Journal of Clinical Virology Plus 4 (2024) 100195

Contents lists available at ScienceDirect

Journal of Clinical Virology Plus

journal homepage: www.elsevier.com/locate/jcvp

Review

A rapid review of the epidemiology and combating strategies of hepatitis C virus infection in Ghana

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ARTICLE INFO

Keywords:
Hepatitis C virus
Genotype
Epidemiology
Prevalence

ABSTRACT

The contribution of viral hepatitis including hepatitis C virus (HCV) to morbidity and death is thought to be substantial in Ghana and should be accorded greater attention. Scopus, PubMed, and Web of Science databases were searched, as well as the Google Scholar search engine, for primary studies published from 1995–2023 inclusive. We specifically searched for primary studies as well as studies using both quantitative and qualitative methodologies. The country lacks population-based studies and comprehensive national HCV surveillance systems, making it difficult to estimate the true burden of HCV accurately. The prevalence of HCV infection is estimated to be between 1.75 and 3.4 % in Ghana. The predominant HCV genotype in the country is genotype 2, followed by genotype 1. The prevalence of genotypes 4, 5, and 6 is very low or nonexistent in Ghana. Older age (>50 years), male gender, and HCV genotype 1b are significantly associated with liver fibrosis and cirrhosis leading to hepatocellular carcinoma. Ghana is among the high-prevalence HCV infection countries. There is a high prevalence of cirrhosis among HCV-infected individuals, with older age and genotype 1b associated with an increased risk. Consequently, more efforts are needed to increase awareness and implementation of national guidelines.

1. Introduction

The prevalence of hepatitis C virus (HCV) varies substantially between countries and regions. The disease is considered endemic in most parts of the world. In Ghana, the prevalence of HCV is estimated to be 3.3% in the general population, with over 900,000 people infected [1]. The most common modes of transmission in Ghana are unsafe medical practices and procedures, including inadequate sterilization of medical equipment. Studies of HCV risk factors in Ghana found that hospital admission, surgery, dental work, and scarification are independently associated with HCV infection [2,3]. However, access to treatment for HCV in Ghana remains limited. Efforts are needed to strengthen HCV diagnosis, prevention, and treatment in Ghana to achieve the WHO hepatitis elimination goals.

According to the World Health Organization (WHO), the prevalence of HCV infection varies greatly among different regions of the world. Despite this, there are significant gaps in the knowledge and understanding of HCV epidemiological data, particularly in developing countries like Ghana. To begin with, a study conducted by Ampofo et al. [4], reported that the prevalence of HCV in Ghana was 3.4%, a figure that is higher than the overall prevalence of HCV in sub-Saharan Africa. However, the study primarily focused on blood donors, which may not accurately represent the general population's true prevalence. Hence, there is still a significant need for population-based studies to estimate the true burden of HCV infection in Ghana.

Another study carried out by Adjei et al. [5], examined the prevalence of HCV among inmates in a single prison in Ghana. The prevalence of HCV in this population was found to be 25.7%, which is significantly

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https://doi.org/10.1016/j.jcvp.2024.100195
Received 19 April 2024; Received in revised form 29 September 2024; Accepted 29 September 2024
Available online 9 October 2024

higher than the national average. However, the study's sample size was relatively small and not representative of the general population. Therefore, further studies are needed to assess the overall prevalence of HCV in prisons and other high-risk populations like injection drug users, sex workers, and men who have sex with men. Moreover, there is a lack of knowledge and awareness of HCV among the general population in Ghana. According to a study conducted by Sagoe et al. [6], only 11.5% of the study population had heard of HCV. This lack of awareness of HCV is likely to contribute to underdiagnosis and underreporting of HCV cases in Ghana.

Currently, Ghana does not have a dedicated HCV surveillance system, which makes it challenging to estimate the prevalence of HCV accurately [7]. The absence of a surveillance system also makes it difficult to design and implement effective prevention and control strategies for HCV. Despite the relatively high prevalence of HCV in Ghana, there are significant gaps in the epidemiological data and knowledge of HCV in the country. Further research is needed to estimate the true burden of HCV in the general population, high-risk populations, and inmates. Additionally, there is a need for increased awareness of HCV among the general population and the implementation of an effective HCV surveillance system in Ghana. Accurate prevalence estimates and stratification based on comprehensive and up-to-date evidence compilations are critical, hence, this rapid review aims to highlight HCV prevalence and management efforts in Ghana, as well as postulate up-to-date recommendations for evidence-based policy-making, public health research, and program prioritization.

2. Methodology

A review of published articles on the prevalence of HCV was done with a developed search strategy aimed at including studies using mainly a qualitative approach. Scientific literature was searched in relevant databases (Google Scholar, Scopus, PubMed, Web of Science, International organizations web pages) for the years 1995 to 2023 inclusive. The search used the terms "(hepatitis C OR HCV) AND (Prevalence OR Epidemiology) AND (Ghana)". All articles with the prevalence of only HCV infection and not coinfection in the relevant subpopulations were considered for inclusion. The search yielded a total of 863 articles. After the removal of duplicates, co-infection, and unrelated papers, 42 articles were used in this rapid review. Search results are represented on a flowchart diagram in Fig. 1 to better elaborate the inclusion/exclusion criteria. This review seeks to address HCV epidemiology according to the following subtopics; (1) Hepatitis C Virus Epidemiology and Prevalence in Ghana; (2) Main routes of HCV transmission and risk factors in Ghana; (3) HCV clinical manifestations in Ghana; (4) HCV Genotypes in Ghana; (5) Deaths due to HCV-related HCC and Cirrhosis in Ghana; (6) HCV screening protocols in Ghana; and (7) HCV infection control strategies in Ghana; (8) Discussion and future suggestions; and (9)

