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## Survey of Hepatitis B Vaccination Coverage, and Knowledge and Socio-Demographic Determinants of Uptake in Members of the Federal Road Safety Corps, Kaduna State, Nigeria

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3 **Survey of Hepatitis B Vaccination Coverage, and Knowledge and Socio-**  
4 **Demographic Determinants of Uptake in Members of the Federal Road Safety**  
5 **Corps, Kaduna State, Nigeria**  
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## STATEMENTS

**Contributorship:** This study was carried out as a dissertation research by CLO under the close supervision of CMB, in partial fulfillment of the requirement for the award of the degree of Master of Public Health by the University of Liverpool, United Kingdom. CLO collected the data and conducted the analyses. These were reviewed by CMB. The manuscript was drafted by CLO and reviewed and revised by CMB. Both authors approved the final version for publication.

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**Ethics Approval:** This study was approved by the University of Liverpool's Ethics Committee and the Ethics Committee of Kaduna State Ministry of Health.

**Participant Consent:** Obtained

**Additional Data:** The table showing the frequency of available and missing data for the study variables is uploaded as a supplementary document. Dataset is available at Dryad data repository via this link:

## 1 ABSTRACT

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8 **Objectives:** To estimate hepatitis B vaccination coverage, and knowledge and socio-  
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10 demographic determinants of full-dose uptake in Federal Road Safety Corps (FRSC) members,  
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12 Kaduna State, Nigeria in order to inform relevant targeted vaccination policies.

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15 **Design:** A cross-sectional survey of FRSC members, Kaduna Sector Command.

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18 **Settings:** Six randomly-selected Unit Commands under Kaduna Sector Command, Kaduna State,  
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Nigeria.

9 **Participants:** Pilot-tested structured self-administered questionnaire was administered to 341  
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11 participants aged 18 years and above with  $\geq 6$  months of service between 17<sup>th</sup> June and 22<sup>nd</sup> July,  
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13 2015. Excluded were FRSC members in RS1 Zonal Command headquarters as the Zonal  
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15 Command includes other States beyond the study scope.

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**Primary Outcome:** Hepatitis B vaccination status of participants categorized as 'not vaccinated'  
for uptake of  $< 3$  doses and 'vaccinated' for uptake of  $\geq 3$  doses.

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**Analysis:** Descriptive analysis estimated hepatitis B vaccination coverage while logistic  
regression ascertained associations.

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**Results:** Any dose hepatitis B vaccination coverage was 60.9%; full-dose coverage was 30.5%.  
Less than 47% of participants scored above hepatitis B virus (HBV) and hepatitis B vaccination  
mean knowledge scores. Female sex (AOR 2.28, 95% CI 1.15-4.52,  $p < 0.05$ ), perceiving there to  
be an occupational risk of exposure to HBV (AOR 2.86, 95% CI 1.06-7.70,  $p < 0.001$ ), and  
increasing hepatitis B vaccination knowledge (AOR 2.68, 95% CI 1.83-3.92,  $p < 0.001$ ) were

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3 22 independent predictors of full-dose hepatitis B vaccination in FRSC members, Kaduna Sector  
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5 23 Command.

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8 24 **Conclusions:** Hepatitis B vaccination coverage and knowledge are poor among FRSC members,  
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10 25 Kaduna Sector Command. Institutionalizing free hepatitis B vaccination could improve uptake  
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12 26 among FRSC members. Educational intervention, geared towards improving FRSC members'  
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14 27 knowledge of hepatitis B vaccination and perception of risk of occupational exposure to HBV, is  
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16 28 recommended for these vulnerable public safety workers. Such enlightenment could be a cheap  
17  
18 29 and easy way of improving hepatitis B vaccination coverage in the study population.

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20  
21 30 **Keywords:** infection control; hepatitis B virus; vaccination coverage; public safety workers

## 22 31 **ARTICLE SUMMARY**

### 23 32 **Strengths and Limitations of this Study**

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29 33 • This is the first study to estimate hepatitis B vaccination coverage of public safety  
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31 34 workers such as the Federal Road Safety Corps in Nigeria despite these workers being  
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33 35 occupationally exposed to hepatitis B virus.
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36 36 • The participating Unit Commands were randomly selected and the study had a high  
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38 37 response rate hence minimizing selection bias and improving the generalizability of the  
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40 38 research findings.
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43 39 • Retrospective studies are prone to recall bias; this was mitigated in this study by omitting  
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45 40 inconsistent data suggestive of guessing at the analysis stage.
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48 41 • Researcher bias was mitigated by the use of a pre-validated data collection instrument  
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50 42 and by pre-determining analytical strategies before data collection while confounding  
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52 43 was minimized through multivariate analysis.
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3 44 • Missing data made sample size in multivariate analysis less than the pre-research  
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5 45 estimate, though the proportion analyzed constituted a good representation of the entire  
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7 46 study population.  
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## 11 47 INTRODUCTION

14 48 Hepatitis B virus (HBV) is a highly infectious blood-borne pathogen usually transmitted via  
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16 49 percutaneous or mucosal exposure to infected blood and body fluids.[1] It is notorious for its  
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18 50 chronic carrier deadly sequel of liver cirrhosis and hepatocellular carcinoma.[2] HBV infection  
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20 51 affects about one third of the world's population with over 350 million persons being chronic  
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22 52 carriers.[3] This results in >2 million deaths from chronic liver diseases annually.[4] Sub-  
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24 53 Saharan Africa and East Asia have the highest HBV prevalence with about 5-10% of the entire  
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26 54 adult population having chronic infections.[1]  
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31 55 Percutaneous exposures to HBV occur in adulthood either accidentally or through unsafe  
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33 56 practices.[3] Transmissions via needle-stick and sharps injuries are frequent occurrences among  
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35 57 health practitioners and vulnerable public safety workers (PSWs).[5-7] PSWs' occupational risk  
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37 58 of HBV infection depends on their level of blood-skin exposure.[8-10] Woodruff et al. estimated  
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39 59 1.9 times (95% confidence interval (CI) 1.1-3.3) increased risk of infection with HBV in PSWs  
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41 60 with blood-skin exposure than in their counterparts without such exposure.[10] The risk of  
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43 61 transmission from infected blood is said to be 100 times more for HBV than for HIV in non-  
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45 62 immune individuals.[2]  
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50 63 Prevention of new HBV infections in adulthood is a recognized global public health priority.[3]  
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52 64 Hepatitis B vaccination (HBVc) is the most effective way of controlling HBV infection.[3] The  
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54 65 World Health Organization (WHO) prescribes universal HBVc of healthcare workers (HCWs)  
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3 66 and PSWs with frequent exposure to blood.[11] A standard three-dose vaccine regimen, with the  
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5 67 second and third doses given one month and six months apart from the initial dose respectively,  
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8 68 is very effective in conferring immunity against HBV.[12] In healthy vaccinated adults,  
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10 69 immunologic memory against HBV is retained for  $\geq 20$  years.[12]  
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12  
13 70 Nigeria is hyperendemic for HBV, with a chronic carrier prevalence rate of up to 39%.[4,6,13]  
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15 71 This prevalence is  $>4$  times that noted in black South Africans (9.6%).[14] This status poses a  
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18 72 great risk of occupational exposure to HBV for HCWs and PSWs with regular blood-skin  
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20 73 contact, though this risk is yet to be estimated in any Nigerian study.  
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23 74 The Federal Road Safety Corps (FRSC) was established by the Federal Government of Nigeria  
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25 75 in 1988 due to the high rate of road traffic crashes (RTCs) in the country.[15] Included in the  
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28 76 road safety functions of FRSC are the rescue and emergency care of RTC victims which brings  
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30 77 them in regular contact with blood.[15] The objectives of this study were to estimate HBVc  
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32 78 coverage, and knowledge and socio-demographic determinants of full-dose uptake in FRSC  
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35 79 members in Kaduna State, Nigeria, in order to inform relevant targeted vaccination policies.  
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## 38 80 **METHODS**

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41 81 **Study Design:** A quantitative cross-sectional survey of FRSC members, KSC, Nigeria.  
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44 82 **Setting and Target Population:** Kaduna State is the third most populous State in Nigeria and  
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46 83 has 3 senatorial zones with 23 local government areas (LGAs).  
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49 84 The FRSC is divided into 12 Zonal Commands; each Zonal Command has Sector Commands  
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51 85 under it with each Sector Command being sub-divided into Unit Commands.[16] There are  
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54 86 currently 204 Unit Commands in Nigeria.[16] The first 11 Unit Commands are located in the  
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87 KSC with the KSC headquarters making them 12 and these cover the entire 23 LGAs in Kaduna  
88 State (Table 1).

89 **Table 1: Location, Coverage and Staff Distribution of Unit Commands (UCs) of FRSC, Kaduna**  
90 **Sector Command, Nigeria, June-July, 2015.**

Commands	Designation	Staff Strength			Number of LGAs Covered	Location (LGA)
		Cadre				
		Officer	Marshal	Total		
Kaduna Sector Command (KSC) Headquarters	RS1.1	46	118	164	2	Kaduna North
Kafanchan UC	RS1.11	15	44	59	4	Jama'a
Birnin Gwari UC	RS1.12	17	35	52	1	Birnin Gwari
Zaria UC	RS1.13	24	66	90	5	Sabon Gari
Saminaka UC	RS1.14	10	36	46	1	Lere
Sabon Tasha UC	RS1.15	16	52	68	1	Chikun
Kakau UC	RS1.16	18	66	84	2	Chikun
Birnin Yero UC	RS1.17	15	44	59	1	Igabi
Gwantu UC	RS1.18	8	31	39	2	Sanga
Katari UC	RS1.19	19	37	56	1	Kachia
Kachia UC	RS1.110	10	26	36	2	Kachia
Tashan Yari UC	RS1.111	10	26	36	1	Makarfi
	<b>Total</b>	<b>208</b>	<b>580</b>	<b>789</b>	<b>23</b>	

91  
92 KSC is one of the four Sector Commands that make up the RS1 Zonal Command whose  
93 headquarters is in Kaduna. There were 789 FRSC members in KSC at the time of this study.  
94 Two major cadres exist in FRSC: Officer and Marshal, though the latter is sub-divided into  
95 Marshal Inspectorate and Road Marshal Assistant. 26% (208/789) of FRSC members, KSC are



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3 96 Officers while 74% (580/789) are Marshals. The study was carried out in six randomly selected  
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5 97 Unit Commands: KSC headquarters, Saminaka, Kakau, Gwantu, Katari, and Kachia.

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8 98 **Inclusion and Exclusion Criteria:** Only FRSC members in KSC aged 18 years and above with  
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10 99  $\geq 6$  months of service were included in the study. This ensured that only adults long enough in  
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12 100 service to be made aware of the risk of HBV were surveyed. FRSC members working in the RS1  
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14 101 Zonal Command headquarters were excluded from the study as the Zonal Command includes  
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16 102 other States beyond the study scope.

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21 103 **Sample Size:** This was estimated using the formula for cross-sectional surveys:  $n = 1.96^2 \times p(1-$   
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23 104  $p)/d^2$ , where  $n$  is the required sample size,  $p$  is prevalence estimate of HBVc in previous studies,  
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25 105 and  $d$  is precision or acceptable error margin (5%).[17] Ogoina et al.'s prevalence estimate of  
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27 106 36.2% in a survey of 290 HCWs in Nigeria[6] was used as proxy since there is no existing study  
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29 107 on PSWs in Nigeria. Anticipating a lower prevalence rate among non-HCWs with expectedly  
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31 108 lower level of awareness of HBVc, 30% prevalence was assumed. ( $N = 1.96^2 \times 0.3(1-0.3)/0.5^2 =$   
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33 109 323). Using 24% as anticipated non-response rate ( $q$ ),[6] a final sample size of 425 was  
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35 110 estimated using the formula:  $N_f = N_s/1-q$ , where  $N_f$  is the final sample size and  $N_s$  the initial  
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37 111 sample size.[18]

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42 112 **Sampling:** The sampling frame was a list of the 12 Unit Commands from the KSC headquarters.  
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44 113 Each Unit Command was considered a cluster. Clusters were randomly selected using a  
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46 114 computer-generated set of random numbers until sample size was achieved. This simple random  
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48 115 selection of clusters was to ensure representativeness of selected Unit Commands.[19] Six Unit  
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50 116 Commands were selected for the study. All FRSC members in the selected Unit Commands were  
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52 117 targeted for questionnaire distribution.

