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PREVALENCE AND TRENDS OF HEPATITIS B AND C AMONG BLOOD DONORS IN ALL BLOOD DONORS CENTERS IN THE NORTHERN REGION OF GHANA: A FIVE-YEAR RETROSPECTIVE STUDY

***[1]Muktar, A. T., [2]Abdulai, A., [3]Aninanya, G. A., [4]Badawi, M.**

[1]Department of Environmental and Occupational Health, School of Public Health, University for Development Studies, Tamale, Ghana*
[2]Department of Global and International Health, School of Public Health, University for Development Studies, Tamale, Ghana
[3]Department of Health Services Management, Policy and Economics, School of Public Health, University for Development Studies, Tamale, Ghana
[4]Deapartment of Health Information, Tamale Teaching Hospital, Tamale, Ghana
**Corresponding author's Email: amtikuma@gmail.com*

Abstract

Blood transfusion is considered a life-saver in health care settings, but could potentially pose as a risk factor for transmission of life-threatening viral infections, including Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBsAg), Hepatitis C Virus (HCV) and Syphilis infections. This study was carried out to assess the prevalence and trends of HBsAg and HCV infections among blood donors in the Northern Region of Ghana. The study was a retrospective one. Therefore data of blood donors recorded in all three blood transfusion centers in the Northern region from 2011 to 2015 were analyzed in an anonymous way with respect to the results of serological screening for HBsAg and HCV infections. SPSS was used in the analysis of data, where chi-square and test for association was done. Overall, 123,142 donors were screened for these viral infections. Majority of the donors who were screened for HBsAg were males representing 50.1% whereas females represented 50.1%. Of those who were screened for HCV, 40.1 4% were males and 61.0% were females. The overall sero-prevalence of HBsAg and HCV were 31.0 % (7319) and 28.0 % (4893) respectively. These infections were more prevalent in male donors (p-value of 0.854). Highest sero-prevalence for both HBsAg and HCV was observed among donors between 20 to 49 years, while both seroprevalence slightly increased with age (p-value of 0.765). These infections with HBsAg and HCV were more prevalent in male donors. Highest sero-prevalence for both HBsAg and HCV was observed among donors between 20 to 49 years, while both seroprevalence slightly increased with age. This means that government and policy makers, as well as other stakeholders should emphasize more on the youth, and especially the male sexes in rolling out interventions and campaigns aimed at mitigating these infections. There exists a decreasing trend of transfusion-transmissible viral infections (i.e. HBsAg and HCV) in blood donations. This indicates that the Ghana National Blood Service's mandate of ensuring the safety of blood supply has been successful since the prevalence of viral infections have been reduced to very low levels in blood donations over the years. However, more effective techniques such as polymerase chain reaction (PCR) are needed to guarantee blood safety. More outreach screening and sensitization programmes by the National Blood Service will help in reducing the prevalence.

Keywords: Viral Infections, Transfusion, Hepatitis, Seropositive, Blood Donors

Introduction

The discovery of transfusion-transmissible infections (TTIs) has heralded a new era in blood transfusion practice worldwide with an emphasis on two fundamental objectives, safety, and protection of human life (Ahmed et

Ghana is one of the developing countries where blood safety remains an issue of major concern in transfusion medicine; especially, when the national blood transfusion services does not have adequate state of the art infrastructure, trained personnel and financial resources.

