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Prevalence of Hepatitis C Infections Among the Outpatient Population of Selected Hospitals Within Kaduna City, Nigeria

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Abstracts: Hepatitis C is a serious blood borne infection of the liver caused by the Hepatitis C Virus. The prolong infection of the liver by this Virus results to liver disease leading to its failure, cirrhosis or hepatocellular carcinoma (Liver cancer). The Hepatitis C Virus is a growing public health problem worldwide infecting an estimate of over 170 million people with majority from Africa and Asia. A total of 300 samples were collected from outpatients in six hospitals within the Kaduna City, Nigeria. Fifty samples were from each hospital. The outpatients' Blood groups and Rhesus factors were identified using Blood group Anti-sera and their respective serum were screened for presence of HCV antibody using commercially available kits. Analysis of the results revealed a prevalence rate of 5.33% within the metropolis. This was regarded as high based on the global epidemiological HCV severity estimates reported by the American Center for Disease Control and Prevention (CDC). Chi square test for independence between two variables showed statistically significant associations between anti-HCV positivity and Sex/Gender with men more positive for anti- HCV than females (10.52%, $P \leq 0.002$), Blood grouping with more positive cases among blood group AB (15.39%, $P \leq 0.03$), Occupation, more positive cases observed among the unemployed (15.38%, $P \leq 0.04$) and patients with HIV/AIDS (40.00%, $P \leq 0.001$). These were identified as key risk factors for the spread of the Virus within the metropolis. The mean age observed for the distribution of the virus (a measure of central tendency) within the City was 32.20 (CI=32.20 ±2.01) years.

Keywords: Prevalence, Hepatitis C Virus, Hepatitis C Infections, Outpatient Population, Selected Hospitals, Kaduna Nigeria

1. Introduction

Hepatitis C is a serious blood borne infection of the liver caused by a virus called the Hepatitis C Virus [1; 2]. The infection of the liver by this Virus can be fatal and is transmitted primarily through contact with infected blood and blood products [3]. Other means of transmission include: Injection drug use, needle stick injury while sexual and mother to child transmission occur but considered inefficient modes [4]. Prolong infection of the liver by the Hepatitis C Virus leads to its gradual deterioration and damage causing Hepatitis C disease with an increasing risk of failure, cirrhosis and hepatoceullar carcinoma [4; 5]. The infection also cause autoimmune reactions including Glomerulonephritis, Purpura and Vasculitis among others [4]. Majority of the victims of the Virus especially those with chronic cases might not even be aware of the infection due to sub-clinical or absence of clinical illness [2; 6]. Acutely

infected persons may show symptoms of fatigue, nausea, vomiting, decreased appetite, abdominal pains, jaundice, grey-colored feces, dark urine among others [7]. The Hepatitis C Virus is about 80nm in diameter; an enveloped virion containing a linear single stranded RNA of positive polarity but without polymerase and belongs to the genus *Hepacivirus* of the *Flaviviridae* family of Viruses [4; 8]. The Virus loses its stability and becomes inactivated when exposed to organic solvents (ether and chloroform), detergents and dry heat at 80°C or wet heat at 60°C [9]. The Hepatitis C viral replication process begins by viral attachment to the surfaces of liver cells (hepatocytes) and lymphocytes [10]. Viral nucleic acid (RNA) is released from the nucleocapsid into the host's cell cytoplasm where replication occurs [8]. The Hepatitis C Virus replicates at a high level and appears to tolerate sequence variation [11]. Interferon alfa combined with ribavirin cures less than 50% of infected persons and no available vaccine against the Virus [9; 10]. Some plants extracts including *Acasia nitolica* among many as well as juice from ginger have shown inhibitory effects against HCV [12]. The Hepatitis C Virus is a growing problem worldwide with an estimate of over 170 million people infected and majority from Africa and Asia [8; 9; 10; 13]. The Virus has been reported in some parts of the World including Nigeria such as: among HIV positive women attending a rehabilitation center and University students co infected with HBV in Maiduguri both in Nigeria [14; 15]. Also, among the public in Makurdi Central, potential blood donors in Ibadan and Kano as well as pregnant women in Kaduna State, Nigeria [16; 17; 18; 19].

This research work determined the prevalence of the Hepatitis C virus among the outpatient population of selected Hospitals within the city in relation to certain risk factors. The assessment of the viral disease burden, making recommendations that could mitigate spread and improve public health constituted the significance of this work.

2. Materials and Methods

The study subjects were children from ages one to the elderly at 90 years including males, females, indigenes and non-indigenes. Ethical approval was obtained from the Kaduna State Ministry of Health Ethical Committee to visit each of these hospitals. A total of six (6) hospitals were visited for sample collections within the metropolis.

Participants were well informed about the importance of the research and its relevance to public health and their consents to participate were obtained through consent forms. Questionnaires were also used to obtain socio-demographic data for risk factors assessment from those with positive response to the consent forms [20].

Fifty blood samples were collected from each of the six hospitals visited making a total of 300 samples in all [20; 21] Two milliliters of blood was collected intravenously from each consented outpatient from the respective hospitals using a 2 ml syringe and transferred immediately into a plain bottle bearing the label for the patient. The samples were taken to the Medical Microbiology laboratory of Kaduna State University, Kaduna, Nigeria for processing.

