REVIEW ARTICLE

Prevalence of hepatitis B virus infection in Nigeria, 2000-2013: A systematic review and meta-analysis

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Abstract

Vaccination against the hepatitis B virus (HBV) in the West African nation of Nigeria is lower than many Sub-Saharan African countries. In Nigeria, HBV is reported to be the most common cause of liver disease. However, the extent of HBV exposure among Nigerians at average risk is unknown. Our aim, therefore, was to accurately estimate the HBV prevalence for the country and the prevalence for specific subgroups. We used electronic databases to select systematic reviews and meta-analyses from 2000 to 2013. Forty-six studies were included (*n* = 34,376 persons). We used a random effects meta-analysis of cross-sectional and longitudinal studies to generate our estimates. The pooled prevalence of HBV in Nigeria was 13.6% (95% confidence interval [CI]: 11.5, 15.7%). The pooled prevalence (% [95% CI]) among subgroups was: 14.0% (11.7, 16.3) for blood donors; 14.1% (9.6, 18.6) for pregnant women attending antenatal clinics; 11.5% (6.0, 17.0) for children; 14.0% (11.6, 16.5) among adults; and 16.0% (11.1, 20.9) for studies evaluating adults and children. HBV prevalence in Nigeria varied by screening method [% (95% CI)]: 12.3% (10.1, 14.4) by using enzyme-linked immunosorbent assay; 17.5% (12.4, 22.7) by immunochromatography; and 13.6% (11.5, 15.7) by HBV DNA polymerase chain reaction. HBV infection is hyperendemic in Nigeria and may be the highest in Sub-Sahara Africa. Our results suggest that large numbers of pregnant women and children were exposed to HBV from 2000 to 2013. Increased efforts to prevent new HBV infections are urgently needed in Nigeria.

Key words: Africa, hepatitis B, meta-analysis, Nigeria, prevalence, public health, survey

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Introduction

Hepatitis B virus (HBV) is a major cause of liver disease morbidity and mortality worldwide, accounting for over 360 million cases of chronic hepatitis and 620,000 deaths per a year.[1] It is hyperendemic (i.e. >8% of the population infected) in Sub-Sahara Africa (SSA) and a major cause of chronic liver disease.[2-4] Perz *et al*. estimated that 44% of cirrhotic liver disease and 47% of heptocellular carcinoma cases in SSA are attributed to HBV.[5] A highly effective and inexpensive recombinant DNA vaccine for hepatitis B has been available since 1982 and debuted in Nigeria in 1995. Unfortunately, vaccination programs in Nigeria have not received adequate attention or funding by the government. Further, community misconceptions have hindered increasing coverage rates.[6,7] The United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) estimated that only 41% of Nigerians were vaccinated against HBV in 2013.[8]

The risk of contracting HBV in Nigeria is substantial, not only due to low vaccination rates but also given that as many as 75% of the population will be exposed.[9] Investigators have reported varying national and risk group-specific estimates. Prior reports suggest a prevalence of 10-15% in the average risk Nigerian population.[10] In Nigeria, investigators have found high HBV prevalence among surgeons (25.7%),[11] voluntary blood donors (23.4%),[12]

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and infants (16.3%).[13] A 2012 study in Kano Nigeria found that among 440 HIV positive patients, 12.3% were co-positive for HBV.[14] Although, pregnant women are generally considered low risk for HBV infection, rates as high as 11% have been reported in Nigeria.[15] Hepatitis B is the commonest cause of chronic liver disease in Nigeria. In southern parts of the country, up to 58.1% of patients with chronic liver disease were found HBsAg positive.[16]

Several authors report on the prevalence of HBV among sub-populations in Nigeria with estimates varying depending on population studied and methods used. However, there is no reliable national survey of HBV exposure in the average risk population and in subgroups most likely to benefit from early detection, surveillance, and treatment. Given this gap in our understanding of HBV in Nigeria, we performed a systematic review and meta-analysis to provide an accurate estimate. We hope that the information presented here will draw attention to HBV as an important cause of morbidity and mortality in Nigeria and will inform those interested in developing policies and programs for its control.

Materials and Methods

Data sources

PubMed, EMBASE, Institute of Science Information, Google Scholar, Scopus, and African Journal Online were searched from 2000 to 2013. The last search was performed on February 31 2014. The keywords Hepatitis B, Hepatitis B surface antigen, prevalence, Nigeria, and similar terms such as HBV, HBsAg, were crossed. References were reviewed to extend the search, and Nigerian content experts were consulted for additional materials.

