

Prevalence of antibody to hepatitis B surface antigen among staff in an Edinburgh hospital*

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SUMMARY

Antibody to hepatitis B surface antigen was detected by radioimmunoprecipitation in 74 (5.5%) of 1336 staff members in a large general hospital in Edinburgh, in 14 (2.9%) of 480 volunteer blood donors in the area, and in 12 (6.1%) of 197 pregnant women attending for the first time at the ante-natal clinic in the hospital. Rates of antibody prevalence rose with age in the sample of hospital staff and in that of the blood donors, particularly among males. On the other hand, in the ante-natal patients antibody prevalence declined with age.

The rates in hospital staff were higher than those in blood donors of comparable age and sex, and high titres of antibody were more common in the staff group. However, no association was found between antibody prevalence and a history of clinical hepatitis, blood transfusion, or recognized contact with cases of hepatitis. Staff who had previously worked in an infectious disease hospital did not show increased antibody prevalence, indicating that simple isolation measures have been adequate to minimize exposure to hepatitis B.

No particular prevalence of infection was seen in physicians and surgeons, in the nursing staff, or in workers in clinical diagnostic laboratories, hospital administration or other areas. One group clearly showing increased antibody prevalence was staff currently working, or who had worked, in the Haemodialysis Unit; this correlated with the outbreak of dialysis-associated hepatitis in 1969-70. However, no evidence suggested that significant dissemination of infection had occurred to other defined groups of hospital staff. Elevated rates were also observed in a small sample of kitchen and portering staff, and in obstetric medical and nursing staff; the latter observations indicate a need for further investigation to identify unsuspected exposure to hepatitis B virus.

INTRODUCTION

Surveys of various communities for the prevalence of antibody (anti-HB_s) to hepatitis B surface antigen (HB_sAg), as an index of past exposure to hepatitis

* Details of the data processing methods used, and an unused copy of the questionnaire form, may be obtained on application to the authors. Requests for reprints should be directed to Professor B. P. Marmion at Department of Bacteriology, Edinburgh University Medical School, Teviot Place, Edinburgh EH8 9AG, Scotland.

B virus, suggest that infection is widespread, mainly subclinical, and occurs in the absence of a clear history of parenteral exposure. With tests of the required sensitivity – passive haemagglutination (HA) or radioimmunoassay (RIA) – the rates of prevalence of antibody were 14.4% in volunteer blood donors in Washington by RIA (Lander, Alter & Purcell, 1971) and 6.7% and 20.0% respectively in New York volunteer and paid donors by HA (Szmunes, Prince, Brotman & Hirsch, 1973). Cherubin *et al.* (1972) reported that the prevalence of antibody varied from 11 to 37% in different patient populations in the New York area and gradually rose to its highest rates at the age of 50–60 years; rates were higher among the poor. In two of these studies there was no relation between the possession of antibody and a history of hepatitis. Surveys of volunteer blood donors in the United Kingdom have given substantially lower rates. D. S. Dane (personal communication) found that about 1.0% of nearly 50,000 blood donors in North-east London were antibody positive by HA, and Hopkins *et al.* (1975) detected antibody in 252 (0.78%) of 31,999 donors in South Eastern Scotland, again by a direct haemagglutination test.