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Human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV) are of great concern because of their prolonged viraemia and carrier or latent state. They also cause fatal, chronic and life-threatening disorders. Blood transfusion accounts for 5-10% of HIV infections in sub-Saharan Africa (Shrestha et al., 2009). Similarly, 12.5% of patients who received blood transfusions are at risk of post-transfusion hepatitis (Nwokeukwu et al., 2014). Hepatitis B virus is highly contagious and relatively easy to be transmitted from one infected individual to another by blood transfusion, during birth, by unprotected sex, and by sharing needles and has a relatively higher prevalence in the tropics (Gani, 2011; Sethi et al., 2014). A study conducted in Addis Ababa, Ethiopia showed that HCV antibody prevalence was 0.9% and higher among HIV positive compared to HIV-negative individuals (4.5% vs. 0.8%, respectively). Similarly, higher prevalence of HCV antibodies was seen among HIV-positive compared to HIV negative antenatal care attendees (2.9% vs. 0.8%, respectively), and sex workers (5.3% vs. 1.3%, respectively) (Nwankwo, 2012). Syphilis is also a systemic disease caused by Treponema pallidum which can be spread by sexual contact, blood transfusion and via vertical transmission (Farshad pour, 2010). A study conducted to assess the prevalence of infection with HIV, syphilis, and HBV among Ethiopian blood donors in 1995 showed that the seroprevalence of HIV-1, syphilis, and HBV was 16.7%, 12.8% and 14.4%, respectively (Li, 2012). Evaluation of trends in the prevalence of viral infections among blood donors is not only essential for estimating the effectiveness of blood safety strategies (Kafi-abad, 2009; Khedmat, 2009; Mohammad Ali, 2014) but it also gives clue to health policymakers to improve the current blood bank strategies to minimize the potential risk of acquiring these infections through blood transfusion (Nwokeukwu, 2014; Li, 2012; Song, 2014).

The continuous prevalence of HIV, HBV, HCV, and syphilis has heightened the problems of blood safety in Ghana. Thus, continuous monitoring of the magnitude of transfusion-transmissible infections in blood donors is important for estimating the risk of transfusion and optimizing donor recruitment strategies to minimize infectious diseases transmission. Therefore, this study

Table 1: Distribution of Blood Donors Stratified by Years for HBsAg and HCV from 2011 to 2015

Date	HBsAg Donors			HCV Donors		
Year	**Population**	**Total Pos.**	**Prevalence**	**Population**	**Total Pos.**	**Prevalence**
2011	24611	2873	11.67	22245	1605	7.22
2012	26546	2820	10.62	25204	1703	6.76
2013	26712	2615	9.79	25237	1865	7.39
2014	24964	2103	8.42	24942	1470	5.89
2015	9178	720	7.84	8754	432	4.93
Totals/ ***Average***	112011	11131	***9.67***	106382	7075	***6.44***

Table 2 shows the trend of HBsAg amongst males according to age categories. The most significant prevalence estimated was seen in the age category 0-14 with 1.49 and 1.57 in the years 2012 and 2014 respectively (average prevalence = 10.7 and 8.66) even though the year with the highest average prevalence was seen to be 11.07. More so, the age category of 50-54 within the years (2013) had the lowest prevalence of 0.17.

Table 2: HBsAg Prevalence for Males Amongst Age Categories – Blood Donors for 5 Years Period

Age	2011 (N=12371)		2012 (N=13168)		2013 (N=13390)		2014 (N=12638)		2015 (N=4491)	
Grouping	**Male(s)**	**%**	**Male(s)**	**%**	**Male(s)**	**%**	**Male(s)**	**%**	**Male(s)**	**%**
0-14	119	0.96	196	1.49	161	1.27	199	1.57	52	1.16
15-19	98	0.79	126	0.96	100	0.79	80	0.63	23	0.51
20-24	115	0.93	156	1.18	107	0.85	83	0.66	46	1.02
25-29	131	1.06	171	1.30	113	0.89	97	0.77	45	1.00
30-34	148	1.20	183	1.39	129	1.02	108	0.85	49	1.09
35-39	163	1.32	145	1.10	145	1.15	100	0.79	31	0.69
40-44	148	1.20	137	1.04	165	1.31	92	0.73	28	0.62
45-49	155	1.25	111	0.84	143	1.13	103	0.82	24	0.53
50-54	132	1.07	91	0.69	148	0.17	86	0.68	22	0.49
55-59	135	1.09	63	0.48	49	0.39	67	0.53	21	0.47
60+	25	0.20	30	0.23	31	0.25	79	0.63	13	0.29
Totals	**1,369**	**11.07**	**1,409**	**10.7**	**1,291**	**7.86**	**1,094**	**8.66**	**354**	**7.87**

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Table 3 shows the summary of prevalence from the age categories within the years. The various categories show a fluctuating decline in prevalence over the years from 2011 to 2015. The age group with the highest prevalence is 0-14 with an average prevalence of 2.02 while age 0-14 recorded the least average prevalence of 0.11 over the years.