Study selection

English language prospective cohort studies and surveys published from 2000 to 2013 were included. Articles that assessed the prevalence of HBV in voluntary blood donors, pregnant women attending antenatal clinics, and in the general population were used. No age restriction was imposed. Children were defined as those of 12 years and below, adolescent as those aged 13-17 years while adults were defined as those of age 18 years and above.

Data extraction and quality assessment

Three investigators independently applied inclusion criteria, selected studies, and extracted data. Consensus adjudication was used to resolve disagreements. Reviewers abstracted data on study year, population characteristics, sample size, prevalence, age, and HBV screening technique [Table 1]. Study quality was assessed using a 12-point scoring system based on the Downs and Black checklist. These are: (objective of the study clearly described, study design clearly stated, participants representative of the population from which they were recruited, participants accrued during the same time period, modest sample size, management of missing data, age, gender and other characteristics explored/reported, e.g. were confounders reported, was detection method of HBV reported, were potential biases reported, was outcome clearly described?), the assessment also included other items known to be associated with study quality.[17] The studies were classified into three levels that represented their quality. The total score was 12 with a higher score indicating better quality.[18]

Statistical analysis

Studies were pooled using the DerSimonian-Laird method of random effects meta-analysis to estimate overall and sub-group specific prevalence.[19-21] Heterogeneity of results was determined by inspecting graphical presentations and calculating Cochran's Q test. The low, medium and high heterogeneity was predefined as a Cochrane Q of 25%, 50%, and 75%, respectively.[19,20] Meta-regression was used to determine potential confounders. The model included study level characteristics such as year of study, region, population, age, and method of HBV screening. Results were expressed as percentages with 95% CIs.

Publication bias was appraised with Egger's and Begg's adjusted rank correlation test and graphically depicted by a funnel plot. Publication bias was dealt with using the Trim and fill method; which is, a rank-based data augmentation technique. It ratifies the use of funnel plots, estimating the number and outcomes of missing studies and adjusting the meta-analysis to incorporate the theoretical missing studies. The level of significance was set at $P < 0.05$.

Results

Our search yielded 249 citations. Forty-six articles were included after applying exclusion criteria, including 31 cross-sectional studies and 15 longitudinal studies [Figure 1].[15,22-65]

Overall prevalence

All included studies were pooled for meta-analysis. The prevalence of HBV infection ranged from 0.5% to 46.8% among analyzed studies. The pooled prevalence estimate for Nigeria was 13.6% (95% confidence interval [CI]: 11.5, 15.7%) [Figure 2]. Assuming Nigeria has an estimated population of 160 million people, the overall HBV burden based on our estimates would be 21,760 million sero-positive persons (95% CI 18,400 000, 25,120 000).

Subgroup analysis

Stratified analysis showed a wide variation in the prevalence of HBV exposure based on study population, year of study, region, and age category [Table 2]. HBV prevalence was

Table 1: Summary of studies on prevalence of hepatitis B viral infection in Nigeria, 2000-2013

