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# Hepatitis B immunity in Australia: a comparison of national and prisoner population serosurveys

H. F. GIDDING[1,2]*, D. MAHAJAN[2], J. REEKIE[3], A. R. LLOYD[4], D. E. DWYER[5] AND T. BUTLER[3]

[1] *School of Public Health and Community Medicine, UNSW Medicine, University of New South Wales, Sydney, NSW, Australia*
[2] *National Centre for Immunisation Research and Surveillance, Westmead, NSW, Australia*
[3] *The Kirby Institute, UNSW Medicine, University of New South Wales, Sydney, NSW, Australia*
[4] *Inflammation & Infection Research Centre, School of Medical Sciences, UNSW Medicine, University of New South Wales, Sydney, NSW, Australia*
[5] *Centre for Infectious Diseases and Microbiology – Public Health, Institute for Clinical Pathology and Medical Research, Westmead Hospital, Sydney, NSW, Australia*

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## SUMMARY

In Australia, hepatitis B (HBV) vaccination is recommended for injecting drug users (IDUs), Indigenous adults and prisoners. We compared immunity to HBV in prisoners and the general population obtained from national serosurveys in 2007. Individuals with HBV surface antibody (HBsAb) positive sera were considered immune from past infection [HBV core antibody (HBcAb) positive] or from vaccination (HBcAb negative). Male prisoners aged 18–58 years had a higher HBsAb seroprevalence than the general population (46·4% *vs.* 39·4%, $P = 0{\cdot}061$). Comparison of HBcAb results was possible for males aged 18–29 years. In this group, higher HBsAb seroprevalence was due to past infection (12·9% *vs.* 3·0%, $P < 0{\cdot}001$), rather than vaccine-conferred immunity (35·3% *vs.* 43·4%, $P = 0{\cdot}097$). All prisoner groups, but especially IDUs, those of Indigenous heritage or those with a previous episode of imprisonment had higher levels of immunity from past infection than the general population (19·3%, 33·0%, 17·1%, respectively, *vs.* 3·0%, $P < 0{\cdot}05$). Indigenous prisoners, non-IDUs and first-time entrants had significantly lower levels of vaccine-conferred immunity than the general population (26·4%, 26·2% and 20·7% respectively *vs.* 43·4%, $P < 0{\cdot}05$). Improving prison-based HBV vaccination would prevent transmission in the prison setting and protect vulnerable members of the community who are at high risk of both infection and entering the prison system.

**Key words**: Australia, hepatitis B, prisoners, seroepidemiological study.

## INTRODUCTION

Hepatitis B (HBV) infection is a major global health concern, causing significant liver-related morbidity and mortality. Those most at risk include infants born to mothers with chronic HBV, injecting drug users (IDUs), Indigenous people, and prisoners. Prisoners are particularly at risk, not only because they include a high proportion of IDUs and Indigenous adults from the community [1], but also because they engage in high-risk activities while in prison such as sharing needles, tattooing,

* Author for correspondence: Dr H. F Gidding, Senior Lecturer and NHMRC Postdoctoral Research Fellow, School of Public Health & Community Medicine, The University of New South Wales, Kensington Campus, Sydney, NSW 2031, Australia.
(Email: hgidding@unsw.edu)

unprotected sex, and other forms of blood-to-blood contact [2].

The first HBV vaccines were licensed in 1982 and have proven to be the most effective means of preventing HBV infection [3]. In Australia, HBV vaccination was initially recommended for infants born to infected mothers (in 1986), and subsequently infants and children from ethnic groups with high rates of infection (including Indigenous children). In 2000, a universal childhood HBV vaccination was included in the National Immunization Program [4]. Adolescent vaccination was recommended in 1996, and between 1998 and 2007, funded school-based programmes replaced general practitioner-based programmes in all states and the Australian Capital Territory, targeting adolescents aged 10–13 years. HBV vaccination for high-risk adults, including IDUs and prisoners, was recommended in 1986, and for Indigenous adults in 2013 [4, 5].