The Blood group and Rhesus factor of each blood sample was determined using Blood group anti-sera. Serum was separated from each sample by centrifuging at 1000 rpm for 10 minutes and used for testing the presence of HCV using an in vitro one step strip style ANTI-HCV rapid screen test kits for detection of antibody to HCV in human serum/Plasma (ISO 13485 Certified Wondfo Biotech Co, Ltd. USA). Results were read and interpreted according to manufacturer's instructions and interpretations. All the results were organized into tables according to risk and demographic factors respectively. Chi square test for independence between two variables was used to determine the association between each risk factor and positivity for Hepatitis C Virus at a fixed level hypothesis testing of 5% significance. The probability values were derived from the calculated and chi square critical values at a certain degree of freedom to identify potential risk factors within the City through test of significance [22; 23]. These were used on hypothesis testing for risk factors and anti-HCV positivity associations.

Null Hypothesis (H_O): There was no association between positivity for anti-HCV and a particular risk factor (Risk and Prevalence were independent).

Alternative Hypothesis (H_A): There was an association between positivity for anti-HCV and a particular risk factor.

3. Results

Out of the 300 samples from the 6 hospitals analyzed, 16 were found to be reactive to anti-HCV. These accounted for 5.33% of the total samples tested. The remaining 284 were found to be non-reactive to anti-HCV making 94.67% of the total samples analyzed. The prevalence rate of 5.33% obtained in this study was regarded as high defined by the HCV severity rates of <1.5%=low, 1.5-3.5%=moderate and ≥3.5%=High [24] (Table 1).

Table 1. *Prevalence and Severity Rate for Hepatitis C infections among outpatients within Kaduna City, Nigeria.*

Anti-HCV Reaction	Number of Persons	Percentages (%)	HCV Severity Rate Classification
Positive	16	5.33	High
Negative	284	94.67	
Total	300	100	

The prevalence of HCV in relation to age was observed to be moderate among children within ages 01-10 but high among outpatients within age groups 11-20, 21-30, 31-40, 41-50 and 51-60 respectively. No positive case was observed among outpatients within ages 61-90. The estimation of critical values and derivation of the probability associating age and positivity for anti-HCV revealed a value of $P \leq 0.85$ (Table 2). The mean age for the spread of HCV among the subjects within the City was observed to be 32.20 years with a CI=32.20 ± 2.01 Years (Appendix).

Table 2. *Age- group prevalence of Hepatitis C infections among outpatients within Kaduna City, Nigeria.*

Risk Factor	Number Tested	Anti-HCV Antibody			
Age Group (Years)		Positive cases	Prevalence rate (%)	HCV Severity rate Classification	$P \leq 0.05$
01-10	31	1	3.22	Moderate	$P \leq 0.85$
11-20	26	2	7.69	High	
21-30	76	3	3.95	High	
31-40	90	4	4.44	High	
41-50	49	5	10.20	High	
51-60	16	1	6.25	High	
61-70	8	0	0.00	Nil	
71-80	3	0	0..00	Nil	
81-90	1	0	0.00	Nil	
Total	300	16			

Table 3 shows that 114 Males and 186 Females were sampled in this study. Twelve males tested positive for anti-HCV antibody accounting for 10.52% of the total males screened. On the other hand, 4 females were reactive to anti-HCV antibody accounting for 2.15% of the total female samples analyzed. The calculated chi square critical value was found to be 9.8208 against a tabulated value of 3.841 at 1 degree of freedom and a probability of $P \leq 0.002$ (Appendix).

Table 3. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Sex/Gender.*

Risk	Number Tested	Anti-HCV Antibody				
Sex		Positive cases	Prevalence rates (%)	X^2 Calculated Critical value	X^2 Tabulated Value at 1df	$P \leq 0.05$
				9.8208	3.841	$P \leq 0.002$
Male	114	12	10.52			
Female	186	4	2.15			
Total	300	16				

Among the 81 singles sampled and tested, 4 were positive for anti-HCV antibody. These accounted for 4.94% of the total singles screened. Twelve samples out of 214 married outpatients analyzed were found reactive to anti-HCV antibody making 5.41% of the total married persons tested. Three widows and 2 separated outpatients tested were found to be non-reactive to anti-HCV respectively. No divorced person was encountered in the study. No significant association was observed between marital status and anti-HCV positivity ($P \leq 0.99$) (Table 4).

