (FRG) | — | — | — | — | — | — | 364 | 0.5 | 633 | 1.6 | 472 | 1.5 | 330 | 0.9 | 167 | 0 | 1966 | 1.1 |
| Iasi (Romania) | 58 | 6.9 | 58 | 17.2 | 102 | 14.7 | 121 | 11.6 | 108 | 12.0 | 83 | 6.0 | 94 | 9.6 | 78 | 7.7 | 702 | 10.8 |
| Izmir (Turkey)[a] | 73 | 8.2 | 84 | 7.1 | 134 | 6.7 | 194 | 12.4 | 345 | 12.2 | 193 | 7.8 | 156 | 5.1 | 142 | 8.4 | 1321 | 9.2 |
| London (UK) | — | — | — | — | — | — | — | — | 228 | 0.4 | 239 | 0 | 186 | 0 | 218 | 0 | 871 | 0.1 |
| Moscow (USSR) | 25 | 4.0 | 52 | 5.7 | 54 | 1.8 | 47 | 6.4 | 118 | 3.4 | 77 | 5.2 | 41 | 2.4 | 64 | 1.6 | 478 | 4.2 |
| Prague (Czechoslovakia) | 108 | 0 | 106 | 0 | 110 | 0.9 | 104 | 3.8 | 186 | 0.5 | 110 | 1.8 | 104 | 2.9 | 164 | 2.4 | 992 | 1.5 |
| Warsaw (Poland)[a] | 51 | 15.7 | 31 | 12.9 | 75 | 4.0 | — | — | — | — | — | — | — | — | — | — | 157 | 9.5 |

[a] Tested by RPHA.
[b] Urban population only.

with generally high HBsAg prevalence rates the antigen was detected in children of less than 5 years of age, whereas in countries with generally low HBsAg prevalence rates it usually began to appear only in late childhood or early adolescence.

The prevalence of HBsAg in normal populations is shown by sex and place of residence (urban/rural) in Tables 2 and 3. There was a clear tendency for HBsAg prevalence to be higher among males than among females in most countries. However, the differences were not significant in the majority of cases. The HBsAg prevalence varied between urban and rural populations. In some countries, such as Argentina and Czechoslovakia, the antigen was significantly more frequent in urban populations, whereas in the Federal Republic of Germany, Japan, and Poland it was more frequent in rural populations. In other countries, however, the differences were small and insignificant.

Table 2. HBsAg prevalence by sex in normal urban and rural populations of all ages in various countries as determined by radioimmunoassay

| Laboratory location | Male | | Female | |
|---|---|---|---|---|
| | No. tested | % positive | No. tested | % positive |
| Dakar (Senegal)[a] | 838 | 12.3 | 940 | 9.4 |
| Entebbe (Uganda) | 381 | 8.1 | 169 | 6.6 |
| Ottawa (Canada)[b] | 1134 | 0.8 | 976 | 0.5 |
| Phoenix (USA) | 369 | 0 | 351 | 0.3 |
| Buenos Aires (Argentina)[a] | 546 | 0.9 | 480 | 0.2 |
| Bangkok (Thailand) | 291 | 12.5 | 343 | 6.7 |
| Poona (India) | 367 | 7.2 | 333 | 5.2 |
| Tokyo (Japan)[a] | 943 | 2.3 | 966 | 2.0 |
| Fairfield (Australia) | 437 | 0.5 | 448 | 0.2 |
| Athens (Greece) | 1465 | 10.1 | 1155 | 8.4 |
| Berlin (GDR)[a] | 436 | 1.4 | 484 | 1.2 |
| Göttingen (FRG)[c] | 165 | 0 | 194 | 0 |
| Munich (FRG) | 1145 | 1.2 | 821 | 0.9 |
| Iasi (Romania) | 356 | 13.2 | 346 | 7.6 |
| Izmir (Turkey)[a] | 782 | 10.5 | 539 | 7.4 |
| Moscow (USSR) | 174 | 5.2 | 304 | 3.6 |
| Prague (Czechoslovakia) | 472 | 1.2 | 520 | 1.5 |

[a] Tested by RPHA.
[b] Urban population only
[c] Population aged 15 years and over only.