Authors	Year	Design	Location	Setting	Population	Age group	Sample size	HBsAg+ (%)	HBeAg status	HBV phase activity	HBV genotype	Method	Quality score (A=9-12) (B=5-8) (C=1-4)
Baba *et al.*[64]	1999	Cross-sectional	Maiduguri	Urban	VBD	15-65	158	15.8	Not stated	Not stated (asymtomatic)	Not used	ELISA	A
Sirisena *et al.*[41]	2002	Cross-sectional	Jos	Urban	VBD	15-65	524	1.3	Not stated	Not stated (asymptomatic)	Not used	ELISA	A
Njoku *et al.*[40]	2002	Cohort	Jos	Urban	VBD	20-40	175	1.3	Not stated	Not stated	Not used	ELISA	A
Christy *et al.*[39]	2003	Cross-sectional	Anambra	Urban	Pregnant women	15-50	120	9.3	Not stated	Not stated	Not used	ICT	A
Otegbayo *et al.*[49]	2003	Cohort	Ibadan	Urban	VBD	17-40	175	21.3	4 (2.3%)	Asymptomatic	Not used	ELISA	B
Chukwuka *et al.*[34]	2004	Cross-sectional	Nnewi	Urban	Children	<12	237	7.6	Not stated	Immune tolerant	Not used	ELISA	A
Jombo *et al.*[61]	2004	Cross-sectional	Jos	Urban	VBD	15-65	300	12.6	Not stated	Not stated	Not used	ELISA	B
Oronsaye and Oronsaye[63]	2004	Cohort	Benin	Urban	VBD	15-65	5737	11	Not stated	Not stated	Not used	ICT	A
Akani *et al.*[60]	2005	Cohort	Port Harcourt	Urban	Pregnant women	15-45	600	4.3	Not stated	Not stated	Not used	ELISA	B
Bukbuk *et al.*[48]	2005	Cross-sectional	Maiduguri	Rural	Children	10-14	150	44.7	Not stated	Immune tolerant	Not used	ELISA	A
Odusanya *et al.*[64]	2005	Cross-sectional	Lagos	Rural	Children	1-4	219	4.6	Not stated	Immune tolerant	Not used	ICT	A
Umolu *et al.*[62]	2005	Cross-sectional	Benin	Urban	VBD	18-25	130	5.8	Not stated	Not stated	Not used	ICT	A
Olajide *et al.*[45]	2007	Cross-sectional	Illorin	Urban	Children	0-5	70	10	Not stated	Not stated	Not used	ELISA	B
Olajide *et al.*[45]	2007	Cross-sectional	Illorin	Urban	VBD§	15-45	70	5.71	Not stated	Not stated	Not used	ELISA	B
Egah *et al.*[51]	2007	Cross-sectional	Jos	Urban	VBD	18-39	258	15.1	Not stated	Not stated	Not used	ELISA	B
Forbi *et al.*[57]	2007	Cross-sectional	Nassarawa	Rural	VBD	5-65	500	11	Not stated	Not stated	Used	DNA (PCR)‡	A
Ndams *et al.*[33]	2007	Cross-sectional	Minna	Urban	Pregnant women	15-45	261	12.3	Not stated	Not stated	Not used	ICT	A
Ugwuja and Ugwu[43]	2007	Cross-sectional	Abakaliki	Urban	Children	<18	385	3.9	Not stated	Not stated	Not used	ELISA	B
Alao *et al.*[31]	2008	Cohort	Otukpo	Rural	VBD	18-60	2500	20	Not stated	Not stated	Not used	Latex agglutination	B
Ado *et al.*[22]	2008	Cohort	Zaria	Urban	VBD	15-60	100	15	Not stated	Not stated	Not used	ELISA	B
Buseri *et al.*[59]	2008	Cohort	Osogbo	Rural	VBD	18-64	1,410	18.6	Not stated	Not stated	Not used	ELISA	A
Olokoba *et al.*[35]	2008	Cross-sectional	Yola	Urban	Pregnant women	15-44	231	8.2	Not stated	Not stated	Not used	ELISA	A
Adekanle *et al.*[54]	2009	Cohort	Ile-Ife	Urban	Pregnant women	18-56	234	17.1	Not stated	Not stated	Not used	ELISA*	B
Adoga *et al.*[36]	2009	Cross-sectional	Abuja	Rural	VBD	<60	1,891	6.0	Not stated	Not stated	Not used	ELISA	B
Aminu *et al.*[26]	2009	Cross-sectional	Zaria	Urban	VBD	16-49	200	12.5	Not stated	Not Stated	Not used	ELISA	B
Lesi *et al*[3]	2009	Cross-sectional	Nnewi	Urban	Pregnant women	14-45	480	8.3	Not stated	Not stated	Not used	ELISA	A
Okocha *et al.*[37]	2009	Cohort	Nnewi	Urban	VBD	18-70	842	5.6	Not stated	Not stated	Not used	ICT	B
Buseri *et al.*[56]	2010	Cross-sectional	Yenagoa	Urban	Pregnant women	15-44	1000	5.3	Not stated	Not stated	Not used	ELISA	A

Contd...

Table 1: Contd...