Population-based serosurveys for markers of prior HBV infection and vaccine-acquired immunity represent the gold standard for evaluating HBV vaccination programmes and informing prevention strategies. Australia is unique in having established national serosurveillance programmes for prisoners and the general population [6, 7] with both providing representative estimates of immunity for their respective populations [8, 9]. A study in one Australian state (New South Wales, NSW) compared overall susceptibility to HBV in prisoners in 2010 with the 2007 general population serosurvey [10]. However, there have been no studies comparing immunity to HBV between prisoners and the general population at a national level, particularly the levels of vaccine-acquired immunity. National prisoner and general population serosurveys were conducted in the same year in 2007, and presented an opportunity to determine whether prisoners represent an under-immunized group with a view to informing vaccination policies in both the prison and community setting.

## METHODS

### Prison entrants' serosurvey

The survey methodology used in the National Prison Entrants' Bloodborne Virus Survey (NPEBBVS) has been described in detail elsewhere [11]. In brief, the study was a consecutive sample of new adult ($\geqslant$18 years) prison entrants (individuals entering prison from the community) over a 2-week period in October 2007. Recruitment was from 17 sentinel reception sites in all Australian correctional jurisdictions except the Northern Territory (NT). Consenting prison entrants were administered a questionnaire (including demographic and risk behaviour information) and a blood sample was collected. Testing for hepatitis B surface antibody (HBsAb) and core antibody (HBcAb) was performed at the laboratory routinely used by the participating reception centre using standard serological methods [11].

Approval for the NPEBBVS was obtained from Departments of Health Human Research Ethics Committees in: the Australian Capital Territory, Tasmania, and Western Australia; Justice Health NSW; and the Departments of Corrective Services in Queensland, Victoria, and Western Australia. Approval was also granted by the Western Australia Aboriginal Health and Information Ethics Committee, and the Curtin University Human Research Ethics Committee.

### National serosurvey

The sera used in this study were selected from a bank of about 7200 sera collected opportunistically in 2007 as part of the national serosurveillance programme [7] from a geographically representative group of 27 diagnostic laboratories receiving samples from hospitalized and ambulant persons throughout Australia. Subjects who were immunosuppressed, had received multiple or recent (within 3 months) blood transfusions, or were known to be infected with HIV were excluded. Sera were identified by a Medical Record Number (MRN), sex, age, state/territory of origin and a unique identifier, to ensure that only one sample from any subject was tested. Sera were tested and interpreted according to the manufacturer's instructions using the Monolisa® Anti-HBs PLUS and Monolisa® Anti-HBc PLUS (Bio-Rad, France) commercial enzyme immunoassays. All testing was performed at the Centre for Infectious Diseases and Microbiology Laboratory Services (CIDMLS). Approval for the serosurvey was obtained from the Western Sydney Area Health Service Human Research Ethics Committee.

### Interpretation of serological test results

Individuals were classified as either HBsAb seropositive or seronegative (no equivocal results were reported). Those with a positive HBsAb result were

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further classified as having either vaccine-conferred immunity (HBcAb negative) or having immunity from past infection (also HBcAb positive). Two individuals in the prisoner serosurvey with equivocal HBcAb results were classified as immune from past infection.

### Comparison between 2007 national and prisoner serosurveys

To make valid comparisons, sera obtained from the NT were excluded from the national serosurvey. In addition, ages were restricted to 18–58 years (the age range of the prisoner serosurvey) to estimate HBsAb seroprevalence and 18–29 years (the age range tested for HBcAb in the national serosurvey) to estimate whether immunity was from past infection or vaccine-conferred. Proportions seropositive and their 95% confidence intervals (CIs) were calculated by age group (18–24, 25–29, 30–39, 40–58 years), year and sex for each serosurvey and by prisoner subgroup (IDU, Indigenous and previous imprisonment status). Age-adjusted seroprevalence was calculated only for males (due to the small sample size for females in the prisoner serosurvey) using the age distribution of the 2007 Australian male population (Australian Bureau of Statistics) as the standard. Adjustment by jurisdiction was not required for the national serosurvey, as sampling was proportional to jurisdiction within each age group. Adjustment of the prisoner serosurvey by both age and jurisdiction was not possible due to the small sample size of the prisoner serosurvey. The 95% CIs for adjusted proportions were calculated according to the method of Lohr [12]. Unadjusted proportions were compared using the $\chi^2$ test and the $z$ approximation to the binomial distribution was used to compare adjusted proportions seropositive. $P$ values <0·05 were considered statistically significant.

