

ORIGINAL ARTICLE

Sero-prevalence of hepatitis B surface (HBsAg) antigen in three densely populated communities in Kumasi, Ghana

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Hepatitis B infection is endemic in many developing countries including Ghana. It is also known that there are differences in the prevalence in communities of different socioeconomic levels. Reports are scanty on the seroprevalence of hepatitis B-virus in densely populated suburbs in Kumasi, Ghana. This study was conducted in three densely populated communities in Kumasi to determine the relative seroprevalence of hepatitis B. Serum samples were collected in 2009 during a cross-sectional survey of individuals from Aboabo, Tafo and Garrison and tested for HBsAg using a commercial test kit (One Step HBsAg Test Device, InTEC Products, INC, China) after obtaining their informed consent. A total of 783 subjects (mean age: 37.93 ± 0.62) had their samples collected for testing. There were 376 females and 407 males. A higher prevalence of HBsAg seropositivity was detected among the males (11.79%) as compared to the females (5.33%). Prevalence of seropositivity was highest among adolescents (19-24 years, 14.14%; 25-34 years, 13.10%) and children (<19 years, 12.26%) and lowest among the aged >54 years old. Of all the three sub-populations sampled, only Garrison was determined to be in the intermediate endemicity class for HBsAg (6.78%); both Aboabo (9.02%) and Tafo (10.0%) are in the high endemicity class. However, overall prevalence of HBsAg seropositivity was 8.68%. Our study suggests that in Ghana, local prevalence of the disease may vary widely, possibly as a consequence of lifestyle and socioeconomic variations even in closely related settlements.

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INTRODUCTION

Hepatitis B continues to pose a tremendous burden of disease globally. Currently, approximately 400 million people have chronic hepatitis B virus (HBV) infection globally (Kowdley, 2004). The prevalence of HBV infection varies widely, with rates ranging from 0.1% to 20% in different parts of the world (Lavanchy, 2004). Studies in sub-Saharan Africa have reported prevalence ranging from 3% to 22% in blood donors (Saha *et al.*, 1988; Ndumbe and

Nyouma, 1990; Allain *et al.*, 1992; Sarkodie *et al.*, 2001; Amidu *et al.*, 2010). Hepatitis B surface antigen (HBsAg) positivity of more than 8% in a community is considered to be “high” in countries which include the Far East, parts of the Middle East, sub-Saharan Africa and the Amazon basin (Berenguer and Wright, 2002). In these regions, serologic evidence of prior HBV infection (anti-hepatitis B core antigen (anti-HBcAg) or anti-hepatitis B surface antigen (anti-HBsAg) positivity is present in the vast majority of individuals (Berenguer and Wright, 2002). Countries like Japan, India, central Asia and the Middle East including Eastern and Southern Europe, as well as parts of South America, are all areas with

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“intermediate” (2% to 7% HBsAg positive) prevalence of chronic HBV infection. “Low” prevalence (<2% HBsAg positive) of chronic HBV is found in regions including the United States, Northern Europe, Australia, and the southern part of South America (Berenguer and Wright, 2002). About 45% of the world population lives in “high” prevalence regions, resulting in the massive global burden associated with the infection (Kowdley, 2004).

According to Lok and McMahon (2001), patients with chronic hepatitis B infection have a 15% to 40% risk of developing conditions such as liver cirrhosis, liver failure, and/or hepatocellular carcinoma (HCC). HBV-related mortality of 15% to 25% has been reported among such patients, perhaps due to lack of universal control schemes (Margolis *et al.*, 1995). So far, the only control programmes rely on screening followed by education in most developing countries (Custer *et al.*, 2004). HBV vaccination programmes in Senegal and the Gambia have reduced HBsAg prevalence from 18.7 to 2.2% and from 10.0% to 0.6% respectively among children in the two countries (Custer *et al.*, 2004). It is important to state that even though Ghana forms part of the 134 developing countries and economies in transition that have successfully introduced hepatitis B vaccine into their National Immunization Schedules by 2003, particularly for newly born infants (aged 6-14 weeks), there is no program for mass screening and vaccination of children born before vaccine introduction, no screening for mothers, adolescents and the general public. This study therefore determined seroprevalence of HBsAg in three densely populated communities in Kumasi in relation to patients’ demographic data.

MATERIALS AND METHODS

Study Area

This prospective study was conducted from January 2008 through December 2008 in Kumasi. Kumasi is the capital city of Ashanti Region and it covers about 254 sq km (97.6 sq miles) in the southern central part of Ghana. There are about 90 suburbs in Kumasi, which has a population of about 1,170,270 and an annual growth rate of 5.47 per cent. Kumasi

has a humid tropical climate with two major seasons, the wet and the dry seasons. Temperatures range between a maximum of 33°C around February/March and a minimum of 19°C in January.