Authors	Year	Design	Location	Setting	Population	Age group	Sample size	HBsAg+ (%)	HBeAg status	HBV phase activity	HBV genotype	Method	Quality score (A=9-12) (B=5-8) (C=1-4)
Dirisu *et al.*[55]	2010	Cross-sectional	Benin	Urban	VBD	18-45	427	46.8	Not stated	Not stated	Not used	ELISA	A
Mbamara and Obiechina[66]	2010	Cohort	Onisha	Rural	Pregnant women	15-41	1353	2.2	Not stated	Not stated	Not used	ICT	A
Okonko *et al.*[52]	2010	Cohort	Abeokuta	Urban	VBD	15-60	200	4.0	Not stated	Not stated	Not used	ELISA	B
Opaleye *et al.*[58]	2010	Cross-sectional	Osobgo	Rural	VBD	15-45	624	13.5	Not stated	Not stated	Not used	ICT	A
Bada *et al.*[12]	2010	Cohort	Benin	Urban	Children	1-90 days	153	16.3	Not stated	Not stated	Not used	ELISA	A
Bukbuk[47]	2010	Cross-sectional	Benin	Urban	pregnant women	17-40	5760	21.5	Not stated	Not stated	Not used	ELISA	B
Adeleke *et al.*[29]	2011	Cross-sectional	Osogbo	Rural	Pregnant women	15-45	200	3.0	Not stated	Not stated	Not used	ELISA	A
Oje *et al.*[24]	2011	Cross-sectional	Ekiti	Urban	VBD	35-44	2000	9.8	Not stated	Not stated	Not used	ELISA	A
David *et al.*[25]	2011	Cohort	Ibadan	Urban	VBD	<16	200	7.0	Not stated	Not sated	Not used	ELISA	B
Ibrahim *et al.*[32]	2011	Cross-sectional	Kano	Urban	Pregnant women	18-44	303	7.9	Not stated	Not stated	Not used	ELISA	A
Adekeye *et al.*[42]	2012	Cross-sectional	Jos	Urban	VBD	10-49	245	20.8	Not stated	Not stated	Not used	ELISA	A
Alikor and Erhabor[38]	2012	Cohort	Port hacourt	Urban	VBD	1-16	251	12.4	Not stated	Not stated	Not used	ELISA	A
Gambo *et al.*[46]	2012	Cross-sectional	Toro	Rural	VBD	18-52	182	26.2	Not stated	Not stated	Not used	ICT†	B
Kemebradikumo and Isa[30]	2012	Cross-sectional	Yenagoa	Rural	Pregnant women	15-45	300	3.76	Not stated	Not stated	Not used	ELISA	A
Kolawole *et al.*[44]	2012	Cohort	Osogbo	Rural	Pregnant women	15-45	200	16.5	Not stated	Not stated	Not used	ELISA	B
Ndako *et al.*[28]	2012	Cross-sectional	Bayara	Rural	Pregnant women	13-49	180	17.2	Not stated	Not stated	Not used	ELISA	B
Okonko[23]	2012	Cross-sectional	Ibadan	Urban	Children	1-15	217	0.5	Not stated	Not stated	Not used	ELISA	B
Ndako[27]	2012	Cross-sectional	Ekiti	Rural	VBD	15-72	2,000	9.8	Not stated	Not stated	Not used	ICT	A
Opaleye *et al.*[50]	2013	Cross-sectional	Osogbo	Rural	VBD	18-65	624	19.9	Not stated	Not stated	Not used	ICT	B

HBeAg=Hepatitis B e antigen; HBsAg=Hepatitis B surface antigen; HBV=Hepatitis B virus; *ELISA=Enzyme-linked immunosorbent assay; †ICT=Immunochromatography; ‡PCR=Polymerase chain reaction; §VBD=voluntary blood donor; Immune phases=Immune tolerant phase; immune active; inactive hepatitis B