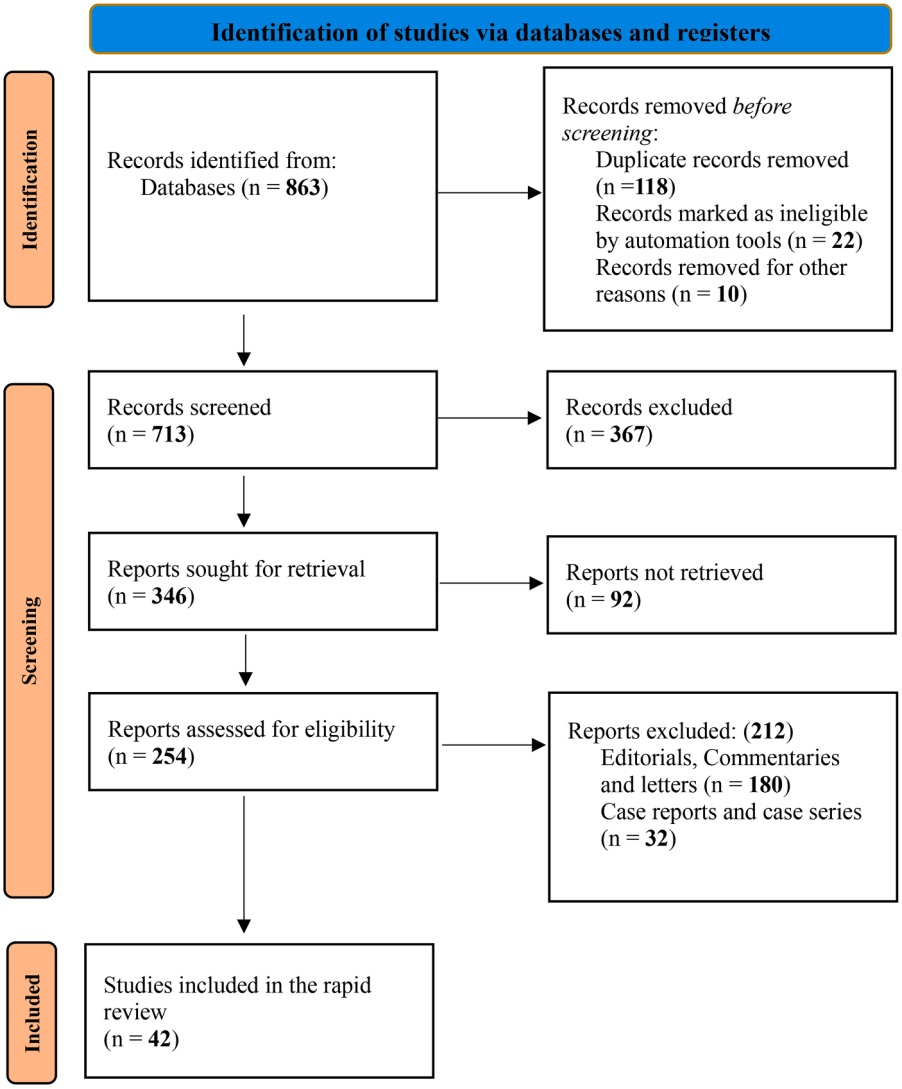

Fig. 1. A flowchart for search and inclusion strategy.

Conclusion.

3. Results

3.1. Hepatitis C virus epidemiology and prevalence

Ghana has a relatively high burden of HCV compared to other African countries. According to a study conducted by Agyeman et al. in 2016 [1], the prevalence of HCV in Ghana was 3.0% (Table 1). The study was conducted among pregnant women and blood donors, and the authors suggested that the high prevalence could be attributed to unsafe blood transfusions and a lack of antenatal care for pregnant women.

Furthermore, data aggregation from previous studies indicates that the current prevalence is 3.44% (2.75 - 4.35) [45,46]. Moreover, recent studies have pointed to specific high-risk populations in Ghana for HCV transmission. For instance, a study conducted by A. M. Nlankpe et al [40] found a high prevalence of HCV among blood donors from northern Ghana. In this study, the prevalence of HCV was found to be 12.71%, which is significantly higher than the national average (3.4%). Additionally, studies have suggested that Ghanaian women who give birth at home also have a higher likelihood of acquiring HCV, particularly during childbirth as stipulated by K. A. Apea-Kubi et. al [16].

3.2. Main routes of HCV transmission and risk factors in Ghana

The main route of HCV transmission in Ghana is through the use of unsterilized needles and syringes in healthcare settings and among people who inject drugs (PWID) [18,39]. A study conducted among PWIDs in Ghana confirmed that needle-sharing practices were common, predisposing them to HCV and other blood-borne infections [17]. Furthermore, unsafe medical procedures, such as the use of contaminated equipment during surgeries and dental procedures (Fig 2) have been reported as a source of HCV transmission in Ghana [35,41,47]. On the other hand, the main risk factors for HCV infection in Ghana include exposure to contaminated blood products, unsafe injections, and traditional scarification practices [12,18,20]. Blood transfusion, chronic hemodialysis, and needlestick injuries among healthcare professionals are also significant risk factors for HCV infection in Ghana [4,24,26,42]. Furthermore, homosexuality and PWID account for a considerable proportion of HCV cases in Ghana, with unsafe injection practices and needle sharing as the primary modes of transmission [39,44,48].

3.3. HCV clinical manifestations in Ghana

HCV-related clinical manifestations in Ghana are not well-documented, and studies conducted mainly focus on the prevalence of HCV infection in high-risk populations such as blood donors and PWIDs [5,40]. Fatigue is the most common symptom reported by HCV-infected individuals in Ghana, followed by abdominal pain, dark urine, and jaundice [5,15,36]. Some patients also report joint pain, itching, and weight loss [12,20,25]. However, most HCV-infected patients in Ghana remain asymptomatic, leading to underreporting and inadequate treatment [6,28,43].

3.4. HCV genotypes in Ghana

The knowledge of HCV genotypes has an impact on the choice of therapy [49]. Studies conducted in Ghana have shown that the predominant HCV genotype in the country is genotype 2, followed by genotype 1 as shown in Table 2 [47]. In a study conducted by Nii-Trebi et al. [35], genotype 2 was found to be the most prevalent (100%).

Additionally, Candotti et. al also suggests that genotype 2 is most prevalent followed by genotype 1 (26.2%) [13]. The prevalence of genotypes 3 and 4 is very low (<2.3%), while genotypes 5 and 6 were not detected in any of the samples [20]. A Bayesian Phylogeographic analysis using a discrete trait model showed that Ghana was the most likely

Table 1
The table displays included studies that reported the prevalence of HCV in Ghana. They are presented from the earliest to the latest per the inclusion strategy.