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3 118 **Data Collection:** Unit Commands of FRSC have compulsory weekly meetings. Permission was  
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5 119 obtained for collection of data at these meetings. Data collection took place between 17<sup>th</sup> June  
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7 120 and 22<sup>nd</sup> July, 2015. Participant information sheet (PIS) was reviewed with the staff with  
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9 121 emphasis on voluntary participation, anonymity and confidentiality of collected data. Inclusion  
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11 122 criteria and implied consent were further explained. Completion of questionnaire was considered  
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13 123 consent to participate. Participants were asked to seal completed questionnaires in the given  
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15 124 envelopes and drop them in a common collection box provided by the researcher. This was to  
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17 125 ensure anonymity. Those not willing to participate were asked to drop the sealed uncompleted  
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19 126 questionnaires in the box alongside participants. Non-responders were therefore not identified  
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21 127 during data collection. Two Unit Commands (KSC Headquarters & Kakau) were re-visited in  
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23 128 subsequent meetings due to poor initial attendance. Routine attendance lists taken by the Unit  
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25 129 Commands at the initial meetings were used to prevent re-participation of previous participants.  
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31 130 **Instruments:** Due to paucity of studies on the research topic, accessing a pre-validated  
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33 131 questionnaire for the study was difficult. After an extensive literature search, only Al-Hussami's  
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35 132 "Hepatitis B Vaccine Knowledge and Acceptance" questionnaire could be found.[20] This  
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37 133 questionnaire has been used for HCWs in United States. It was validated in two pilot studies with  
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39 134 testing for inter-reliability but the test statistic was not reported.[20] There were 44 multiple  
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41 135 choice questions including some open-ended ones. A structured anonymous self-administered  
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43 136 questionnaire was adapted from this questionnaire for the present study (appendix A). Only  
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45 137 questions relevant to the research questions were selected. Questions were simplified to suit the  
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47 138 literacy status of the study population. The adapted study questionnaire contained 17 questions  
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49 139 that elicited information on demographics (sex, age, duration of service, cadre and rank), HBV  
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51 140 knowledge and perception of risk of exposure, and HBVc knowledge and status. Though rank  
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141 was obtained, this was not included in analysis since it mirrors cadre. The questionnaire was  
 142 pilot-tested on FRSC members in RS1 Zonal Command headquarters.

143 **Statistical Analysis:** Table 2 describes the variables in the study.

Table 2: Description of Variables in the Study, FRSC, KSC, Nigeria, June-July, 2015.

Variable	Description	Type of Data
Independent Variables		
Sex	This was the gender of study participants categorized as either male or female	Nominal
Age	This variable ascertained the age of participants on their last birthday. It was categorized to enhance anonymity from 18 years which is the age definition of commencement of adulthood to $\geq 50$ years which marks the age before retirement from Nigerian Civil Service at 60 years. The categories included: 18-29 years; 30-39 years; 40-49 years; $\geq 50$ years	Ordinal
Duration of Service	This variable elicited how long a respondent had been in service with the Federal Road Safety Corps. It was categorized into: 6 months-2 years (probation period in civil service); 3- 10 years; 11 years to 19 years; and $\geq 20$ years (close to retirement by service year at 35 years).	Ordinal
Cadre	This ascertained the official class of participant based on position and seniority in office. There were two major categories: Officers and Marshals with the latter sub-categorized into Marshal Inspectorate and Field Marshal Assistant in a descending order. It also signified educational qualification order with the least educated being the Field Marshal Assistant.	Nominal/Ordinal
Risk Perception	This ascertained the level of perception of occupational risk of exposure to HBV by respondents. It was initially categorized into: No risk of exposure, low risk of exposure, moderate risk of exposure, high risk of exposure, and I don't know. This was later	Nominal/Ordinal

Table 2: Description of Variables in the Study, FRSC, KSC, Nigeria, June-July, 2015.

Variable	Description	Type of Data
	dichotomized for further analysis by merging the 'I don't know' group with the 'no risk' group to form a 'no risk perceived' category with the rest forming the 'risk perceived' category.	
HBV Knowledge Score	This variable sought to estimate the level of knowledge of basic information on HBV. It includes questions on HBV awareness, seriousness compared to HIV, and route of transmission. For each participant, the number of questions answered correctly was noted as the score (see scoring table in appendix B).	Continuous
HBVc Knowledge Score	This measured the level of basic knowledge of hepatitis B vaccination among participants. It comprised questions on HBVc awareness, effectiveness, recommended full dosage and duration of protection from full-dose vaccination. For each participant, the number of questions answered correctly was noted as the score (appendix B).	Continuous
Dependent Variable		
Hepatitis B Vaccination (HBVc) Status	Information was elicited on whether participant had ever received HBVc and the number of doses received. Descriptive analysis was done using these data. Dichotomization of data was also done for logistic regression analysis. Since only those with $\geq 3$ doses of HBVc uptake are considered fully protected,[2] those with $\geq 3$ doses were labeled 'vaccinated' and the rest 'not vaccinated'. This was noted as the HBVc status of each participant.	Nominal

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145 All analyses were conducted using statistical package for social sciences version 21. Descriptive  
 146 analysis ascertained frequencies and distributions of data. Histograms showed both HBV  
 147 knowledge and HBVc knowledge scores to be normally distributed, hence their mean and  
 148 standard deviations (SD) were calculated as was the percentage of participants scoring above the

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3 149 mean scores. Since the outcome variable (HBVc status) was binary, logistic regression analysis  
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5 150 was used in testing for associations with the independent variables (sex, age, duration of service,  
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8 151 cadre, risk perception, and HBV and HBVc knowledge scores).[21] To mitigate confounding,  
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10 152 univariate analyses were first carried out and the variables identified as significantly associated  
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12 153 ( $p < 0.05$ ) with HBVc status were included in the multivariate analysis for independent predictors  
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14 154 of full-dose HBVc uptake.[21] Adjusted odds ratios (AOR) with 95% confidence interval (CI)  
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16 155 for each variable was computed and significance level set at  $p < 0.05$ . Missing data on each  
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19 156 variable were excluded in the analysis of the variable.  
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## 22 157 **RESULTS**

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25 158 354 questionnaires were distributed in the six Unit Commands sampled from FRSC, KSC. 6  
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28 159 questionnaires were discarded for having missing data on up to 3 of the independent variables or  
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30 160 on the dependent variable and 2 or more independent variables. 7 questionnaires were submitted  
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32 161 blank. 341 completed questionnaires were included for analysis, giving a response rate of 96.3%.  
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35 162 Appendix C shows percentage of missing data for each of the 14 questions analyzed. Missing  
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37 163 data were most frequent on the question on recommended dose of vaccine (9.7%; 33/341)  
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39 164 followed by that on the duration of protection from full-dose HBVc (8.5%; 29/341). All  
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41 165 participants provided data on cadre. Most respondents were males; aged 30-39 years; had worked  
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44 166 between 3-10 years with FRSC; and were of Marshal Cadre (table 3).  
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Table 3: Socio-Demographic Characteristics of Study Sample of FRSC Members, KSC, Nigeria, June-July, 2015.

Variable	Frequency	Percentage
Sex (n=327)		
Male	260	79.5
Female	67	20.5
Age (n=338)		
18-29 years	64	18.9
30-39 years	167	49.4
40-49 years	87	25.7
≥50 years	20	5.9
Duration of Service (n=339)		
6 months-2 years	36	10.6
3-10 years	188	55.5
11-19 years	87	25.7
≥20 years	28	8.3
Cadre (n=341)		
Officer	96	28.2
Marshal	245	71.8
- Marshal Inspectorate	111	32.6
- Field Marshal Assistant	134	39.3

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171 **HBV Knowledge:** The mean total number of correct answers to HBV knowledge questions was  
 172 3.0 out of 6.0 (SD 1.5). 46% (157/341) of participants scored above the mean. The proportion of  
 173 correct answers to HBV knowledge questions ranged from 2.1% (7/337) on route of transmission  
 174 of HBV to 93.2% (317/340) on having ever heard of HBV. 22.6% (76/337) of respondents  
 175 answered 'I don't know' to the question pertaining to the route of transmission of HBV and this  
 176 response was the most frequent. Merely 2.1% (7/337) correctly identified contact with infected  
 177 blood and blood-contaminated body fluid as routes of transmission of HBV. Only 4 participants  
 178 (1.2%; n=341) answered all 6 HBV knowledge questions correctly while 16 (4.7%, n=341)

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3 179 answered none correctly. HBV infection was perceived as more serious than HIV by most  
4  
5 180 respondents (56.7%; 190/335) while about 3.0% (10/335) felt it was less serious than HIV.  
6  
7  
8 181 20.6% (69/335) claimed no knowledge of the seriousness of HBV compared to HIV while 19.7%  
9  
10 182 (66/335) ascribed equal severity to the two.

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12  
13 183 **HBVc Knowledge:** The mean number of correct answers to HBVc questions was 2.0 out of 4.0  
14  
15 184 (SD 1.1). 42.2% (144/341) of participants had scores higher than the mean score. All four  
16  
17 185 questions on HBVc were answered correctly by only 4.1% (14/341) of participants while no  
18  
19 186 correct answer was given by 11.7% (40/341). Rate of correctness ranged from 6.1% (19/312) on  
20  
21 187 question on duration of protection from full-dose HBVc to 86.6% (291/336) on having ever  
22  
23 188 heard of HBVc. Most respondents (62.9%; 210/334) described HBVc as very effective. While  
24  
25 189 6.9% (23/334) rated it slightly effective, 2.7% (9/334) felt it was not effective at all. 27.5%  
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27 190 (92/334) of respondents indicated not knowing its effectiveness. 54.9% (169/308) of responding  
28  
29 191 participants correctly identified recommended full HBVc dose as  $\geq 3$  doses while 1.6% (5/308)  
30  
31 192 and 3.9% (12/308) thought it was 1 dose and 2 doses respectively. Up to 39.6% (122/308)  
32  
33 193 indicated not knowing the recommended full dose of HBVc.

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35  
36 194 **Perception of Risk of Occupational Exposure to HBV:** While most respondents (55.3%;  
37  
38 195 188/340) rated themselves at high risk of occupational exposure to HBV, 22.4% (76/340) did not  
39  
40 196 know their risk status. 5.3% (18/340) of respondents considered themselves at no risk of  
41  
42 197 exposure to HBV while 5.9% (20/340) and 11.2% (38/340) rated themselves at low and  
43  
44 198 moderate risks of exposure respectively. After dichotomizing this variable into 'no risk  
45  
46 199 perceived' and 'risk perceived' categories, 72.4% (246/340) had some level of risk perception  
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48 200 while 27.6% (94/340) had no risk perception for HBV.  
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3 201 **HBVc Coverage:** Of the 341 participants, 6 did not provide data on their HBVc status. 10 others  
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5 202 answered 'yes' to having ever received HBVc but omitted the number of doses received and  
6  
7 203 were therefore inputted as missing data. 325 respondents (95.3%) were included in the sub-  
8  
9 204 analysis. 60.9% (198/325) of the respondents affirmed having ever received  $\geq 1$  dose of HBVc.  
10  
11 205 50.0% of these (99/198) had received  $\geq 3$  doses resulting in full-dose coverage of 30.5% (99/325)  
12  
13 206 among the respondents. 39.1% (127/325) of respondents had never received HBVc. Together  
14  
15 207 with the 99 participants with  $< 3$  doses, 69.5% (226/325) were classified 'not vaccinated' while  
16  
17 208 30.5% (99/325) were labeled 'vaccinated'.  
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22 209 **Logistic Regression Analyses:** All the variables were significantly associated with HBVc on  
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24 210 univariate analyses (table 4) and were included in the multivariate analysis for independent  
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26 211 predictors of full-dose HBVc uptake (table 5). Being female was associated with about twice the  
27  
28 212 likelihood of having received full-dose HBVc (table 5). When risk perception was analyzed as a  
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30 213 dichotomous variable ('no risk perceived' versus 'risk perceived'), those with any level of risk  
31  
32 214 perception for occupational exposure to HBV were about 3 times more likely to have received  
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34 215 full-dose HBVc than those without risk perception for HBV (table 5). Though the odds of being  
35  
36 216 fully vaccinated increased with duration of service, this was not statistically significant. While  
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38 217 HBV knowledge was not a significant predictor of full-dose HBVc, knowledge of HBVc was  
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40 218 significantly associated with full-dose HBVc with each unit increase in number of correct  
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42 219 answers being associated with up to three times increased likelihood of being fully vaccinated  
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44 220 (table 5).  
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**Table 4: Univariate Binary Logistic Regression Analyses Showing Unadjusted Odds Ratios of the Association between Independent Variables and Full-Dose Hepatitis B Vaccination Uptake among FRSC Members, KSC, Nigeria, June-July, 2015**