It has long been recognized that hospital staff have a greater risk of contracting clinical hepatitis than persons who are not so employed (Kuh & Ward, 1950; Byrne, 1966). The association of an increased risk of clinical hepatitis with work in chronic maintenance haemodialysis units, in renal transplant units, or in the clinical laboratories receiving specimens from these units is well established (Ringertz & Nystrom, 1967; Koff, 1970; Williams *et al.* 1974). The prevalence of anti-HB_s in such staff groups has indicated the possible extent of subclinical infection. Lewis *et al.* (1973) found that 16% of a sample of health care personnel had anti-HB_s, compared with 8.7% of a matched control group; the presence of antibody correlated with the history of hepatitis in the health care personnel but not in the controls. Studies by Pattison, Maynard, Berquist & Webster (1975) of 513 employees of a large metropolitan hospital in the South-Western United States revealed that 13% of the study population had anti-HB_s. Only 14% of those with antibody had a history of clinical hepatitis. Sero-positivity (HB_sAg or anti-HB_s) was not related to sex but showed a stepwise increase in prevalence with age and duration of employment. Prevalence rates of HB_sAg or anti-HB_s were greatest in the lowest socioeconomic group and among those with greatest exposure to blood products. When the interacting variables of age and socioeconomic group were taken into account, an increased exposure to hepatitis B virus was judged to have occurred in laboratory technicians and 'practical nurses' (= essentially nursing aides), but not in physicians, registered nurses, clerical and housekeeping staff, etc. Work areas associated with a greater exposure were operating rooms, laboratories, obstetric and gynaecological, medical and paediatric wards. Similarly, Froesner, Peterson, Holmes & Deinhardt (1975) in Chicago obtained a clear correlation between the prevalence of antibody in hospital staff and contact with patients or blood specimens.

In the United Kingdom Reed *et al.* (1974) reported that 36% of clinical or laboratory staff in a liver unit had anti-HB_s (RIA), while 7% of factory workers were positive by the same method. Studies with leucocyte migration inhibition

tests in the same populations gave reaction rates of 86 % in the liver unit staff and 30 % in the factory workers; it is possible therefore that assay of anti-HB_s by RIA substantially underestimates the extent of exposure to hepatitis B virus.

In Edinburgh, in 1969–70, there was a severe outbreak of hepatitis B among haemodialysis patients and staff in the Royal Infirmary and the Western General Hospital (Bone *et al.* 1972). Since then, various control measures (Marmion & Tonkin, 1972), including regular testing of patients and staff for HB_sAg, have curtailed the introduction of virus into the unit and maintained it in an infection-free state during the period 1970–5 (B. P. Marmion, R. W. Tonkin & C. J. Burrell, unpublished results). Codes of practice have been established for the handling of specimens in the clinical diagnostic laboratories (Percy-Robb, Proffitt & Whitby, 1970). Nevertheless, doubts remained about the true extent of subclinical infection that had occurred during the outbreak, and about other possible exposure factors applying to hospital staff as a consequence of their occupation. Accordingly, the prevalence of anti-HB_s among various categories of staff between November, 1973, and April, 1974, was examined and related to occupational and other epidemiological data. The findings were compared with antibody rates in volunteer blood donors and in pregnant women attending their first ante-natal clinic in the Infirmary.

MATERIALS AND METHODS

Population sampled

Hospital staff

All categories of staff of the Royal Infirmary, Edinburgh, were asked to participate voluntarily in the survey; if a poor response in any category was obtained, a second approach was made. Completed questionnaire forms and a single specimen of serum were obtained from 1336 staff members.

The general information sought included age, sex and a history with dates of the following events: hepatitis or infective jaundice, tattooing, transfusion with blood or blood products, a course of injections (in the past five years), close contact with patients with hepatitis, or involvement in an 'accident' with blood or tissue fluids from a patient with hepatitis (during the previous year).

Staff were also asked if they lived (or had lived) mainly in a city or country environment and whether they had been, for at least one year, in certain tropical areas. The staff were also asked to designate their occupation (e.g. clinical medical graduate, physician, surgeon, etc.) and to indicate their present area of work in the hospital. Those who had worked in the past in the Haemodialysis and Renal Units, the Intensive Care Unit, the Cardiopulmonary Bypass Unit, the Operating Theatres or in the Accident and Emergency Area, or in an Infectious Disease Hospital, were asked to give the length of time spent in each area. Finally, in another part of the questionnaire, clinical medical graduates, laboratory staff, nurses and other supporting staff were asked for details about length of time since graduation, length of employment and the nature of work in other specialties or laboratory disciplines.

