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Awareness about Hepatitis B and/or C Viruses among Residents of Adama and Asella Cities

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Nov 23, 2017

Acknowledgments

My gratitude goes to God Almighty, the essence of my existence, all I have ever been and will ever be in life, I owe it all to you.

I would like to thank my friends those who were enumerators and facilitators during data collection and population of Adama and Assela cities for their will, patience and participation during interview.

I also thank Adama Science and Technology University for funding the research project.

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LIST OF ABBREVIATIONS

DNA…………………………..Deoxyribonucleic Acid

HBV…………………………..Hepatitis B Virus

HCV…………………………..Hepatitis C Virus

HCC………………………… Hepatocellular Carcinoma

HBsAg………………………..Hepatitis B Surface Antigen

HIV…………………………...Human Immuno Deficiency Virus

HDV…………………………Hepatitis D Virus

IDU…………………………...Intravenous Drug Use

LR…………………………… Likelihood Ratio

ML…………………………... Maximum Likelihood

MCMC………………………..Markov Chain Monte Carlo

OR……………………………Odds Ratio

OLS…………………………...Ordinary Least Squares

SE……………………………...Standard Error

WHO…………………………World Health Organization

WIHS…………………………Women's Interagency HIV Study

ART……………………………Antiretroviral Therapy

Ab………………………………Antibody

Ag………………………………Antigen

CHB……………………………chronic hepatitis B infection

CLD……………………………Chronic liver disease

ELISA…………………………..Enzyme linked immune sorbent assay

HAV……………………………..hepatitis A virus

HBIG………………………………..hepatitis B immune globulin

HBsAg………………………………Hepatitis B surface antigen

RNA…………………………………Ribose nucleic acid

US …………………………………...ultrasound

SVR………………………………….Sustained Viral Response

PPE……………………………………Personal Protective Equipment

NMWH………………………………..Non-Medical Waste handlers

SRSM …………………………………Simple Random Sampling Method

Awareness about Hepatitis B and/or C Viruses among Residents of Adama and Asella Cities

Abstract

Hepatitis B and C viruses affect the liver and cause major global public health problem. The present study intended to asses awareness of residents at Adama and Assela cities towards infectious disease, Hepatitis B and/or C, using classical logistic regression models. A two stage stratified random sampling method was employed to select 589 households from Adama city and 533 from Assela city. Awareness of respondents was determined based on the mean score aggregated over 19 items. Respondents who scored above the mean value were categorized as aware and those scored below mean value were categorized as not aware. About 45.8% of the respondents at Adama city and 44.9% respondents at Assela city were aware about the infectious diseases. From logistic regression analysis, we identified four out of twelve predictors as a major determinates on awareness of the residents towards the infectious diseases. These were educational level, monthly income, reading habit and use of media. The results indicate that, for instance, odds of awareness for respondents with high school level of education increased by the factor 1.151 as compared with respondents with elementary and less level of education. It is recommended that awareness campaigns should be enhanced to increases the knowledge of the public on Hepatitis B and/or C infections with emphasis on its mode of transition and measures to reduce the risk of controlling the viruses (practicing safe sex and avoiding of sharing infection needles, tooth brushes, or shaving razors).

Key words: *Hepatitis B and/or C Viruses, Logistic regression*

1. INTRODUCTION

1.1 Background

The liver is one of the body's powerhouses. It helps process nutrients and metabolizes medication. The liver also helps clear to the body from toxic waste products. The word Hepatitis means an inflammation of the liver, and one of many things, including a liver or bacterial infection, liver injury caused by a toxin (poison) or even an attack to the liver by the body's own immune system, can cause it. Although there are several forms of Hepatitis, the disease is usually caused by one of three viruses: Hepatitis A, Hepatitis B, and Hepatitis C Viruses**.** Both hepatitis B virus (HBV) and C virus (HCV) are spread mainly through contaminated blood and blood products, sexual contact and contaminated needles **[65].**

