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Prevalence of Human Immunodificency Virus, Hepatitis B, and Hepatitis C viral infections among forensic autopsy cases at the University Teaching Hospital in Lusaka, Zambia

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ABSTRACT

A cross-sectional study was conducted to determine the seroprevalence of Human Immunodeficiency Virus (HIV), Hepatitis B (HBV), and Hepatitis C (HCV) viruses among forensic autopsy cases at the University Teaching Hospital, Lusaka Zambia. The study enrolled three hundred and three adult decedents with a median age 34 (interquartile range: 28 - –42) years, age range (18–67). Males predominated (87.1 %). The seroprevalence of HIV, HBV, HCV, and HIV and HBV co-infection was 32.7 %, 7.9 %, 1.3 % and 2.6 % respectively.
HIV infection was highest in suicides (37.8 %) and accidents (36.6 %).
In conclusion, HIV infection was higher than that of the general population.

1. Introduction

Human Immunodeficiency Virus (HIV), Hepatitis B (HBV) and C (HCV) Viruses are blood-borne infections that share similar modes of transmission and continue to be a significant health problem globally [1]. HIV, HBV, and HCV are transmissible from decedents by exposure to body fluids or exposure through accidental contamination by sharp instruments, such as needles or surgical instruments, and through contaminated surfaces [2]. Whatever the state of human remains, the potential for exposure to pathogens is always present, and despite infection control precautions, the risk for acquiring these infections is high [3].

HIV, HBV, and HCV are Group 3 pathogens that cause severe human disease and present a severe hazard to medicolegal death investigators [4]. In managing infection prevention, an environment must be created that minimizes the transmission of these viruses from the human remains [5]. Members of the community, police officers, and the forensic pathology team, are at an increased risk of exposure to these infections at the death scene, during body transportation and within the autopsy suite [6,7].

In 2018, the World Health Organisation (WHO) global estimates showed that 39.9 million people were infected with HIV, while HBV and HCV affected 325 million people [8]. Co-infections among the three viruses are common and are associated with end-stage hepatic failure leading to death [9,10]. The global information and education (Avert) report on HIV and AIDS in Zambia showed an HIV prevalence rate of 11.3 % in the general population, as published in 2018 [11]. There is no data for the prevalence of HBV and HCV in the general population in Zambia.

Forensic autopsy cases are of unknown serological status for HIV, HBV, and HCV, and thus pose a potential risk for infection. These cases often have unclear circumstances of death, and many situations may involve drug abusers and persons with promiscuous sexual behaviour. This poses a risk to police officers, 'pathologist's assistants, and laboratory staff who may deal with autopsy material [12,13]. Information on the prevalence of HIV, HBV, and HCV will help improve infection prevention measures and policy direction in medicolegal death investigations. The goal of the study was to determine the prevalence of HIV, HBV, and HCV in forensic autopsy cases in Lusaka, Zambia.

2. Methodology

This cross-sectional study was conducted at the UTH autopsy suite between December 2017 and December 2018 in Lusaka, Zambia. The study included adults aged 18–67 brought in for medicolegal death investigations. The exclusion criteria included; cases after four days of the death, cases where blood could not be drawn, and cases in which informed consent could not be obtained. Ethical approval was obtained from the University of Zambia Biomedical Research Ethics Committee (UNZABREC).

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A sample size of 292 was calculated using the CDC epi info statistic calculator. Three hundred and twenty-one (321) cases were recruited to account for cases with incomplete information. Eighteen (18) cases were excluded due to incomplete information, and three hundred and three (303) cases were analyzed.

Cases were recruited using convenience sampling. The next of kin was approached privately and gave written consent. The age, sex, and manner of death were obtained from the coroner's order for autopsy and final autopsy report.

Four (4) millilitres of venous blood was collected using needle and syringe by the attending pathologist and stored in a plain vacutainer tube, and transported to the laboratory at UTH skin clinic where testing for HIV, HBV, and HCV was done following the standard operating procedure of the laboratory for these tests.

Data were entered into Microsoft Excel 2010 and transferred to Statistical Package for Social Sciences (SSPS) version 25. The variables included age, sex, and serostatus for HIV, HBV, HCV, co-infections, and manners of death. Age had a Shapiro-Wik test that showed significant divergence from normality, W (137) = 0.958, p > 0.001, Levene homogeneity test revealed the variable had variances that were not equal, F (1,274) = 3.344, p = 0.059 and the distribution was moderately skewed (0.640). Therefore, the median with the inter-quartile range was reported. Gender was reported categorically. Viral serostatus and co-infections were reported categorically (0 – absent; 1-present) as HIV, HBV, HCV, HIV + HBV, HIV + HCV, HBV + HCV, and HIV + HBV + HCV. The decedents were categorized into five groups based on the manner of death. The point prevalence ratio was calculated for each explaining variable. The confidence interval at 95 % was reported. Associations were conducted using Chi-square with all assumptions met; otherwise, fisher's exact test was reported. A non-parametric moods median test was conducted to compare the medians between the groups.