Table 3: HCV Prevalence for Males Amongst Age Categories – Blood Donors for 5 Years Period

Age Grouping	2011 (N=6564)		2012 (N=8617)		2013 (N=10801)		2014 (N=10775)		2015 (N=5104)	
	Male(s)	%	Male(s)	%	Male(s)	%	Male(s)	%	Male(s)	%
0-14	66	1.01	174	2.02	75	0.69	120	0.11	37	0.72
15-19	51	0.78	83	0.96	34	0.31	69	0.64	16	0.31
20-24	87	1.33	101	1.17	68	0.63	52	0.48	30	0.59
25-29	97	1.48	97	1.13	116	1.07	68	0.63	23	0.45
30-34	88	1.34	88	1.02	137	1.27	63	0.58	19	0.37
35-39	81	1.23	80	0.93	111	1.03	74	0.69	20	0.39
40-44	83	1.26	61	0.71	118	1.09	68	0.63	19	0.37
45-49	86	1.31	61	0.71	119	1.10	49	0.45	12	0.24
50-54	66	1.01	44	0.51	93	0.86	61	0.57	13	0.25
55-59	64	0.98	36	0.42	32	0.29	57	0.53	10	0.20
60+	23	0.35	19	0.22	15	0.14	24	0.22	12	0.24
Totals	**792**	**12.08**	**844**	**9.80**	**918**	**8.48**	**705**	**5.53**	**250**	**4.13**

With regards to the trend of distribution of prevalence in females according to age categories as shown in the table 4, the most significant HBsAg prevalence amongst the years is 5.98% representing 2011. The minimal prevalence amongst females was 3.99 representing the year 2015.

Table 4: HBsAg Prevalence for Females Amongst Age Categories – Blood Donors for 5 Years Period

Age Group-ing	2011 (N=24611)		2012 (N=26546)		2013 (N=26712)		2014 (N=24964)		2015 (N=9178)	
	Female(s)	%	Female(s)	%	Female(s)	%	Female(s)	%	Female(s)	%
0-14	160	0.65	202	0.76	171	0.64	162	0.65	54	0.59
15-19	115	0.47	128	0.48	93	0.35	81	0.32	27	0.29
20-24	131	0.53	149	0.56	102	0.38	83	0.33	40	0.44
25-29	143	0.58	169	0.64	121	0.45	90	0.36	49	0.53
30-34	114	0.46	184	0.69	136	0.51	87	0.35	45	0.49
35-39	167	0.68	141	0.53	152	0.57	101	0.40	35	0.38
40-44	152	0.62	143	0.54	162	0.61	89	0.36	32	0.35
45-49	161	0.65	106	0.40	146	0.55	93	0.37	22	0.24
50-54	143	0.58	95	0.36	151	0.57	75	0.30	25	0.27
55-59	150	0.61	66	0.25	58	0.22	58	0.23	22	0.24
60+	38	0.15	28	0.11	32	0.12	90	0.36	16	0.17
Totals	**1,474**	**5.98**	**1,411**	**5.32**	**994**	**4.97**	**1,009**	**4.03**	**367**	**3.99**

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From table 5 above, the highest HCV prevalence for females according to age categories is 7.30 representing the year 2013 and the minimal prevalence is 5.02 representing the year 2015.