	Name of the first author	Population of study	Year of Study	Reported HCV prevalence	Additional Results
1	F. E. A. Martinson [8]	Rural children	1996	5.4%	Did not differ significantly by age or gender
2	M. H. Wansbrough-Jones [9]	pregnant women and blood donors	1998	2.8%	Higher prevalence in males (4.6%) than in females (1.0%)
3	J. K. Acquaye [10]	blood donors	2000	5.2%	Blood samples from 1300 healthy blood donors were screened for HCV antibodies by an ELISA technique.
4	D. Candotti [11]	blood donors	2001	1.3%	high-prevalence of HCV in blood donor populations
5	F. Sarkodie [12]	blood donors	2001	55%	All blood donations should be screened for hepatitis B virus (HBV), HIV, and HCV markers.
6	W. Ampofo [4]	blood donors	2002	0.9%	High transfusion risk
7	D. Candotti [13]	Blood donor	2003	1.3%	HCV infection in Ghana is characterized by a high rate of recovery
8	A. T. Lassey [14]	mothers	2004	2.5%	High carrier rate
9	A. Blankson [15]	Cirrhosis patients	2005	7.1%	High seroprevalence
10	A. A. Adjei [5]	inmates and officers	2006	2%	High seroprevalence
11	K. A. Apea-Kubi [16]	antenatal and gynecological patients	2006	5.2%	High transmissible risk of HCV
12	A. A. Adjei [17]	prison inmates and officers	2007	18.7%	Independent determinants for HCV infections among officers were age between 25 and 46, female gender, being unmarried, being employed in prison service for longer than 10 years, and history of sexually transmitted diseases
13	N. Amidu [18]	blood donors	2010	3.57%	High seroprevalence of blood-borne infections in blood donors
14	B. Nkrumah [19]	blood donors	2011	9.4%	Hepatitis C viral (HCV) infection was highest among males
15	K. W. C. Sagoe [6]	naïve individuals	2012	3.6%	High prevalence of hepatitis C

(continued on next page)

Table 1 (*continued*)

16	J. H. Bonney [20]	Viral hemorrhagic fevers (VHF) patients	2013	7.8%	Hepatitis B and C with active virus replication is high
17	R. Ephraim [21]	Type 2 diabetes patients	2014	0	Seroprevalence of HBV was higher than that of HCV in T2DM patients
18	W. Walana [22]	Blood donors	2014	4.4%	High prevalence of HCV
19	P. Adoba [23]	barbers	2014	0.5 %	Poor knowledge of HCV
20	R. Ephraim [24]	pregnant women	2015	7.7%	High prevalence of hepatitis C among pregnant women; blood transfusion, tattooing, and sharing of hypodermic needles were associated with hepatitis C infection.
21	S. King [25]	HIV-infected subjects	2015	1.0%	HCV antibody screening assays variably overestimated HCV prevalence among HIV-infected subjects in Ghana
22	J. E. Layden [26]	blood donors	2015	74.4% to 88%	Individuals from the northern and upper regions of Ghana had greater risks of infection.
23	A. A. Agyeman [1]	blood donors, pregnant women, and parturients	2016	3.0 %	High prevalence of chronic hepatitis C infection in Ghana
24	M. B. Yakass [27]	people with infertility attending an IVF clinic	2016	0.4%	Low prevalence in this group
25	S. Y. Lokpo [28]	blood donors	2017	5.81%	Asymptomatic blood-borne pathogen burden was high
26	S. Y. Lokpo [29]	blood donors	2017	1.84%	Asymptomatic viral hepatitis among the adult population is estimated at the intermediate to high endemicity level.
27	F. Völker [30]	expectant mothers	2017	1.1%	High-prevalent pregnancy-relevant infections
28	C. de Mendoza [31]	Dried blood spots (DBS)	2019	0.6%	Low prevalence of hepatitis C from dried blood spots
29	M. T. Frempong [32]	pregnant women	2019	12.0%	High HCV prevalence among pregnant women
30	B. Osei-Tawiah [33]	Psychiatric Patients	2019	2%	Psychiatric patients in Ghana are at increased risk of blood-borne viruses
31	M. M. Birjandi [34]	blood-based RDT	2019	1.6%	The risk of positive RDT has a reverse relationship with aging
32	N. I. Nii-Trebi [35]	blood donors	2019	1%	Predominance of genotype 2 HCV among healthy individuals
33	C. Nkansah [36]	voluntary blood donors	2020	11.7%	Relatively high seroprevalence of hepatitis infections
34	A. K. Tetteh [37]	pregnant women	2020	2.7%	Seroprevalence determined in this study is classified as 'intermediate,'
35	K. O. Duedu [38]	children	2021	0.5%	Low prevalence of hepatitis C among Ghanaian children
36	L. J. Messersmith [39]	PWID	2021	2%	urgent need to implement harm reduction interventions targeting PWID
37	A. M. Nlankpe [40]	blood donors	2021	12.71%	Very high and endemic prevalence
38	S. S. Osei [41]	pregnant women	2021	2.5%	HCV prevalence in pregnant women
39	R. K. Ephraim [42]	hemodialysis patients	2022	6.7%	High prevalence
40	G. Mawuli [43]	sickle cell disease	2022	9%	High prevalence
41	Y. A. Nartey [44]	blood bank registers	2023	2.62% crude 4.58% estimate	There are significant regional differences in HCV burden across Ghana.

Abbreviations: PWID: Persons Who Inject Drugs; HCV: Hepatitis C Virus; IVDU: Intravenous Drug Users; ELISA: Enzyme-Linked Immunoassay; HIV: Human Immunodeficiency Virus; HBV: Hepatitis B Virus; IVF: In Vitro Fertilization; DBS: Dried Blood Spots; RDT: Rapid Diagnostic Test; VHF: Viral hemorrhagic fevers; T2DM: Type 2 Diabetes Mellitus

geographical region of origin of HCV-2 [50,51].