The general plan of the investigation had been cleared with a hospital ethical

committee in return for certain assurances of confidentiality. To ensure the latter, and to exclude bias, serum samples and questionnaire forms were not identified by name but were given different, unrelated, identification numbers from a collection of random numbers. The sample number, and that of the questionnaire, were matched in the computer at the stage of statistical analysis and it was not possible for staff examining sera or processing forms to relate serological results to individuals or their questionnaires.

Blood donors

Serum samples, and details of age, sex and occupation, were obtained from 480 consecutive volunteer blood donors attending the Blood Transfusion Service, Edinburgh. In 199 (41%) of the donors sampled, it was possible to assign the donors to social classes I–V, in accordance with the Registrar-General's Classification of Occupations; however as most individuals belonged to Social Class III, further analysis of the effect of social class was not carried out. Potential donors with a known history of hepatitis, or of contact with a case of hepatitis in the previous six months, had been excluded in line with Blood Transfusion Service policy.

Ante-natal samples

Serum samples, and details of age and occupation (or husband's occupation), were obtained from 197 pregnant women at their first visit to the Maternity Pavilion of the Royal Infirmary, Edinburgh. Social class was determined as above, but as with the blood donors most individuals belonged to Social Class III.

Detection of antibody (anti-HB_s) to HB_sAg by radioimmunoprecipitation (RIP)

Serum samples were diluted 1/30 in phosphate-buffered saline containing 0.5% bovine serum albumin, and 20 or 100 μ l portions incubated for 3 days at 4°C in the presence of 50 μ l ¹²⁵I-labelled HB_sAg (50 c.p.s. and approx. 1 ng HB_sAg protein). Rabbit anti-human IgG was added, and after a further 16 h at 4°C, complexes of human globulin–anti-globulin were separated by low-speed centrifugation. The percentage of ¹²⁵I-HB_sAg precipitated was calculated for each sample (Burrell, Proudfoot, Keen & Marmion, 1973).

All positive samples were titrated at dilutions of 1/30, 1/300, 1/3000 and 1/30,000. Samples near a 'cut-off' value (3 \times s.d. above the mean value for six negative controls tested in each assay) were re-tested at 1/30, and if necessary on more than one occasion; only those samples giving a repeatable result above the 'cut off' value were taken as positive. In most instances, re-testing was done with labelled antigen of a different subtype to that used initially. With a few sera, reproducible positive results were obtained only with the labelled antigen of one subtype. Limited testing of sera in a commercially available solid-phase radioimmunoassay (Ausab) revealed essentially similar results to those obtained by RIP.

Table 1. Age and sex composition of the study groups

| Sex | Group | Age (years) | | | | | | | Totals* |
|---------|--------------------|---------------|---------------|---------------|---------------|---------------|---------------|-------------|--------------|
| | | 15-19 | 20-24 | 25-29 | 30-39 | 40-49 | 50-59 | 60+ | |
| Males | Hospital staff | 28 (8.5) | 49 (14.9) | 93 (28.3) | 77 (23.4) | 38 (11.6) | 33 (10.0) | 11 (3.3) | 329 (100) |
| | Blood donors | 11 (3.5) | 51 (16.1) | 60 (19.0) | 98 (31.0) | 47 (14.9) | 38 (12.0) | 11 (3.5) | 316 (100) |
| Females | Hospital staff | 112 (11.5) | 267 (27.4) | 127 (13.0) | 128 (13.1) | 164 (16.8) | 161 (16.5) | 15 (1.5) | 974 (100) |
| | Blood donors | 12 (7.3) | 44 (26.8) | 32 (19.5) | 30 (18.3) | 23 (14.0) | 16 (9.8) | 7 (4.3) | 164 (100) |
| | Antenatal patients | 29 (14.7) | 66 (33.5) | 71 (36.0) | 28 (14.2) | 3 (1.5) | 0 (—) | 0 (—) | 197 (100) |

() = percentage of subsample.

* In Tables 1 and 2 those results related to incomplete questionnaire forms have been omitted from the analysis of the staff population.