Table 5: HCV Prevalence for Females Amongst Age Categories – Blood Donors for 5 Years Period

Age Grouping	2011 (N=11260)		2012 (N=12491)		2013 (N=12965)		2014 (N=12620)		2015 (N=4398)	
	Female(s)	%	Female(s)	%	Female(s)	%	Female(s)	%	Female(s)	%
0-14	76	0.67	172	0.38	77	0.59	146	1.16	31	0.70
15-19	43	0.38	84	0.67	30	0.23	74	0.59	19	0.43
20-24	88	0.78	119	0.95	65	0.50	56	0.44	33	0.75
25-29	91	0.81	91	0.73	119	0.92	67	0.53	24	0.55
30-34	82	0.73	86	0.69	144	1.11	59	0.47	22	0.50
35-39	89	0.79	78	0.62	126	0.97	78	0.62	23	0.52
40-44	85	0.75	67	0.54	121	0.93	72	0.57	18	0.41
45-49	88	0.78	68	0.54	124	0.96	53	0.42	11	0.25
50-54	74	0.66	41	0.33	98	0.76	66	0.52	14	0.32
55-59	76	0.67	32	0.26	31	0.24	68	0.54	12	0.27
60+	21	0.19	21	0.17	12	0.09	26	0.21	14	0.32
Totals	**813**	**7.21**	**859**	**5.88**	**947**	**7.30**	**765**	**6.07**	**221**	**5.02**

Trend Analysis

The trend pattern of the prevalence for each year was taken into consideration and developed into trend lines. Male to female prevalence was compared yearly and interpreted as well as trends for total prevalence yearly.

A steady significant decrease in prevalence rate of HBsAg was revealed throughout the period under study, from 2011 to 2015 in the prevalence of 11.67 through to 7.84 (Fig. 1).