3.5. Deaths due to HCV-related HCC and cirrhosis in Ghana

Chronic HCV infection is a significant cause of liver disease in Ghana, and HCV-related HCC and cirrhosis are considerable concerns in this population [52]. Studies that have been modeled to show deaths attributed to chronic HCV infection leading to cirrhosis indicate that about 7% (4 - 9) of these deaths are related to HCV infection [53]. Surveys indicate that about 4.3% of HCV-infected individuals attending clinics are diagnosed with HCC [15,25]. Furthermore, there are reports of a high prevalence of cirrhosis among HIV/HCV co-infected inmates of Ashanti regional prisons in Ghana. Results from this study indicated that 39.1% of the participants had cirrhosis, with a higher prevalence rate among those infected with genotype 1b [17]. The annual deaths linked to HCV are estimated to be 552 (387 - 764) as shown in Fig. 3 [45]. According to the WHO 2020 target for HCV-related mortality, Ghana maintained steady progress until the recent decade when it surpassed the targeted mark. The outcomes of HCV infection in Ghana include liver fibrosis, cirrhosis, and HCC [54].

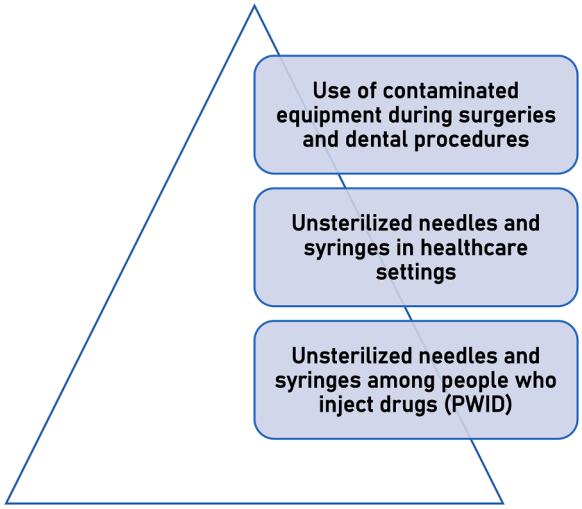

Fig. 2. An illustration of the identified major routes of HCV transmission in Ghana. The routes show that PWIDs are a primary group leading the transmission cycle of HCV. Transmission in healthcare settings to a lesser extent is also a route in spreading the disease. PWID: People Who Inject Drugs.

Table 2
A table showing included studies conducted in Ghana that reported the prevalence of different HCV genotypes.

	Name of the first author	Year	Study population	HCV genotype(s) reported	Prevalence
1	M. H. Wansbrough-Jones [9]	1998	pregnant women and blood donors	Genotype 2	71.4%
2	D. Candotti [13]	2003	blood donors	Genotype 2	87%
3	J. H. Bonney [20]	2013	Viral hemorrhagic fevers (VHF) patients	Genotypes 1, 2, 4	Identified
4	J. C. Forbi [47]	2015	HCV-positive blood donors	Genotypes 1 (HCV-1) Genotype 2 (HCV-2)	15% 85%
5	N. I. Nii-Trebi [35]	2019	healthy individuals	Genotype 2	100%
6	G. Mawuli [43]	2022	sickle cell disease patients	Genotype 1	100%

3.6. HCV screening protocols in Ghana

The guidelines recommend that all individuals at risk of HCV infection, including HIV-positive individuals, intravenous drug users, hemodialysis patients, healthcare workers, and individuals with a history of blood transfusion, should undergo HCV screening using serological tests, such as enzyme immunoassay (EIA). The guidelines also recommend confirmatory testing using nucleic acid testing (NAT) for HCV RNA [39,55]. Additionally, there are HCV indicators for Ghana (Fig 4a) that show progress in eliminating the virus [45].

3.7. HCV infection control strategies in Ghana

HCV infection control strategies are mainly focused on blood safety and infection prevention in healthcare settings. These strategies include the use of sterile equipment for injections, blood transfusions, and hemodialysis, as well as regular screening of blood donors for HCV infection [56]. A national policy for viral hepatitis was enacted in 2014 [53]. This strategy has been illustrated in Fig. 4b. Its main aim is to optimize and accelerate the process of eliminating all viral hepatitis including HCV and HBV. However, studies have shown that infection prevention practices in healthcare settings in Ghana are suboptimal. Some studies [44,56,57] reported poor adherence to infection prevention practices among healthcare workers in Ghana, which could contribute to the transmission of HCV in healthcare facilities.

4. Discussion

Hepatitis C (HCV) is considered a silent killer since it can remain asymptomatic for years, causing irreversible liver damage and increasing the risk of developing cirrhosis and liver cancer [58]. HCV transmission in Ghana is primarily associated with healthcare-related and illicit drug-related factors. These transmission routes should be addressed adequately through the implementation of comprehensive prevention strategies, including but not limited to, harm reduction programs, improving the quality of healthcare, screening of blood products, and increasing public awareness of safe injection practices [49]. These measures can help reduce HCV transmission rates significantly and prevent the occurrence of future HCV-related complications.

While the burden of HCV is substantial, there are still gaps in our knowledge of the epidemiology and prevalence of HCV, particularly in developing countries like Ghana. There are challenges in collecting and analyzing data on HCV. The country lacks population-based studies, making it difficult to estimate the true burden of HCV accurately [7]. In addition, there is a struggle with assessing and diagnosing HCV due to limited access to testing and treatment [44] as well as a lack of a comprehensive national HCV surveillance system, making it challenging to monitor the disease's epidemiology. Moreover, specific high-risk populations exist, which account for most HCV transmission, and yet, comprehensive data is limited on these populations, contributing to underdiagnosis and underreporting of HCV cases [1,59]. Furthermore, there are significant gaps in knowledge and understanding of HCV epidemiology and prevalence. Addressing these challenges requires more population-based studies, improving access to testing and treatment, increasing awareness of HCV, and implementing a comprehensive HCV surveillance system [57]. Continued investments in research and prevention programs are critical to reducing the burden of HCV in Ghana [60].

As noted, the Hepatitis C virus infection (HCV) is a serious global health concern, which can lead to chronic liver disease and hepatocellular carcinoma (HCC). Although HCV has a variety of clinical manifestations, many infected individuals remain asymptomatic [29]. The clinical manifestations of HCV infection in Ghana follow a similar pattern as the global trends [28,29,40]. Healthcare providers need to be able to recognize and manage HCV-related symptoms effectively with the recommended therapies available. Hepatitis C-related morbidity and mortality can be reduced effectively by early diagnosis and treatment. There is a need for more studies in Ghana to determine the clinical course of HCV infection and its associated manifestations to inform treatment and management guidelines.