Independent Variable	Sample Size	Odds Ratio	95% CI (p-value)
Sex	313		
Male		1	
Female		2.66	1.51-4.70 (0.001)
Age	323		
18-29 years		1	
30-39 years		2.08	0.97-4.44 (0.059)
40-49 years		3.30	1.47-7.40 (0.004)
≥50 years		5.67	1.84-17.50 (0.003)
Duration of service	323		
6 months-2 years		1	
3-10 years		5.69	1.31-24.72 (0.020)
11-19 years		9.48	2.12-42.35 (0.003)
≥20 years		13.39	2.61-68.56 (0.002)
Cadre	325		
Officer		1	
Marshal Inspectorate		1.69	0.92-3.09 (0.091)
Road Marshal Assistant		2.10	1.18-3.74 (0.012)
Risk Perception for Occupational Exposure to HBV	324		
I don't know		1	
No risk		3.92	0.78-19.63 (0.096)
Low risk		11.33	2.94-43.63 (<0.001)
Moderate risk		9.61	2.85-32.43 (<0.001)
High risk		11.07	3.87-31.70 (<0.001)
Risk perception for Occupational Exposure to HBV	324		
No risk perceived		1	
Risk perceived		7.39	3.27-16.71 (<0.001)
HBV Knowledge Score	325	1.37	1.15-1.62 (<0.001)
HBVc Knowledge Score	325	2.97	2.16-4.08 (<0.001)

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**Table 5: Multivariate Binary Logistic Regression Analysis for Independent Predictors of Full-Dose Hepatitis B Vaccination Uptake among Members of FRSC, KSC, Nigeria, June-July, 2015.**

Independent Variable	Adjusted Odds Ratio n=309	95% CI (p-value)
Sex		
Male	1	
Female	2.28	1.15-4.52 (0.019)
Age		
18-29 years	1	
30-39 years	1.40	0.47-4.18 (0.542)
40-49 years	0.99	0.28-3.55 (0.987)
≥50 years	1.08	0.20-5.76 (0.931)
Duration of service		
6 months-2 years	1	
3-10 years	2.12	0.39-11.41 (0.384)
11-19 years	2.73	0.45-16.59 (0.276)
≥20 years	5.25	0.68-40.47 (0.112)
Cadre		
Officer	1	
Marshal Inspectorate	1.60	0.77-3.33 (0.208)
Road Marshal Assistant	0.87	0.41-1.85 (0.720)
Risk Perception for Occupational Exposure to HBV		
I don't know	1	
No risk	2.93	0.47-18.41 (0.251)
Low risk	7.12	1.47-34.47 (0.015)
Moderate risk	4.50	1.03-19.63 (0.045)
High risk	3.90	1.08-14.09 (0.038)
Risk perception for Occupational Exposure to HBV		
No risk perceived	1	
Risk perceived	2.86	1.06-7.70 (<0.001)
HBV Knowledge Score	1.03	0.80-1.31 (0.843)
HBVc Knowledge Score	2.68	1.83-3.92 (<0.001)

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227 In summary, full-dose HBVc was 30.5% while any dose coverage was 60.9%. Female sex,

228 perceiving their occupation as conveying a risk of HBV, and increasing HBVc knowledge were

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3 229 significant independent predictors of full-dose HBVc uptake among members of FRSC in  
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5 230 Kaduna State, Nigeria.  
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## 8 231 **DISCUSSION**

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11 232 Like all other studies on HCWs in Nigeria,[13,23-25] this study has further demonstrated high  
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13 233 HBVc initiation rate (60.9%) with low completion rate (30.5%). This completion rate implies  
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15 234 that only 30.5% of members of the FRSC, KSC were adequately protected against HBV  
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17 235 infection.[2] This means that almost 70% of these rescue workers perform their duties without  
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19 236 adequate protection from HBV. This also places the accident victims whom they seek to rescue  
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21 237 at risk of infection with HBV from infected FRSC members. This could lead to an unbroken  
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23 238 cycle of infectivity, morbidity and mortality from HBV in a nation still struggling with the HBV  
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25 239 scourge. Poor uptake of HBVc among those at occupational risk of exposure to HBV in Nigeria  
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27 240 is a common observation across studies.[13,22-27] Non-existence of a universal HBVc policy in  
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29 241 the country for HCWs and vulnerable PSWs could be contributory to poor vaccine uptake.  
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31 242 HBVc is sourced individually by workers except for sporadic free immunization programmes in  
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33 243 some institutions. Lee et al. demonstrated up to 78% HBVc coverage among a subset of PSWs in  
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35 244 United States which has institutionalized HBVc policy for HCWs and vulnerable PSWs.[28] The  
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37 245 Centers for Disease Control and Prevention (CDC) recommends routine immunization of HCWs  
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39 246 against HBV.[2] Occupational Safety and Health Administration (OSHA) designated police and  
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41 247 firefighters as HCWs considering their often adopted role of emergency medical service  
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43 248 providers.[7] FRSC members are exposed to blood and sharps injuries from accident scenes.  
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45 249 Though there are no statistical estimates from previous studies to quantify their occupational  
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47 250 exposure levels, their job descriptions and high prevalence of RTCs in Nigeria presumably place  
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49 251 them at high risk of exposure to HBV in this hyperendemic setting.[15,29] In a nation with 39%

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3 252 prevalence for chronic HBV,[4] HBVc coverage of 30.5% for FRSC members, KSC is low.  
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5 253 OSHA includes workers in public safety institutions among personnel to receive mandatory free  
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7 254 HBVc provided at employer's cost as contained in the "Bloodborne Pathogens Standard".[30,31]  
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10 255 From this study, it is recommended that the Federal Government of Nigeria, through the Federal  
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12 256 Ministry of Health, provide free HBVc to all FRSC staff in KSC who are not yet fully  
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14 257 vaccinated, and enact a policy to institutionalize free mandatory HBVc for all unimmunized  
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16 258 trainees at the initial basic training programme for newly recruited staff. This will ensure  
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18 259 adequate HBVc coverage of FRSC staff before exposure to rescue operations.  
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22 260 Among FRSC members, females are 2.28 times more likely to be fully vaccinated against HBV  
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24 261 compared to their male counterparts. Osazuwa-Peters et al. observed a similar but insignificant  
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26 262 female preponderance in HBVc among dental professionals in Edo State, Nigeria.[32]  
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28 263 Contrarily, Adekanle et al., in their survey of HCWs in Ile-Ife, Nigeria, observed 1.8 times  
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30 264 increased chances of males receiving HBVc compared to females,[26] although this finding may  
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32 265 be due to males in the study being mainly doctors who had the advantage of professional  
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34 266 knowledge of HBVc. It is possible that, in the present study, females could be exposed to HBVc  
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36 267 knowledge during antenatal hospital visits and while taking their children for immunization.  
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41 268 More than 50% of respondents perceived themselves at high risk of occupational exposure to  
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43 269 HBV. Disturbingly though, close to a quarter of the study participants claimed no knowledge of  
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45 270 their risk status. Together with those who perceived themselves to be at no risk, 27.6% of FRSC  
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47 271 members had no risk perception for occupational exposure to HBV while 72.4% perceived  
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49 272 themselves at risk. This falls within the range of 30% to 78% risk perception observed in studies  
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51 273 among HCWs in Nigeria.[13,27] While the rate of risk perception was high, having  
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53 274 approximately 28% with no risk perception for HBV is quite disconcerting from a public health  
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3 275 perspective considering the blood-skin exposure that rescue of accident victims could entail.  
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5 276 Perception of threat of a disease provides cue for action in favour of a health-promoting  
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7 277 behaviour.[33] This was demonstrated in this study as those who perceived themselves at risk of  
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9 278 occupational exposure to HBV were three times more likely to be vaccinated than those with no  
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11 279 risk perception. All risk categories had higher odds of vaccination compared to those without  
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13 280 risk perception. It is therefore important that FRSC members understand the risk of exposure to  
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15 281 HBV (even if they feel it is low) as this appears to increase their likelihood of getting vaccinated.  
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20 282 Knowledge of HBV and HBVc among study participants was poor. Less than 47% of  
21  
22 283 participants scored above the mean knowledge scores for HBV and HBVc. Knowledge was  
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24 284 poorest for the route of transmission of HBV and duration of protection from full-dose HBVc.  
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26 285 Not knowing the route of transmission of HBV means that FRSC members might not take  
27  
28 286 adequate precautions during rescue operations nor adopt preventive measures against the virus. It  
29  
30 287 could also lead to stigmatization of FRSC members already infected with HBV due to wrong  
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32 288 assumption of infectivity through casual contact with their sweat and saliva. HBV knowledge  
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34 289 score was however not an independent predictor of HBVc in the study. This conflicts with  
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36 290 Adekanle et al.'s observation of twice increased likelihood of complete HBVc among those with  
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38 291 good knowledge of HBV in their survey of HCWs in Ile Ife, Nigeria.[26] Their study though did  
39  
40 292 not elicit information on HBVc knowledge as was done in this study. HBVc knowledge could  
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42 293 have confounded the demonstrated association between HBV knowledge and HBVc uptake.  
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44 294 Only 6.1% of participants knew that full-dose HBVc gives protection for  $\geq 20$  years. This was  
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46 295 despite the description of HBVc as very effective by 62.9% of participants. Knowing that  
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48 296 receiving  $\geq 3$  doses of the vaccine can give one lifetime protection from HBV could incentivize  
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50 297 full-dose uptake among FRSC members. HBVc knowledge was the most significant and precise

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3 298 independent predictor of full-dose HBVc in this study. This contradicts Ogoina et al.'s finding of  
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5 299 no significant association between knowledge of HBVc and full-dose vaccination among HCWs  
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8 300 in two tertiary hospitals in Nigeria.[6] However, they did not ascertain knowledge of vaccine  
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10 301 effectiveness and duration of protection from full-dose vaccination.

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13 302 Educational programme towards improvement of HBV and HBVc knowledge, and risk  
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15 303 perception among FRSC members is a recognized relevant public health intervention from this  
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18 304 study. The programme can be included in the schedules of the already existing compulsory  
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20 305 weekly in-house training/manpower development of staff and in the routine basic training  
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22 306 programme for new staff. Such enlightenment would be a cheap and easy intervention to  
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25 307 improve HBVc uptake. Existing evidence on the positive impact of educational intervention on  
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27 308 vaccine uptake is however weak.[34] The educational intervention should therefore be rigorously  
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29 309 evaluated to ascertain its impact on HBVc uptake in FRSC members.