Table 4. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Marital Status.*

Risk Factor	Number Tested	Anti HCV Antibody				
Marital status		Positive Cases	Prevalence Rates (%)	X^2 Calculated Critical value	X^2 Tabulated Value at 4 df	$P \leq 0.05$
				0.3426	9.488	$P \leq 0.99$
Singles	81	4	4.94			
Married	214	12	5.41			
Widowed	3	0	0.00			
Separated	2	0	0.00			
Divorced	0	0	0.00			
Total	300	16				

Table 5 shows that 86 subjects belong to blood group A. Analysis of samples from these subjects revealed 4 positive cases for anti-HCV accounting for 4.65% of this category of outpatients. Sixty six outpatients belonged to blood group B out of which 7 were found reactive to anti-HCV accounting for 10.61% of the total blood group B persons tested. Thirteen samples were found to belong to blood group AB out of which 2 persons reacted positively for anti-HCV making 15.39% of the blood group AB persons screened. The remaining 135 outpatients belong to blood group O out of which 3 tested positive for the Hepatitis C Virus accounting for 2.22% of the total blood group O individuals' tested. The Chi square calculated value was found to be 8.9294 against a tabulated value of 7.8150 at 3 degree of freedom giving a probability value of $P \leq 0.03$.

Table 5. *Prevalence of HCV infections among outpatients within Kaduna Metropolis in relation to Blood Groups.*

Risk Factor	Number Tested	Anti-HCV Antibody				
Blood Group		Positive Cases	Prevalence Rates (%)	X^2 Calculated Critical value	X^2 Tabulated Value at 3 df	$P \le 0.05$
				8.9294	7.8150	$P \le 0.03$
A	86	4	4.65			
B	66	7	10.61			
AB	13	2	15.39			
O	135	3	2.22			
Total	300	16				

Investigations of Rhesus factor reactions from the blood samples collected revealed 284 outpatients to be Rhesus positive while 16 were Rhesus negative. Out of the 284 Rhesus positive outpatients tested, 16 were found to be positive for anti-HCV antibody. These accounted for 5.63% of Rhesus positive persons tested. The remaining 16 Rhesus negative individuals were non reactive (0.00%) to anti-HCV antibody. The calculated Chi square critical value was found to be 0.9481 against a tabulated value of 3.8410 at 1 degree of freedom giving a non significant probability value of $P \le 0.33$ (Table 6).

Table 6. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Rhesus factor.*

Risk Factor	Number Tested	Anti-HCV Antibody				
RH Factor		Positive Cases	Prevalence Rates (%)	X^2 Calculated Critical value	X^2 Tabulated Value at 1 df	$P \le 0.05$
				0.9481	3.8410	$P \le 0.33$
RH^+	284	16	5.63			
RH^-	16	0	0.00			
Total	300	16				

Table 7 shows that 63 Civil Servants were tested for anti HCV in this study. Two out of this 63 were found to be reactive to anti HCV antibody. These accounted for 3.17% of the total civil servants tested. Out of the 48 business men and women tested, 5 were positive for anti-HCV antibody accounting for 10.12% of total samples from this category of patients. Thirteen unskilled workers were tested and none (0.00%) was found reactive to anti HCV. Four out of the 26 unemployed tested were positive for anti-HCV. These accounted for 15.38% of the total unemployed outpatients sampled.

Patients with occupation captioned "Others" consisted of students, farmers, clergies and retirees. Analysis of 150 samples from these outpatients revealed 5 to be reactive to anti-HCV accounting for 3.37% of these patients. A statistical significant association was observed between anti-HCV positivity and occupation with a probability of $P \le 0.04$

Table 7. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Occupation.*

Risk Factor	Number Tested	Anti-HCV Antibody				
Occupation		Positive Cases	Prevalence Rates (%)	X^2 Calculated Critical value	X^2 Tabulated Value at 4 df	$P \le 0.05$
				10.1336	9.4880	$P \le 0.04$
Civil Service	63	2	3.17			
Business	48	5	10.12			
Unskilled workers	13	0	0.00			
Unemployed	26	4	15.38			
Others	150	5	3.37			
Total	300	16				

Out of 40 samples from outpatients with tribal marks analyzed, none was positive for anti-HCV (0.00%, $P \le 0.12$). Seventy four persons had knowledge of hepatitis out of which 3 reacted positively to anti-HCV antibody accounting for 4.05% of this population ($P \le 0.57$). Two hundred and eight outpatients eat in public places. Analysis of their samples revealed 11 persons (5.29%, $P \le 0.96$) to be positive for anti-HCV. Two hundred and twelve subjects had history of sharing beddings or clothes out of which 11 tested positive for anti-HCV (5.19%, $P \le 0.86$). Twenty six individuals were from families with positive history of HCV infections. Analysis of their samples revealed no positive reaction for anti-HCV antibody (0.00%, $P \le 0.21$) (Table 8).

Table 8. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Social Factors.*

Risk Factor	Number Tested	Anti-HCV Antibody				
Social Factors		**Positive Cases**	**Prevalence Rates (%)**	X^2 **Calculated Critical value**	X^2 **Tabulated Value at 1 df**	$P \leq 0.05$
Tribal Marks	40	0	0.00	2.4727	3.8410	$P \leq 0.12$
Have Knowledge of Hepatitis	74	3	4.05	0.3205	3.8410	$P \leq 0.57$
Eat in public places	208	11	5.29	0.0025	3.8410	$P \leq 0.96$
Sharing clothes/Bedding	212	11	5.19	0.03062	3.8410	$P \leq 0.86$
Positive Family History	26	0	0.00	1.5449	3.8410	$P \leq 0.21$