The main risk factors for HCV infection in Ghana are similar to those reported globally, including exposure to contaminated blood products, unsafe injection practices, and illicit drug use [12,18,20]. More comprehensive prevention and control measures are warranted to reduce HCV transmission including harm reduction programs for PWID, improved screening protocols for blood transfusions, and general public awareness campaigns. By addressing these risk factors, it is possible to reduce the burden of HCV-related morbidity and mortality in Ghana. The virus can be classified into six genotypes and several subtypes based on its genetic diversity. The HCV genotypes found in Ghana are HCV-1, 2, and 4. Genotype 2 is the most prevalent in Ghana with HCV-1 closely following [20,35]. Genotype 4 is barely present in Ghana. While genotype 3 prevalent elsewhere, is not found in Ghana [20]. The prevalence of genotypes 5 and 6 is very low or nonexistent [43,61]. Knowing the specific HCV genotype prevalent in a particular population is important for effective treatment and management of HCV infection since some

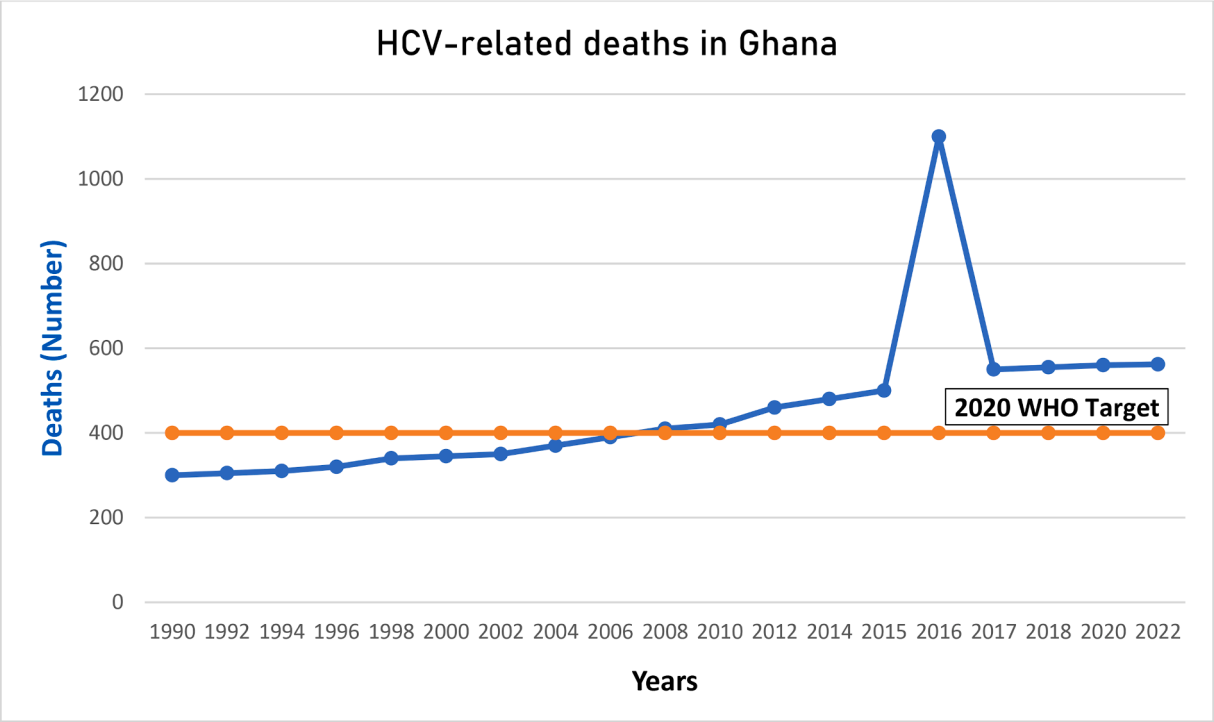

Fig. 3. A run chart showing the overall HCV-related deaths in Ghana. The chart shows that the current number of deaths that are attributed to HCV is above 400 deaths per year. This shows that there is excess death according to the WHO 2020 target for the country of less than 400 deaths per year. WHO: World Health Organization; HCV: Hepatitis C Virus.

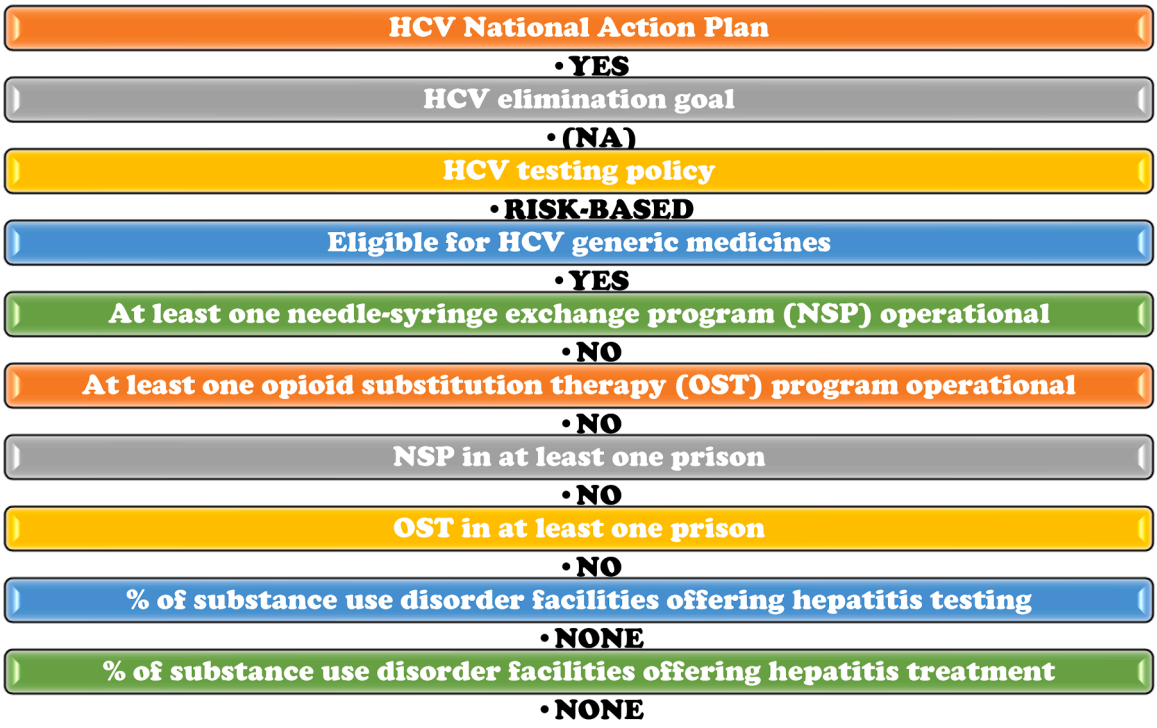

Fig. 4a. An illustration of the HCV indicators for Ghana. This illustration shows each indicator and its current status. HCV: Hepatitis C Virus; NA: Not Available; NSP: Needle—Syringe exchange Program; OSP: Opioid Substitution Therapy; Percentage (%).