Completion and analysis of questionnaires

The total hospital staff at this time (excluding student nurses, who were deliberately sampled on a restricted basis) was approximately 3370; therefore, excluding the 76 student nurses who did participate in the survey, the 1336 participants represented 37% of the hospital staff. The response rate was approximately 65% among laboratory staff; medical and nursing staff, however, showed lower response rates similar to the figure for the total sample.

The need to ensure confidentiality carried the penalty that the questionnaires could not be checked with the participant for omissions or inconsistencies. Data on age and sex were missing from 33 forms; 11 participants did not indicate their age, 17 their sex, and 5 indicated neither age nor sex. Hence, the age and sex-specific comparisons between hospital staff and the control groups of blood donors, that were necessitated by the different age structure of the samples, were based on some 1303 returns from hospital staff. Only 478 (36%) of the 1336 participants in the survey indicated how many years they had worked in their present post. Again, there were 202 staff, of known age and sex who had worked in the Haemodialysis Unit at some time but only 150 of them indicated the length of time worked. Consequently it was not possible to analyse the relation between reaction rates and length of employment.

RESULTS

General information on study populations

The age and sex composition of the different populations under study is shown in Table 1 and their prevalence rates of anti-HB_s in Table 2. There were some differences in the age structure of the groups studied, in particular between that of the ante-natal patients and the other groups. Analysis of the data (Linear Logistic Model; Cox, 1969) showed that age, group and sex interactions were significantly related to antibody prevalence; this has been taken into account in all subsequent analyses of various subpopulations.

Table 2. Prevalence of anti-HBs (percent) by sex and study group

| | Male | Female | Total |
|----------------|--------------|--------------|---------------|
| Hospital staff | 8.2 (27/329) | 4.6 (46/985) | 5.6 (73/1314) |
| Blood donors | 3.5 (11/316) | 1.8 (3/164) | 2.9 (14/480) |
| Antenatal sera | — | 6.1 (12/197) | 6.1 (12/197) |

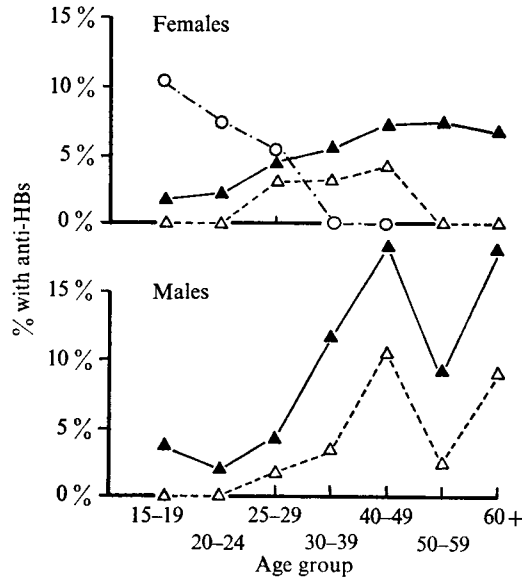


Fig. 1. Age-specific prevalence rates for anti-HBs by study groups. Positive results among hospital staff (\blacktriangle — \blacktriangle), blood donors (\triangle — \triangle), and ante-natal samples (\circ — \circ) are shown as a percentage of the individual population sampled in each age group. Sample sizes are shown in Table 1.

Relation of antibody prevalence to age and sex

In males, the prevalence of antibody increased with age in both the hospital staff and blood donors (Fig. 1); antibody prevalence was significantly higher among male staff than among blood donors (analysis by several 2×2 tables, $P < 0.005$). The decline in the proportion of reactors in the 50–59 age group and the increase in the 60+ age group, in both male hospital staff and blood donors, were not statistically significant owing to the limited sizes of the samples.

A less marked but significant increase in prevalence with age was noted among female hospital staff and female blood donors (Cox's test for trend with age; Fig. 1); however, although the prevalence was again higher among staff than blood donors, this difference was not statistically significant. In contrast, antibody was commoner among the young in the ante-natal group; the negative regression of antibody prevalence with age was at the borderline of significance (Cox's test for trend, $z = -1.707$, $0.05 < P < 0.10$). The overall rate among antenatal samples was higher than that in female blood donors (comparison of crude rates based on ages 15–49; $\chi^2 = 3.04$, $0.05 < P < 0.10$).