Analysis of samples from patients with history of different clinical cases revealed no positive case for anti-HCV from 24 blood recipients and 25 subjects with hypertension respectively ($P \leq 0.23$, $P \leq 0.22$). On the other hand, analysis of samples from 13 Diabetics revealed 2 positive cases for anti-HCV. These accounted for 15.39% of total diabetics tested also giving a chi square calculated critical value of 2.744 against a tabulated value of 3.8410 at 1 degree of freedom ($P \leq 0.10$). Two out of five HIV/AIDS patients tested were positive for anti-HCV making 40.00% of this category of subjects. A highly significant association was observed between HIV/AIDS patients and anti-HCV positivity ($P \leq 0.001$). Subjects with clinical history named "Others" included those with undiagnosed clinical cases. Analysis of their samples revealed no positive case (0.00%, $P \leq 0.73$) (Table 9).

Table 9. *Prevalence of HCV infections among outpatients within Kaduna City in relation to individual Clinical history.*

Risk Factor	Number tested	Anti-HCV Antibody				
Clinical History		**Positive Cases**	**Prevalence Rates (%)**	X^2 **Calculated Critical value**	X^2 **Tabulated Value at 1 df**	$P \leq 0.05$
Blood recipients	24	0	0.00	1.4696	3.8410	$P \leq 0.23$
Hypertension	25	0	0.00	1.5324	3.8410	$P \leq 0.22$
Diabetics	13	2	15.39	2.744	3.8410	$P \leq 0.10$
HIV/AIDS	5	2	40.00	11.915	3.8410	$P \leq 0.001$
Others	2	0	0.00	0.1172	3.8410	$P \leq 0.73$

4. Discussions

Most recent global estimates for Hepatitis C prevalence revealed fluctuations in rates from one region of the world to another with approximately 10% in Egypt in Africa [24]. The prevalence rate of 5.33% obtained in this study is regarded as high defined by the HCV severity rates of <1.5%= low, 1.5-3.5%=moderate and ≥3.5%=high [24; 26]. This suggests that quiet a significant number of the human population within the city is infected with the Virus. The city is thus highly endemic probably due to unavailability of HCV Vaccines or inadequate knowledge for preventive measures among the population. This trend agrees with reports of previous studies in some locations of the state such as: 5.2% among blood donors in Ahmadu Bello University Teaching Hospital (ABUTH) Shika Zaria, 4.5% among pregnant women and 6.2% obtained in the study of molecular epidemiology of the virus in Kaduna state [19; 27; 28]. Nevertheless, the result of this study is higher than 1.4% reported among blood donors in Ibadan in 2012 and 2.8% reported in Makurdi North Central in 2013 both in Nigeria [16; 17]. Similar to other reports of previous studies in different population subgroups in Nigeria, Africa and even the Middle East, there are different prevalence rates for Hepatitis C infections by locations [29]. Higher prevalence have been reported in other locations in Nigeria such as 13.3% among residents of a local community in Keffi in Nassarawa state, 8.00% among first year undergraduate of the University of Ilorin Kwara State, 8.62% among women attending a rehabilitation centre, 10% among children attending the University of Maiduguri Teaching Hospital, Maiduguri, Borno state, Nigeria [14; 30; 31; 32]. The 5.33% rate obtained in this study is greater than the 5.20% reported in 2012 in Kaduna metropolis. Similarly, the 3.4% reported among blood donors in Kano in 2012 is greater than the 1.3% reported among blood donors in 2010 in same Kano, Nigeria [18; 19; 33]. These trends suggest a rising or increasing in prevalence for the Hepatitis C Virus in these locations. The difference between the prevalence rate observed in this study and reports of previous studies above could be due to location and population differences hence prevalence rates are known to vary between population groups and from one location to another [29].

The mean age of 32.20 years obtained as measure of central tendency suggests the average age at higher risks for the distribution of the HCV within the city $(CI = 32.20 \pm 2.01)$.

The prevalence rate of 3.22% among ages 01-10 classified as moderate suggests moderate exposure of infants and children to the Virus with a minimal or absence of mother to child transmission. The higher prevalence in relation to age observed within ages 41-50 (10.20%) suggests that individuals within this age group are more exposed to the Virus than persons in other age groups. This could probably be attributed to the active lifestyles associated with individuals within this age group. This report is closely

similar to a previous report of 10.70% among pregnant women attending antenatal at the University of Benin Teaching Hospital ages 38 years [33]. The absence of any positive case among patients ages 61 and above suggests that the elderly are less exposed to the Hepatitis C Virus. This could be due to reduced human activity caused by ageing. This agrees with a previous report of 0.0% among blood donors above 54 years in Kano, Nigeria [18]. The probability value $P \leq 0.85$ Suggest that age contributes insignificantly to hepatitis C positivity. All persons become infected when expose to the Virus regardless of age.