## RESULTS

### Prison entrants' serosurvey

In 2007, 740 (75%) of the 992 consecutive prison entrants in all Australian correctional jurisdictions except the NT participated in the survey. A small percentage (26/740, 3·5%) did not to provide blood. Of the 714 who provided sera, 531 (74%) were tested for HBsAb and are included in the analysis. All except one of the 531 sera were also tested for HBcAb. The entrants tested for HBsAb (Table 1) were reasonably representative of the full-time prisoner population of Australia as described in the Australian Bureau of Statistics Census [9]; the prisoner sample comprised 90% men (*vs.* 93% in the census), 19% Aboriginal (*vs.* 22% in the census of jurisdictions other than the NT), 32% were first-time entrants (*vs.* 43% in the census), and the median age was 30 years (*vs.* 33 years in the census).

Of the 531 prisoners tested, 48·2% (95% CI 43·9–52·6) were HBsAb positive, 20·0% (95% CI 16·6–23·6) were immune from past infection and 28·2% (95% CI 24·5–32·3) had vaccine-conferred immunity. HBsAb seroprevalence was similar across the age groups tested (Table 2). However, this concealed underlying trends; younger age was associated with increased vaccine-conferred immunity and lower immunity from past infection (Table 1). These trends were seen for each risk group and tended to be linear (data not shown), except for Indigenous prisoners and non-IDUs, in whom immunity from past infection was higher in the 25–29 years age group than in the 18–24 years age group ($P < 0·001$, and $P = 0·038$, respectively; see Fig. 1, for males only), but was relatively constant in older ages (data not shown).

There were no significant differences between male and female prisoners in the levels of immunity due to vaccination or past infection (Table 1), or the overall seroprevalence of HBsAb (Table 2). The pattern of immunity by risk group was also similar for males and females. The only exception was that females who were first-time prison entrants had significantly higher levels of immunity from past infection than their male counterparts [26·3% *vs.* 8·0%, $P = 0·027$ (unadjusted comparison); Table 1]. For males, age-adjusted immunity from past infection was 2·6 times higher in Indigenous *vs.* non-Indigenous, 4·2 times higher in IDUs *vs.* non-IDUs, and 2·9 times higher in previous *vs.* first-time entrants ($P < 0·001$ for all comparisons; Table 1). Moreover, males with a previous imprisonment were more than twice as likely ($P < 0·001$) as first-time male entrants to have vaccine-conferred immunity. Similar trends were seen for unadjusted estimates for females.

### Comparison of 2007 national and prisoner serosurveys

HBsAb seroprevalence was higher in the prisoner serosurvey than in the national serosurvey for all age/sex groups except those aged 18–24 years, which showed the opposite trend (Table 2). However, none of these differences was statistically significant.

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Table 1. *Hepatitis B immune status by risk category and sex, 2007 prisoner serosurvey, ages 18–58 years*