Positive samples were then classed as either 'high titre' ($> 1/300$) or 'low titre'

($\leq 1/300$) and analysed separately by age and population group. Reactors with high titres of antibody comprised 20 out of the 74 positive hospital staff, 2 out of 14 positive blood donors and 0 out of 12 positive antenatal cases. There was no evidence for an effect of sex on the distribution of high titre samples. The possession of antibody at high titre was of greater prevalence in hospital staff than in controls ($0.01 < P < 0.025$). Similarly, hospital staff who possessed antibody showed a greater likelihood of high titre antibody than antibody positive persons outside the hospital (comparison of crude rates; $\chi^2 = 4.75$, $0.025 < P < 0.05$); however the demonstration above that blood donors and antenatal cases showed different patterns of exposure with age indicates that combining results from these two groups may not yield a representative control sample of the community at large.

Possible exposure to infection unrelated to employment

Analysis of age- and sex-specific data from hospital staff indicated that the following factors were without effect on antibody prevalence; a history of blood transfusion or a course of parenteral injections; a history of close contact with a case of hepatitis or an accident with potentially infective material; and place of residence, whether mainly in a city or in the country. Of 16 persons who said they had tattoos, 3 were antibody-positive; however, multiple exposure factors were operating in these cases, and tattooing could not be directly implicated in infection. Five out of 29 persons who had resided for more than a year in S.E. Asia were antibody-positive; however, here again multiple exposure factors were operating. Antibody was commoner among those with a history of hepatitis ($8/109 = 7.3\%$) compared with those without such a history ($65/1224 = 5.3\%$); however, this effect was not significant when differences in the age structure of the two samples were taken into account.

Experience with infection among various categories of hospital staff

The possibility that some subcategories of hospital staff were more heavily exposed to infection than the sample as a whole was examined by determination of the antibody prevalence rates in each occupational subcategory. Subgroups with substantially increased rates were then further analysed to ascertain the effect of age, sex and occupational history on the apparently increased prevalence of antibody reactors.

Table 3 sets out the antibody prevalence crude rates by present occupational subcategories; the samples included approximately 300 laboratory staff, 160 clinical medical graduates and 400 nursing staff. Most groups of hospital staff of adequate sample size had rates of antibody prevalence that were close to that for the total sample, suggesting that there was no undue exposure in these subgroups in respect of *present* occupation. Exceptions chosen for further study were workers in the Haemodialysis Unit and in the Kitchen and Portering Services.

Past employment in the Operating Theatres, Accident and Emergency Clinic, Intensive Care Unit, Cardiopulmonary Bypass Unit, or in an Infectious Diseases Hospital, was not associated with increased antibody prevalence.

Table 3. *Composition of staff population and overall anti-HB_s prevalence*

| Area of present employment | Age/sex known | Age/sex not known | No. positive Age and sex known | Total |
|---------------------------------|---------------|-------------------|--------------------------------|------------|
| Administration | 89 | — | 4 (4.4) | 89 (100) |
| Bacteriology | 62 | 1 | 4 (6.3) | 63 (100) |
| Blood Transfusion | 123 | 4 | 7 (5.5) | 127 (100) |
| Clinical Chemistry | 41 | 1 | 2 (4.7) | 42 (100) |
| Haematology | 43 | 3 | 4 (8.6) | 46 (100) |
| Kitchen | 45 | 3 | 5 (10.4) | 48 (100) |
| Medical Physics | 22 | 1 | 1 (4.3) | 23 (100) |
| Med. Wds. + Outpatients | 194 | 3 | 8 (4.1) | 197 (100) |
| Haemodialysis Unit | 34 | 4 | 6 (15.8) | 38 (100) |
| Pathology | 43 | — | 2 (4.6) | 43 (100) |
| Pharmacy | 26 | — | 0 (0) | 26 (100) |
| Porter | 11 | — | 4 (—) | 11 (—) |
| Radiology | 20 | — | 0 (0) | 20 (100) |
| Surgical Wards | 156 | 4 | 9 (5.6) | 160 (100) |
| Theatre, accident and emergency | 67 | 4 | 3 (4.2) | 71 (100) |
| Virology | 7 | — | 0 (—) | 7 (—) |
| Cardiac Bypass Unit | 19 | — | 2 (10.5) | 19 (100) |
| Maternity Pavilion | 109 | 3 | 4 (3.5) | 112 (100) |
| Others | 119 | 1 | 4 (—) | 120 (—) |
| Area not known | 73 | 1 | 4 (—) | 74 (—) |
| Total | 1303 | 33 | 73* (5.5) | 1336 (100) |