The 186 females sampled against 114 males indicate that more females participated in this study than males. The 10.52% observed among males greater than 2.15% in females suggest that males are more exposed to the Virus than females within the City. This could probably be due to masculine responsibilities and activities that expose males to the Virus more than females. This trend agrees with reports of previous studies for higher prevalence in males than females among HBV-HCV co infected students of the University of Maiduguri (4.9%, 2.6%) [15]. Also, 3.4% among males and 0.0% among females blood donors in Kano [18]. The calculated chi square critical value of 9.8208 against a tabulated value of 3.841 at one degree of freedom suggests enough/significant evidence to reject the null hypothesis which states that gender and HCV positivity are independent. This shows a significant association between gender and HCV positivity with males (10.52%) being more positive for HCV antibody than females (2.15%) ($P \leq 0.002$).

The high prevalence of HCV (5.41%) observed among the married could be attributed to positive family cases. The prevalence rate of 4.91% observed among singles could be due to active and risky lifestyles caused by exertion of youthful exuberance leading to exposure to the Virus. The sample size of the married (214) and singles (81) observed to be much higher than other study groups in this category might have contributed to the large number of positive cases recorded respectively. The absence of any positive case among the widows and separated suggests a calm lifestyle among these study groups. The calculated critical value of 0.3426 against a tabulated value of 9.488 at 4 degrees of freedom suggests the absence of evidence to reject the null hypothesis. Therefore, no significant association observed between marital status and positivity for HCV antibody ($P \leq 0.99$). This results agree with reports of previous studies among blood donors in Kano for higher prevalence among the married (2.8%) than the singles (0.6%) with a probability of P=0.929 [18]. On the other hand, this contrasts a previous report of 3.7% among singles against 0.9% among married patients in Sokoto, Nigeria (P=0.263) [35]. This variation in trend could be attributed to location and exposure differences suggesting all persons have the same predisposition to infection when exposed to the Virus regardless of marital status [29].

This study revealed blood group O individuals to be more common than individuals with other blood groups within the City. Nevertheless, higher HCV prevalence was obtained among blood group AB outpatients. This agrees with previous reports for 231 blood group O persons out of 300 blood donors in Portharcourt city, Nigeria [29]. Also 119/347 blood donors in the Al-Ramadi city of Bagdad and higher prevalence among blood AB blood donors [36]. The higher prevalence of 15.39% observed among subjects of blood group AB suggest that individuals with this blood group have a high tendency for HCV infection when exposed to the Virus, while blood group O persons have the least tendency for HCV infection (2.22%). This could probably be due to differences in immunity for the different blood groups.. The calculated chi square critical value of 8.9294 which was greater than the tabulated value of 7.8150 at 3 degree of freedom showed a significant association between blood group and HCV positivity within the City ($P \leq 0.03$). This suggests that blood group is a potential risk factor for HCV infection among the inhabitants of Kaduna City.

The larger number of Rhesus positive individuals (284/300) observed than Rhesus negative persons (16/300) suggests that Rhesus positive individuals are more in population within the City than Rhesus negative persons. This agrees with reports of previous studies in other locations of the world such as: 115/130 among blood donors in Iran and 5984/6361 among blood donors in Gondar University Teaching Hospital Ethiopia [37; 38]. The probability value of $P \leq 0.33$ supported by a calculated Chi square critical value of 0.9481 against a tabulated value of 3.8410 at 1 degree of freedom shows that there was no significant association between Rhesus factor and HCV positivity. This supported the null hypothesis that Rh factor and HCV positivity are independent suggesting that Rhesus factor is not a potential risk factor for Hepatitis C infections among the outpatients tested.

The highest prevalence of 15.38% observed among the unemployed could probably be attributed to hardship and inadequate economic resources predisposing them to risky lifestyles exposing them to the Virus. Unskilled workers in this study referred to commercial bus drivers, tailors, industrial cleaners, hair dressers. The absence of any positive case among these subjects suggests their less exposure to sources of HCV infection. This could probably be due to little number of outpatients in this category sampled (13/300) or the absence of occupational exposure that predisposes them to contraction of the Virus. On the contrary, previous studies have reported higher prevalence among subjects with other occupation such as: 2.7% being highest among student blood donors in Ibadan, 2.5% among self employed blood donors in Kano, 4.2%, (P=1.33) among the employed in Makurdi North Central, Nigeria [16; 17; 18]. These differences could probably be due to variations in traditions, lifestyles and location [29]. The calculated chi square critical value of 10.1336 against a tabulated value of 9.4880 at 4 degree of freedom supports the rejection of the null hypothesis but acceptance of the alternative hypothesis. This suggests that, there is a statistically significant association between occupation and HCV positivity ($P \leq 0.04$). Occupation was thus a potential risk factor for HCV infection within the Kaduna City. The more the occupational exposure to the Hepatitis C Virus, the more the predisposition to infection.

Though a high prevalence rates for HCV was observed among outpatients eating in public places (5.29%), there was no statistically significant association between this social factor and positivity for HCV antibody ($P \leq 0.12$) This suggests that eating in public places does not risk contraction of HCV but those with the positive cases might have been affected by other potential risk that enabled them to contract the Virus. The absence of a significant association between sharing of clothes or Bedding materials and HCV positivity ($P \leq 0.86$) suggests that these items do not significantly contribute to the spread of HCV infections among the population within the City. Therefore, sharing of clothes or Beds with HCV positive persons does not pose a significant risk for HCV contraction within the Kaduna City. The probability value of $P \leq 0.21$ shows that living among HCV positive family members does not predisposes one to contraction of the Virus without exposure. This could explain the 0.00% prevalence rate observed among outpatients from positive family members.