3. Results

Table 1 shows the frequency distribution of the characteristics, serostatus, and manner of death of the participants. A total of 303 cases were analyzed, giving a prevalence of 32.7 %, 7.9 %, and 1.3 % for HIV, HBV, and HCV, respectively. There were more males recruited in the study (87.1 %). The age range was 18–67, with a median age of 34 (interquartile range; 33–37). The prevalence of natural causes, accidents, and suicides was 45.2 %, 30.7 %, and 12.2 %, respectively. Undetermined and homicides accounted for 8.9 % and 3%, respectively. Violent deaths (suicide, homicide, and accidents) accounted for 45.9 %.

HIV positivity was higher in males compared to females (33.0 % vs 30.8 %) and highest in decedents that committed suicide at 37.8 %. HIV was high in accidental (36.6 %) and natural (32.8 %) deaths and lowest in homicides (11.1 %). HIV infection was highest in those aged 41–45 years (44.4 %) and 51–55 years (43.8 %). HBV was higher in males (8.33 %) compared to females (5.1 %) and highest in those that committed suicide (18.9 %). HIV and HBV co-infection were present in 8 (2.6 %). Other coinfections included HIV + HCV (0.3 %), HBV + HCV (0.1 %) and HIV + HBV + HCV (0.3 %), all in males. One decedent had all three infections.

Table 2 shows the associations between characteristics of the participants (N = 303) and the categories of deaths. There was no significant difference with regards sex, HIV, HBV, HCV and co-infection between violent and non-violent deaths, violent and undetermined deaths, and between non-violent and undetermined deaths. Moods median comparative test between age and manner of death; non-violent vs violent deaths (□2 (1) = 7.654, p = 0.006), non-violent vs. undetermined deaths (□2 (1) = 0.078, p = 0.780) and violent vs undetermined deaths (□2 (1) = 3.055, p = 0.080).

There was a higher frequency of non-violent deaths (58.2 %) in cases above 34 years, while there was a higher frequency of violent

Table 1
Frequency distribution of characteristics of participants (N = 303), serostatus, and manner of death.

Demographic Characteristic	Overall n (%)	HIV n (%)	HBV n (%)	HCV n (%)	HIV +HBV n (%)	HIV +HCV n (%)	HBV +HCV n (%)	HIV + HBV + HCV n (%)
All participants (303)	303	99 (32.7)	24 (7.9)	4 (1.3)	8 (2.6)	1 (0.3)	3 (1.0)	1 (0.3)
Gender								
• Female	39 (12.9)	12 (30.8)	2 (5.1)	0 (0.0)	2 (5.1)	0 (0.0)	0 (0.0)	0 (0.0)
• Male	264 (87.1)	87 (33.0)	22 (8.3)	4 (1.5)	6 (2.3)	1 (0.4)	3 (1.1)	1 (0.4)
Age range category								
• 18 – 20	17 (5.6)	4 (23.5)	2 (11.8)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
• 21 – 25	32 (10.6)	11 (34.4)	4 (12.5)	0 (0.0)	1 (3.1)	0 (0.0)	0 (0.0)	0 (0.0)
• 26 – 30	55 (18.2)	19 (34.6)	2 (3.6)	0 (0.0)	1 (1.8)	0 (0.0)	0 (0.0)	0 (0.0)
• 31 – 35	59 (19.5)	20 (33.9)	6 (10.2)	3 (5.1)	3 (5.1)	1 (1.7)	3 (5.1)	1 (1.7)
• 36 – 40	47 (15.5)	12 (25.5)	4 (8.5)	0 (0.0)	1 (2.1)	0 (0.0)	0 (0.0)	0 (0.0)
• 41 – 45	36 (11.9)	16 (44.4)	2 (5.6)	0 (0.0)	1 (2.8)	0 (0.0)	0 (0.0)	0 (0.0)
• 46 – 50	18 (5.9)	6 (33.3)	1 (5.6)	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
• 51 - 55	16 (5.3)	7 (43.8)	1 (6.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
• >56	23 (7.6)	4 (17.4)	2 (8.7)	0 (0.0)	1 (4.4)	0 (0.0)	0 (0.0)	0 (0.0)
Age: Median (IQR)	34 (28−42)	33 (28−42)	32 (25−41)	32 (31−41)	31 (29−40)	31	31	31
Manner of Death								
• Natural	137 (45.2)	45 (32.9)	11 (8.0)	2 (1.5)	3 (2.2)	1 (0.7)	2 (1.5)	1 (0.7)
• Accident	93 (30.7)	34 (36.6)	5 (5.4)	2 (2.2)	2 (2.2)	0 (0.0)	1 (1.1)	0 (0.0)
• Suicide	37 (12.2)	14 (37.8)	7 (18.9)	0 (0.0)	3 (8.1)	0 (0.0)	0 (0.0)	0 (0.0)
• Undetermined	27 (8.9)	5 (18.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
• Homicide	9 (3.0)	1 (11.1)	1 (11.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Category of death								
• Non-Violent (Natural) Deaths	137 (45.2)	45 (32.9)	11 (8.0)	2 (1.5)	3 (2.2)	1 (0.7)	2 (1.5)	1 (0.7)
• Violent (Suicide, Homicide, Accidental) Deaths	139(45.9)	49 (35.3)	13 (9.4)	2 (1.4)	5 (3.6)	0 (0.0)	1 (0.7)	0 (0.0)
• Undetermined	27 (8.9)	5 (18.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