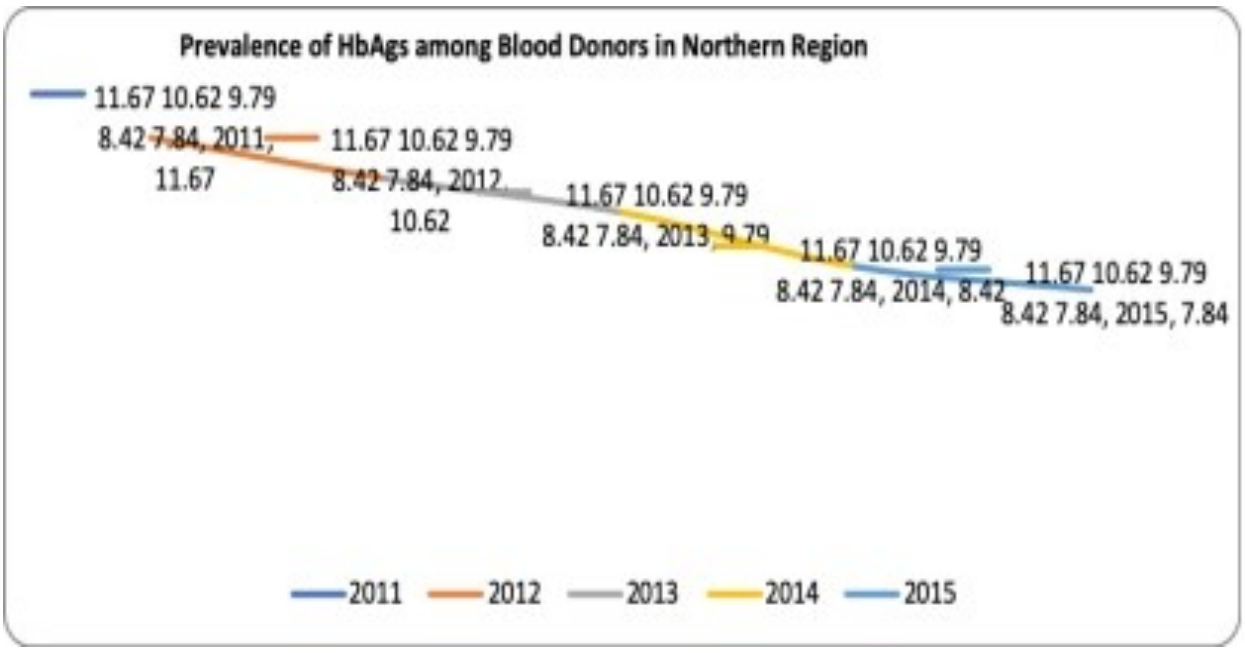

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Fig. 2 denotes a steady downward trend line from 2011 (7.2%) to 2012 (6.8) and a sharp rise in 2013 (7.4%). A more steady downward trend is shown from 2014 (5.9%) to 2015 (4.9%).

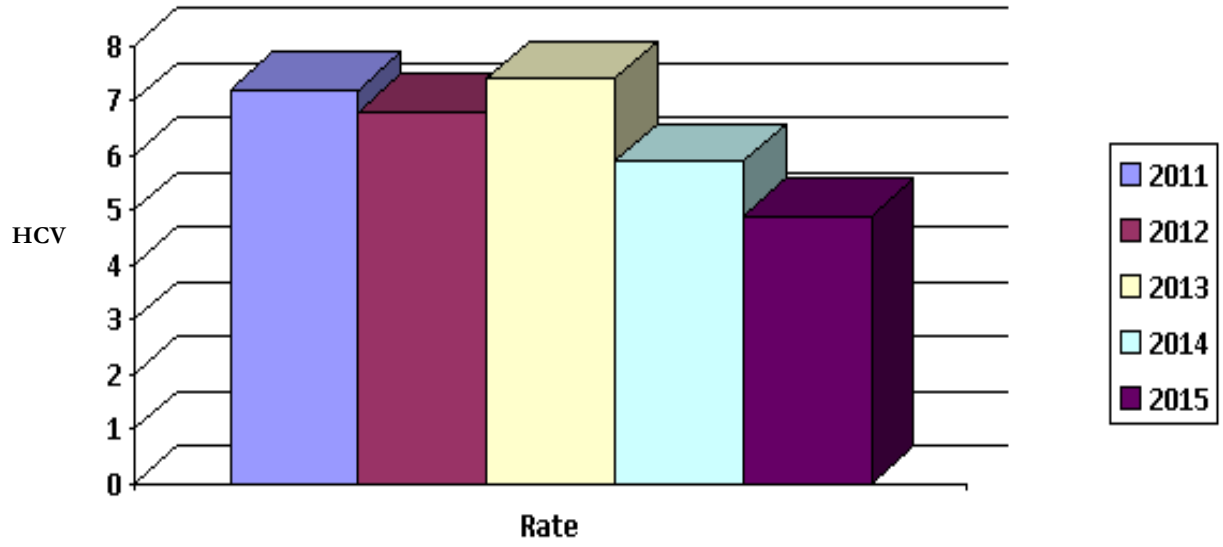

Fig. 2: Trend of Cases of HCV Among Donors of Blood Within the Northern Region 2011-2015

Fig. 3 shows the trend of prevalence from 2011 to 2015 for HBsAg. The trend shows a steady decline in yearly prevalence from 2011 to 2015 with 11.07 to 7.87 for males while females also recorded a steady prevalence decrease from 2011 to 2015 with 5.98 and 3.99 respectively. However, it was revealed that there was a sharp decline and an increase in the prevalence from 2013 to 2014 for males.