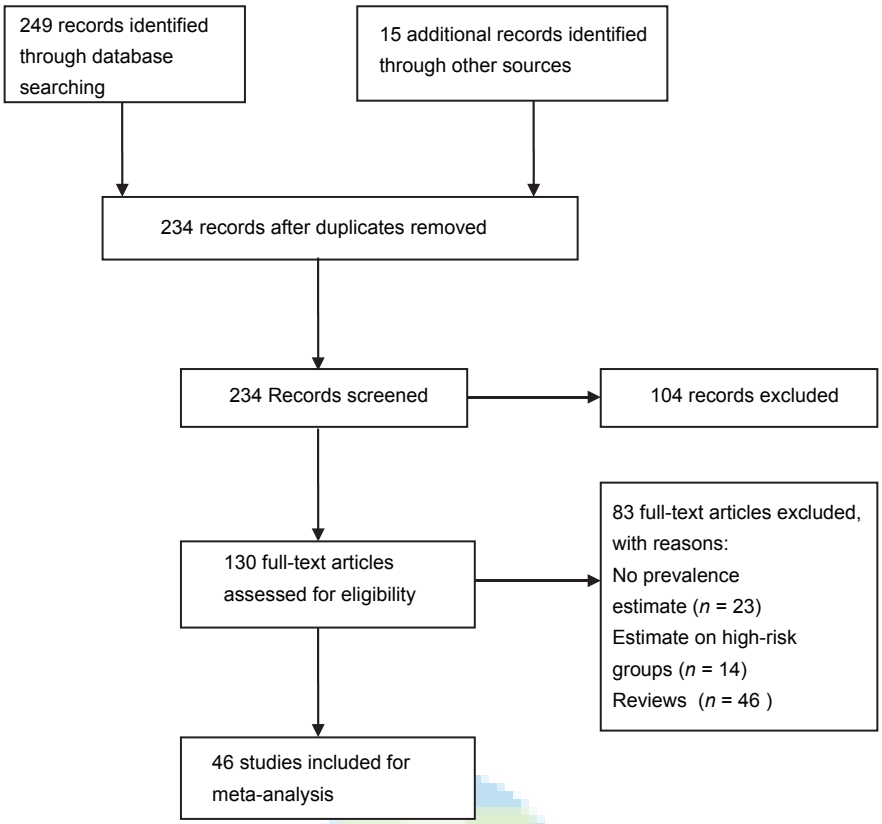

Figure 1: Flow diagram of the studies reviewed for inclusion into meta-analysis

Table 2: Estimated hepatitis B prevalence by study design, year, age, population, and region, Nigeria, 2000-2013

Category	Subgroup	Studies reviewed	Prevalence % (95% CI)	I^2%	*P*
Study design	Cross-sectional	31	14 (12, 16)	97.8	0.001
	Prospective cohort	15	12 (9, 16)	98.0	0.001
Study population	Blood donors	24	14.0 (11.7, 16.3)	96.3	0.003
	Pregnant women	14	14.1 (9.6, 18.6)	98.0	0.007
Age	Children	9	11.5 (6.0, 17.0)	95.6	0.005
	Adults	34	14.0 (11.6, 16–5)	98.2	<0.001
	Both	4	16.0 (11.1, 20.9)	77.6	<0.001
Study year	2000	1	15.8 (10.1, 21.5)	<0.001	<0.001
	2001	0	-	-	-
	2002	2	11.6 (8, 15.5)	44.7	0.17
	2003	2	53.9 (10.3, 11.8)	99.6	<0.001
	2004	3	10.5 (8.3, 12.8)	56.4	<0.001
	2005	4	13.5 (4.6, 22.4)	96.9	<0.001
Study year	2006	0	-	-	-
	2007	6	9.6 (5.5, 13.7)	86.6	<0.001
	2008	4	15.7 (11.0, 20.5)	96.8	<0.001
	2009	5	9.0 (6.3, 11.6)	86.3	<0.001
	2010	7	14.0 (8.1, 19.9)	99.0	<0.001
Study year	2011	4	7.0 (6.3, 11.6)	87.7	<0.001
	2012	8	13.0 (8.2, 17.7)	96.0	<0.001
	2013	1	19.9 (16.7, 23.0)	<0.001	<0.001
Region	North	19	14. 7 (11.4, 17.9)	94.7	<0.001
	South	28	13.6 (11.5, 15.7)	98.4	<0.001

CI=Confidence interval

greatest among pregnant women attending antenatal clinics 14.1% (95% CI, 9.6, 18.6%) followed closely by voluntary blood donors 14.0% (95% CI, 11.7, 16.3%). The highest prevalence occurred in 2003 at 53.9% (95% CI, 10.3, 118%)