Table 3. HBsAg prevalence in normal urban and rural populations of both sexes and all ages in various countries as determined by radioimmunoassay

| Laboratory location | Urban | | Rural | |
|---|---|---|---|---|
| | No. tested | % positive | No. tested | % positive |
| Dakar (Senegal)[a] | 586 | 11.4 | 1192 | 10.5 |
| Entebbe (Uganda) | 454 | 6.3 | 96 | 8.3 |
| Buenos Aires (Argentina)[a] | 765 | 0.7 | 261 | 0.4 |
| Bangkok (Thailand) | 415 | 8.0 | 215 | 11.3 |
| Poona (India) | 244 | 7.0 | 456 | 5.4 |
| Tokyo (Japan)[a] | 952 | 1.4 | 957 | 2.9 |
| Fairfield (Australia) | 442 | 0.5 | 443 | 0.2 |
| Athens (Greece) | 1515 | 9.9 | 1105 | 8.6 |
| Berlin (GDR)[a] | 445 | 1.1 | 475 | 1.5 |
| Göttingen (FRG) | 210 | 0 | 149 | 0 |
| Munich (FRG)[b] | 360 | 0.3 | 1576 | 1.3 |
| Iasi (Romania) | 475 | 11.6 | 227 | 9.2 |
| Izmir (Turkey)[a] | 677 | 9.9 | 644 | 8.5 |
| Moscow (USSR) | 402 | 4.2 | 76 | 3.9 |
| Prague (Czechoslovakia) | 582 | 2.4 | 410 | 0.3 |
| Warsaw (Poland)[a, c] | 201 | 2.5 | 209 | 5.2 |

[a] Tested by RPHA.
[b] Population aged 15 years and over only.
[c] Population aged 18 years and over only.

Several groups of population at high risk and some psychiatric and venereal disease patients were also investigated for HBsAg prevalence. The results are summarized in Table 4. HBsAg prevalence rates in haemodialysis unit staff and patients in four investigated countries (Australia, the German Democratic Republic, Romania, and the USSR) were significantly higher than in the general populations of those countries. In other high-risk population groups, such as hospital and laboratory personnel, institutionalized individuals, and psychiatric and venereal disease patients, the HBsAg prevalence rates were in most cases also higher than those in normal populations. This was not the case, however, in institutionalized persons and psychiatric patients in Romania, in whom antigenaemia rates were comparable with those in the normal population.

### *Distribution of HBsAg subtypes*

The distribution of HBsAg subtypes in the investigated populations is shown in Table 5. Higher preva-

Table 4. HBsAg prevalence in different high-risk population groups and patients in various countries as determined by radioimmunoassay

| Laboratory location | Haemodialysis staff/patients | | Hospital and laboratory personnel | | Institutionalized persons | | Psychiatric patients | | Venereal disease patients | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive |
| Fairfield (Australia) | 125 | 0.8 | — | — | 166 | 0.6 | 90[a] | 44.4 | 307 | 5.2 | 688 | 12.8 |
| Berlin (GDR) | 96 | 21.9 | 111 | 3.6 | 142[a] | 6.3 | 87[a] | 35.6 | 108 | 13.0 | 544 | 16.1 |
| Iasi (Romania) | 23 | 26.1 | — | — | 120[a] | 9.2 | 293 | 11.9 | 114 | 17.5 | 550 | 16.2 |
| Moscow (USSR) | 22 | 13.6 | 31 | 6.4 | 221 | 8.9 | — | — | — | — | 274 | 9.6 |
| Prague (Czechoslovakia) | — | — | 466 | 1.5 | — | — | 159[a] | 5.7 | — | — | 625 | 3.6 |

[a] Children only.