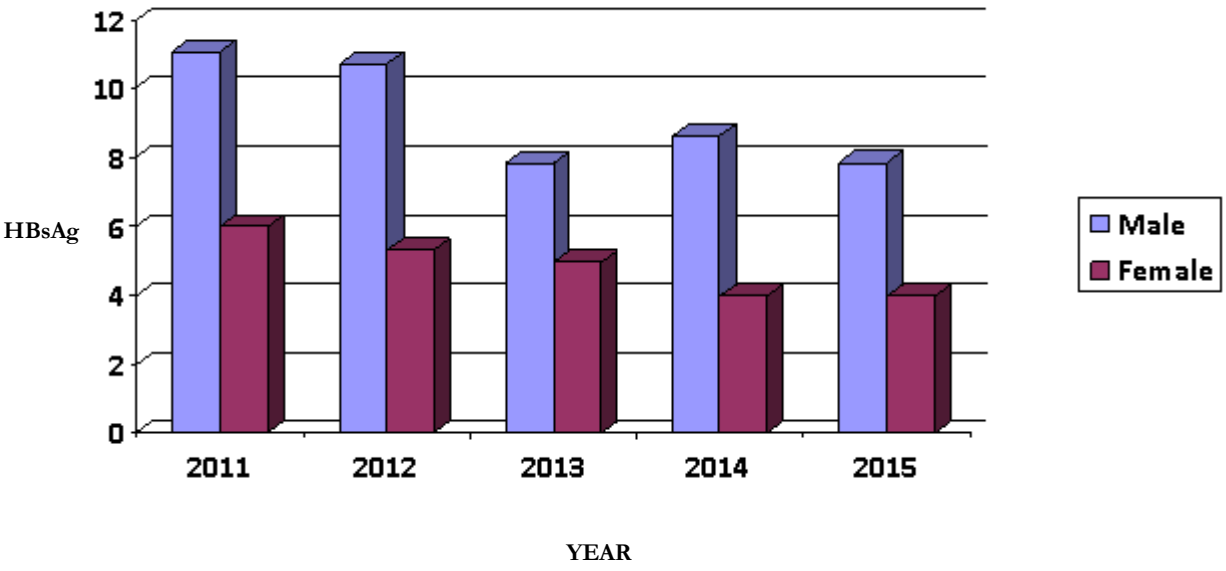

Fig. 3: Trend Analysis of Male and Female Prevalence from 2011 to 2015 for HBsAg

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The Fig. 4 shows the prevalence trend of HCV amongst blood donors from 2011 to 2015. Only females had a sharp increase in 2013 with a significant difference of 1.42%. Also, the graph revealed a general steady decline in the prevalence from 2011 to 2015 for both males and females with a statistically significant difference of 7.95% and 2.19% respectively.

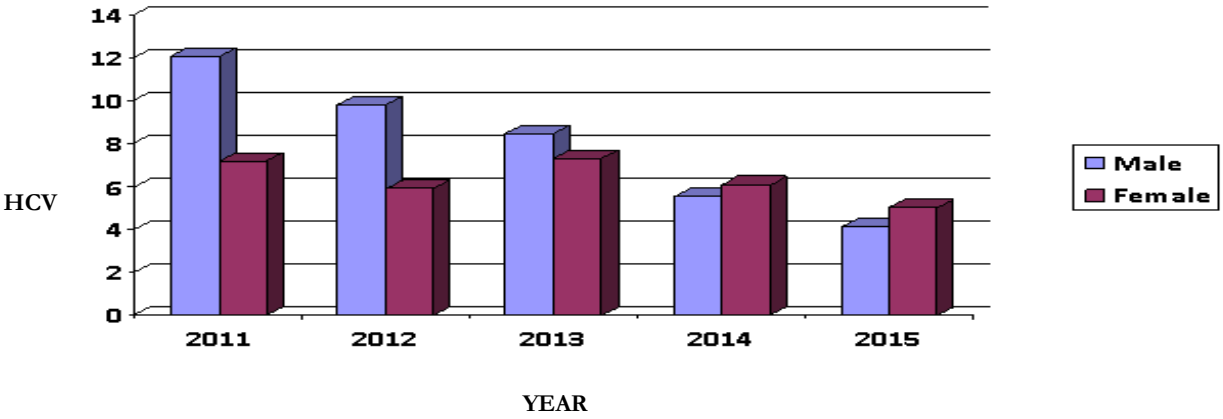

Figure 4: Trend Analysis of Male and Female Prevalence from 2011 to 2015 for HCV

The summary statistics for the independent samples t-test (Table 6) shows a mean difference between males and females to be 19.80 with standard deviations of 436.55 and 461.80 respectively. Both males and females recorded a slightly high standard error for means to be 195.23 and 206.52 respectively.