The probability value of $P \leq 0.001$ for HIV/AIDS outpatients showed a statistically significant association between HIV/AIDS and positivity for HCV antibody. This was contributed by the large prevalence rate for HCV observed among HIV/AIDS patients (40%). A Prevalence rate of 3.3% for Hepatitis C Virus has been reported among HIV patients at Mulago Hospital in Uganda [39]. The difference in the rates could be due to population or sub-regional differences [29]. Persons with clinical conditions such as Diabetes and Hypertension did not show any significant association with HCV positivity ($P \leq 0.10$, $P \leq 0.22$). These suggest that being diabetic or hypertensive is not a predisposition factor for contracting HCV but only with exposure to the Virus. The absence of any positive case among blood recipients (0.00%) could be attributed to improvements in screening of blood samples for transfusion. Therefore, blood transfusion did not contribut significantly to the spread of HCV within the City ($P \leq 0.23$). Patients with undiagnosed clinical cases captioned "Others" did not show any significant association with HCV positivity ($P \leq 0.73$).

5. Conclusion and Recommendations

This study confirmed reports of previous studies that HCV is a growing global health problem. A prevalence rate of 5.33% was obtained for HCV infections within the Kaduna City, Nigeria. This is regarded as high indicating that the city is hyper endemic with the Virus.

Potential risk factors associated with HCV contraction identified among the population within the Kaduna City include:

Gender particularly among males, Blood group (AB), Occupation and HIV/AIDs positivity

More research needs to be carried out on HCV Vaccines. There is need for governments around the nations of the globe to support researches on HCV so that effective control mechanisms can be developed against this Virus. Intervention organizations, Charity groups, Religious Bodies and Non-Governmental Organizations should assist communities particularly to treat infected cases in order to curb the spread of this Virus. Also, Education and Public enlightenment to be carried out by health personnel so that infected individuals could seek further confirmatory tests in order to guard against the development of liver complication.

Key

HCV=Hepatitis C Virus

X^2=Chi Square

CI=Confidence Interval

%=Percentage

P =Probability

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Appendix: Prevalence of Hepatitis C Infections Among the Outpatients Population of Selected Hospitals Within the Kaduna Metropolis, Nigeria

Table A1. *Prevalence of HCV among outpatients within Kaduna City in relation to Age.*

Ages	Anti-HCV		Total Number of persons Tested
	Negative	Positive	
01-10	30	1	31
	29.35	*1.65*	
11-20	24	2	26
	24.61	*1.39*	
21-30	73	3	76
	71.95	*4.05*	
31-40	86	4	90
	85.20	*4.80*	
41-50	44	5	49
	46.39	*2.61*	
51-60	15	1	16
	15.15	*0.85*	
61-70	8	0	8
	7.57	*0.43*	
71-80	3	0	3
	2.84	*0.16*	
81-90	1	0	1
	0.95	*0.053*	
Total	284	16	300

$X^2 = \frac{(O_i - E_i)^2}{E_i}$, X^2 =Chi Square, Oi=Observed Number of Cases in category I, Ei=Expected Number of cases in i.

For the different ages, $X^2 = \sum_i \frac{(O_i - E_i)^2}{E_i}$. Oi=Non italicized Figures in the table, i=Italicized Figures.

For HCV above,

$$X^2 = \sum_i \frac{(O_i - E_i)^2}{E_i} .=$$

$$\frac{(30-29.35)^2}{29.35} + \frac{(24-24.61)^2}{24.61} + \frac{(73--71.95)^2}{71.95} + \frac{(86-85.20)^2}{85.20} + \frac{(44-46.39)^2}{46.39} + \frac{(15-15.15)^2}{15.15} + \frac{(8-7.57)^2}{7.57}$$
$$+ \frac{(3-2.84)^2}{2.84} + \frac{(1-0.95)^2}{0.95} + \frac{(1-1.65)^2}{1.65} + \frac{(2-1.39)^2}{1.39} + \frac{(4-4.80)^2}{4.80} + \frac{(5-2.61)^2}{2.61} \frac{(1-0.85)^2}{0.85} + \frac{(0-0.43)^2}{0.43}$$
$$+ \frac{(0-0.16)^2}{0.16} + \frac{(0-0.053)^2}{0.053} + \frac{(3-4.05)^2}{4.05} = 4.004 = P \leq 0.86$$

Chi Square critical region for DF=8 is 15.507, this is greater than the calculated chi square critical value of 4.004, thus null hypothesis accepted, age and HCV positivity are independent.