| | Males | | | Females | | |
|---|---|---|---|---|---|---|
| Risk category* | Total tested | % Immune through past infection (95% CI)† | % Vaccine conferred immunity (95% CI)† | Total tested | % Immune through past infection (95% CI)† | % Vaccine conferred immunity (95% CI)† |
| Age group, years | | | | | | |
| 18–24 | 138 | 7·2 (3·5–12·9) | 38·4 (30·3–47·1) | 7 | 0 | 42·9 (9·9–81·6) |
| 25–29 | 104 | 21·2 (13·8–30·3) | 30·8 (22·1–40·6) | 16 | 12·5 (1·6–38·3) | 43·8 (19·7–70·1) |
| 30–39 | 151 | 25·8 (19·1–33·6) | 23·8 (17·3–31·4) | 27 | 33·3 (16·5–54·0) | 18·5 (6·3–38·1) |
| 40–58 | 83 | 26·5 (17·4–37·3) | 16·9 (9·5–26·7) | 5 | 40 (5·3–85·3) | 0 |
| Indigenous | 83 | 44·9 (31·2–58·7)‡ | 21·2 (10·6–31·7)‡ | 18 | 27·8 (9·7–53·5) | 33·3 (13·3–59·0) |
| Non-Indigenous | 387 | 17·5 (12·6–22·4)‡ | 24·9 (19·9–29·8)‡ | 36 | 22·2 (10·1–39·2) | 22·2 (10·1–39·2) |
| IDU | 262 | 37·8 (26·8–42·7)‡ | 26·5 (20·1–32·9)‡ | 41 | 26·8 (14·2–42·9) | 29·3 (16·1–45·5) |
| Non-IDU | 214 | 9·1 (4·3–13·9)‡ | 21·1 (14·9–27·4)‡ | 14 | 14·3 (1·8–42·8) | 21·4 (4·7–50·8) |
| First-time entrant | 150 | 9·9 (5·5–14·0)‡ | 13·7 (9·3–18·1)‡ | 19 | 26·3 (9·1–51·2) | 21·1 (6·1–45·6) |
| Previous imprisonment | 323 | 28·3 (21·9–34·7)‡ | 29·3 (23·5–35·1)‡ | 36 | 22·2 (10·1–39·2) | 30·6 (16·3–48·1) |
| Total | 476 | 22·3 (16·4–28·2)‡ | 24·1 (18·7–29·6)‡ | 55 | 23·6 (13·2–37·0) | 27·3 (16·1–41·0) |

CI, Confidence interval; IDU, injecting drug user.
* Three samples were missing whether first-time/previous imprisonment, seven were missing Indigenous status.
† Percent of the total tested for each sex and risk category.
‡ Adjusted to the age-specific distribution of the 2007 Australian male population.

Table 2. *Hepatitis B surface-antibody seroprevalence by age group, sex and serosurvey*

| | Prisoner serosurvey | | | | National serosurvey | | | |
|---|---|---|---|---|---|---|---|---|
| | Males | | Females | | Males | | Females | |
| Age group (years) | Total tested | % Seropositive (95% CI) | Total tested | % Seropositive (95% CI) | Total tested | % Seropositive (95% CI) | Total tested | % Seropositive (95% CI) |
| 18–24 | 138 | 45·7 (37·2–54·3) | 7 | 42·9 (9·9–81·6) | 86 | 50·0 (39·0–60·9) | 98 | 45·9 (35·8–56·3) |
| 25–29 | 104 | 51·9 (41·9–61·8) | 16 | 56·3 (29·9–80·3) | 95 | 41·1 (31·1–51·6) | 102 | 42·2 (32·4–52·3) |
| 30–39 | 151 | 49·7 (41·4–57·9) | 27 | 51·9 (31·9–71·3) | 88 | 40·9 (30·5–51·9) | 97 | 40·2 (30·4–50·7) |
| 40–58 | 83 | 43·4 (32·5–54·7) | 5 | 40·0 (5·3–85·3) | 156 | 33·9 (26·6–41·9) | 160 | 36·3 (28·8–44·2) |
| Total | 476 | 47·9 (43·3–52·5) | 55 | 50·9 (37·1–64·7) | 425 | 40·2 (35·5–45·1) | 457 | 40·5 (35·9–45·1) |

CI, Confidence interval.

*Males, 18–58 years*

Overall, male prisoners had a higher age-adjusted HBsAb seroprevalence than males in the national serosurvey, although the difference was not statistically significant (46·4% *vs.* 39·4%, $P = 0·061$, Table 3). However, when divided into risk groups, significant differences were identified; Indigenous, IDUs, and entrants with a previous imprisonment had a significantly higher seroprevalence than the national serosurvey, while non-IDUs and first-time entrants had a significantly lower seroprevalence (Table 3).