Table 2
Associations between characteristics of all participants (N = 303) and categories of deaths.

Demographic Characteristics	Non-Violent Deaths (N = 137)	Violent Deaths (N = 139)			Undetermined (N = 27)		
All participants (N = 303)	N (%)	N (%)	Chi-square	P-value	N (%)	Chi-square	P-value
Age, years Median (M)	–	34 [M]	7.002	0.008	37 [M]	0.005	0.945
Sex							
• Male	119 (86.9)	125 (89.9)	0.633	0.426	20 (74.1)	2.854	0.138*
• Female	18 (13.1)	14 (10.1)			7 (25.9)		
• 16 – 20	6 (4.4)	11 (7.9)	22.999	0.003	0 (0.0)	N/a	N/a
• 21 – 25	7 (5.1)	20 (14.4)			5 (18.5)		
• 26 – 30	18 (13.1)	33 (23.7)			4 (14.8)		
• 31 – 35	31 (22.6)	24 (17.3)			4 (14.8)		
• 36 – 40	24 (17.5)	18 (12.9)			5 (18.5)		
• 41 – 45	15 (10.9)	17 (12.2)			4 (14.8)		
• 46 – 50	10 (7.3)	7 (5.0)			1 (3.7)		
• 51 - 55	9 (6.6)	4 (2.9)			9 (6.6)		
• 56 - 67	17 (12.4)	5 (3.6)			1 (3.7)		
Viral Serostatus							
• HIV	45 (32.8)	49 (35.3)	0.178	0.673	5 (18.5)	2.185	0.139
• HBV	11 (8.0)	13 (9.4)	0.152	0.696	0 (0.0)	N/a	N/a
• HCV	2 (0.7)	2 (0.7)	N/a	N/a	0 (0.0)	N/a	N/a
• HIV + HBV	3 (2.2)	5 (3.6)	0.486	0.723*	0 (0.0)	N/ame also	N/a
• HIV +HCV	1 (0.7)	0 (0.0)	N/a	N/a	0 (0.0)	N/a	N/a
• HBV + HCV	2 (1.5)	1 (0.7)	0.352	0.495#	0 (0.0)	N/a	N/a
• HIV + HBV + HCV	1 (0.7)	0 (0.0)	N/a	N/a	0 (0.0)	N/a	N/a

[b]Exact test- Chi-square; [c]T-test reported.
Fishers test expected count assumption not met.
* Fishers test – Expected value assumption met two-sided significance reported.

deaths (58.5 %) in cases less than 34 years (p = 0.006). Chi-square associations determined violent deaths were more likely between the ages 31 and 35 (□ 2 (1) = 22.999, p = 0.003).

4. Discussion

This study has determined the prevalence of HIV, HBV, and HCV infections in forensic autopsies in Lusaka. There were more males (87.1 %) compared to their female counterparts due to the males being more predisposed to sudden and unexpected deaths due to complications of the disease resulting from poor health-seeking habits [14]. Males are also more likely to engage in criminal activities and drug abuse [15,16]. The age range 21–45 constituted 75.7 % of the study population. This population is most at risk of engaging in behaviour that predisposes them to premature death, such as increased alcohol intake and outdoor activities [16].

The prevalence of HIV (32.7 %) in this study is higher than that of the general population in Zambia (11.3 %) [11]. The reason for this finding is obscure. However, Pekka & Bernard (2015, P.13) postulated that the forensic case population has a higher prevalence of HIV infection due to its involvement in high-risk behaviour such as prostitution and drug abuse [12]. A similar study in Maryland showed a higher HIV prevalence in forensic autopsy cases compared to the general population [17]. HIV infection was highest in those aged 41–45 (44.4 %) and 51–55 (43.8 %), similar to the Zambia population-based HIV impact assessment report 2015–2016 [11].