() = percentage of total in subgroup.

* One case with age/sex not known was antibody positive.

Table 4. *Association between past employment in the Haemodialysis Unit and the presence of anti-HB_s*

| Sex | Age (years) | Staff who had | | | |
|---------|-------------|------------------------------|----------|----------------------------------|-----------|
| | | Worked in Haemodialysis Unit | | Not worked in Haemodialysis Unit | |
| | | Antibody positive | Total | Antibody positive | Total |
| Males | ≤ 29 | 2 (10) | 21 (100) | 4 (3) | 147 (100) |
| | ≥ 30 | 6 (22) | 27 (100) | 14 (11) | 129 (100) |
| Females | ≤ 29 | 3 (3) | 89 (100) | 11 (3) | 405 (100) |
| | ≥ 30 | 6 (9) | 65 (100) | 23 (6) | 366 (100) |
| Totals | | 17 | 202 | 52 | 1047 |

() = percentage of total in subgroup.

It was already known from observations on serum samples collected as part of routine surveillance of the staff of the Haemodialysis and Renal Transplant Units that antibody prevalence rates were at 23.6% at the end of the first year of the outbreak in 1969/70; consequently the finding in this survey of a rate of 15.8% (6/38) in present staff members of the Haemodialysis Unit was not unexpected. In addition, 17 (8.4%) of 202 staff who had worked in the Unit at any time had anti-HB_s.

When age and sex were included in the analysis (Table 4), a history of work in the Haemodialysis Unit was associated with increased antibody prevalence (Cox, Linear logistic Model; $0.05 < P < 0.10$). The effect of past employment in the Haemodialysis Unit was allowed for in the analysis of the experience of staff elsewhere in the hospital.

The high rates of antibody reactors in kitchen staff and in the small sample of porters are not readily explained; further investigations are required to determine if they are due to the socio-economic structure of the samples, as observed by Lewis *et al.* (1973).

Prevalence of antibody among clinical medical graduates

In the questionnaire, subgroups of this general category were defined on the basis of two or more years in any of a number of designated medical, surgical, dental or other specialist fields. None of these categories showed rates strikingly above that for the sample as a whole with the exception of the obstetricians of whom 5 (29.4%) of 17 had antibody. None of those with antibody gave a history of clinical hepatitis, or a skin penetration incident with known infective material, or of past work in the Haemodialysis Unit. In comparison, the combined prevalence rate for physicians and surgeons was 6.7% (3 out of 45). As there were no significant differences in age distribution between the sample of obstetricians, and the combined sample of physicians and surgeons, the crude antibody prevalence rates in the two groups were compared. Obstetricians were found to have a higher antibody prevalence ($z = 1.95$, $0.05 < P < 0.10$).

However, the number of obstetricians sampled was small and specialty classification presented difficulties with a few individuals; consequently further sampling is being undertaken to substantiate these preliminary findings.

Prevalence of antibody among nurses

Registered nurses were asked to indicate their main area of work since registration. Obstetric nurses proved to be the only high prevalence category; 10.8% (5/46) of those who had worked solely in obstetrics, and 6.6% (5/75) of those who had worked at any time in obstetrics, were antibody positive, in comparison with 4.5% (9/198) of those whose past work did not include obstetrics. After analysis (linear logistic model for the proportion who were antibody positive) allowing for age group, the antibody prevalence in the former group was greater than that among their non-obstetric colleagues at a borderline level of significance ($0.05 < P < 0.10$).