### 31 32 **Study Strengths and Limitations:** 33

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35 311 This was a descriptive cross-sectional survey which limits its suitability for demonstrating  
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38 312 temporal relationships between explanatory and outcome variables.[35] It nevertheless shows  
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40 313 independent associations useful in understanding predictors of full-dose HBVc in this study  
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42 314 population so as to inform relevant public health interventions. Recall bias is another limitation  
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45 315 of this retrospective study design as participants may not have remembered accurately their  
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47 316 vaccination history, which could have introduced information bias.[36] However, this was  
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49 317 addressed at the analysis stage by omitting inconsistent data suggestive of guessing. Simple  
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51 318 random sampling using the staff register would have been most ideal in selecting a representative  
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54 319 sample with minimal selection bias;[21] this was not feasible considering the disproportionate

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3 320 distribution of some of the socio-demographic variables like sex and cadre in the study  
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5 321 population. Also, the response rate of 96.3% was impressive and minimizes selection bias  
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7 322 wherein non-participants could differ significantly from participants in the study variables.[37]  
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10 323 This enhances the generalizability of research findings by improving the external and internal  
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12 324 validity of the study.[37] The presence of Unit Commanders and other senior members of staff at  
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14 325 the meetings during data collection and their participation in the research could have contributed  
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16 326 to the high response rate. Subordinates who ordinarily may not have wished to participate could  
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18 327 have felt a psychological obligation to participate with their bosses. This power influence was  
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20 328 minimized by the use of PIS which emphasized voluntary participation, and by anonymous data  
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22 329 collection procedures. Quantitative studies are prone to researcher bias.[21] This was minimized  
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24 330 by the use of a pre-validated questionnaire and by pre-determining analytical strategies before  
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26 331 data collection. Possible exchange of information among participants could have introduced  
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28 332 information bias. This was mitigated by the presence of the researcher during data collection  
29  
30 333 with prior emphasis on non-communication between participants. Though the study's  
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32 334 questionnaire was adapted and pilot-tested to reflect the study context, it was not tested for inter-  
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34 335 rater reliability and validity within the study population. Missing data reduced the sample size  
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36 336 for the multivariate analysis from 341 to 309. This sample size was less than the pre-study  
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38 337 estimate (323) and could lack sufficient power to detect significant associations, hence  
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40 338 predisposing to type II error.[21] It however constitutes a randomized 39% (309/789) of the  
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42 339 study population, which is a good representation.[38] Confounding, a known menace in  
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44 340 observational studies, was minimized at the analytical stage through multivariate logistic  
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46 341 regression.[21] The research estimates on the association of varied levels of risk perception with  
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3 342 full-dose HBVc were not precise, having very wide 95% CIs. This could be due to random errors  
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5 343 in the sample.[36] A larger sample size in future studies could yield more precise estimates.  
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## 8 344 **CONCLUSION**

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11 345 Persons with chronic HBV are at 15%-25% risk of premature mortality from the sequels of liver  
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13 346 cirrhosis and hepatocellular carcinoma.[39]. Controlling HBV transmission is an important  
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15 347 public health issue internationally and in Nigeria where the virus is hyperendemic. HBV  
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17 348 infection is a preventable disease and prevention is best achieved with HBVc.[3] FRSC members  
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19 349 come in regular contact with blood and are at risk of contracting the virus. HBVc coverage  
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21 350 among FRSC members in Kaduna State, Nigeria is low (30.5%). Knowledge of HBV and HBVc  
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23 351 is poor in this study population. Female sex, perceiving there to be an occupational risk of  
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25 352 exposure to HBV, and increasing HBVc knowledge are independent predictors of HBVc uptake  
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27 353 among FRSC members, KSC. Institutionalized free HBVc is recommended for FRSC staff.  
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29 354 Educational intervention aimed at creating proper awareness of the occupational risk of HBV  
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31 355 and the importance of HBVc, is required to improve HBVc coverage among this vulnerable  
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33 356 group of PSWs. Recommended future studies include: a qualitative study to ascertain FRSC  
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35 357 members' perception of HBVc and subjective reasons for non-uptake of the vaccine; a sero-  
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37 358 prevalence study to determine the actual immune status of FRSC members in KSC and estimate  
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39 359 the prevalence of HBV in this study group for appropriate intervention; and validation of  
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41 360 questionnaire in the Nigerian context with pretesting and retesting for reliability.  
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For peer review only

## APPENDIX A: ADAPTED STUDY QUESTIONNAIRE

## HEPATITIS B VACCINATION QUESTIONNAIRE

## For Official Use Only

Researcher.....

Questionnaire no: 

Date of Data Collection (DD/MM/YY).....

**IMPLIED CONSENT (Please read before completing questionnaire):** Having gone through the research information contained in the participant information sheet, by completing this questionnaire you are consenting to participate in the study. If you do not wish to complete the questionnaire, please put the blank version into the envelope and I will collect it with all other questionnaires.

Thank you.

**Please only complete the questionnaire if you are aged 18 years and above and have at least 6 months of service with FRSC**

**Note:** This questionnaire is anonymous; please do not write your name on it. Kindly give an answer to all the questions as it pertains to you and please answer as truthfully as you can.

Please check (✓) only the box that most correctly answers the question, making sure you make only one selection for each question except where otherwise indicated.

**Section A: Demographic Questions**

1. What is your sex?

Male

Female

2. What was your age on your last birthday?

- 18 to 29 years
- 30 to 39 years
- 40 to 49 years
- 50 years and above

### Section B: Employment History

3. How long have you worked with Federal Road Safety Corps (FRSC)?

- 6 months to 2 years
- 3 years to 10 years
- 11 years to 19 years
- 20 years and above

4. What is your cadre?

- Officer
- Marshal Inspectorate
- Road Marshal Assistant

5. Please check (✓) the box below your rank

ACM	CC	DCC	ACC	CRC	SRC	RC	DRC	ARC

CI	DCI	ACI	PMI	SMI	MI-I	MI-II	MI-III	CRMA	DCRMA	SRMA	RMAI	RMAII	RMAIII



### Section C: Perception of Risk of Exposure to Hepatitis B Virus

6. Have you ever heard about hepatitis B virus infection?

Yes

No

7. How serious do you think being infected with hepatitis B virus is compared to HIV?

Less serious than HIV

As serious as HIV

More serious than HIV

I don't know

8. How can someone be infected with hepatitis B virus? (please check (✓) all the correct boxes if your answer is more than one)

Through contact with blood of an infected person

Through contact with saliva of an infected person

Through contact with sweat of an infected person

Through contact with body fluid contaminated by blood of an infected person

I don't know

1  
2  
3 9. How much do you think your work with FRSC exposes you to the risk of  
4 contracting hepatitis B virus infection?  
5  
6

- 7  No risk of exposure  
8  
9  Low risk of exposure  
10  
11  Moderate risk of exposure  
12  
13  High risk of exposure  
14  
15  I don't know  
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19  
20 **Section D: Hepatitis B vaccination Knowledge and Status**  
21

22 10. Have you ever heard about hepatitis B vaccination?  
23

- 24  Yes  
25  
26  No  
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29  
30 11. How effective do you think hepatitis B vaccination is in protecting someone  
31 against hepatitis B virus infection?  
32

- 33  Not effective  
34  
35  Slightly effective  
36  
37  Very effective  
38  
39  I don't know  
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41  
42

43  
44 12. Have you ever received hepatitis B vaccination?  
45

- 46  Yes  
47  
48  No  
49  
50

51 **If your answer to question 12 is 'No', answer question 13; if it is 'Yes', go to**  
52 **question 14**  
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13. Why have you not received hepatitis B vaccination? (Please check (✓) all the correct boxes if your answer is more than one)

- I am not aware of hepatitis B vaccination
- I do not know where to go and receive it
- I don't have time
- It is expensive
- I don't see the need
- I am afraid of contracting the virus from the vaccine
- Others (please state).....

14. If your answer to question 12 is 'Yes', how many doses of hepatitis B vaccine have you received?

- 1 dose
- 2 doses
- 3 doses
- More than 3 doses

15. When did you receive the last dose of hepatitis B vaccine?

- Less than 1 month ago
- 1 month to 3 months ago
- 4 months to 6 months ago
- More than 6 months ago

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16. What do you think is the recommended full dose of hepatitis B vaccine?

- 1 dose
- 2 doses
- 3 or more doses
- I don't know

17. How long does a full dose of hepatitis B vaccine protect someone?

- Less than 1 year
- 1 year to 5 years
- 6 years to 10 years
- 11 years to 19 years
- 20 years or more
- I don't know

**Thank you for your time!**

## APPENDIX B: Knowledge Scoring Table

Scoring Table: HBV (A) and HBVc (B) Knowledge Questions and Scoring Pattern

A. Question	Options checked	Score
Have you heard about hepatitis B virus infection? <b>(one option)</b>	Yes (✓)	1
	No (✓)	0
How serious do you think being infected with hepatitis B virus is compared to HIV? <b>(one option)</b>	Less serious than HIV (✓)	0
	As serious as HIV (✓)	0
	More serious than HIV (✓)	1
	I don't know (✓)	0
How can someone be infected with hepatitis B virus? (please check (✓) all the correct boxes if your answer is more than one)	Through contact with blood of an infected person (✓)	1
	Through contact with saliva of an infected person <b>(blank)*</b>	1
	Through contact with sweat of an infected person <b>(blank)*</b>	1
	Through contact with body fluid contaminated by blood of an infected person (✓)	1
	I don't know (✓)	0 for all options
Maximum HBV knowledge Score		6 of 6
Minimum HBV knowledge Score		0 of 6
B. Question	Options	Score
Have you ever heard about hepatitis B vaccination? <b>(one option)</b>	Yes (✓)	1
	No (✓)	0
How effective do you think hepatitis B vaccination is in protecting someone against hepatitis B virus infection? <b>(one option)</b>	Not effective (✓)	0
	Slightly effective (✓)	0
	Very effective (✓)	1
	I don't know (✓)	0
What do you think is the recommended full dose of hepatitis B vaccine? <b>(one option)</b>	1 dose (✓)	0
	2 doses (✓)	0
	3 or more doses (✓)	1
	I don't know (✓)	0
How long does a full dose of hepatitis B vaccine protect	Less than 1 year (✓)	0

A. Question	Options checked	Score
someone? (one option)	1 year to 5 years (✓)	0
	6 years to 10 years (✓)	0
	11 years to 19 years (✓)	0
	20 years or more (✓)	1
	I don't know (✓)	0
Maximum HBVc knowledge score		4 of 4
Minimum HBVc knowledge score		0 of 4

\* HBV can be found in saliva but the concentration is very low compared to blood; direct injection through bites is required to transmit the virus via this medium.<sup>1,2</sup> Transmission has not been observed through sweat.<sup>1</sup>

### References:

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**Appendix C: Frequency of Available Data and Missing Data from Completed Questionnaires, Federal Road Safety Corps, Kaduna Sector Command, Nigeria, June-July, 2015**

Variable	Valid Sample Size	Available Data	Percentage	Missing Data	Percentage
Sex	341	327	95.9	14	4.1
Age	341	338	99.1	3	0.9
Duration of Service	341	339	99.4	2	0.6
Cadre	341	341	100	0	0
Ever heard of HBV infection?	341	340	99.7	1	0.3
Seriousness of HBV compared to HIV	341	335	98.2	6	1.8
Route of Transmission of HBV	341	337	98.8	4	1.2
Perception of Risk of exposure to HBV	341	340	99.7	1	0.3
Ever heard of hepatitis B vaccination?	341	336	98.5	5	1.5
Effectiveness of hepatitis B vaccination	341	334	97.9	7	2.1
Ever received hepatitis B vaccination?	341	325	95.3	16	4.7
Number of doses received	198	198	100	0	0
Recommended full dose of hepatitis B vaccine	341	308	90.3	33	9.7
Duration of protection from full-dose HBVc	341	312	91.5	29	8.5

**STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***

Section/Topic	Item #	Recommendation	Reported on page #
<b>Title and abstract</b>	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3,4
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	8,9
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	10,11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-11
Bias	9	Describe any efforts to address potential sources of bias	8-10
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10-12
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10-12
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	12
		(d) If applicable, describe analytical methods taking account of sampling strategy	11,12
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			



Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12-17
		(b) Give reasons for non-participation at each stage	12
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12,13
		(b) Indicate number of participants with missing data for each variable of interest	12
Outcome data	15*	Report numbers of outcome events or summary measures	15
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15-17
		(b) Report category boundaries when continuous variables were categorized	10
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	17,18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	21-23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	18-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	21,22
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## Hepatitis B Vaccination Coverage, Knowledge and Socio-Demographic Determinants of Uptake in High-Risk Public Safety Workers in Kaduna State, Nigeria: A Cross-Sectional Survey

Journal:	<i>BMJ Open</i>
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Secondary Subject Heading:	Epidemiology, Occupational and environmental medicine, Infectious diseases
Keywords:	Infection control < INFECTIOUS DISEASES, Hepatitis B virus, Vaccination coverage, Public safety workers

SCHOLARONE™  
Manuscripts

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3 **Hepatitis B Vaccination Coverage, Knowledge and Socio-Demographic Determinants of**  
4 **Uptake in High-Risk Public Safety Workers in Kaduna State, Nigeria: A Cross-Sectional**  
5 **Survey**  
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33 summary, tables, acknowledgment and references).

34 **Number of tables:** 5

35 **Number of references:** 38

36 **Number of supplementary files (appendices) for online only publication:** 3  
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## STATEMENTS

**Contributorship:** This study was carried out as a dissertation research by CLO under the close supervision of CMB, in partial fulfillment of the requirement for the award of the degree of Master of Public Health by the University of Liverpool, United Kingdom. CLO collected the data and conducted the analyses. These were reviewed by CMB. The manuscript was drafted by CLO and reviewed and revised by CMB. Both authors approved the final version for publication.