Table 5. Distribution of HBsAg subtypes in populations of various countries

| Laboratory location | Total determined | *ad* | | *adw* | | *adr* | | *ay* | | *ayw* | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % | No. | % | No. | % |
| Dakar (Senegal) | 146 | | | | | | | | | 146 | 100 |
| Entebbe (Uganda) | 16 | 9 | 56.3 | 1 | 6.3 | | | 6 | 37.4 | | |
| Ottawa (Canada) | 7 | 4 | 57.1 | | | | | 3 | 42.9 | | |
| Bangkok (Thailand) | 38 | 21 | 55.3 | 7 | 18.4 | 10 | 26.3 | | | | |
| Poona (India) | 4 | | | | | | | | | 4 | 100 |
| Tokyo (Japan) | 37 | | | 17 | 45.9 | 20 | 54.1 | | | | |
| Fairfield (Australia) | 31 | | | 26 | 83.9 | | | | | 5 | 16.1 |
| Athens (Greece) | 70 | 1 | 1.4 | | | | | 69 | 98.6 | | |
| Göttingen (FRG) | 253 | 206 | 81.4 | | | | | 47 | 18.6 | | |
| Munich (FRG) | 279 | 229 | 81.1 | | | | | 50 | 17.9 | | |
| Iasi (Romania) | 32 | 2 | 6.2 | 3 | 9.4 | | | 19 | 59.4 | 8 | 25.0 |
| Moscow (USSR) | 5 | | | | | | | | | 5 | 100 |
| Prague (Czechoslovakia) | 13 | 9 | 69.2 | | | | | 4 | 30.8 | | |

lence of *ad* subdeterminant over *ay* was found in central European countries, whereas the *ay* subtype predominated in eastern and southern Europe. In Canada, both *ad* and *ay* were found at approximately the same rate; however, the number of subtyped specimens was very low. In West Africa (Senegal) all the 146 subtyped antigens were of the *ayw* type, whereas in East Africa (Uganda) *ad* was seen more frequently than *ay*. In Australia, subtype *adw* was significantly more common than *ayw*. The *adw* subtype was also more frequent in Thailand, but no *ayw* was found; the *adr* subtype was detected instead. In Japan, both *adw* and *adr* subtypes were common.

### *Prevalence of anti-HBs*

The age-specific prevalence of anti-HBs in normal populations in different parts of the world is illustrated in Table 6. An increasing antibody prevalence rate was found with increasing age in populations of all countries studied; however, average rates were generally higher in African and Asian countries, such as Thailand (42.4%) and Uganda (49.6%), than in Australia (2.9%), Canada (3.8%), and northern and central European countries (Czechoslovakia 11.7%, German Democratic Republic 16.1%, Federal Republic of Germany 5.3% and 4.6%, and United Kingdom

Table 6. Age-specific Anti-HBs prevalence among normal urban and rural populations as determined by radioimmunoassay

| | Age group (years) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0–4 | | 5–9 | | 10–14 | | 15–19 | | 20–29 | | 30–39 | | 40–49 | | ⩾ 50 | | Total | |
| | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive |
| Entebbe (Uganda) | 30 | 36.7 | 26 | 26.9 | 21 | 33.3 | 81 | 39.5 | 177 | 48.6 | 79 | 64.6 | 19 | 89.5 | 21 | 66.7 | 454 | 49.6 |
| Rabat (Morocco) | 109 | 6.4 | 71 | 22.4 | 49 | 33.8 | 53 | 32.0 | 37 | 16.2 | 14 | 57.1 | – | – | – | – | 333 | 19.8 |
| Ottawa (Canada)[a, b] | 79 | 1.3 | 165 | 0.6 | 208 | 0 | 303 | 3.0 | 459 | 4.8 | 245 | 3.3 | 210 | 6.2 | 638 | 5.2 | 2307 | 3.8 |
| Bangkok (Thailand) | 46 | 13.0 | 62 | 9.7 | 96 | 33.3 | 81 | 27.2 | 176 | 55.1 | 74 | 64.9 | 51 | 64.7 | 25 | 76.0 | 611 | 42.4 |
| Poona (India) | 9 | 11.1 | 62 | 12.9 | 108 | 13.0 | 131 | 11.5 | 159 | 25.2 | 147 | 32.0 | 115 | 47.0 | 109 | 52.3 | 840 | 28.1 |
| Tokyo (Japan)[a] | 145 | 2.1 | 203 | 3.4 | 204 | 9.3 | 200 | 14.0 | 367 | 15.5 | 202 | 23.8 | 199 | 26.1 | 389 | 25.7 | 1909 | 16.4 |
| Fairfield (Australia) | 95 | 1.1 | 95 | 0 | 100 | 4.0 | 84 | 3.6 | 175 | 1.7 | 89 | 3.4 | 94 | 2.1 | 176 | 5.7 | 908 | 2.9 |
| Athens (Greece) | 73 | 4.1 | 363 | 8.5 | 173 | 16.2 | 141 | 23.4 | 457 | 32.8 | 416 | 36.8 | 516 | 39.5 | 1142 | 49.8 | 3281 | 35.7 |
| Berlin (GDR) | 60 | 15.0 | 44 | 9.1 | 53 | 13.2 | 65 | 23.1 | 119 | 12.6 | 63 | 11.1 | 64 | 9.4 | 147 | 24.5 | 615 | 16.1 |
| Göttingen (FRG) | 40 | 5.0 | 40 | 0 | 40 | 2.5 | 39 | 2.6 | 40 | 2.5 | 40 | 5.0 | 40 | 7.5 | 80 | 11.3 | 359 | 5.3 |
| Munich (FRG) | – | – | – | – | – | – | 364 | 0.5 | 633 | 3.5 | 472 | 4.7 | 330 | 6.4 | 167 | 13.8 | 1966 | 4.6 |
| Iasi (Romania) | 56 | 10.7 | 52 | 17.3 | 98 | 22.5 | 116 | 43.1 | 108 | 50.9 | 89 | 58.4 | 98 | 62.2 | 80 | 56.3 | 697 | 43.0 |
| London (UK) | – | – | – | – | – | – | – | – | 228 | 7.0 | 239 | 11.3 | 186 | 9.1 | 218 | 10.5 | 871 | 9.7 |
| Moscow (USSR) | 25 | 44.0 | 52 | 43.4 | 54 | 35.2 | 47 | 40.4 | 118 | 34.7 | 77 | 50.6 | 41 | 51.2 | 64 | 64.0 | 478 | 43.7 |
| Prague (Czechoslovakia) | 108 | 2.8 | 106 | 7.6 | 110 | 8.2 | 104 | 8.7 | 186 | 15.6 | 110 | 14.5 | 104 | 8.7 | 163 | 20.2 | 991 | 11.7 |