Table 6: Summarized Statistics for male and female Blood Donor's HBsAg Prevalence

	Sex	N	Mean	Standard Deviation	Standard Error Mean
HBsAg	Male	5	1103.20	436.554	195.233
	Female	5	1123.00	461.800	206.523

Table 7 shows the independent sample test for equality of means and variances as shown above. From Levene's test for equality of variance, we have an F-statistic which produces a p-value of 0.80. This tells us that we fail to reject H_0, which means that the population variance for males and females in the entire population are not different. The test statistics for equality of means from the group with equal variances depicts a not significant value of 0.946 compared to the significance level of 0.796 with a confidence interval of -675.159 to 635.559. From the test of significance, we say that there is no statistically significant difference between the prevalence of males and females over the five-year period.

Table 7: Independent Samples Test for Assumed and Equal Variances of Male and Female Donors

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HBsAg	**Equal variances assumed**	0.071	0.796	0-.070	8	0.946	-19.800	284.197	-675.159	635.559
	Equal variances not assumed			0-.070	7.975	0.946	-19.800	284.197	-675.519	635.919

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Table 8 reveals that mean statistics was 551.40 for males and 574.60 for females respectively which depicts a difference in means across the years but an unknown difference in statistical significance. The difference between the standard deviations was 13.47. A confidence level of 95% with a 1.96 critical value was used in a one-tailed test to obtain the t-test value of 0.036 (Table 9). The p-value of 0.854 is greater than a 95% confidence level with 1.96 critical value which is 0.05 ($p>0.05$).

The test statistics, therefore, falls in the region of rejection, hence to fail to reject H_0. So, therefore, there is no difference between the prevalence amongst males and female blood donors in the region, any difference detected is as a result of chance.

Table 8: Summarized Statistics for Male and Female Blood Donor's HCV Prevalence

	Sex	N	Mean	Std. Deviation	Std. Error Mean
HCV	**Male**	5	551.40	381.653	170.681
	Female	5	574.60	395.124	176.705

Table 9: Independent Samples Test for Assumed and Equal Variances of Male and Female Donors

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HCV	**Equal variances assumed**	0.036	0.854	-0.094	8	0.927	-23.200	245.675	-589.729	543.329
	Equal variances not assumed			-0.094	7.990	0.927	-23.200	245.675	-589.847	543.447

Discussion

HBsAg and HCV infections occurrence among blood donors in the northern region was determined by serological methods of which the results were compared year on to assess the trends in five consecutive years, 2011, 2012, 2013, 2014, and 2015. The general trend of HBsAg cases across the years showed a general and steady decline all year on. Statistics from early studies have also shown that there is a general decline in cases of HBsAg amongst blood donors as confirmed by Miller et al. (2014).

This study trend estimated conforms to the trend of HBsAg cases in blood donors as stipulated by earlier studies such as the study conducted by Elbjeirami WM, Arsheed NM, Al-Jedani HM, Elnagdy N, Hazem M, et al. (2015) and Liu et al. (2013).

This significant decline might be attributed to other factors like social and economic determinants as well as awareness creation of these viral infections in the country.

More so, the trend of HCV was also examined and it was realized that there was a steady decline with a sharp increase in 2013 and a subsequent decline trend line estimated, which depicts a statistically insignificant decline in the prevalence rate across the five (5) years period. These actually contest the view of other studies that depicts a marginal decline in trend of HCV cases across the years in blood donors, as stated by Rezvan (2009).