**Competing Interests:** None declared.

**Funding:** This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

**Ethics Approval:** This study was approved by the University of Liverpool's Ethics Committee and the Ethics Committee of Kaduna State Ministry of Health.

**Participant Consent:** Obtained

**Data sharing:** Extra data can be accessed via the Dryad data repository at <http://datadryad.org/> with the doi:10.5061/dryad.545q0

## 1 ABSTRACT

2 **Objectives:** To estimate hepatitis B vaccination (HBVc) coverage, and knowledge and socio-  
3 demographic determinants of full-dose uptake in Federal Road Safety Corps (FRSC) members,  
4 Kaduna State, Nigeria in order to inform relevant targeted vaccination policies.

5 **Design:** A cross-sectional survey of FRSC members, Kaduna Sector Command.

6 **Settings:** Six randomly-selected Unit Commands under Kaduna Sector Command, Kaduna State,  
7 Nigeria.

8 **Participants:** Pilot-tested structured self-administered questionnaire was administered to 341  
9 participants aged 18 years and above with  $\geq 6$  months of service between 17<sup>th</sup> June and 22<sup>nd</sup> July,  
10 2015. Excluded were FRSC members in Road Safety (RS) 1 Zonal Command headquarters as  
11 the Zonal Command includes other States beyond the study scope.

12 **Primary Outcome:** HBVc status of participants categorized as 'not vaccinated' for uptake of <3  
13 doses and 'vaccinated' for uptake of  $\geq 3$  doses.

14 **Analysis:** Descriptive analysis estimated HBVc coverage while logistic regression ascertained  
15 associations.

16 **Results:** Most participants were males, aged 30-39 years, with 3-10 years of service, and of  
17 Marshal cadre. HBVc coverage was 60.9% for  $\geq 1$  dose and 30.5% for  $\geq 3$  doses. Less than 47%  
18 of participants scored above the mean knowledge score for hepatitis B virus (HBV) and HBVc.  
19 Female sex (AOR 2.28, 95% CI 1.15-4.52,  $p < 0.05$ ), perceiving there to be an occupational risk  
20 of exposure to HBV (AOR 2.86, 95% CI 1.06-7.70,  $p < 0.001$ ), and increasing HBVc knowledge  
21 (AOR 2.68, 95% CI 1.83-3.92,  $p < 0.001$ ) were independent predictors of full-dose HBVc in  
22 FRSC members, Kaduna Sector Command.

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3  
4 23 **Conclusions:** HBVc coverage and knowledge are poor among FRSC members, Kaduna Sector  
5  
6 24 Command. Educational intervention, geared towards improving FRSC members' knowledge of  
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8 25 HBVc and perception of risk of occupational exposure to HBV, is recommended for these  
9  
10 26 vulnerable public safety workers. Such enlightenment could be a cheap and easy way of  
11  
12 27 improving HBVc coverage in the study population.

13  
14  
15 28 **Keywords:** infection control; hepatitis B virus; vaccination coverage; public safety workers  
16

## 17 18 29 **ARTICLE SUMMARY**

### 19 20 30 **Strengths and Limitations of this Study**

- 21  
22  
23 31 • This is the first study to estimate hepatitis B vaccination coverage of public safety  
24  
25 32 workers such as the Federal Road Safety Corps in Nigeria despite these workers being  
26  
27 33 occupationally exposed to hepatitis B virus.
- 28  
29 34 • The participating Unit Commands were randomly selected and the study had a high  
30  
31 35 response rate hence minimizing selection bias and improving the generalizability of the  
32  
33 36 research findings.
- 34  
35 37 • Retrospective studies are prone to recall bias; this was mitigated in this study by omitting  
36  
37 38 inconsistent data suggestive of guessing at the analysis stage.
- 38  
39 39 • Researcher bias was mitigated by the use of a pre-validated data collection instrument  
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41 40 and by pre-determining analytical strategies before data collection while confounding  
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43 41 was minimized through multivariate analysis.
- 44  
45 42 • Missing data made sample size in multivariate analysis less than the pre-research  
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47 43 estimate, though the proportion analyzed constituted a good representation of the entire  
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49 44 study population.
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## 46 INTRODUCTION

47 Hepatitis B virus (HBV) is a highly infectious blood-borne pathogen usually transmitted via  
48 percutaneous or mucosal exposure to infected blood and body fluids.[1] HBV infection affects  
49 about one third of the world's population with >350 million persons being chronic carriers.[2,3]  
50 Sub-Saharan Africa and Southeast Asia have the highest prevalence of about 10-20% for chronic  
51 HBV.[2] HBV infection has heterogeneous outcomes: acute viral hepatitis, spontaneous  
52 clearance, or chronicity with its common fatal sequelae of hepatic cirrhosis and hepatocellular  
53 carcinoma (HCC).[3,4] Most adult-onset infections resolve spontaneously with only 5-10%  
54 resulting in chronic carriage.[2] Chronicity is commonly associated with early childhood  
55 exposures with an estimated 90% of perinatal transmissions becoming chronic infections.[4]  
56 Perinatal and horizontal transmissions are the predominant routes of HBV infection in  
57 hyperendemic settings.[5]

58 Hepatitis B vaccination (HBVc) is the most effective way of controlling HBV infection.[6] HBV  
59 control in sub-Saharan Africa targets mother-to-child transmissions via HBVc of children 0-5  
60 years.[2,7] Though chronicity has been the major HBV outcome of public health interest, recent  
61 subtle transitions in the global mortality burden of HBV outcomes however demands  
62 readjustment of this focus. In a comparative systematic analysis of global disease burden,  
63 Lozano et al. demonstrated the trend in HBV-related outcomes between 1990 and 2010.[8]  
64 Though HBV-related HCC caused more deaths than acute HBV infection, the percentage  
65 increase in age-standardized death rates was about eleven times higher for acute HBV infection  
66 (29.2%) than for HBV-related HCC (2.6%) while death from HBV-related liver cirrhosis  
67 declined by 18.5%.[8] This growing mortality trend for acute HBV infection demands a renewed  
68 public health action in addressing this often neglected outcome of HBV. Prevention strategies for

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4 69 HBV should also target those at high risk of acute infections. Public safety workers (PSWs) such  
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6 70 as fire-fighters, correctional officers, rescue workers and emergency medical service providers  
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8 71 with regular exposure to blood or body fluids, have similar risks as hospital-based healthcare  
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10 72 workers (HCWs) of contracting HBV.[9] Besides, HCWs or PSWs, in the course of their duties,  
11  
12 73 can infect children who consequently become chronic carriers. Controlling HBV infection in  
13  
14 74 HCWs and PSWs is therefore of public health relevance. World Health Organization (WHO)  
15  
16 75 prescribes universal HBVc of HCWs and PSWs with frequent blood-skin exposure.[10] A  
17  
18 76 standard three-dose vaccine regimen, with the second and third doses given one month and six  
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20 77 months apart from the initial dose respectively, is very effective in conferring immunity against  
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22 78 HBV for  $\geq 20$  years.[1,11]

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28 79 Nigeria is hyperendemic for HBV; Schweitzer et al. reported a pooled HBV prevalence estimate  
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30 80 of 9.76% (95% confidence interval (CI) 9.59-9.93).[5] This hyperendemic status poses a great  
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32 81 risk of occupational exposure to HBV for HCWs and PSWs with regular blood-skin contact,  
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34 82 though this risk has not been estimated in any Nigerian study. The risk of transmission from  
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36 83 infected blood is said to be 100 times more for HBV than for HIV in non-immune  
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38 84 individuals.[11] HBVc became part of the Nigerian National Programme on Immunization for  
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40 85 children 0-5 years in 2004.[12] Sub-optimal immunization coverage is however still a huge  
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42 86 problem, especially in northern Nigeria.[12,13] To effectively control HBV in the Nigerian  
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44 87 setting would therefore require plurality of approaches. Prevention of new infections in at-risk  
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46 88 adults should complement prevention of perinatal transmissions. There is currently no universal  
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48 89 HBVc programme for high-risk adults in Nigeria. Such adults, however, can access HBVc  
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50 90 individually in primary healthcare centres at subsidized rates.  
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3 91 The Federal Road Safety Corps (FRSC) was established by the Federal Government of Nigeria  
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5 92 in 1988 due to the high rate of road traffic crashes (RTCs) in the country.[14] Road safety  
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8 93 functions of FRSC include rescue and emergency care of RTC victims and this brings them in  
9  
10 94 regular contact with blood.[14] All FRSC members participate in rescue operations, though this  
11  
12 95 is more frequent for the Marshal cadre. Crashed vehicles with broken glasses increase the risk of  
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14 96 sharps injuries for these PSWs. This exposes them and the accident victims they rescue to a high  
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16 97 risk of HBV infection in this hyperendemic setting. No study exists on HBVc coverage of PSWs  
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18 98 in Nigeria. The objectives of this study were to estimate HBVc coverage, and knowledge and  
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20 99 socio-demographic determinants of full-dose uptake in FRSC members, Kaduna State, Nigeria,  
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22 100 in order to inform relevant targeted vaccination policies.  
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## 28 101 **METHODS**

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31 102 **Study Design:** A quantitative cross-sectional survey of FRSC members, Kaduna Sector  
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33 103 Command (KSC), Nigeria.  
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36 104 **Setting and Target Population:** Kaduna State is the third most populous State in Nigeria and  
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38 105 has 3 senatorial zones with 23 local government areas (LGAs).  
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42 106 The FRSC is divided into 12 Zonal Commands; each Zonal Command has Sector Commands  
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44 107 which are sub-divided into Unit Commands (UCs).[15] There are currently 204 UCs in  
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46 108 Nigeria.[15] The first 11 UCs are located in the KSC with the KSC headquarters making them  
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48 109 12; these cover the entire 23 LGAs in Kaduna State (Table 1).  
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113 **Table 1: Location, Coverage and Staff Distribution of Unit Commands (UCs) of FRSC, Kaduna**  
 114 **Sector Command, Nigeria, June-July, 2015.**

Commands	Designation	Staff Strength			Number of LGAs Covered	Location (LGA)
		Cadre				
		Officer	Marshal	Total		
Kaduna Sector Command (KSC) Headquarters	*RS1.1	46	118	164	2	Kaduna North
Kafanchan UC	RS1.11	15	44	59	4	Jama'a
Birnin Gwari UC	RS1.12	17	35	52	1	Birnin Gwari
Zaria UC	RS1.13	24	66	90	5	Sabon Gari
Saminaka UC	RS1.14	10	36	46	1	Lere
Sabon Tasha UC	RS1.15	16	52	68	1	Chikun
Kakau UC	RS1.16	18	66	84	2	Chikun
Birnin Yero UC	RS1.17	15	44	59	1	Igabi
Gwantu UC	RS1.18	8	31	39	2	Sanga
Katari UC	RS1.19	19	37	56	1	Kachia
Kachia UC	RS1.110	10	26	36	2	Kachia
Tashan Yari UC	RS1.111	10	26	36	1	Makarfi
	<b>Total</b>	<b>208</b>	<b>580</b>	<b>789</b>	<b>23</b>	

\*RS: Road Safety

116 KSC is one of the four Sector Commands that make up the RS1 Zonal Command whose  
 117 headquarters is in Kaduna. Two major cadres exist in FRSC: Officer and Marshal, though the  
 118 latter is sub-divided into Marshal Inspectorate and Road Marshal Assistant. At the time of this  
 119 study, there were 789 FRSC members in KSC, 26% of which were officers and 74% Marshals.  
 120 The study was conducted in six randomly selected UCs: KSC headquarters, Saminaka, Kakau,  
 121 Gwantu, Katari, and Kachia.

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3 122 **Inclusion and Exclusion Criteria:** Only FRSC members in KSC aged  $\geq 18$  years with  $\geq 6$   
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5 123 months of service were included in the study. This ensured that only adults long enough in  
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7 124 service to be made aware of the risk of HBV were surveyed. FRSC members in RS1 Zonal  
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9 125 Command headquarters were excluded from the study as the Zonal Command includes other  
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11 126 States beyond the study scope.