genotypes are linked with poor prognosis [62]. Future studies should focus on determining the prevalence of HCV genotypes in other regions of Ghana as well as in other countries in the sub-Saharan region.

Furthermore, HCV infection in Ghana is a significant contributor to the liver disease burden, hence, understanding its outcomes is crucial. There is a high prevalence of cirrhosis and an increased risk of HCC among HCV-infected individuals with cirrhosis [53]. Chronic HCV infection remains an important contributor to liver disease burden.

Fig. 4b. A Cyclical Schematic Diagram of the National Policy on Viral Hepatitis for Ghana. This shows the cyclical process that is being used in tackling and possibly eliminating HCV in the country.

Future studies should investigate the incidence, risk factors, and management of HCV-related liver disease. While Ghana has national guidelines for HCV screening and infection control, implementation remains suboptimal [53]. A study by Nlankpe and colleagues [40] found a low HCV screening rate in Ghana. The low screening rate illustrates the need for increased awareness and implementation of the national guidelines. Therefore, more efforts are needed to increase awareness and implementation of national guidelines.

4.1. *Future suggestions*

We recommend more epidemiologic studies on HCV vaccine research, HCV treatment options, and the proper implementation of national hepatitis elimination strategies. Future epidemiologic investigations should focus more on risk groups especially men who have sex with men, inmates, and IV drug abusers. Low- and middle-income countries (LMICs) should improve strategic information by developing an electronic data management system and expanding their surveillance systems. A HEPSANET-like network should be established specifically for HCV, enabling the use of longitudinal cohort studies to examine the long-term outcomes of chronic hepatitis C, as well as the cost-effectiveness and feasibility of different models of care in LMICs.

To scale up care delivery for people living with HCV (PLWHCV), decentralization, integration of services, and task-sharing with adequate funding for required infrastructure will be crucial. However, new approaches such as "Treat all" or "Treat-all-except" should be considered. Further evidence from implementation science research, including qualitative evaluations of the understanding, attitudes, and acceptability of these approaches by both PLWHCV and the Ministry of Health is needed [63]. Additionally, mother-to-child transmission of HCV should be drastically reduced by ensuring HCV testing for pregnant women is free to all and exploring the integration of HCV testing into the HIV and TB antenatal programs. Ultimately, LMICs should improve linkage to care and increase financial accessibility for HCV patients by adding HCV treatment to the national health insurance benefits package and reducing the cost of diagnostics and treatment through price negotiations and bulk purchasing.

5. Conclusion

Data on the natural history of HCV infection in low- and middle-income countries, particularly in Africa, is scarce. Ghana lacks population-based studies and comprehensive national HCV surveillance systems, making it difficult to estimate the true burden of HCV accurately. The prevalence of genotypes 4, 5, and 6 is very low or nonexistent. Additionally, there is a high prevalence of cirrhosis among HCV-

infected individuals, with older age and HCV genotype 1b associated with an increased risk. Consequently, more efforts are needed to increase awareness and implementation of national guidelines in Ghana. The future for hepatitis elimination may be promising provided there is a strong coalition of stakeholders including health services, the Ministry of Health, the Hepatitis Foundations, leading clinicians, and major teaching and tertiary hospitals that are dedicated to working towards the WHO 2030 elimination goals.

CRediT authorship contribution statement

Marcarious M. Tantuoyir: Writing – original draft, Writing – review & editing, Project administration, Formal analysis, Data curation, Conceptualization. **Muhammed Camara:** Writing – review & editing, Data curation, Conceptualization. **Marjan Sohrabi:** Writing – review & editing, Supervision, Project administration. **SeyedAhmad SeyedAlinaghi:** Writing – review & editing, Supervision, Project administration. **Zahra Ahmadinejad:** Writing – review & editing, Supervision, Project administration, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethics

The synthesis is part of a thesis project and obtained the approval of the Ethics and Research Committee of Tehran University of Medical Sciences with the appropriate IRB Code *(IR.TUMS.MEDICINE.REC.1400.1108)*. The narrative synthesis strictly adheres to plagiarism rules and responsible and objective publication of data.

Consent for publication

Not applicable

Availability of data and materials

Not applicable

Funding

None

Acknowledgments

This was a joint project conducted between the School of Medicine, Iranian Research Center for HIV/AIDS, Iranian Institute for Reduction of High-Risk Behaviors, and the Infectious Disease Department, Imam Khomeini Hospital Complex, Tehran University of Medical Sciences, Iran.