[a] Tested by PHA.
[b] Urban population only.

9.7%). Nevertheless, in southern and eastern European countries, such as Greece, Romania, and the USSR, the average prevalence rates were also high and comparable with those in Africa and Asia (35.7–43.7%).

The prevalence of anti-HBs in different high-risk population groups and in psychiatric and venereal disease patients is shown in Table 9. Except for males and females, except in Canada and Uganda, where higher rates were detected in males than in females. As to place of residence, the only significantly higher prevalence rate of anti-HBs was found in rural Thailand; in other countries, prevalence differences between urban and rural populations were insignificant (Table 8).

The prevalence of anti-HBs in different high-risk population groups and in psychiatric and venereal disease patients is shown in Table 9. Except for Romania, where the prevalence rates in these groups were comparable with those in the normal population, anti-HBs in other investigated countries such as Australia, Czechoslovakia, the German Democratic Republic, and the USSR, were detected significantly more often in the high-risk groups and in patients.

## DISCUSSION

Difficulties often arise when attempts are made to compare the results of international serological surveys in which techniques of different sensitivities and specificities are employed. Our study on the prevalence of markers of hepatitis B virus infection in various countries was devoid of such difficulties, since the same reagents and RIA or RPHA were used throughout. Owing to its specificity and simplicity, RPHA, although slightly less sensitive than RIA, was recommended by the WHO Expert Committee on Viral Hepatitis (*1*) as a technique suitable for screening large numbers of sera for HBsAg. The same applies to PHA for detection of anti-HBs.

Table 7. Anti-HBs prevalence by sex in normal urban and rural populations of all ages in various countries as determined by radioimmunoassay

| Laboratory location | Male | | Female | |
|---|---|---|---|---|
| | No. tested | % positive | No. tested | % positive |
| Entebbe (Uganda) | 315 | 56.5 | 139 | 34.3 |
| Ottawa (Canada)[a, b] | 1235 | 4.9 | 1072 | 2.4 |
| Bangkok (Thailand) | 279 | 47.0 | 332 | 42.5 |
| Poona (India) | 441 | 30.0 | 399 | 27.3 |
| Tokyo (Japan)[a] | 943 | 14.3 | 966 | 18.6 |
| Fairfield (Australia) | 443 | 3.0 | 465 | 2.8 |
| Athens (Greece) | 1836 | 36.4 | 1442 | 33.6 |
| Berlin (GDR) | 289 | 18.0 | 326 | 14.6 |
| Göttingen (FRG) | 165 | 4.8 | 194 | 5.4 |
| Munich (FRG) | 1145 | 4.0 | 821 | 5.4 |
| Iasi (Romania) | 356 | 42.5 | 341 | 44.3 |
| Moscow (USSR) | 174 | 47.1 | 304 | 41.8 |
| Prague (Czechoslovakia) | 472 | 11.9 | 519 | 11.6 |

[a] Tested by PHA.
[b] Urban population only.