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15  
16 127 **Sample Size:** This was estimated using the formula for cross-sectional surveys:  $n = 1.96^2 \times p(1-$   
17  
18 128  $p)/d^2$ , where  $n$  is the required sample size,  $p$  is prevalence estimate of HBVc in previous studies,  
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20 129 and  $d$  is precision or acceptable error margin (5%).[16] Ogoina et al.'s prevalence estimate of  
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22 130 36.2% in a survey of 290 HCWs in Nigeria[17] was used as proxy since there is no existing  
23  
24 131 study on PSWs in Nigeria. Anticipating a lower prevalence rate among non-HCWs with  
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26 132 expectedly lower level of awareness of HBVc, 30% prevalence was assumed. ( $N = 1.96^2 \times 0.3(1-$   
27  
28 133  $0.3)/0.5^2 = 323$ ). Using 24% as anticipated non-response rate ( $q$ ),[17] a final sample size of 425  
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30 134 was estimated using the formula:  $N_f = N_s/1-q$ , where  $N_f$  is the final sample size and  $N_s$  the initial  
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32 135 sample size.[18]

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38 136 **Sampling:** The sampling frame was a list of the 12 UCs from the KSC headquarters. Each UC  
39  
40 137 was considered a cluster. Clusters were randomly selected using a computer-generated set of  
41  
42 138 random numbers until sample size was achieved. This simple random selection of clusters was to  
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44 139 ensure representativeness of selected UCs.[19] Six UCs were selected for the study. All FRSC  
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46 140 members in the selected UCs were targeted for questionnaire distribution.

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51 141 **Data Collection:** UCs of FRSC have compulsory weekly meetings. Permission was obtained for  
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53 142 data collection at these meetings. The UCs were informed of the research prior to visits. Data  
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55 143 were collected between 17<sup>th</sup> June and 22<sup>nd</sup> July, 2015. Participant information sheet (PIS) was  
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3 144 reviewed with the staff with emphasis on voluntary participation, anonymity and confidentiality  
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5 145 of collected data. Inclusion criteria and implied consent were further explained; completion of  
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8 146 questionnaire was considered consent to participate. Participants were asked to seal completed  
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11 147 questionnaires in the given envelopes and drop them in a common collection box provided by the  
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13 148 researcher. This was to ensure anonymity. Those unwilling to participate were asked to drop the  
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15 149 sealed uncompleted questionnaires in the box alongside participants. Non-respondents were  
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18 150 therefore not identified during data collection. Two UCs (KSC Headquarters & Kakau) were re-  
19  
20 151 visited in subsequent meetings due to poor initial attendance. Routine attendance lists taken by  
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22 152 the UCs at the initial meetings were used to prevent re-participation of previous participants.

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25 153 **Instruments:** Due to paucity of studies on the research topic, accessing a pre-validated  
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28 154 questionnaire for the study was difficult. After an extensive literature search, only Al-Hussami's  
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30 155 "Hepatitis B Vaccine Knowledge and Acceptance" questionnaire could be found.[20] This  
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33 156 questionnaire has been used for HCWs in United States. It was validated in two pilot studies with  
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35 157 testing for inter-reliability but the test statistic was not reported.[20] There were 44 multiple  
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37 158 choice questions including some open-ended ones. A structured anonymous self-administered  
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40 159 questionnaire was adapted from this questionnaire for the present study (appendix A). Only  
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42 160 questions relevant to the research questions were selected. Questions were simplified to suit the  
43  
44 161 literacy status of the study population. The adapted study questionnaire contained 17 questions  
45  
46 162 that elicited information on demographics (sex, age, duration of service, cadre and rank), HBV  
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48 163 knowledge and perception of risk of exposure, and HBVc knowledge and status. Though rank  
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51 164 was obtained, this was not included in analysis since it mirrors cadre. The questionnaire was  
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54 165 pilot-tested on FRSC members in RS1 Zonal Command headquarters.

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57 166 **Statistical Analysis:** Table 2 describes the variables in the study.  
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Table 2: Description of Variables in the Study, FRSC, KSC, Nigeria, June-July, 2015.

Variable	Description	Type of Data
Independent Variables		
Sex	This was the gender of study participants categorized as either male or female	Nominal
Age	This variable ascertained the age of participants on their last birthday. It was categorized to enhance anonymity from 18 years which is the age definition of commencement of adulthood to $\geq 50$ years which marks the age before retirement from Nigerian Civil Service at 60 years. The categories included: 18-29 years; 30-39 years; 40-49 years; $\geq 50$ years	Ordinal
Duration of Service	This variable elicited how long a respondent had been in service with the Federal Road Safety Corps. It was categorized into: 6 months-2 years (probation period in civil service); 3- 10 years; 11 years to 19 years; and $\geq 20$ years (close to retirement by service year at 35 years).	Ordinal
Cadre	This ascertained the official class of participant based on position and seniority in office. There were two major categories: Officers and Marshals with the latter sub-categorized into Marshal Inspectorate and Field Marshal Assistant in a descending order. It also signified educational qualification order with the least educated being the Field Marshal Assistant.	Nominal/Ordinal
Risk Perception	This ascertained the level of perception of occupational risk of exposure to HBV by respondents. It was initially categorized into: No risk of exposure, low risk of exposure, moderate risk of exposure, high risk of exposure, and I don't know. This was later dichotomized for further analysis by merging the 'I don't know' group with the 'no risk' group to form a 'no risk perceived' category	Nominal/Ordinal

Table 2: Description of Variables in the Study, FRSC, KSC, Nigeria, June-July, 2015.

Variable	Description	Type of Data
	with the rest forming the 'risk perceived' category.	
Hepatitis B Virus (HBV) Knowledge Score	This variable sought to estimate the level of knowledge of basic information on HBV. It includes questions on HBV awareness, seriousness compared to HIV, and route of transmission. For each participant, the number of questions answered correctly was noted as the score (see scoring table in appendix B).	Continuous
Hepatitis B Vaccination (HBVc) Knowledge Score	This measured the level of basic knowledge of HBVc among participants. It comprised questions on HBVc awareness, effectiveness, recommended full dosage and duration of protection from full-dose vaccination. For each participant, the number of questions answered correctly was noted as the score (appendix B).	Continuous
Dependent Variable		
HBVc Status	Information was elicited on whether participant had ever received HBVc and the number of doses received. Descriptive analysis was done using these data. Dichotomization of data was also done for logistic regression analysis. Since only those with $\geq 3$ doses of HBVc uptake are considered fully protected,[11] those with $\geq 3$ doses were labeled 'vaccinated' and the rest 'not vaccinated'. This was noted as the HBVc status of each participant.	Nominal

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168 All analyses were conducted using SPSS version 21. Descriptive analysis ascertained frequencies  
 169 and distributions of data. Histograms showed both HBV knowledge and HBVc knowledge  
 170 scores to be normally distributed, hence their mean and standard deviations (SD) were calculated

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3 171 as was the percentage of participants scoring above the mean scores. Since the outcome variable  
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5 172 (HBVc status) was binary, logistic regression analysis was used in testing for associations with  
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8 173 the independent variables (table 2).[21] To mitigate confounding, univariate analyses were first  
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10 174 carried out and the variables identified as significantly associated ( $p < 0.05$ ) with HBVc status  
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12 175 were included in the multivariate analysis for independent predictors of full-dose HBVc.[21]  
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14  
15 176 Adjusted odds ratios (AOR) with 95% CI for each variable was computed and significance level  
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17 177 set at  $p < 0.05$ . Missing data on each variable were excluded in the analysis of the variable.  
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## 20 21 178 **RESULTS**

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24 179 There were 354 questionnaires distributed in the six UCs sampled from FRSC, KSC. Six  
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26 180 questionnaires were discarded for having missing data on up to 3 of the independent variables or  
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28 181 on the dependent variable and  $\geq 2$  independent variables. Seven questionnaires were submitted  
29  
30 182 blank. In all, 341 completed questionnaires were included for analysis, giving a response rate of  
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32 183 96.3%. Appendix C shows percentage of missing data for each of the 14 questions analyzed.  
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35 184 Missing data were most frequent on the question on recommended dose of vaccine (9.7%;  
36  
37 185 33/341) followed by that on the duration of protection from full-dose HBVc (8.5%; 29/341). All  
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39 186 participants provided data on cadre. Most respondents were males; aged 30-39 years; had worked  
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41 187 between 3-10 years with FRSC; and were of Marshal Cadre (table 3).  
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Table 3: Socio-Demographic Characteristics of Study Sample of FRSC Members, KSC, Nigeria, June-July, 2015.

Variable	Frequency	Percentage
Sex (n=327)		
Male	260	79.5
Female	67	20.5
Age (n=338)		
18-29 years	64	18.9
30-39 years	167	49.4
40-49 years	87	25.7
≥50 years	20	5.9
Duration of Service (n=339)		
6 months-2 years	36	10.6
3-10 years	188	55.5
11-19 years	87	25.7
≥20 years	28	8.3
Cadre (n=341)		
Officer	96	28.2
Marshal	245	71.8
-Marshal Inspectorate	111	32.6
- Field Marshal Assistant	134	39.3

192

193 **HBV Knowledge:** The mean total number of correct answers to HBV knowledge questions was  
 194 3.0 out of 6.0 (SD 1.5). Only 46% (157/341) of participants scored above the mean. The  
 195 proportion of correct answers to HBV knowledge questions ranged from 2.1% (7/337) on route  
 196 of transmission of HBV to 93.2% (317/340) on having ever heard of HBV. Approximately  
 197 22.6% (76/337) of respondents answered 'I don't know' to the question pertaining to the route of  
 198 transmission of HBV and this response was the most frequent. Merely 2.1% (7/337) correctly  
 199 identified contact with infected blood and blood-contaminated body fluid as routes of  
 200 transmission of HBV. Only 4 participants (1.2%; n=341) answered all 6 HBV knowledge



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3 201 questions correctly while 16 (4.7%, n=341) answered none correctly. HBV infection was  
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5 202 perceived as more serious than HIV by most respondents (56.7%; 190/335) while about 3.0%  
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7  
8 203 (10/335) felt it was less serious than HIV. While 20.6% (69/335) claimed no knowledge of the  
9  
10 204 seriousness of HBV compared to HIV, 19.7% (66/335) ascribed equal severity to the two.

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12  
13 205 **HBVc Knowledge:** The mean number of correct answers to HBVc questions was 2.0 out of 4.0  
14  
15 206 (SD 1.1). Approximately 42.2% (144/341) of participants had scores higher than the mean score.  
16  
17 207 All four questions on HBVc were answered correctly by only 4.1% (14/341) of participants  
18  
19 208 while no correct answer was given by 11.7% (40/341). Rate of correctness ranged from 6.1%  
20  
21 209 (19/312) on question on duration of protection from full-dose HBVc to 86.6% (291/336) on  
22  
23 210 having ever heard of HBVc. Most respondents (62.9%; 210/334) described HBVc as very  
24  
25 211 effective. While 6.9% (23/334) rated it slightly effective, 2.7% (9/334) felt it was not effective at  
26  
27 212 all and 27.5% (92/334) indicated not knowing its effectiveness. Roughly 54.9% (169/308) of  
28  
29 213 respondents correctly identified recommended full HBVc dose as  $\geq 3$  doses while 1.6% (5/308)  
30  
31 214 and 3.9% (12/308) thought it was 1 dose and 2 doses respectively. Up to 39.6% (122/308)  
32  
33 215 indicated not knowing the recommended full dose of HBVc.