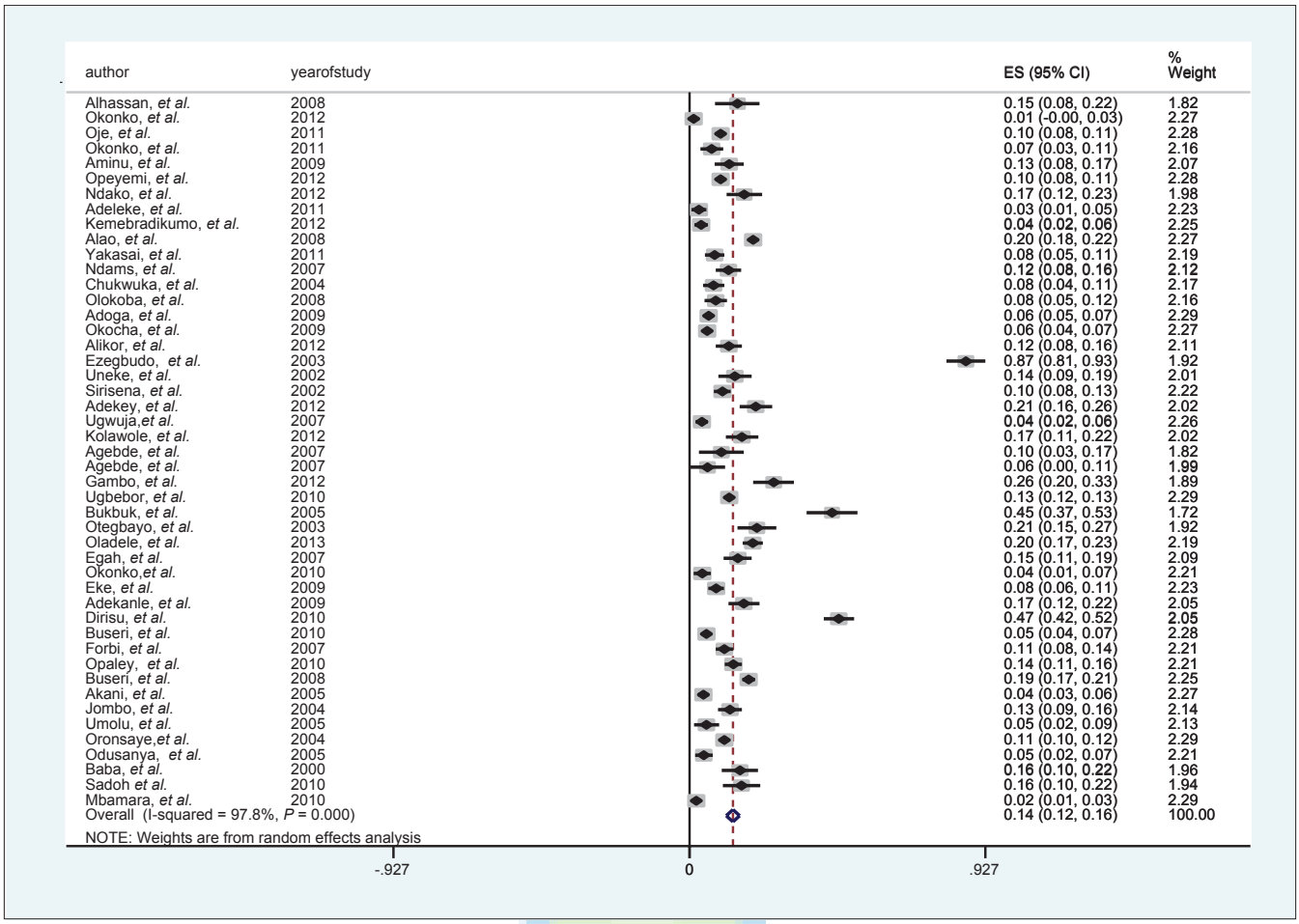

Figure 2: Forest plot of studies included in meta-analysis with pooled HBV prevalence

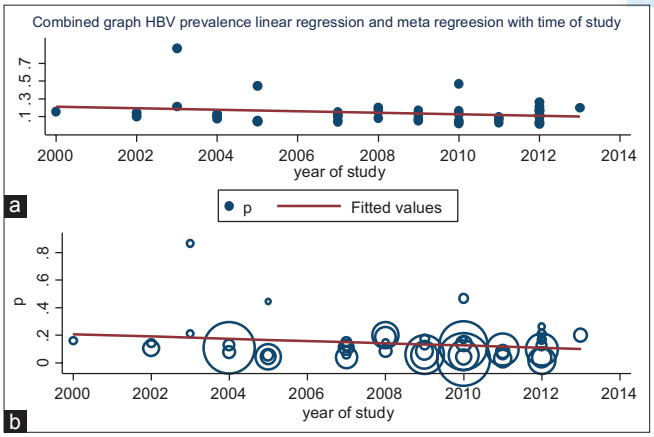

Figure 3: (a) Regression plot depicting correlation of HBV prevalence with year of study. (b) Meta-regression plot showing the trend in HBV prevalence with year of study

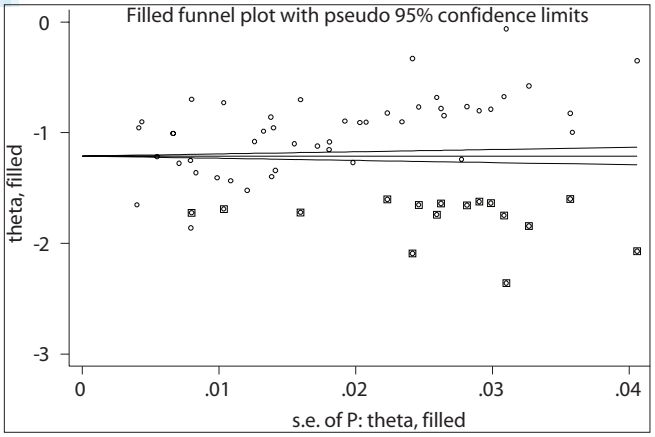

Figure 4: Graphic representation of Publication bias with Funnel plot of included studies and representation of missing studies using Trim and Fill method

and the lowest in 2011 at 7.0% (95% CI, 6.3, 11.6%). HBV prevalence was estimated to be 14.0% (95% CI, 11.6, 16.5%) among adults and 11.5% (95% CI, 6.0, 17.9%) among children. Prevalence was slightly greater for Northern Nigeria at 14.7% (95% CI, 11.4, 17.0%) compared with 13.6% (95% CI 11.5, 15.7%) for Southern Nigeria.