Table 8. Anti-HBs prevalence in normal urban and rural populations of both sexes and all ages in various countries as determined by radioimmunoassay

| Laboratory location | Urban | | Rural | |
|---|---|---|---|---|
| | No. tested | % positive | No. tested | % positive |
| Entebbe (Uganda) | 380 | 47.0 | 74 | 43.9 |
| Bangkok (Thailand) | 407 | 38.3 | 204 | 51.2 |
| Poona (India) | 274 | 30.7 | 566 | 26.7 |
| Tokyo (Japan)[a] | 952 | 17.0 | 957 | 15.9 |
| Fairfield (Australia) | 458 | 2.4 | 450 | 3.4 |
| Athens (Greece) | 1940 | 37.8 | 1338 | 32.2 |
| Berlin (GDR) | 287 | 17.8 | 328 | 14.9 |
| Göttingen (FRG) | 210 | 6.1 | 149 | 4.1 |
| Munich (FRG) | 360 | 8.3 | 1576 | 3.8 |
| Iasi (Romania) | 469 | 42.4 | 228 | 44.4 |
| Moscow (USSR) | 402 | 42.8 | 76 | 35.5 |
| Prague (Czechoslovakia) | 581 | 11.5 | 410 | 12.0 |

[a] Tested by PHA.

Table 9. Anti-HBs prevalence in different high-risk population groups and patients in various countries as determined by radioimmunoassay

| Laboratory location | Haemodialysis staff/patients | | Hospital and laboratory personnel | | Institutionalized persons | | Psychiatric patients | | Venereal disease patients | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive | No. tested | % positive |
| Fairfield (Australia) | 125 | 16.8 | – | – | 166 | 9.0 | 88[a] | 43.2 | 307 | 13.4 | 686 | 20.6 |
| Berlin (GDR) | 95 | 44.2 | 109 | 18.4 | 134[a] | 37.0 | 75[a] | 52.0 | 226 | 19.9 | 639 | 34.3 |
| Iasi (Romania) | 24 | 33.3 | – | – | 134[a] | 43.3 | 295 | 53.6 | 114 | 49.1 | 567 | 44.8 |
| Moscow (USSR) | 22 | 86.4 | 31 | 87.1 | 221 | 40.0 | – | – | – | – | 274 | 71.2 |
| Prague (Czechoslovakia) | – | – | 455 | 35.8 | – | – | 159[a] | 24.2 | – | – | 614 | 30.0 |

[a] Children only.

Although the study did not suffer from the pitfalls of comparing results obtained by different techniques, it faced the shortcomings related to the testing of non-homogeneous population samples. It has been shown repeatedly that the HBsAg prevalence rates in the normal population may differ considerably within a country, depending on various local ethnic, socioeconomic, cultural, geographic, religious, and other factors, and it is in this sense that our population samples do not represent homogeneous entities (*2*, *3*).[a] It should therefore be pointed out that the data presented may reflect only the local situation in the areas from which serum specimens were sampled, and

[a] Similar findings have been reported by I. Gust, personal communication.

may not, therefore, be representative of the whole country. Nevertheless, taking into consideration these limiting factors, the study indicates a generally higher frequency of HBsAg chronic carriers in the investigated populations in African and Asian countries than in the Americas, Australia, and some European countries, especially those of northern and central Europe. In southern and eastern European countries, however, the HBsAg prevalence rates were generally higher and in some of them were comparable with the prevalence rates in Asian and African countries.

From the data on age prevalence of HBsAg it can be concluded that in areas with generally low rates of HBsAg the antigenaemia seems to build up gradually during late childhood, whereas in those with high HBsAg prevalence the antigen can frequently already be detected in preschool children. This would suggest early contact with infection, possibly as a consequence of its intrafamiliar spread and/or vertical transmission from HBsAg-carrier mothers to their children. Previously, it was shown that the risk of perinatal transmission of hepatitis B virus infection in countries with high carrier rates of HBsAg may reach 40–50% (*4*, *5*, *6*).