*Males, 18–29 years*

For males aged 18–29 years, age-adjusted HBsAb seroprevalence was similar in the prisoner and national serosurveys (Table 4). However, this similarity belies an underlying variation in mode of acquisition – prisoners had lower levels of vaccine-conferred immunity ($P = 0·097$) and a more than fourfold higher level of immunity from past infection ($P < 0·001$) than was found in the national serosurvey.

All prisoner risk groups had higher levels of immunity from past infection than was found in the

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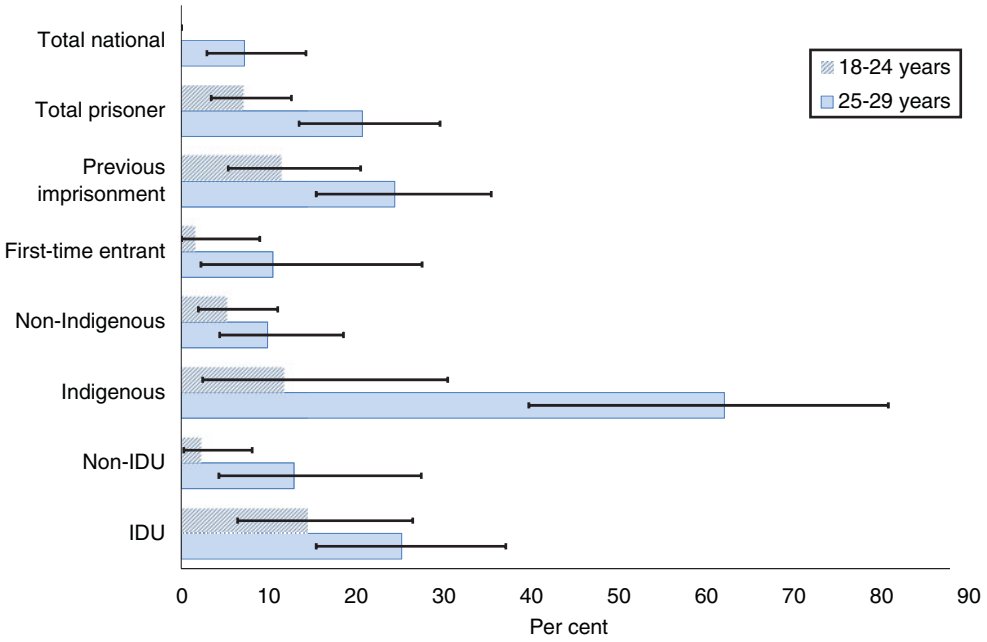


**Fig. 1.** Proportion of males aged 18–24 and 25–29 years immune due to past infection by risk category, age group and serosurvey. IDU, Injecting drug user.

Table 3. *Age-adjusted* hepatitis B surface-antibody seroprevalence by serosurvey and risk group, males aged 18–58 years*

| Serosurvey | Risk group | % Seropositive (95% CI) |
|---|---|---|
| Prisoner | Indigenous | 66·1 (52·9–79·3) |
| | Non-Indigenous | 42·4 (36·4–48·4) |
| | IDU | 61·3 (53·3–69·3) |
| | Non-IDU | 30·2 (22·9–37·5) |
| | First-time prison entrant | 23·6 (15·4–31·8) |
| | Previous imprisonment | 57·6 (50·7–64·4) |
| | Total | 46·4 (40·8–51·9) |
| National | Total | 39·4 (34·6–44·2) |

CI, Confidence interval; IDU, injecting drug user.
* Adjusted to the age specific distribution of the 2007 Australian male population.

national serosurvey, with the difference statistically significant for Indigenous ($P < 0{\cdot}001$), non-Indigenous ($P = 0{\cdot}048$), IDUs ($P < 0{\cdot}001$), and entrants with a previous imprisonment ($P < 0{\cdot}001$, Table 4). The increase in levels of past infection between the 18–24 and 25–29 years age groups was almost twice as high for prisoners overall (difference 13·9%, 95% CI 5·0–23·0) as for the national serosurvey (difference 7·4%, 95% CI 2·1–12·7) with a more than fivefold increase for Indigenous prisoners ($P < 0{\cdot}001$, Fig. 1).