This trend suggests that not much is being done in controlling the enabling factors and determinants of the incidence of syphilis across the years.

It was also realized from the analysis that there was a significant and consistent decline in prevalence notified yearly according to males and females within the age categories estimated. This was basically a trend seen in HBsAg prevalence within the age categories of males and females.

It was also revealed from the analysis that, HCV prevalence as estimated for females appreciated significantly from 5.8 in 2012 to 7.3 in 2013 while for males there was a significant and steady decline from 2011 to 2015 with 12.08 to 4.13 respectively. This steady but slow prevalence seen over the five-year period in our analysis raises a lot of concerns with regards to the degree of blood donors reactive to various viruses of interest to public health. This in the opinion of the researchers poses a lot

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of threat to the work force, human development and socio-economic growth of the country.

Nevertheless, the research team also further sought to find out whether there is a significant difference in prevalence between males and females across the years of interest regarding HBsAg and HCV. The results noted that, there was no significant difference between the prevalence of males and females for HBsAg and HCV reactive cases amongst blood donors. This therefore tells us that, there is no significant difference in the infection rate of males and females in the region for blood donors.

Lastly, an average prevalence of 6.7 was seen over the five years period for HBsAg cases whiles a 5.5 prevalence was recorded for HCV cases for blood donors within the regional setting. This tells us that the rate of spread of HBsAg is more predominant than the spread of HCV.

Even though the Ghana Health Service has set up a body to manage the affairs of other serious infections like HIV, much is yet to be done for HBsAg and its related complications in the country. However much has been done with regards to awareness of HBsAg, it still poses a strong public health threat to the region and the country as a whole.

The rate of infections keeps fluctuating for HBsAg giving an indication to how volatile the virus is as well as having an averagely high prevalence over the years.

Conclusion

Infections with HBsAg and HCV were more prevalent in male donors. Highest sero-prevalence for both HBsAg and HCV was observed among donors between 20 to 49 years, while both seroprevalence slightly increased with age. This means that government and policy makers, as well as other stakeholders should emphasize more on the youth, and especially the male sex in rolling out interventions and campaigns aimed at mitigating these infections. There exists a decreasing trend of transfusion-transmissible viral infections (i.e. HBsAg and HCV) in blood donations. This indicates that the Ghana National Blood Service's mandate of ensuring the safety of blood supply has been successful since the prevalence of viral infections have been reduced to very low levels in blood donations over the years. However, more effective techniques such as polymerase chain reaction (PCR) are needed to guarantee blood safety. More outreach screening and sensitization programmes by the National Blood Service will help in reducing the prevalence.

In conclusion, blood bank services represent the heart of blood transfusion in the country and as such plays an important role in the health service delivery to saving lives.

It is therefore important that all blood donated be screened for possible infections of certain infectious diseases of public health concern. The prevalence trend to HBsAg and HCV of blood donors for the five years period informs the service to carefully monitor the screening process to further reduce the risk of transfusing infected blood to vulnerable patients.

Measures such as more sensitive techniques, education, and sensitization must be carried out to ensure that people are well enlightened and protected from these infections of public health interest.

The trend of HBsAg and HCV amongst blood donors is averagely higher than the clinical trends over the years of interest. This tells us of a worrying trend of reactive but not confirmed cases of HBsAg and confirmed cases of HCV that are in one way or the other not treated. Measures should be taken to address these huge cases left to the mercies of their communities.

Also measures such as sensitive techniques as well as confirmation of these cases, education and sensitization of the populace should be enhanced in order to enlighten and to protect the exposed population to these diseases.

The study is limited by the fact that no history of the subjects is known with regards to blood donation and other factors. But it is assumed that those conditions would have been addressed as part of the protocol for the blood donation exercise.

Competing Interests

No competing interests.

Ethical consideration

This study was approved by the ethics review team of the Navrongo Health Research Center Institutional Review Board with reference number NHRCIRB 328.

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