Although the frequency of antigenaemia was higher in males and in urban populations in some countries, the reverse was true in others. In most cases, the differences were not significant. Similar variable results have also been found in other studies (*7*, *8*, *9*).

Investigations into HBsAg prevalence in various high-risk population groups and in psychiatric and venereal disease patients showed, as expected, higher frequencies of antigenaemia in countries with relatively low HBsAg prevalence rates in the normal population. Such clear differences were not seen, however, in areas of high HBsAg prevalence in Romania, where the high-risk population categories examined (institutionalized persons and institutionalized psychiatric patients) had prevalence rates comparable with those of normal population groups matched for age and place of residence.

The results of the subtyping of HBsAg-positive specimens followed the pattern of previously reported geographical distributions of antigen subdeterminants (*10*, *11*). It should be noted that, since the number of specimens available for subtyping HBsAg varied considerably in different countries, comparison of these results is difficult. For a clearer picture of the geographical distribution of subtypes of HBsAg, additional studies are needed.

Anti-HBs prevalence in all the population categories investigated followed the trend of a steady increase with advancing age. On average, however, it appeared to be significantly greater in areas of high HBsAg prevalence than in those of low HBsAg prevalence. This is in agreement with previously reported findings (*1*). Although no significant differences in anti-HBs prevalence rates were observed relative to sex and place of residence (urban/rural), such differences were significantly more marked in high risk population groups than in the normal population. However, this was true only for areas where anti-HBs prevalence rates in the normal population were relatively low. In areas of high anti-HBs prevalence in Romania, the differences between the prevalence rates in normal and high risk populations were not significant; thus the pattern was similar to that of HBsAg prevalence rates in these two populations. This indicates clearly that high-risk population groups cannot be defined categorically, as the situation may vary from country to country. This is especially true for countries with high HBsAg or anti-HBs prevalence (*1*).

## *Annex*

## LIST OF PARTICIPATING SCIENTISTS AND LABORATORIES

J. Barrera Oro, Instituto Nacional de Microbiologia "Carlos G. Malbran", Buenos Aires, Argentina

H. Bilgehan, Ege University, Izmir, Turkey

F. Deinhard & G. Frösner, Max von Pettenkofer-Institute, University of Munich, Federal Republic of Germany

Zenab Abdel Gawad, Egyptian Organization for Biological Products and Vaccines, Agouza, Cairo, Egypt

N. P. Gupta, Virus Research Centre, Poona, India

I. Gust, Fairfield Hospital, Fairfield, Victoria, Australia

J. Helcl, Institute of Hygiene and Epidemiology, Prague, Czechoslovakia

E. S. Ketiladze, The D. I. Ivanovskij Institute of Virology, Moscow, USSR

S. D. King, University of the West Indies, Kingston, Jamaica

J. E. Maynard, K. Berquist, & I. L. Doto, CDC Phoenix Laboratories, Phoenix, AZ, USA

J. L. Melnick, Baylor College of Medicine, Houston, Texas, USA

S. Nejmi, Hôpital Militaire d'Instruction Mohamed V, Rabat, Morocco

A. Nowoslawski, National Institute of Hygiene, Warsaw, Poland
G. Papaevangelou, School of Medicine, Athens, Greece
J. Roffi, Institut Pasteur de Dakar, Dakar, Senegal
K. Spies, Institut für Medizinische und Allgemeine Mikrobiologie, Virologie und Epidemiologie, Berlin, German Democratic Republic
I. Tagaya, National Institute of Health, Tokyo, Japan
R. Thomssen, Institute of Hygiene, University of Göttingen, Federal Republic of Germany
P. M. Tukei, East African Virus Research Institute, Entebbe, Uganda. Present address: Medical Research Center, Nairobi, Kenya
C. Wasi, Siriraj Hospital, Bangkok, Thailand
O. Zavate, Institute of Public Health and Medical Research, Iasi, Romania
A. J. Zuckerman, London School of Hygiene and Tropical Medicine, London, England