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40 216 **Perception of Risk of Occupational Exposure to HBV:** While most respondents (55.3%;  
41  
42 217 188/340) rated themselves at high risk of occupational exposure to HBV, 22.4% (76/340) did not  
43  
44 218 know their risk status. Whereas 5.3% (18/340) of respondents considered themselves at no risk  
45  
46 219 of exposure to HBV, 5.9% (20/340) and 11.2% (38/340) rated themselves at low and moderate  
47  
48 220 risks of exposure respectively. After dichotomizing this variable into 'no risk perceived' and  
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50 221 'risk perceived' categories, 72.4% (246/340) had some level of risk perception while 27.6%  
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52 222 (94/340) had no risk perception for HBV.  
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3 223 **HBVc Coverage:** Of the 341 participants, 6 did not provide data on their HBVc status. Ten  
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6 224 others answered 'yes' to having ever received HBVc but omitted the number of doses received  
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8 225 and were therefore inputted as missing data. Only 325 respondents (95.3%) were included in the  
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10 226 sub-analysis. Roughly 60.9% (198/325) of the respondents affirmed having ever received  $\geq 1$   
11  
12 227 dose of HBVc and 50.0% of these (99/198) had received  $\geq 3$  doses resulting in full-dose coverage  
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14  
15 228 of 30.5% (99/325) among the respondents. Approximately 39.1% (127/325) of respondents had  
16  
17 229 never received HBVc. Together with the 99 participants with  $< 3$  doses, 69.5% (226/325) were  
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19 230 classified 'not vaccinated' while 30.5% (99/325) were labeled 'vaccinated'.  
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23 231 **Logistic Regression Analyses:** All the variables were significantly associated with HBVc on  
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25 232 univariate analyses (table 4) and were included in the multivariate analysis for independent  
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27 233 predictors of full-dose HBVc uptake (table 5). Being female was associated with about twice the  
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29 234 likelihood of having received full-dose HBVc (table 5). When risk perception was analyzed as a  
30  
31 235 dichotomous variable ('no risk perceived' versus 'risk perceived'), those with any level of risk  
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33 236 perception for occupational exposure to HBV were about 3 times more likely to have received  
34  
35 237 full-dose HBVc than those without risk perception for HBV (table 5). Though the odds of being  
36  
37 238 fully vaccinated increased with duration of service, this was not statistically significant. While  
38  
39 239 HBV knowledge was not a significant predictor of full-dose HBVc, knowledge of HBVc was  
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41 240 significantly associated with full-dose HBVc with each unit increase in number of correct  
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43 241 answers being associated with up to three times increased likelihood of being fully vaccinated  
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45 242 (table 5).  
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**Table 4: Univariate Binary Logistic Regression Analyses Showing Unadjusted Odds Ratios of the Association between Independent Variables and Full-Dose Hepatitis B Vaccination Uptake among FRSC Members, KSC, Nigeria, June-July, 2015**

Independent Variable	Sample Size	Odds Ratio	95% CI (p-value)
Sex	313		
Male		1	
Female		2.66	1.51-4.70 (0.001)
Age	323		
18-29 years		1	
30-39 years		2.08	0.97-4.44 (0.059)
40-49 years		3.30	1.47-7.40 (0.004)
≥50 years		5.67	1.84-17.50 (0.003)
Duration of service	323		
6 months-2 years		1	
3-10 years		5.69	1.31-24.72 (0.020)
11-19 years		9.48	2.12-42.35 (0.003)
≥20 years		13.39	2.61-68.56 (0.002)
Cadre	325		
Officer		1	
Marshal Inspectorate		1.69	0.92-3.09 (0.091)
Road Marshal Assistant		2.10	1.18-3.74 (0.012)
Risk Perception for Occupational Exposure to HBV	324		
I don't know		1	
No risk		3.92	0.78-19.63 (0.096)
Low risk		11.33	2.94-43.63 (<0.001)
Moderate risk		9.61	2.85-32.43 (<0.001)
High risk		11.07	3.87-31.70 (<0.001)
Risk perception for Occupational Exposure to HBV	324		
No risk perceived		1	
Risk perceived		7.39	3.27-16.71 (<0.001)
HBV Knowledge Score	325	1.37	1.15-1.62 (<0.001)
HBVc Knowledge Score	325	2.97	2.16-4.08 (<0.001)

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**Table 5: Multivariate Binary Logistic Regression Analysis for Independent Predictors of Full-Dose Hepatitis B Vaccination Uptake among Members of FRSC, KSC, Nigeria, June-July, 2015.**

Independent Variable	Adjusted Odds Ratio n=309	95% CI (p-value)
Sex		
Male	1	
Female	2.28	1.15-4.52 (0.019)
Age		
18-29 years	1	
30-39 years	1.40	0.47-4.18 (0.542)
40-49 years	0.99	0.28-3.55 (0.987)
≥50 years	1.08	0.20-5.76 (0.931)
Duration of service		
6 months-2 years	1	
3-10 years	2.12	0.39-11.41 (0.384)
11-19 years	2.73	0.45-16.59 (0.276)
≥20 years	5.25	0.68-40.47 (0.112)
Cadre		
Officer	1	
Marshal Inspectorate	1.60	0.77-3.33 (0.208)
Road Marshal Assistant	0.87	0.41-1.85 (0.720)
Risk Perception for Occupational Exposure to HBV		
I don't know	1	
No risk	2.93	0.47-18.41 (0.251)
Low risk	7.12	1.47-34.47 (0.015)
Moderate risk	4.50	1.03-19.63 (0.045)
High risk	3.90	1.08-14.09 (0.038)
Risk perception for Occupational Exposure to HBV		
No risk perceived	1	
Risk perceived	2.86	1.06-7.70 (<0.001)
HBV Knowledge Score	1.03	0.80-1.31 (0.843)
HBVc Knowledge Score	2.68	1.83-3.92 (<0.001)

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3 251 In summary, full-dose HBVc was 30.5% while  $\geq 1$  dose coverage was 60.9%. Female sex,  
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5 252 perceiving their occupation as conveying a risk of HBV, and increasing HBVc knowledge were  
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8 253 significant independent predictors of full-dose HBVc uptake among members of FRSC in  
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10 254 Kaduna State, Nigeria.  
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## 13 255 **DISCUSSION**

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17 256 Like all other studies on HCWs in Nigeria,[22-25] this study has further demonstrated high  
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19 257 HBVc initiation rate (60.9%) with low completion rate (30.5%). This completion rate implies  
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21 258 that only 30.5% of members of the FRSC, KSC were adequately protected against HBV  
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23 259 infection.[11] This means that almost 70% of these rescue workers perform their duties without  
24  
25 260 adequate protection from HBV. This also places the accident victims whom they seek to rescue  
26  
27 261 (children inclusive) at risk of infection with HBV from infected FRSC members. This could lead  
28  
29 262 to an unbroken cycle of infectivity, morbidity and mortality from HBV in a nation still struggling  
30  
31 263 with the HBV scourge. Poor uptake of HBVc among those at occupational risk of exposure to  
32  
33 264 HBV in Nigeria is a common observation across studies.[22-28] Adoption of a universal HBVc  
34  
35 265 policy in the country for HCWs and vulnerable PSWs could improve vaccine uptake. FRSC  
36  
37 266 members are exposed to blood and sharps injuries from accident scenes. In a nation with high  
38  
39 267 prevalence of chronic HBV,[5] HBVc coverage of 30.5% for FRSC members, KSC is low. A  
40  
41 268 sero-prevalence study to investigate the actual prevalence of HBV in these PSWs for appropriate  
42  
43 269 intervention is therefore recommended.  
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51 270 Among FRSC members, females are 2.28 times more likely to be fully vaccinated against HBV  
52  
53 271 compared to their male counterparts. Osazuwa-Peters et al. observed a similar but insignificant  
54  
55 272 female preponderance in HBVc among dental professionals in Edo State, Nigeria.[29]  
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3 273 Contrarily, Adekanle et al., in their survey of HCWs in Ile-Ife, Nigeria, observed 1.8 times  
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5 274 increased chances of males receiving HBVc compared to females,[27] although this finding may  
6  
7  
8 275 be due to males in the study being mainly doctors who had the advantage of professional  
9  
10 276 knowledge of HBVc. In this present study, females could probably be exposed to HBVc  
11  
12 277 knowledge during antenatal hospital visits and while taking their children for immunization.

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16 278 More than 50% of respondents perceived themselves at high risk of occupational exposure to  
17  
18 279 HBV. Disturbingly though, close to a quarter of participants claimed ignorance of their risk  
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20 280 status. Together with those who perceived themselves to be at no risk, 27.6% of FRSC members  
21  
22 281 had no risk perception for occupational exposure to HBV while 72.4% perceived themselves at  
23  
24 282 risk. This falls within the range of 30% to 78% risk perception observed in studies among HCWs  
25  
26 283 in Nigeria.[22,28] Despite high risk perception rate, having approximately 28% with no risk  
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28 284 perception for HBV is quite disconcerting from a public health perspective considering the  
29  
30 285 blood-skin exposure that rescue of accident victims could entail. Those who perceived  
31  
32 286 themselves at risk of occupational exposure to HBV were three times more likely to be  
33  
34 287 vaccinated than those without risk perception. All risk categories had higher odds of vaccination  
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36 288 compared to those without risk perception. It is therefore important that FRSC members  
37  
38 289 understand the risk of exposure to HBV (even if they feel it is low) as this appears to increase  
39  
40 290 their likelihood of getting vaccinated.  
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47 291 Knowledge of HBV and HBVc among study participants was poor. Less than 47% of  
48  
49 292 participants scored above the mean knowledge scores for HBV and HBVc. Knowledge was  
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51 293 poorest for the route of transmission of HBV and duration of protection from full-dose HBVc.  
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53 294 Not knowing the route of transmission of HBV means that FRSC members might take  
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55 295 inadequate precautions against HBV during rescue operations. It could also lead to  
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3 296 stigmatization of FRSC members already infected with HBV due to wrong assumption of  
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6 297 infectivity through casual contact with sweat and saliva. HBV knowledge score was however not  
7  
8 298 an independent predictor of HBVc in the study. This conflicts with Adekanle et al.'s observation  
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10 299 of twice increased likelihood of complete HBVc among those with good knowledge of HBV in  
11  
12 300 their survey of HCWs in Ile Ife, Nigeria.[27] Their study though did not elicit information on  
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14 301 HBVc knowledge, a potential confounder in the demonstrated association.

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18 302 Despite 62.9% of respondents describing HBVc as very effective, only 6.1% knew that full-dose  
19  
20 303 HBVc gives protection for  $\geq 20$  years. Knowing that receiving  $\geq 3$  doses of the vaccine can  
21  
22 304 provide lifetime protection from HBV could incentivize full-dose uptake. HBVc knowledge was  
23  
24 305 the most significant and precise independent predictor of full-dose HBVc in this study. This  
25  
26 306 contradicts Ogoina et al.'s finding of no significant association between HBVc knowledge and  
27  
28 307 full-dose vaccination among HCWs in two tertiary hospitals in Nigeria.[17] However, they did  
29  
30 308 not ascertain knowledge of vaccine effectiveness and duration of protection from full-dose  
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32 309 vaccination.

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38 310 Age, cadre and duration of service were not significantly associated with HBVc in this study.  
39  
40 311 Izegbu et al. observed more likelihood of HBVc with decreasing age,[30] while Sofola et al.  
41  
42 312 associated increasing cadre with HBVc.[31] In another instance, longer duration of service was  
43  
44 313 demonstrated to be associated with HBVc.[32] All these studies were among health professionals  
45  
46 314 who expectedly have professional exposure to HBV and HBVc knowledge unlike the present  
47  
48 315 study population.