References

[1] A.A. Agyeman, et al., Epidemiology of hepatitis C virus in Ghana: a systematic review and meta-analysis, BMC. Infect. Dis. 16 (1) (2016) 391.
[2] E. Akyar, Risk Factors for Hepatitis C in Western Africa: An Observational Study in a STI Clinic, Age (Omaha) 35 (2018) 54.
[3] E. Akyar, et al., Hepatitis C-HIV Co-Infection and Observed Risk Factors in Kumasi, Ghana, in: APHA's 2019 Annual Meeting and Expo (Nov. 2-Nov. 6), APHA, 2019.
[4] W. Ampofo, et al., Prevalence of blood-borne infectious diseases in blood donors in Ghana, J. Clin. Microbiol. 40 (9) (2002) 3523–3525.
[5] A.A. Adjei, et al., Prevalence of human immunodeficiency virus, hepatitis B virus, hepatitis C virus and syphilis among prison inmates and officers at Nsawam and Accra, Ghana, J. Med. Microbiol. 55 (5) (2006) 593–597.
[6] K.W.C. Sagoe, et al., Prevalence and impact of hepatitis B and C virus co-infections in antiretroviral treatment naïve patients with HIV infection at a major treatment center in Ghana, J. Med. Virol. 84 (1) (2012) 6–10.
[7] (CGHE), C.f.G.H.E. Ghana National Hepatitis Elimination Profile: Key Takeaways. 2022 26 Jan 2022 [cited 2023; Available from: https://www.globalhep.org/news/ghana-national-hepatitis-elimination-profile-key-takeaways.
[8] F.E.A. Martinson, et al., Seroepidemiological survey of hepatitis B and C virus infections in Ghanaian children, J. Med. Virol. 48 (3) (1996) 278–283.
[9] M.H. Wansbrough-Jones, et al., Prevalence and genotype of hepatitis C virus infection in pregnant women and blood donors in Ghana, Trans. R. Soc. Trop. Med. Hyg. 92 (5) (1998) 496–499.
[10] J.K. Acquaye, D. Tettey-Donkor, Frequency of hepatitis C virus antibodies and elevated serum alanine transaminase levels in Ghanaian blood donors, West Afr. J. Med. 19 (4) (2000) 239–241.
[11] D. Candotti, F. Sarkodie, J.P. Allain, Residual risk of transfusion in Ghana, Br. J. Haematol. 113 (1) (2001) 37–39.
[12] F. Sarkodie, et al., Screening for viral markers in volunteer and replacement blood donors in West Africa, Vox. Sang. 80 (3) (2001) 142–147.
[13] D. Candotti, et al., Frequent recovery and broad genotype 2 diversity characterize Hepatitis C virus infection in Ghana, West Africa, J. Virol. 77 (14) (2003) 7914–7923.
[14] A.T. Lassey, et al., Hepatitis C virus seroprevalence among mothers delivering at the Korle-Bu Teaching Hospital, Ghana, East African Med. J. 81 (4) (2004) 198–201.
[15] A Blankson, et al., Sero-prevalence of hepatitis B and C viruses in cirrhosis of the liver in Accra, Ghana, Ghana Med. J. 39 (4) (2005) 132.
[16] K.A. Apea-Kubi, et al., HTLV-1 and other viral sexually transmitted infections in antenatal and gynaecological patients in Ghana, West Afr. J. Med. 25 (1) (2006) 17–21.
[17] A.A. Adjei, et al., Correlates of HIV, HBV, HCV and syphilis infections among prison inmates and officers in Ghana: A national multicenter study, BMC. Infect. Dis. (8) (2008).
[18] N. Amidu, et al., Seroprevalence and risk factors for human immunodeficiency virus, hepatitis B and C viruses infections among blood donors at the Bolgatanga Regional Hospital in Bolgatanga, Ghana, J. Ghana Sci. Assoc. 12 (1) (2010) 77–88.
[19] B. Nkrumah, M. Owusu, P. Averu, Hepatitis B and C viral infections among blood donors. A retrospective study from a rural community of Ghana, BMC. Res. Notes. (2011) 4.
[20] J.H. Bonney, et al., Hospital-based surveillance for viral hemorrhagic fevers and hepatitides in Ghana, PLoS. Negl. Trop. Dis. 7 (9) (2013) e2435.
[21] R. Ephraim, et al., Seroprevalence of Hepatitis B and C Viral Infections among Type 2 Diabetics: A Cross-sectional Study in the Cape Coast Metropolis, Ann. Med. Health Sci. Res. 4 (5) (2014) 719–722.
[22] Walana, W., et al., Sero-prevalence of HIV, HBV and HCV Among Blood Donors in the Kintampo Municipal Hospital, Ghana. 2014.
[23] P. Adoba, et al., High Prevalence of Hepatitis B and Poor Knowledge On Hepatitis B and C viral Infections Among barbers: A cross-Sectional Study of the Obuasi municipality, 15, BMC Public Health, Ghana, 2015.
[24] R Ephraim, et al., Seroprevalence and risk factors of hepatitis B and hepatitis C infections among pregnant women in the asante akim north municipality of the ashanti region, Ghana; a cross sectional study, Afr. Health Sci. 15 (3) (2015) 709–713.
[25] S. King, et al., Antibody screening tests variably overestimate the prevalence of hepatitis C virus infection among HIV-infected adults in Ghana, J. Viral. Hepat. 22 (5) (2015) 461–468.
[26] J.E. Layden, et al., High frequency of active HCV infection among seropositive cases in West Africa and evidence for multiple transmission pathways, Clin. Infect. Dis. 60 (7) (2015) 1033–1041.
[27] M.B. Yakass, et al., Prevalence of blood borne viruses in IVF: An audit of a fertility centre, Jornal Brasileiro de Reproducao Assistida 20 (3) (2016) 132–136.
[28] S.Y. Lokpo, et al., The Burden and Trend of Blood-Borne Pathogens among Asymptomatic Adult Population in Akwatia: A Retrospective Study at the St. Dominic Hospital, Ghana, J. Trop. Med. (2017), 2017.
[29] S.Y. Lokpo, et al., Viral Hepatitis Endemicity and Trends among an Asymptomatic Adult Population in Ho: A 5-Year Retrospective Study at the Ho Municipal Hospital, Ghana, Hepat. Res. Treat. (2017) 6174743. **2017**.
[30] F. Völker, et al., Prevalence of pregnancy-relevant infections in a rural setting of Ghana, BMC. Pregnancy. ChildBirth 17 (1) (2017).
[31] C. de Mendoza, et al., Screening for retroviruses and hepatitis viruses using dried blood spots reveals a high prevalence of occult hepatitis B in Ghana, Ther. Adv. Infect. Dis. 6 (2019) 2049936119851464.
[32] M.T. Frempong, et al., Hepatitis B and C infections in HIV-1 and non-HIV infected pregnant women in the Brong-Ahafo Region, Ghana, PLoS One 14 (7) (2019).
[33] B. Osei-Tawiah, et al., Prevalence of HIV, Hepatitis B, Hepatitis C and Syphilis Infections among Patients in a Psychiatric Hospital in Ghana, Int. J. Virol. AIDS 6 (2019) 050.
[34] M.M. Birjandi, M. Oroei, The prevalence of positive rapid diagnostic test of hepatitis C virus infection in Ghana, Pan African Med. J. 36 (2020) 1–11.
[35] N.I. Nii-Trebi, et al., Core encoding sequences of Hepatitis C virus in Ghanaian blood donors are predominantly mosaics of different genotype 2 strains and cannot distinguish subtypes, BMC. Infect. Dis. 19 (1) (2019).
[36] C. Nkansah, et al., Seroprevalence and trend of hepatitides among blood donors in a district hospital in Ghana: a nine-year retrospective, descriptive cross-sectional study, J. Immunoassay Immunochemistry 41 (1) (2020) 71–83.
[37] A.K. Tetteh, et al., A Hepatitis C Sentinel Seroprevalence, Cape Coast, Ghana, J. Microbiol. Infect. Dis. 10 (01) (2020) 52–55.