The communities sampled for the study were Aboabo, Tafo and Garrison. These communities are heterogeneous, composed of different settler tribes from many countries from sub-Saharan Africa. These people mix and cohabit with the indigenes, the Asante tribe who are in the majority. The unique central placement of Kumasi makes it a major hub for commerce and traversing point for travelers from all parts of Ghana and elsewhere from northern parts of West Africa. These communities have poor housing infrastructure and are mostly densely populated suburbs. The houses are of low cost and therefore are easily affordable for fresh immigrants, making those areas heavily populated with untidy environments and low levels of care for children who walk about barefooted and half-dressed. High heaps of garbage are dotted all over with drains mostly choked with filth, smelly effluence mixed with plastic materials from homes. These conditions prevent free flow of water after rains with rain water out-bursting its banks and flowing into homes and shops. Some remain stagnant, become putrid and smelly. These characteristics pervade the communities with Tafo being the most affected followed by Aboabo.

Subject and sample collection

Each of the three communities was visited three times within the period under study (January 2008 to December 2008) with talks on health education being conducted on each session. It was during this health education that hepatitis screening was conducted after obtaining ethical approval from the Committee on Human Research, Publication and Ethics (CHRPE), Kwame Nkrumah University of Science and Technology, School of Medical Sciences (KNUST-SMS) and the Komfo Anokye Teaching Hospital (KATH), Kumasi, Ghana. The samples were taken after the study was explained to them and those who consented had their samples taken in each suburb. A total of seven hundred and eighty three (783) subjects comprising 407 males

and 376 females who consented had their blood samples taken by venipuncture. Serum was extracted from the blood samples and tested for HBsAg.

Testing for HBsAg

Two drops (60µl) of the test serum was placed in the test kit well (Intec Products, INC, China) which contains labeled HBsAg antibody-dye conjugate. The serum flows through the absorbent device by chromatography, and the labeled HBsAg antibody-dye conjugate binds to HBsAg in the serum forming an antibody-antigen complex. This complex binds to the immobilized antibody in the positive reaction zone to produce a magenta color band when the concentration of HBsAg is above a certain detection threshold. Unbound dye conjugate binds to the reagent in the negative control zone to produce a magenta-colour band when the reagents and device are functioning correctly. A negative specimen produces a single distinct colour band in the control area. A positive specimen produces two colour bands in both the test line and the control area.

Statistical analysis

Continuous data were expressed as mean \pm SD and categorical data expressed as proportion. In all cases a p-value <0.05 was considered significant. The data was analyzed using Stata/IC 10.0 for windows (StataCorp LP, USA, <http://www.stata.com>).

RESULTS

Blood samples from a total of 783 subjects were drawn from Ababo, Tafo and Garrison, suburbs of Kumasi. The mean age distribution of the studied population stratified by community is as shown in Table 1. The mean age of the Tafo sub-population sampled was 40.9 ± 17.5 years, being the oldest followed by Garrison with mean age of 40.0 ± 16.5 years and then Aboabo with the mean age of 33.0 ± 17.1 years (Table 1). Overall, the estimated prevalence of HBsAg sero-positivity was 68(8.68%). The HBsAg positive prevalence levels by community ranged from 16(6.78%) in Garrison, 24(9.02%) in Aboabo and 28(10.00%) in Tafo.

Table 1: Summary of demographic characteristics for the three subpopulations studied

Age (yrs)	Aboabo (n= 266)	Tafo (n= 280)	Garrison (n= 237)	Combined (N= 783)
<19	14.86 \pm 2.80	15.38 \pm 3.57	14.41 \pm 4.47	14.91 \pm 3.28
19-24	20.94 \pm 1.55	21.70 \pm 1.65	21.44 \pm 1.75	21.27 \pm 1.64
25-34	28.89 \pm 2.90	29.71 \pm 2.76	28.24 \pm 2.90	25.54 \pm 5.38
35-44	49.05 \pm 2.65	38.83 \pm 2.97	39.35 \pm 2.54	39.09 \pm 2.71
45-54	48.68 \pm 2.72	48.85 \pm 2.46	48.94 \pm 3.04	48.82 \pm 2.71
55-64	58.06 \pm 2.73	58.47 \pm 2.73	58.89 \pm 3.13	58.52 \pm 2.86
>64	70.71 \pm 5.28	71.08 \pm 6.17	72.41 \pm 5.11	71.39 \pm 5.65
Total	33.0 \pm 17.1	40.9 \pm 17.5	40.0 \pm 16.5	37.93 \pm 0.62

In the studied population, there were more males with HBsAg sero-positivity 48/407(11.79%) than females 20/375(5.33%). HBsAg positivity by community indicated Aboabo to have the highest male positivity of 13.95% and 4.38% for females; in Tafo there were 12.93% positive males and 7.93% females; whilst in Garrison there were 9.26% males and 1.35% females (Table 2).