## RÉSUMÉ

### FRÉQUENCE DES MARQUEURS DE L'INFECTION À VIRUS DE L'HÉPATITE B DANS DIVERS PAYS: ÉTUDE COLLECTIVE DE L'OMS

Une étude collective OMS sur l'hépatite virale B, à laquelle ont participé 21 laboratoires de 20 pays, est décrite. Cette étude visait à définir la fréquence de l'antigène de surface de l'hépatite B (HBsAg), de ses sous-types et de l'anticorps correspondant (anti-HBs) selon l'âge et le sexe et en secteur urbain ou rural, dans des populations normales de différentes parties du monde. Des groupes à haut risque dans les populations et des malades souffrant de diverses affections ont également fait l'objet d'investigations. Les résultats de l'étude ont confirmé que la fréquence de HBsAg et de l'anti-HBs était plus élevée dans les pays d'Afrique et d'Asie que dans les Amériques, en Australie et en Europe septentrionale et centrale. Néanmoins, dans certains pays de l'est et du sud de l'Europe, la fréquence de HBsAg et de l'anti-HBs était haute et comparable à celle qu'on observe en Afrique et en Asie. Là où la fréquence de HBsAg et de l'anti-HBs est faible, elle semble augmenter graduellement à la fin de l'enfance et au début de l'adolescence, alors que dans les pays où ces marqueurs sont fréquents on les décèle souvent chez des enfants d'âge préscolaire. Bien que la fréquence de HBsAg et de l'anti-HBs tende à être plus élevée dans les populations urbaines que rurales et masculines que féminines, dans la plupart des cas les différences n'étaient pas significatives. En revanche, la fréquence des marqueurs de l'infection à virus de l'hépatite B était significativement plus élevée dans les groupes à haut risque que dans les populations normales. Toutefois, cette situation n'était clairement définie que dans les zones où, chez la population normale, la fréquence de HBsAg et de l'anti-HBs était basse. En ce qui concerne la répartition géographique des sous-types de HBsAg, on observait une plus grande fréquence du sous-déterminant *ad* que du sous-déterminant *ay* dans les pays d'Europe centrale, tandis qu'en Europe orientale et méridionale le sous-type *ay* prédominait. En Afrique occidentale, *ayw* était le seul variant rencontré, tandis qu'en Afrique orientale *ad* était plus fréquent que *ay*. En Australie, *adw* et *ayw* étaient détectés l'un et l'autre, tandis qu'en Extrême-Orient et en Asie du Sud-Est seuls *adw* et *adr* étaient observés.

## REFERENCES

1. WHO Technical Report Series, No. 602, 1977 (*Advances in viral hepatitis*: report of the WHO Expert Committee on Viral Hepatitis).
2. SZMUNESS, W. Recent advances in the study of the epidemiology of hepatitis. *American journal of pathology,* **81**: 629 (1975).
3. OUDART, J.-L. & ROFFI, J. Antigen HBs dans les populations rurales du Sénégal. *Medicina tropical,* **38**: 565 (1978).
4. PAPAEVANGELOU, G., HOOFNAGLE, J. H. & KREMASTINOU, J. Transplacental transmission of hepatitis B virus by symptom-free chronic carrier mothers. *Lancet,* **2**: 746 (1974).
5. STEVENS, C. A. ET AL. Vertical transmission of hepatitis B antigen in Taiwan. *New England journal of medicine,* **292**: 771 (1975).
6. OKADA, K. ET AL. Hepatitis B surface antigen in the serum of infants after delivery from asymptomatic carrier mothers. *Journal of pediatrics,* **80**: 360 (1975).
7. BLUMBERG, B. S. ET AL. Australia antigen as a hepatitis virus—variation in host response. *American journal of medicine,* **48**: 1 (1970).
8. SZMUNESS, W. ET AL. The epidemiology of hepatitis B infections in Africa. Results of a pilot survey in the Republic of Senegal. *American journal of epidemiology,* **98**: 104 (1973).
9. PRINCE, A. M. Prevalence of serum hepatitis antigen (SH) in different geographic regions. *American journal of tropical medicine and hygiene.* **19**: 872 (1970).
10. COUROUCÉ, A.-M. ET AL., ed. HBs antigen subtypes. In: *Proceedings of the International Workshop on HBs Antigen Subtypes, Paris, April 1975,* Basel, Karger, 1976 (Bibliotheca haematologica, No. 42), p. 42.
11. NISHIOKA, K. ET AL. Hepatitis B antigen, antigen subtypes, and hepatitis B antibody in normal subjects and patients with liver disease, *Bulletin of the World Health Organization,* **52**: 293 (1975).