Table A2. *A Frequency Distribution Table from Table A1 above.*

Age Range	Mid Age (m_1)	No of persons Tested (f_1)	$m_1 f_1$	$(M_1 - \overline{X})^2 f_1$
01-10	5.50	31	170.50	22,099.59
11-20	15.50	26	403.00	7,251.59
21-30	25.50	76	1938.00	3,411.64
31-40	35.50	90	3195.00	980.10
41-50	45.50	49	2229.50	8,677.61
51-60	55.50	16	888.00	8,686.24
61-70	65.50	8	524.00	8,871.12
71-80	75.50	3	226.50	5,624.67
81-90	85.50	1	85.50	2,840.
Total		300	9,660.00	68,433.00

Frequency Distribution Table for the Mean, Standard Deviation and 95% Confidence Interval. From table above

The mean age is given by $\overline{X} = \frac{\sum_{n=300}^{n} M_1 f_1}{N}$

M_1= Middle age for the Age Range.

F_1=Number of persons tested in the age range /frequency.

N=Total number of persons in the study/Sample Size=(300)

$$\overline{X} = \frac{\sum_{n=300}^{n} M_1 f_1}{N} = \frac{9,660}{300} = 32.2 \text{ years}$$

i). The Standard Deviation $(\sigma) = \sqrt{\frac{\sum_{n=300}^{n} (M_1 - \overline{X})^2 f}{N-1}}$

$$\sigma = \sqrt{\frac{68,433}{300-1}} = \sqrt{\frac{68,433}{299}} = 15.12 \text{ years.}$$

ii). The standard error of the mean age $S_{\overline{X}} = \frac{\sigma}{\sqrt{n}}$

σ =Standard Deviation=15.12 Years.

N=Sample Size=300

$$S_{\overline{X}} = \frac{15.12}{\sqrt{300}} = 0.873$$

The 95% Confidence Interval (CI) of the mean age in years in the study is given by

$$\text{CI} = \overline{X} \pm t_{\alpha/2} df * S_{\overline{X}}$$

$\overline{X}$ =Mean age=32.20 Years.

$\alpha = 0.05$ Probability.

$df = 9-1$=8 (Nine age ranges used)

$S_{\overline{X}}$ =0.873

Therefore, the 95% CI for the mean age is

$$\text{CI} = 32.20 \pm 2.306 \times 0.873$$

$$= 32.20 \pm 2.01 \text{ Years.}$$

Table A3. *Prevalence of HCV among outpatients within Kaduna Metropolis in relation to Sex.*

Sex	Anti-HCV		Total Number of persons Tested
	Negative	Positive	
Male	102	12	114
	107.92	*6.08*	
Female	182	4	186
	176.08	*9.92*	
Total	284	16	300

$$X^2 = \sum_i \frac{(O_i - E_i)^2}{E_i} .= \frac{(102-107.92)^2}{107.92} + \frac{(182-176.08).^2}{176.08} +$$
$$\frac{(12-6.08)^2}{6.08} + \frac{(4-9.92)^2}{9.92} = 9.8208 \; P \leq 0.002$$

The Chi Square Critical region for df=1 is 3.841 which is less than the calculated critical value of 9.8208, therefore null hypothesis is rejected, alternative hypothesis accepted. There is a significant association between gender/sex and HCV positivity.

Table A4. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Marital Status.*

Marital Status	Anti -HCV		Total Number of persons Tested
	Negative	Positive	
Single	77	4	81
	76.68	*4.32*	
Married	202	12	214
	202.59	*11.41*	
Widowed	3	0	3
	2.84	*0.16*	
Separated	2	0	2
	1.89	*0.11*	
Divorced	0	0	0
	0.00	*0.00*	
Total	284	16	300

$$X^2 = \sum_i \frac{(O_i - E_i)^2}{E_i} .= \frac{(77-76.68)^2}{76.68} + \frac{(202-202.59)^2}{202.59} + \frac{(3-2.84)^2}{2.84} + \frac{(2-1.89)^2}{1.89} + \frac{(4-4.32)^2}{4.32} + \frac{(12-11.41)^2}{11.41} + \frac{(0-0.16)^2}{0.16} + \frac{(0-0.11)^2}{0.11} = 0.3426 = P \le 0.99$$

The chi square Critical region for DF=4 is 9.488. This is greater than the calculated critical value of 0.3426, the null hypothesis is accepted. There is no significant association between marital status and HCV positivity.

Table A5. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Blood Groups.*

Blood Group	Anti-HCV		Total Number of persons Tested
	Negative	Positive	
A	82	4	86
	81.41	*4.59*	
B	59	7	66
	62.48	*3.52*	
AB	11	2	13
	12.31	*0.69*	
O	132	3	135
	127.80	*7.20*	
Total	284	16	300

$$X^2 = \sum_i \frac{(O_i - E_i)^2}{E_i} .= \frac{(82-81.41)^2}{81.41} + \frac{(59-62.48)^2}{62.48} + \frac{(11-12.31)^2}{12.31} + \frac{(132-127.80)^2}{127.80} + \frac{(4-4.59)^2}{4.59} + \frac{(7-3.52)^2}{3.52} + \frac{(2-0.69)^2}{0.69} + \frac{(3-7.20)^2}{7.20} = 8.9294 = P \le 0.03$$