Prisoners who had previously been incarcerated or were IDUs had similar levels of vaccine-conferred immunity to the national serosurvey, while non-IDUs, first-time entrants, and Indigenous prisoners had significantly lower levels ($P \leqslant 0{\cdot}025$). Being a non-IDU and first-time entrant were correlated ($P < 0{\cdot}001$), with 72·1% of first-time entrants also reporting non-IDU status (compared to 50·2% of all male prisoners aged 18–29 years). By contrast, there were similar or fewer non-IDUs or first-time entrants who were Indigenous (17·4% and 11·6%, respectively) compared to all male prisoners aged 18–29 years (19·7%). All risk groups and the national serosurvey showed higher levels of vaccine-conferred immunity in the 18–24 years group (which mainly includes birth cohorts eligible for free adolescent HBV vaccination) compared to the older cohort aged 25–29 years (most of whom were not eligible for free HBV vaccination; Fig. 2). However, the difference was less overall in the prisoner serosurvey (7·6%, 95% CI −4·4 to 19·6), than in the national serosurvey (16·3%, 95% CI 2·1–30·5), although the CIs were wide and overlapping.

## DISCUSSION

This study provides the first national comparison of HBV immunity in prisoners and the general Australian population. Prisoners had a slightly higher prevalence of HBsAb than the general population. However, in the 18–29 years age group (where direct

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Table 4. *Age adjusted* hepatitis B immune status by serosurvey and risk group, males aged 18–29 years*

| Serosurvey | Risk group | % Past infection (95% CI) | % Vaccine conferred (95% CI) | % Total immune (95% CI) |
|---|---|---|---|---|
| Prisoner | Indigenous | 33·0 (21·7–44·4) | 26·4 (13·4–39·3) | 59·4 (45·9–72·9) |
| | Non-Indigenous | 7·3 (3·6–11·0) | 37·2 (30·3–44·1) | 44·5 (37·4–51·6) |
| | IDU | 19·3 (12·1–26·4) | 43·5 (34·2–52·8) | 62·8 (53·7–71·9) |
| | Non-IDU | 6·8 (1·9–11·6) | 26·2 (18·5–33·9) | 32·9 (24·4–41·5) |
| | First-time entrant | 5·4 (0·2–10·5) | 20·7 (12·4–29·1) | 26·1 (16·7–35·5) |
| | Previous imprisonment | 17·1 (11·3–23·0) | 44·0 (36·0–52·0) | 61·1 (53·2–69·0) |
| | Total | 12·9 (8·8–17·0) | 35·3 (29·3–41·3) | 48·2 (41·9–54·5) |
| National | Total | 3·0 (0·9–5·2) | 43·4 (35·9–50·8) | 46·4 (38·9–53·8) |

CI, Confidence interval; IDU, injecting drug user.
* Adjusted to the age-specific distribution of the 2007 Australian male population.