HBV prevalence also varied by screening method, [Table 3]. Among all populations, the HBV prevalence was estimated as 12.3% (95% CI, 10.1, 14.4%), 17.5% (95% CI, 12.4, 22.7), and 13.6% (CI, 11.5, 15.7) by using enzyme link immunosorbent assay (ELISA), immunochromatography (ICT), and HBV DNA polymerase chain reaction, respectively.

Table 3: Estimated prevalence of HBV among average risk populations by screening method, Nigeria, 2000-2013

Method	Prevalence % (95% CI)	Studies reviewed	I^2 %	*P*
ELISA*	12.3 (10.1, 14.4)	34	96.1	<0.001
ICT†	17.5 (12.4, 22.7)	12	99.1	<0.001
PCR‡	13. 6 (11.5, 15.7)	1	0.00	<0.001

HBV=Hepatitis B virus; CI=Confidence interval; *ELISA=Enzyme-link immunosorbent assay; †ICT=Immunochromatography; ‡PCR=Polymerase chain reaction

Only one study additionally reported on HBeAg, with 4(2.3%) reported for both HBsAg and HBeAg positive; while none of the studies commented on HBV phase activity.

Meta-regression analysis did not show that study year, region, population, age, or method of screening confounded prevalence estimates. However, this analysis suggested that HBV prevalence decreased by 0.8% annually [Figures 3].

There was evidence of publication bias with Egger's test having a $P = 0.007$, whereas Begg's test had a $P = 0.0001$. This was depicted graphically by a funnel plot which incorporated the Trim and filled method. It showed asymmetry of prevalence reported by various studies. Prevalence reported in reviewed studies were represented by diamond points, whereas augmented data point derived based on the trim and fill method are indicated by the addition of a square placed around the data symbol [Figure 4].

Discussion

In 2010, the World Health Assembly adopted resolution 63.18 to recognize viral hepatitis as a global health problem.[66] In response, the WHO developed a four-prong strategy aimed at raising awareness/mobilizing resources, policy, preventing transmission and screening and treatment.[67] While 180 countries included Hepatitis B vaccination as part of their routine vaccination schedule and the worldwide coverage approached 80% in 2011, disparities remain between developed and developing countries.[67]

Nigeria has made notable gains along the four-prong strategy, for example, by registering hepatitis–related cancer cases, creating national guidelines for prevention of infection in health care workers, adopting universal vaccination, and screening all donated blood.[67] However, national policies aimed at prevention of mother to child infections and elimination of HBV are lacking; this is perhaps reflected in our finding that approximately 14% of Nigerians were exposed to HBV from 2000 to 2013. This estimate would place Nigeria as one most affected countries in Africa and indeed the world.[68] The prevalence peaked at 53.9% in 2003, although this estimate was weighted by only two studies.

Our finding of a skewed funnel plot, suggests publication bias that may be due to wide variability in the reported prevalence, and gaps for unreported prevalence in other sub-populations. This have been accounted for by the "filled" data points derived from the trim and fill method. However, the finding may also be due to other reasons, such as variation in the sensitivity of HBV screening kits and methodological quality of the studies and indeed, in study sample sizes. Furthermore, it may be due to variation in the temporal prevailing risk for HBV among the populations of primary studies and chance occurrence. However, we are of the opinion that the difference in the prevailing risk among the studied populations likely accounts for the skewing of the funnel plot.[69]

Whereas, routine detection of HBV infection has been based on the detection of HBsAg, occasionally this could be undetected creating occult HBV infection. In a study of HBV occult infection among HIV positive patients, Opaleye, *et al.*,[70] found HBV DNA in 21/188 (11.2%) of patients without detectable HBsAg. A similar study in South-Eastern Nigeria found 8.0% with HBV DNA among HBsAg negative blood donors.[71]

Nigeria has multiple challenges of terrain and treasury, making an accurate evaluation of HBV carrier rates extremely difficult. The country is vast and diverse; with its semi-arid plains and plateau in the north, the highland and coastal plains in the south; the dispersion of much of its population among rural areas, and the perennial challenge of resources. Thus, the findings of our study are important for policy formulation pending the conduct of a national sero-prevalence survey.