The prevalence of HBV and HCV was 7.9 % and 1.3 %, respectively; however, no studies are available in Zambia that has determined the prevalence of these viruses in the general population. Data from a study in Maryland showed a higher prevalence of HBV (23.2 %) and HCV (19.1 %) in forensic autopsy cases compared to this study. The difference is attributed to the high number of cases that were intravenous drug users in their study [17]. HBV infection was higher in males (8.33 %) than females (5.1 %), and all HCV infections were in males. Only males showed co-infections. The findings may be due to females being less predisposed to virus infection than males as a result of their more effective antiviral immune defences [18].

Natural causes in our study were the most prevalent. This was attributed to the new policy in the medicolegal office to autopsy all sudden and unexpected deaths from the community. A study in Ghana showed a similar trend, and this may be due to similarities in the social-economic status of the two countries [19]. The HIV prevalence was 32.8 % among natural causes. This may be due to poor health-seeking behaviour in those with HIV infection in the community [14].

Deaths attributed to accidents were the second most prevalent (30.7 %) and were predominantly composed of road traffic accidents. This is attributed to poorly maintained roads, impairment of the driver by alcohol, and human error. Studies in South Africa and Ethiopia showed similar findings [20,21]. The HIV prevalence was 36.6 % among accidental deaths. The finding is obscure even though it is logical to make the inference that the burden of HIV infection could be higher in the general population than is currently stated. A search of the literature shows no data.

Suicides were the third most prevalent manner of death (12.2 %). The reason for this finding is obscure, though financial constraints, undiagnosed mental illnesses, and broken relationships may play a role. However, in South Africa, higher suicide rates were associated with increasing socioeconomic status [22], HIV and HBV prevalence were highest among suicides in this study. This may be related to the social stigma associated with HIV and HBV infection being sexually transmitted diseases [23]. A Swiss study showed that people with HIV have a three times chance of committing suicide than the general population [24].

Undetermined deaths accounted for 8.9 % of all manners of death. This is an acceptable percentage in our medicolegal office because of inadequate forensic toxicology services to aid the diagnosis in toxicological deaths. The

manner of death may also be undetermined due to non-structural heart diseases that predominate in adolescence and early adulthood [25]. The HIV prevalence in this group was 18.5 %. The reason is unknown for this finding.

Homicide was the least common manner of death. The reason for this is due to stringent policies on law enforcement in the country and general, peaceful culture. This is at variance with South African statistics, which show that homicides are the most prevalent manner of death (36.2 %). The difference is attributed to the high level of violence in South Africa [22]. The HIV prevalence was lowest among homicides (11.1 %). The reason for this is obscure. A study in New York showed a much lower prevalence of HIV infection among homicide [26]. The result in our study differs from those in the New York study because Zambia is in sub-Saharan Africa, which is the epicenter of HIV infection according to the 2019 Global information and education on HIV and AIDS (AVERT) [11].

There was no significant difference concerning sex, HIV, HBV, HCV, and co-infection between violent and non-violent deaths, violent and undetermined deaths, and between non-violent and undetermined deaths. The frequency of non-violent deaths was higher in cases above 34 years, while violent deaths were higher in cases below the age of 34 years. Chi-square associations determined that violent deaths were more likely between the ages of 31 and 35 years. This finding may be attributed to the high-risk behavior and outdoor activities by those in this age band [15].

5. Conclusion and recommendations

HIV (32.7 %) was the most prevalent in forensic autopsies with HBV and HCV, accounting for 7.9 % and 1.3 %, respectively. While safety precautions are taken in the autopsy suite, we propose that the non-medical team who at increased risk of acquiring these infections, be trained in infection prevention, and the correct use of personal protective equipment. We recommend routine infection prevention measures appropriate for grade 3 infections to be mandatory in all forensic autopsy cases.

Declaration of Competing Interest

The authors report no declarations of interest.

CRediT authorship contribution statement

Cordilia Himwaze: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization, Project administration, Funding acquisition. **Luchenga Mucheleng'anga:** Fellow of Forensic Pathology (U of T) MMED Pathology (UNZA), Forensic pathologist, Conceptualization, Validation, Investigation, Data curation, Writing - original draft, Writing - review & editing, Visualization. **Stephanie N. Siyumbwa:** Software, Validation, Formal analysis, Data curation, Writing - review & editing, Visualization. **Trevor Kaile:** Conceptualization, Writing - review & editing, Supervision. **Peter Julius:** Conceptualization, Methodology, Validation, Formal analysis, Data curation, Writing - review & editing, Visualization, Supervision.

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