When the studied population was stratified based on age, the 19-24 years group had the highest HBsAg

prevalence of about 14.14%; followed by the 25-34 years age group with prevalence of 13.10%. The youngest age group (<19 years) had prevalence of 12.26% and lowest prevalence (2.63%) was found among those of 45-54 years (Figure 1). Also, when the population was stratified based on age, generally, there were more male with HBsAg sero-positivity as compared to the female participant (Table 2).

Table 2: HBsAg sero-positivity distribution between gender stratified by age and community

Variables	n(%)	Male 95% CI	P value	Female n(%)	Female 95% CI	P value
Age (yrs)						
<19	9/66(13.64)	5.36-21.92		4/40(10.00)	0.7-19.3	
19-24	11/60(15.94)	7.3-24.58		3/30(10.00)	-0.74-20.74	
25-34	20/110(18.18)	10.97-25.39		2/58(3.45)	-1.25-8.15	
35-44	4/59(6.78)	0.36-13.2		7/80(8.75)	2.56-14.94	
45-54	1/41(2.44)	-2.28-7.16		2/73(2.74)	-1.00-6.48	
55-64	2/27(7.41)	-2.47-17.29		1/55(1.82)	-1.71-5.35	
>64	1/35(2.86)	-2.66-8.38	0.0059	1/39(2.56)	-2.4-7.52	0.0340
Community						
Aboabo	18/129(13.95)	7.97-19.93		6/137(4.38)	0.95-7.81	
Tafo	15/116(12.93)	6.82-19.04		13/164(7.93)	3.79-12.07	
Garrison	15/162(9.26)	4.8-13.72		1/74(1.35)	-1.28-3.98	
Total	48/407(11.79)	6.52-17.63		20/376(5.33)	1.15-7.95	

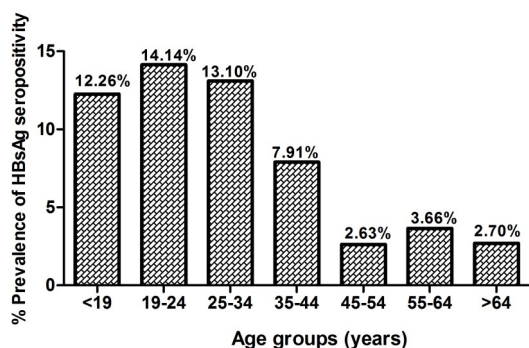


Figure 1: The prevalence of HBsAge stratified by age

DISCUSSION

In this study an attempt has been made to determine the prevalence of Hepatitis in three communities in Kumasi. Results from this study showed HBsAg positivity prevalence being 2.4 times more among males than the females. Available reports show that men are more likely to test positive for HBsAg than women (Jayaprakash *et al.*, 1983; Asakura *et al.*, 1991; Behal *et al.*, 2008). Similar results were reported in the US where infection of male to female ratio of 1.5:1 was reported in 1990 (CDC, 2004). Zhang *et al.*, (2008) found a male to female infection ratio of 3.3:1 in China. These results indicate that the equilibrium gender ratio is always skewed towards males

in populations randomly sampled for HBsAg sero-prevalence. This trend is independent of both the prevailing risk factors and the level of endemicity in any randomly sampled population. This is true even in cases where the number of females sampled is slightly greater. Some studies suggest that plasma clearance rate for HBsAg in males is slower compared to females and this might be responsible for this ratio (Thursz, 1997; Behal *et al.*, 2008).