The variation noted between sub-populations may have resulted from differences in the risks of acquisition of HBV infection and unmeasured socioeconomic and environmental factors across Nigeria. In the past, there were practices that increased the risk of HBV infection such as mass childhood circumcision in the north; even though, it's still been practiced in some rural areas. Similarly, there is usage of local unsterilized blades for commercial barbing services and use of unsterilized tools for facial marks and tattoos.

Whereas most SSA countries are classified as hyperendemic for HBV, prevalence do vary among countries. Although Nigeria share similarity with South Africa in the burden of HIV, the Nigerian estimate is higher than that of South Africa, with a prevalence of 10%.[71,72] Nigeria has prevalence similar to neighboring countries such as Ghana 5-10%, Cameroon 8-20% Benin 12% and Chad 12%.[73-75]

Furthermore, finding of high HBV seroprevalence in SSA countries like Nigeria is echoed in a meta-analysis by Rossi *et al.*, were high prevalence of HBV were found among migrants to developed countries from high HBV burden regions including SSA.[76]

Encouragingly, our meta-analysis suggests that there is a sustained decline in the prevalence of HBV infection over the last 13 years. A similar pattern has been observed in other African countries like Gambia and Senegal where the HBV prevalence rates have declined progressively from 10-0.6% to 18.7-2.2%, respectively.[72] The observed decline in HBV prevalence in Nigeria may be related to a gradual increase in HBV vacation among children. In 2000-2005, HBV vaccination coverage was reported as zero by UNICEF, 18% in 2006, and peaked at 41% in 2013.[8] While most recently reported coverage level is low by the worldwide average, the impact can be magnified with a rapid reduction in HBV prevalence. This type of response was demonstrated in the Gambia.[77] Therefore, incremental efforts and even small scale efforts aimed at HBV prevention and control are likely to have great benefit.

Nigeria is one of the countries with the highest population in the world; with children and young adults constituting the bulk of these numbers. It is also a low-middle income nation, with gross national income per capita purchasing power parity (PPP) of $2290.[67] Moreover, it has relatively low life expectancy at birth of 54 years.[67] It is also the country with the third highest burden of HIV in the world.[78] While HIV has decimating effect on the socioeconomic fabric of the country; HBV could lead to chronic liver disease and cancer of the liver and ultimately early death marked by loss of able-bodied young adults. Both diseases are share common means of transmission. There have been positive results following various interventions aimed at curbing the burden of HIV in Nigeria as evident by a sustained decline in HIV prevalence. Thus, it should be envisaged that proper implementation of interventions such as early immunization and screening of high risk groups could further reduce HBV burden as well as improve Nigeria's socioeconomic indices.

Limitations

The accuracy of detection for active HBV infection depends on the screening method. Additional markers such as HBV Igm and HBV core antigen must be used to distinguish past infection from active infection. DNA testing, conversely, detects the presence of hepatitis even before the appearance of antibodies.[79] Most included studies used ELISA for HBV screening. ICT is less sensitive than ELISA and thus yield false positives. This could explain the discrepancy in HBV prevalence between ICT compared to other methods in our analysis.[80] Further, reporting over a 13-year period, we may have included studies using different generations of screening kits and thus their sensitivity and specificity may have varied.

In Nigeria, blood donations are routinely screened for HBV. Consequently, they are a convenient sample and comprised the bulk of our analysis. This population may have had a difference risk profile than other groups. Using voluntary blood donors largely excluded women and children who infrequently donate blood in Nigeria. Thus, the HBV prevalence in voluntary blood donors could be considered as a surrogate representation of young and middle-aged men exclusively. Nevertheless, we believe the estimated HBV prevalence for this population is robust as it is similar to other studies from SSA countries.[72-74]

Our analysis showed that HBV prevalence was hyperendemic among women. Data in this population were limited as HBV estimates were sourced from hospital-based antenatal care that represents only a fraction of all antenatal care received by women. Further, our analysis included more studies reporting on HBV prevalence in males than women. Therefore, it is possible we underestimated the true prevalence in this population.

Conclusion

Our study suggests that the HBV is hyperendemic in Nigeria. It underscores the need for universal vaccination of all children and the development of policies to prevent mother to child transmission. Our work is useful for planning interim national control strategies to combat hepatitis B infection as well as providing a robust basis for ultimately organizing hepatitis B national prevalence surveys and control measures.

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