[38] K.O. Duedu, et al., Low seroprevalence of hepatitis c among children at the princess Marie Louis children's hospital in accra, Ghana, Pan African Med. J. (2021) 40.
[39] L.J. Messersmith, et al., High levels of used syringe use and unsafe sex among people who inject drugs in Kumasi, Ghana: an urgent call for a comprehensive harm reduction approach, Harm. Reduct. J. 18 (1) (2021).
[40] A.M. Nlankpe, et al., Seroepidemiology of Hepatitis B and C Virus Infections: A Five-Year Retrospective Study among Blood Donors in Saboba District in the Northern Region of Ghana, Biomed. Res. Int. (2021), 2021.
[41] S.S. Osei, et al., Prevalence of HBV and HCV among Pregnant Women Attending Kumasi South Hospital (KSH), Ghana, Prevalence 7 (2021) 19.
[42] R.K. Ephraim, et al., Prevalence of Hepatitis B, C and HIV infections among haemodialysis patients at the Cape Coast Teaching Hospital, Ghana; A retrospective study, Ann. Med. Lab. Sci. 2 (1) (2022) 42–51.
[43] G. Mawuli, et al., Hepatitis C virus (HCV) infection among patients with sickle cell disease at the Korle-Bu teaching hospital, Virol. J. 19 (1) (2022) 1–9.
[44] Y.A. Nartey, et al., Hepatitis C virus seroprevalence, testing, and treatment capacity in public health facilities in Ghana, 2016-2021; A multi-centre cross-sectional study, PLoS. One 18 (6) (2023) e0287580.
[45] Elimination, C.f.G.H. HCV Country Profile: Ghana. 2022 June 2022 [cited 2023 September 14, 2023]; Available from: https://www.globalhep.org/country-progress/ghana.
[46] J. Schmelzer, et al., Global prevalence of hepatitis C virus in children in 2018: a modelling study, Lancet Gastroenterol. Hepatol. 5 (4) (2020) 374–392.
[47] J.C. Forbi, et al., Next-generation sequencing reveals frequent opportunities for exposure to hepatitis c virus in Ghana, PLoS. One 10 (12) (2015).
[48] A.A. Adjei, et al., Correlates of hepatitis C virus infection among incarcerated Ghanaians: a national multicentre study, J. Med. Microbiol. 56 (2007) 391–397. Pt 3.
[49] K. Tachi, Hepatitis C virus infection in Ghana: time for action is now, Ghana Med. J. 52 (1) (2018) 1–2.
[50] M.A. Purdy, et al., A re-evaluation of the origin of hepatitis C virus genotype 2 in West Africa, J. Gen. Virol. 96 (8) (2015) 2157–2164.
[51] M. Assih, et al., Genetic diversity of hepatitis viruses in West-African countries from 1996 to 2018, World J. Hepatol. 10 (11) (2018) 807–821.
[52] J.D. Yang, et al., Characteristics, management, and outcomes of patients with hepatocellular carcinoma in Africa: a multicountry observational study from the Africa Liver Cancer Consortium, Lancet Gastroenterol. Hepatol. 2 (2) (2017) 103–111.
[53] Elimination, C.f.G.H. Ghana National Policy on Viral Hepatitis, 2014. 2020 07 May 2020 [cited 2023 September 14]; Available from: https://www.globalhep.org/evidence-base/ghana-national-policy-viral-hepatitis-2014.
[54] A.P. Venook, et al., The incidence and epidemiology of hepatocellular carcinoma: a global and regional perspective, Oncologist. 15 (S4) (2010) 5–13.
[55] M. El Ekiaby, N. Lelie, J.-P. Allain, Nucleic acid testing (NAT) in high prevalence–low resource settings, Biologicals 38 (1) (2010) 59–64.
[56] D.S. Chen, et al., Strategies to manage hepatitis C virus infection disease burden Volume 4, J. Viral. Hepat. 24 (2017) 44–63.
[57] A. Agyei-Nkansah, S. Taylor-Robinson, The state of Ghanaian liver medicine, Pan African Med. J. (2021) 39.
[58] (WHO), W.H.O. Hepatitis C. 2022 18 July 2023 [cited 2023; Available from: https://www.who.int/news-room/fact-sheets/detail/hepatitis-c.
[59] A.M. Nlankpe, et al., Seroepidemiology of Hepatitis B and C Virus Infections: A Five-Year Retrospective Study among Blood Donors in Saboba District in the Northern Region of Ghana, Biomed. Res. Int. (2021) 5599705, 2021.
[60] C.L. Ward, et al., Availability and Prices of WHO Essential Diagnostics in Laboratories in West Africa: A Landscape Survey of Diagnostic Testing in Northern Ghana, J. Appl. Lab. Med. 6 (1) (2021) 51–62.
[61] M. Namayandeh, et al., Hepatitis C virus genotypes in patients with chronic hepatitis C infection in southern Iran from 2016 to 2019, Microbiol. Immunol. 64 (11) (2020) 762–767.
[62] S. Merat, et al., The efficacy of 12 weeks of sofosbuvir, daclatasvir, and ribavirin in treating hepatitis C patients with cirrhosis, genotypes 1 and 3, Hepat. Mon. 17 (1) (2017).
[63] C.W. Spearman, et al., A new approach to prevent, diagnose, and treat hepatitis B in Africa, BMC Glob. Public Health 1 (1) (2023) 24.