The Chi Square critical region for the DF=3 is 7.815. The calculated critical value of 8.9294 is greater than the tabulated value of 7.815, the null hypothesis is rejected, the alternative hypothesis accepted. There is a statistical significant association between blood group and HCV positivity

Table A6. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Rhesus factor.*

Rhesus	Anti-HCV		Total Number of persons Tested
	Negative	Positive	
RH^+	268	16	284
	268.85	*15.15*	
RH^-	16	0	16
	15.15	*085*	
Total	284	16	300

$$X^2 = \sum_i \frac{(O_i - E_i)^2}{E_i} .= \frac{(268-268.85)^2}{268.85} + \frac{(16-15.15).^2}{15.15} + \frac{(16-15.15)^2}{15.15} + \frac{(0-0.85)^2}{0.85} = 0.9481$$

$$p \leq 0.33$$

The Chi Square Critical region for df=1 is 3.841. The calculated critical value of 0.9481 is less than the tabulated chi critical value of 3.841 at 1 df. The null hypothesis is accepted. There is no significant association between Rhesus factor and Blood group

Table A7. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Occupation.*

Occupation	Anti -HCV		Total Number of persons Tested
	Negative	Positive	
Civil Service	61	2	63
	59.64	*3.36*	
Business	43	5	48
	45.44	*2.56*	
Unskilled Worker	13	0	13
	12.31	*0.69*	
Unemployed	22	4	26
	24.61	*1.39*	
Others	145	5	150
	142.00	*8.00*	
Total	284	16	300

$$X^2 = \sum_i \frac{(O_i - E_i)^2}{E_i} .= \frac{(61-59.64)^2}{59.64} + \frac{(43-45.44)^2}{45.44} + \frac{(13-12.31)^2}{12.31} + \frac{(22-24.61)^2}{24.61} + \frac{(145-142)^2}{142} + \frac{(2-3.36)^2}{3.36} + \frac{(5-2.56)^2}{2.56} + \frac{(0-0.69)^2}{0.69} + \frac{(4-1.39)^2}{1.39} + \frac{(5-8)^2}{8} = 10.1336 = p \leq 0.04$$

The Chi square critical Value for df 4=9.488. The calculated critical value of 10.1336 is greater than the tabulated value of 9.488 at 4 df, therefore, the null hypothesis is rejected.

Table A8. *Prevalence of HCV infections among outpatients within Kaduna City in relation to Social Factors.*

Social Factors	HCV Antibody		Total Number of persons Tested	Critical Region Calculated/Table 1 df P Value	Decision
	Negative	Positive			
Tribal Marks	40	0	40		
	37.87	*2.13*		2.4727/3.841	
No Marks	244	16	260	$P \leq 0.12$	Null Hypothesis accepted
	246.13	13.*89*			
Total	284	16	300		
Have Knowledge of Hepatitis	71	3	74		
	70.05	*3.95*		0.3205/3.841	Null Hypothesis
No knowledge of Hepatitis	213	13	226	$P \leq 0.57$	accepted
	213.95	*12.05*			
Total	284	16	300		
Eat in public places	197	11	208		
	196.91	*11.09*		0.0025/3.841	Null hypothesis
Don't eat in public places	87	5	92	$P \leq 0.96$	accepted
	87.09	*4.91*			
Total	284	16	300		
Sharing clothes/Beddings	201	11	2 12		
	200.69	*11.31*		0.03062/3.841	Null hypothesis
Don't Share clothes/Beddings	83	5	88	$P \leq 0.86$	accepted
	83.31	*4.69*			
Total	284	16	300		
Positive Family History	26	0	26		
	24.61	*1.39*		1.5449/3.841	Null hypothesis
No positive Family History	258	16	274	$P \leq 0.21$	accepted
	259.39	*14.61*			
Total	284	16	300		

Table A9. *Prevalence of HCV infections among outpatients within Kaduna City in relation to individual Clinical history.*

Clinical History	Anti -HCV		Total Number of persons Tested	Critical Region Calculated/Table 1 df P Value	Decision
	Negative	Positive			
Blood Recipient (Yes)	24	0	24		
	22.72	*1.28*			
(No)	260	16	276	1.4696/3.841 $P \leq 0.23$	Null hypothesis accepted
	261.28	*14.72*			
Total	284	16	300		
Hypertensive (Yes)	25	0	25		
	23.67	*1.33*		1.5324/3.841 $P \leq 0.22$	Null hypothesis accepted
(No)	259	16	275		
	260.33	*14.67*			
Total	284	16	300		
Diabetics (Yes)	11	2	13		
	12.31	*0.69*		2.744/3.841 $P \leq 0.10$	Null hypothesis accepted
(No)	273	14	287		
	271.69	*15.31*			
Total	284	16	300		
HIV/AIDS (Yes)	3	2	5		
	4.73	*0.27*		11.915/3.841 $P \leq 0.001$	Null hypothesis rejected
(No)	281	14	295		
	279.27	*15.73*			
Total	284	16	300		
Others (Yes)	2	0	2		
	1.89	*0.11*		0.1172/3.841 $P \leq 0.73$	Null hypothesis accepted
(No)	282	16	298		
	282.11	*15.89*			
Total	284	16	300		

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