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53 316 Educational programme towards improvement of HBV and HBVc knowledge, and risk  
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55 317 perception among FRSC members is a recognized relevant public health intervention from this  
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3 318 study. The programme can be included in the schedules of the already existing compulsory  
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6 319 weekly in-house training/manpower development of staff and in the routine basic training  
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8 320 programme for new staff. Such enlightenment would be a cheap and easy intervention to  
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10 321 improve HBVc uptake. Existing evidence on the positive impact of educational intervention on  
11  
12 322 vaccine uptake is however weak.[33] The educational intervention should therefore be rigorously  
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15 323 evaluated to ascertain its impact on HBVc uptake in FRSC members.  
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18 324 **Study Strengths and Limitations:**  
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20  
21 325 This was a descriptive cross-sectional survey which limits its suitability for demonstrating  
22  
23 326 temporal relationships between explanatory and outcome variables.[34] It nevertheless shows  
24  
25 327 independent associations useful in understanding predictors of full-dose HBVc in this study  
26  
27 328 population so as to inform relevant public health interventions. Recall bias is another limitation  
28  
29 329 of this retrospective study design as participants may not have remembered accurately their  
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31 330 vaccination history thereby introducing information bias.[35] This was mitigated at the analysis  
32  
33 331 stage by omitting inconsistent data suggestive of guessing. Simple random sampling using the  
34  
35 332 staff register would have yielded a more representative sample;[21] disproportionate distribution  
36  
37 333 of such socio-demographic variables as sex and cadre in the study population made this  
38  
39 334 unfeasible. The response rate of 96.3% was however impressive and minimizes selection bias  
40  
41 335 thereby enhancing the generalizability of research findings by improving the external and  
42  
43 336 internal validity of the study.[36] The presence of Unit Commanders and other senior members  
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45 337 of staff at the meetings during data collection and their participation in the research could have  
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47 338 contributed to the high response rate. Subordinates who ordinarily may have declined  
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49 339 participation could have felt a psychological obligation to participate with their bosses. This  
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51 340 power influence was minimized by the use of PIS which emphasized voluntary participation, and  
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3 341 by anonymous data collection procedures. While anonymity and self-administration of  
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6 342 questionnaire could lessen social desirability bias, the use of social desirability scale would have  
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8 343 been more appropriate in demonstrating this bias for appropriate statistical control.[37]  
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10 344 Researcher bias was minimized by the use of a pre-validated questionnaire and by pre-  
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12 345 determining analytical strategies before data collection.[21] Possible exchange of information  
13  
14 346 among participants could have introduced information bias. This was mitigated by the presence  
15  
16 347 of the researcher during data collection with prior emphasis on non-communication between  
17  
18 348 participants. Some participants who claim ignorance of HBV might have a different designation  
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20 349 for the disease in the local language. This could bias the findings on HBV knowledge. Though  
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22 350 the study's questionnaire was adapted and pilot-tested to reflect the study context, it was not  
23  
24 351 tested for inter-rater reliability and validity within the study population. Missing data reduced  
25  
26 352 the sample size for the multivariate analysis from 341 to 309. This was less than the pre-study  
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28 353 estimate (323) and could lack sufficient power to detect significant associations, hence  
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30 354 predisposing to type II error.[21] It however constitutes a randomized 39% (309/789) of the  
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32 355 study population, which is a good representation.[38] Confounding, a known menace in  
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34 356 observational studies, was minimized at the analytical stage through multivariate logistic  
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36 357 regression.[21] The research estimates on the association of varied levels of risk perception with  
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38 358 full-dose HBVc had very wide 95% CIs. This could be due to random errors in the sample.[36]  
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40 359 A larger sample size in future studies could yield more precise estimates.  
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## 49 **CONCLUSION**

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52 361 Controlling HBV transmission is an important public health issue internationally and in Nigeria  
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54 362 where the virus is hyperendemic. HBV infection is a preventable disease and prevention is best  
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56 363 achieved with HBVc.[6] FRSC members come in regular contact with blood and are at risk of  
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3 364 contracting HBV. HBVc coverage among FRSC members in Kaduna State, Nigeria is low  
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6 365 (30.5%). Knowledge of HBV and HBVc is poor in this study population. Female sex, perceiving  
7  
8 366 there to be an occupational risk of exposure to HBV, and increasing HBVc knowledge are  
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10  
11 367 independent predictors of HBVc uptake among FRSC members, KSC. Educational intervention  
12  
13 368 aimed at improving awareness of the occupational risk of HBV and the importance of HBVc, is  
14  
15 369 required to improve HBVc coverage among this vulnerable group of PSWs. Recommended  
16  
17 370 future studies include: a qualitative study to ascertain FRSC members' perception of HBVc and  
18  
19 371 subjective reasons for non-uptake of the vaccine; a sero-prevalence study to determine the actual  
20  
21 372 immune status of FRSC members in KSC and estimate the prevalence of HBV in this study  
22  
23 373 group for appropriate intervention; and validation of questionnaire in the Nigerian context with  
24  
25 374 pretesting and retesting for reliability.  
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29

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37  
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## APPENDIX A: ADAPTED STUDY QUESTIONNAIRE

## HEPATITIS B VACCINATION QUESTIONNAIRE

## For Official Use Only

Researcher.....

Questionnaire no: 

Date of Data Collection (DD/MM/YY).....

**IMPLIED CONSENT (Please read before completing questionnaire):** Having gone through the research information contained in the participant information sheet, by completing this questionnaire you are consenting to participate in the study. If you do not wish to complete the questionnaire, please put the blank version into the envelope and I will collect it with all other questionnaires.

Thank you.

**Please only complete the questionnaire if you are aged 18 years and above and have at least 6 months of service with FRSC**

**Note:** This questionnaire is anonymous; please do not write your name on it. Kindly give an answer to all the questions as it pertains to you and please answer as truthfully as you can.

Please check (✓) only the box that most correctly answers the question, making sure you make only one selection for each question except where otherwise indicated.

**Section A: Demographic Questions**

1. What is your sex?

Male

Female



2. What was your age on your last birthday?

- 18 to 29 years
- 30 to 39 years
- 40 to 49 years
- 50 years and above

### Section B: Employment History

3. How long have you worked with Federal Road Safety Corps (FRSC)?

- 6 months to 2 years
- 3 years to 10 years
- 11 years to 19 years
- 20 years and above

4. What is your cadre?

- Officer
- Marshal Inspectorate
- Road Marshal Assistant

5. Please check (✓) the box below your rank

ACM	CC	DCC	ACC	CRC	SRC	RC	DRC	ARC

CI	DCI	ACI	PMI	SMI	MI-I	MI-II	MI-III	CRMA	DCRMA	SRMA	RMAI	RMAII	RMAIII

### Section C: Perception of Risk of Exposure to Hepatitis B Virus

6. Have you ever heard about hepatitis B virus infection?

Yes

No

7. How serious do you think being infected with hepatitis B virus is compared to HIV?

Less serious than HIV

As serious as HIV

More serious than HIV

I don't know

8. How can someone be infected with hepatitis B virus? (please check (✓) all the correct boxes if your answer is more than one)

Through contact with blood of an infected person

Through contact with saliva of an infected person

Through contact with sweat of an infected person

Through contact with body fluid contaminated by blood of an infected person

I don't know

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2  
3  
4 9. How much do you think your work with FRSC exposes you to the risk of  
5 contracting hepatitis B virus infection?  
6

- 7  No risk of exposure  
8  
9  Low risk of exposure  
10  
11  Moderate risk of exposure  
12  
13  High risk of exposure  
14  
15  I don't know  
16  
17  
18  
19

20 **Section D: Hepatitis B vaccination Knowledge and Status**  
21

22  
23 10. Have you ever heard about hepatitis B vaccination?  
24

- 25  Yes  
26  
27  No  
28  
29

30 11. How effective do you think hepatitis B vaccination is in protecting someone  
31 against hepatitis B virus infection?  
32  
33

- 34  Not effective  
35  
36  Slightly effective  
37  
38  Very effective  
39  
40  I don't know  
41  
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43  
44

45 12. Have you ever received hepatitis B vaccination?  
46

- 47  Yes  
48  
49  No  
50  
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52 **If your answer to question 12 is 'No', answer question 13; if it is 'Yes', go to**  
53 **question 14**  
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13. Why have you not received hepatitis B vaccination? (Please check (✓) all the correct boxes if your answer is more than one)

- I am not aware of hepatitis B vaccination
- I do not know where to go and receive it
- I don't have time
- It is expensive
- I don't see the need
- I am afraid of contracting the virus from the vaccine
- Others (please state).....

14. If your answer to question 12 is 'Yes', how many doses of hepatitis B vaccine have you received?

- 1 dose
- 2 doses
- 3 doses
- More than 3 doses

15. When did you receive the last dose of hepatitis B vaccine?

- Less than 1 month ago
- 1 month to 3 months ago
- 4 months to 6 months ago
- More than 6 months ago

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16. What do you think is the recommended full dose of hepatitis B vaccine?

- 1 dose
- 2 doses
- 3 or more doses
- I don't know

17. How long does a full dose of hepatitis B vaccine protect someone?

- Less than 1 year
- 1 year to 5 years
- 6 years to 10 years
- 11 years to 19 years
- 20 years or more
- I don't know

**Thank you for your time!**

## APPENDIX B: Knowledge Scoring Table

Scoring Table: HBV (A) and HBVc (B) Knowledge Questions and Scoring Pattern

A. Question	Options checked	Score
Have you heard about hepatitis B virus infection? <b>(one option)</b>	Yes (✓)	1
	No (✓)	0
How serious do you think being infected with hepatitis B virus is compared to HIV? <b>(one option)</b>	Less serious than HIV (✓)	0
	As serious as HIV (✓)	0
	More serious than HIV (✓)	1
	I don't know (✓)	0
How can someone be infected with hepatitis B virus? (please check (✓) all the correct boxes if your answer is more than one)	Through contact with blood of an infected person (✓)	1
	Through contact with saliva of an infected person <b>(blank)*</b>	1
	Through contact with sweat of an infected person <b>(blank)*</b>	1
	Through contact with body fluid contaminated by blood of an infected person (✓)	1
	I don't know (✓)	0 for all options
Maximum HBV knowledge Score		6 of 6
Minimum HBV knowledge Score		0 of 6
B. Question	Options	Score
Have you ever heard about hepatitis B vaccination? <b>(one option)</b>	Yes (✓)	1
	No (✓)	0
How effective do you think hepatitis B vaccination is in protecting someone against hepatitis B virus infection? <b>(one option)</b>	Not effective (✓)	0
	Slightly effective (✓)	0
	Very effective (✓)	1
	I don't know (✓)	0
What do you think is the recommended full dose of hepatitis B vaccine? <b>(one option)</b>	1 dose (✓)	0
	2 doses (✓)	0
	3 or more doses (✓)	1
	I don't know (✓)	0
How long does a full dose of hepatitis B vaccine protect	Less than 1 year (✓)	0

A. Question	Options checked	Score
someone? (one option)	1 year to 5 years (✓)	0
	6 years to 10 years (✓)	0
	11 years to 19 years (✓)	0
	20 years or more (✓)	1
	I don't know (✓)	0
Maximum HBVc knowledge score		4 of 4
Minimum HBVc knowledge score		0 of 4

\* HBV can be found in saliva but the concentration is very low compared to blood; direct injection through bites is required to transmit the virus via this medium.<sup>1,2</sup> Transmission has not been observed through sweat.<sup>1</sup>

### References:

1. Canadian Center for Occupational Health and Safety (CCOHS). Hepatitis B. *OSH Facts Sheet* 2014. [http://www.ccohs.ca/oshanswers/diseases/hepatitis\\_b.html](http://www.ccohs.ca/oshanswers/diseases/hepatitis_b.html) (Accessed: 27th July 2015).
2. Centers for Disease Control and Prevention (CDC). When Someone Close to You has Viral Hepatitis. *Division of Viral Hepatitis* 2010. <http://www.cdc.gov/hepatitis/HBV/PDFs/HepBWhenSomeoneClose.pdf> (Accessed: 26th June 2015).

**Appendix C: Frequency of Available Data and Missing Data from Completed Questionnaires, Federal Road Safety Corps, Kaduna Sector Command, Nigeria, June-July, 2015**

Variable	Valid Sample Size	Available Data	Percentage	Missing Data	Percentage
Sex	341	327	95.9	14	4.1
Age	341	338	99.1	3	0.9
Duration of Service	341	339	99.4	2	0.6
Cadre	341	341	100	0	0
Ever heard of HBV infection?	341	340	99.7	1	0.3
Seriousness of HBV compared to HIV	341	335	98.2	6	1.8
Route of Transmission of HBV	341	337	98.8	4	1.2
Perception of Risk of exposure to HBV	341	340	99.7	1	0.3
Ever heard of hepatitis B vaccination?	341	336	98.5	5	1.5
Effectiveness of hepatitis B vaccination	341	334	97.9	7	2.1
Ever received hepatitis B vaccination?	341	325	95.3	16	4.7
Number of doses received	198	198	100	0	0
Recommended full dose of hepatitis B vaccine	341	308	90.3	33	9.7
Duration of protection from full-dose HBVc	341	312	91.5	29	8.5



STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3,4
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	7
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-10
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	9,10
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	11-12
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-12
Bias	9	Describe any efforts to address potential sources of bias	9-13
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10-13
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	10-13
		(b) Describe any methods used to examine subgroups and interactions	NA
		(c) Explain how missing data were addressed	13
		(d) If applicable, describe analytical methods taking account of sampling strategy	10-13
		(e) Describe any sensitivity analyses	NA
<b>Results</b>			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	13-18
		(b) Give reasons for non-participation at each stage	13
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13,14
		(b) Indicate number of participants with missing data for each variable of interest	13
Outcome data	15*	Report numbers of outcome events or summary measures	16
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	16-18
		(b) Report category boundaries when continuous variables were categorized	12
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22-23
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	19-22
Generalisability	21	Discuss the generalisability (external validity) of the study results	22,23
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).