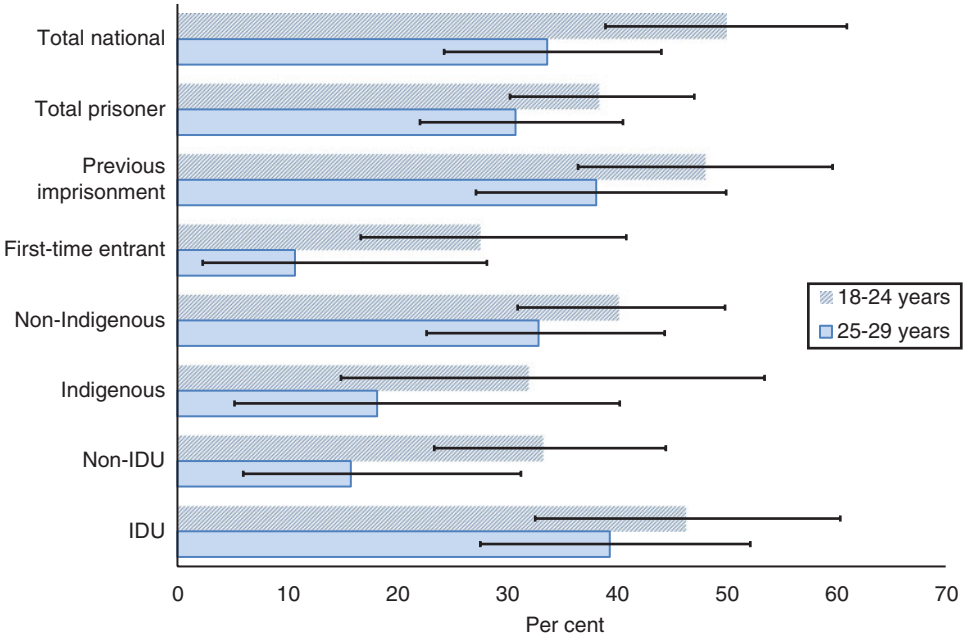


**Fig. 2.** Proportion of males aged 18–24 and 25–29 years with vaccine-conferred immunity by risk category, age group and serosurvey. IDU, Injecting drug user.

comparison between serosurveys was possible) the higher HBsAb seroprevalence was due to a more than fourfold higher level of immunity from past infection, rather than to higher vaccine-conferred immunity. All prisoner risk groups, but especially IDUs, those of Indigenous heritage, and those with a previous imprisonment, had higher levels of immunity from past infection than the general population, confirming the importance of the Australian government's recommendations for vaccinating each of these three risk groups [5]. Despite the recommendations, vaccine-conferred immunity in IDUs and in those with a previous imprisonment was no higher than in the general population, and in Indigenous prisoners immunity was significantly lower. Also of note is that, despite slightly higher levels of past infection, non-IDUs and first-time entrants had considerably lower levels of vaccine-conferred immunity than the general population. These findings, along with the fact that many prisoners aged 18–24 years appear to have missed out on the school-based adolescent vaccination programme, highlight the utility of prison-based HBV vaccination programmes.

There have been few prison-based or nationally representative population serosurveys conducted in other developed countries and none that have been conducted in recent years. However, our results are similar to those obtained in a serosurvey of inmates in three US

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jails using sera collected in 1999–2000 [13]. This study showed 13% of prisoners aged 20–29 years and 19% of all prisoners had evidence of immunity from past infection, the latter figure being fourfold higher than was reported in a national serosurvey of the general population in 1994 (5%) [14]. By contrast, a study in eight prisons in England and Wales in 1997 found only a twofold higher prevalence of immunity to past infection compared to a national opportunistic serosurvey of the general population in 1996 (8% *vs.* 4%, respectively) [15,16]. Variation in the seroprevalence of HBV markers between prisons has been noted [17]. This may explain the differences between studies, but also highlights the importance of nationally representative samples.

Despite the increased risk of infection in the prisoner population and recommendations for vaccination, vaccine-conferred immunity for prisoners aged 18–29 years was 8% lower than in the general population, although this difference was not statistically significant. The higher levels of vaccine-conferred immunity in IDUs, and entrants with a previous imprisonment than in other prisoner groups suggests some impact of targeted vaccination programmes. However, vaccine-conferred immunity in IDUs and those with a previous imprisonment was no higher than in the general population, and not high enough to prevent ongoing transmission, as evidenced by the high levels of past infection in these risk groups. A modelling study in the UK suggests that vaccination of IDUs on entry to prison is an effective way of increasing coverage in the broader IDU community given the high proportion of IDUs who experience incarceration at some stage and the difficulty reaching some IDUs in the community setting [18]. Another reason to vaccinate IDUs in prison is that recently released IDUs are considered to be at higher risk of contracting HBV, than IDUs without a history of incarceration, due to increased injecting drug use and syringe sharing [19].

Of concern are the significantly lower levels of vaccine-conferred immunity and higher levels of past infection in Indigenous prisoners compared to the general population and the other risk groups targeted for vaccination. These findings suggest that Indigenous prisoners represent an especially vulnerable group not identified in the community and that culturally appropriate prevention strategies, including education and HBV vaccination are vital in the prison setting. This is especially the case for young Indigenous prisoners, as the risk of past infection was shown to increase markedly between ages 18–24 and 25–29 years.