In this study, the sero-prevalence of HBsAg obtained was 8.68%. Sero-prevalence from this study is higher than values from Italy, <2% (Custer *et al.*, 2004); Singapore, 5% (Goh, 1992); Thailand, 4.51% (Luksamijarulkul *et al.*, 2002); Brasil, 1.9% (Martelli *et al.*, 1991) and elsewhere in the US, 0.15% (Kim *et al.*, 2004). The results in this study was however lower than those reported among blood donors in northern Ghana where 12.64% was obtained (Amidu *et al.*, 2010) and another study recorded 15% in Kumasi (Sarkodie *et al.*, 2001). In the West African sub-region, sero-prevalence levels ranging from 3%-22% have been reported among blood donors (Saha *et al.*, 1988; Ndumbe and Nyouma, 1990; Allain *et al.*, 1992; Sarkodie *et al.*, 2001). These results are also similar to those of other studies in Asian countries with high endemicity (Andre, 2000; Behal *et al.*, 2008). Generally studies of HBV (and HCV) prevalence are often conducted in blood

donor populations because of convenience of/and access to a large sample size. These studies may not truly represent the general population as some age groups are often left out. Therefore prevalence in blood donors may underestimate the population prevalence if potential donors with a high-risk profile, like history of jaundice, injection drug use, multiple sexual partners, etc. are screened out by questionnaires. Conversely, prevalence in blood donors might overestimate that of the general population if professional blood donors were included, who are often injection drug users selling blood for money (Syed *et al.*, 2009). There are however recent reports indicating changing trends in sero-epidemiological patterns of HBV infection in some Asian countries as a result of urbanization and massive immunization drives (Chang *et al.*, 1997; Andre, 2000; Harpaz *et al.*, 2000). Where economic constraints hinder universal immunization, even partial immunization strategies have proven expedient as in the cases of the Gambia and Senegal, where HBsAg prevalence among children was reduced from 10.0% to 0.6% in Gambia and from 18.7 to 2.2% in Senegal, after implementing vaccination in only a portion of their population (Custer *et al.*, 2004). From our study, and by comparison, densely populated communities may not have the highest levels of infection to prompt a scare. But potentially, carriers are reservoirs of infection that may eventually spill over into the general population which suggests that the general population of Kumasi is not free of the disease. But this study is an epidemiologic one and therefore results obtained in here merit attention.

Of all the three sub-populations sampled, Garrison falls in the intermediate endemicity category while both Aboabo and Tafo may be classified as highly endemic. Meanwhile there is no previous history of mass immunization in any of the suburbs under study. According to Hou *et al.*, (2005) variations in epidemiologic patterns, when they occur in the same country, may also hint of local differences in water supply and personal hygiene. The high seroprevalence observed in the communities studied is reasonably explained by the perennial lack of adequately treated pipe-borne water, good sanitation and overcrowding leading to undue pressure on the

few existing social amenities. In most of these suburbs, living conditions are low with levels of comparability to slums and must be a major focus of primary prevention programs of the Ghana Health Service.

Highly endemic populations share common features that allow the efficient transmission of the virus from child-to-child rather than from mother-to-child (Edmunds *et al.*, 1996). The most notable are a high number of children living in crowded room and even sharing beds. These children play together and may be potentially infected by already infected ones; perhaps who were infected by their infected parents. Studies show that in areas of high HBV endemicity a large proportion of the population is infected during childhood (Edmunds *et al.*, 1996). Again, the vast majority of such infections are a combination of mother-to-child (*vertical infections*) or child-to-child (*horizontal infections*) (Kane, 1995) although unequally. Actually, in sub-Saharan Africa over 90% of all carriers would be expected to be infected by horizontal transmission which is the main cause of infection in childhood and the most prominent force of infection in developing countries (Edmunds *et al.*, 1996). If that is the case, then at least the point can be made that effective primary prevention of infection in highly endemic areas must necessarily target the school setting and communities like the ones studied here with high populations of children. Further studies would however be required to validate this assertion.

Most people with acute hepatitis B recover without treatment, within about four to eight weeks, and it is recommended not to spread it to others by avoiding any open cuts of infected people. People in this category are advised against unprotected sex, blood donation and not to share any needles, syringes, razors or toothbrushes as they may be contaminated with small amounts of infected blood (Syed *et al.*, 2009). The current standard of care for patients infected with HBV is through combination therapy with pegylated interferon alfa (PEG-IFN alfa) and the nucleoside analogue ribavirin (Syed *et al.*, 2009). The addition of protease inhibitors to the

combination of PEG-IFN alfa and ribavirin is becoming the new standard of care.

CONCLUSION

HBsAg prevalence levels in the suburbs of Kumasi were 6.78% for Garrison, 9.02% for Aboabo and 10.0% for Tafo. The overall prevalence of HBsAg sero-positivity in the study population was 8.68%, suggesting that local prevalence levels of HBsAg may vary widely. The HBV infection prevalence in Tafo and Aboabo are therefore in the high endemicity class, with intermediate endemicity observed at Garrison.

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