DISCUSSION

There are clearly a number of limitations to the survey.

(1) The need for confidentiality and anonymity prevented checks on the accuracy of the data and made it impossible to resolve conflicting statements by participants.

(2) Sampling bias may have been introduced due to the 37% response rate from hospital staff; this was unavoidable owing to the voluntary nature of the project.

(3) The groups used as controls (volunteer blood donors and antenatal cases) for the hospital staff are unlikely to have represented a random sample of the general community with respect to hepatitis B exposure. In particular, it was not possible to examine the effect of socio-economic status adequately.

Within these limitations, the results were reassuring in that the prevalence rates of antibody in most of the occupational categories were near those for the staff sample as a whole. Among hospital staff, rates in excess of the general rate were found in present or past workers in the Haemodialysis Unit, in the Kitchen and Portering staff and in Obstetricians, Gynaecologists and trained obstetric nurses. The results with Haemodialysis staff were in line with expectation and with the results of independent periodic serological surveys of the Staff in the Unit. In the past a notable feature of dialysis-associated hepatitis has been the increased frequency of clinical hepatitis in the staff of laboratories receiving specimens from dialysis or transplant units. Clinical chemistry laboratories have generally been most at risk (Ringertz & Nystrom, 1967). However, our results do not suggest significant dissemination of subclinical infection to these areas.

Judgement must be reserved on the significance of the high rates of antibody in Kitchen/Portering staff; and in obstetricians and gynaecologists and trained obstetric nurses, in particular in relation to the apparently high rate of hepatitis B infection in the ante-natal population. The samples were numerically small and further investigation is required.

Prevalence rates among blood donors and staff were lower in our survey than figures from the U.S.A. (Lander *et al.* 1971; Szmuness *et al.* 1973; Lewis *et al.* 1973; Pattison *et al.* 1975; Froesner *et al.* 1975). The exclusive use of volunteer blood donations, and cultural and ethnic factors, may have contributed to this. We have previously reported 16 out of 100 volunteer blood donors in Edinburgh to have anti-HB_s by radioimmuno-precipitation (Burrell, Parker, Ramsay & Proudfoot, 1974); the lower figure reported in this survey is likely to be due to improved sampling of the donor population, and to elimination of low titre false positive results. An increase of antibody prevalence with increasing age has previously been noted among blood donors (Szmuness *et al.* 1973; Froesner *et al.* 1975), hospital personnel (Pattison *et al.* 1975), and among different patient populations (Cherubin *et al.* 1972). Our findings revealed that this effect was more marked in males than in females, both in blood donors and in hospital staff, and that male staff and blood donors tended to show a higher antibody prevalence than their female counterparts. In contrast, antibody prevalence among ante-natal sera showed a significant decline with increasing age; in this population, the prevalence among 15–24 year olds was 8.4% (8/95), whereas 2.1% (8/379) female hospital staff and 0/56 female blood donors in the same age group were antibody positive. Further investigation of the factors producing an apparently high rate of hepatitis B infection in this population is required.

No relation was seen between antibody prevalence and a history of clinical hepatitis; nor was there an association between a past history of blood transfusion and antibody prevalence, in contrast to the findings of Lewis *et al.* (1973) in U.S.A. In addition, there was no relation between antibody prevalence and recognised

close contact with a case of hepatitis or an accident with infective material. These findings suggested that most infections were subclinical, and that staff having recognized exposure within the hospital to patients with clinical hepatitis were protected by current measures of segregation. In this context it was noted that those who had previously worked in an infectious disease hospital showed a lower total antibody prevalence than that shown by the staff as a whole. Uncomplicated clinical cases of hepatitis B requiring admission to hospital in Edinburgh are usually admitted to the infectious disease hospital and nursed with simple isolation procedures; the findings support the conclusion that transmission of infection to staff in this situation is minimal.

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