Non-IDUs and first-time prison entrants, particularly those aged >24 years who would not have been eligible for school-based vaccination programmes, had significantly lower levels of vaccine-conferred immunity compared to the general population, while also tending to have a higher risk of past infection with HBV. Additional research is required to better characterize these prisoner groups so that they can also be targeted earlier in community settings. However, the present findings add to the importance of prison-based vaccination to capture less well-characterized at-risk groups in the community.

Prison-based vaccination can also provide an opportunity to 'catch-up' adolescents who have missed vaccination as part of the school-based programme. The higher levels of vaccine-conferred immunity in those aged 18–24 years compared to those aged 25–29 years, suggests an impact of the school-based vaccination programme in both the prisoners and general population as most individuals aged 18–24 years (but not 25–29 years) would have been eligible for this programme. However, the improvement achieved in prisoners was less than half the increase seen in the general population (7·6% *vs.* 16·3%). Even though the difference was not statistically significant, these findings suggest that prisoners may have had less opportunity for school-based vaccination, again emphasizing utility for prison-based vaccination. Indeed, a survey of young offenders in NSW showed that 56% had left school before commencing year 10, 60% had not attended school regularly (skipped school more than twice per week), and 89% had been suspended from school at some point [20].

With around 44 000 people entering Australian prisons each year and a median sentence length of 36 months [1, 21] a period of imprisonment represents an opportunity to vaccinate a considerable number of people who are at increased risk of HBV and/or have lower levels of immunity than the general population. In this setting an accelerated vaccination schedule of 0, 1, 2, and 12 months may be used [5]. The first three doses result in high levels of protection earlier than the standard schedule (0, 1, 6 months) [5], which is important in the high-risk prison environment, and may also result in better compliance [22]. However, to achieve comparable levels of immunity in the longer term, the accelerated schedule requires a fourth dose at 12 months [5]. It is important to note that most prisoners would not be incarcerated

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for long enough to complete this four-dose schedule. However, re-incarceration, which is common, is an opportunity to provide the booster dose.

There are some limitations to this study. First, HBV immunity was based on antibody levels, which may decline to undetectable levels over time even though a protective immune memory persists [23]. Second, the opportunistic nature of the general population serosurvey makes it difficult to detect any biases because less is known about the participants [7]. However, we minimized any potential for bias by excluding patients who are more likely to have false-negative results, and by sampling from most major laboratories throughout Australia that serviced mainly ambulatory populations. Furthermore, we have previously been able to demonstrate that this method gives similar results to that obtained from a prospectively collected, random sample [8]. Third, both serosurveys were conducted in 2007 and patterns of infection, immunization and immunity may have changed since then. However, this analysis is of the most recent national serosurvey available, and it is a strength that both the national and prisoner serosurveys were conducted in the same year. Furthermore, the most recent prisoner serosurvey, conducted in 2010, showed similar levels of HBcAb to the 2007 prisoner serosurvey [24]. In addition, even though vaccine-conferred immunity had increased between the 2007 and 2010 prisoner serosurveys in the youngest adult age groups, patterns of immunity by birth cohort remained unchanged [6]. Therefore, the findings and conclusions from this study remain relevant. Finally, due to the small sample size, comparisons of adjusted national and prisoner samples for females or adjusted estimates for males by factors other than age were not possible. The sample sizes for each prisoner risk group were also small, and a comparison by immune status between serosurveys was only possible for the 18–29 years age group. We recommend that the next national serosurvey includes all adult age groups to enable future comparisons across a broader age range.

In conclusion, the results of this analysis highlight the vulnerability of prisoners to HBV infection and the need for higher vaccination coverage in this group. Improving prison-based vaccination coverage would not only prevent transmission in the prison setting, but also enhance immunity in known community risk groups (IDUs and Indigenous people) as well as other, less easily identifiable, members of the community who have lower vaccine-conferred immunity than the general population while also being at increased risk of HBV infection.

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## DECLARATION OF INTEREST

None.

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