Hepatitis B virus (HBV) and hepatitis C viruses are hepatotropic virus whose primary replication occurs in the liver **[35].** The natural history and clinical course of hepatitis B virus (HBV) differs from that of hepatitis C virus (HCV) infection. However, similarities may be drawn in the context of chronic disease and public health burden. Chronic infection by these viruses leads to slow progressive liver disease that over a period of up to 30 years may result in cirrhosis, chronic liver failure and hepatocellular carcinoma (HCC) **[46].**

WHO estimates that there are 350 million people with chronic HBV infection and 170 million people with chronic HCV infection worldwide. HBV is estimated to result in 563,000 deaths and HCV result in 366,000 deaths annually **[4].** Chronic Hepatitis B and C infections are leading causes of cirrhosis and Hepatocellular carcinoma (HCC) which is considered as the third Cancer associated cause of deaths worldwide. WHO estimated that the prevalence of infection in Africa is on average more than 10 %. However, a study conduct on Addis Ababa showed that the mean prevalence of HBsAg was 6.1 percent [**65].**

Liver diseases due to HBV has become an enormous global problem. It was estimated that worldwide 2 billion people have been infected with HBV and more than 350 millions have chronic lifelong infection. In 1989, HCV was cloned first time. It is estimated that 170 million people are newly infected each year.

HBV has diameter of about 40nm. It affects humans and chimpanzees, but there are closely related members of this family that also infect other mammals and birds. HBV is DNA virus and is enveloped. Hepatitis B can range in severity from a mild illness lasting a few weeks to a serious, lifelong illness. Hepatitis B can be either ”acute” or ”chronic”. Acute Hepatitis B Virus is a short term illness that occurs within the first 6 months after someone is exposed to the hepatitis B Virus. However, acute infection does not always lead to chronic infection. Chronic hepatitis B virus infection is long-term illness that occurs when the hepatitis B Virus remains in a person’s body.

Hepatitis C is a contagious liver disease that results from infection with the Hepatitis C Virus. It can range in severity form mild illness lasting a few weeks to a serious, life long illness. Chronic Hepatitis C is a serious disease that can result in long-term health problems, or even death. There is no vaccine for Hepatitis C. The best way to prevent Hepatitis C is by avoiding behaviors that can spread the disease, especially infection drug use.

It is estimated that 130-170 million people or 3 percent of the world population are currently living with chronic Hepatitis C. About 3-4 million people are infected per year, and more than 350,000 people die yearly from Hepatitis C related diseases. Rates have increased substantially in the 20th century due to a combination of IDU and intravenous medication or poorly sterilized medical equipment.

Hepatitis has no symptoms, so infected people pass it on other without knowing. The majority of infected persons might not be aware of their infection because it mimics a typical illness and the co-infected stigma attached to the disease prompts secrecy resulting in no treatments.

Both HBV and HCV can cause acute inflammatory hepatitis that can result in fulminate liver failure. Chronic infection can result in liver fibrosis and ultimately cirrhosis and hepatocellular carcinoma conditions resulting in increased mortality. Both HBV and HCV can complicate HIV treatment, and HCV can accelerate the progression of HIV disease.

Viral hepatitis is a major health problem worldwide and cause acute and/or chronic hepatitis, which can leads to the development of extensive liver scarring (cirrhosis), liver failure, liver cancer and death. Viral hepatitis is the tenth leading cause of death and the leading cause of liver

cancer worldwide **[46, 4].** HBV and HCV can be ended with development of cirrhosis and liver cancer **[22].** More than 500 million people worldwide are persistently infected with either of these two viruses thus presenting a major global health problem **[75].** Because the two hepatotropic viruses share the same modes of transmission, co-infection with the two viruses is common, especially in areas with a high prevalence of HBV infection and among people at high risk for infection **[85, 62].** There are several million carriers worldwide, which provide a huge reservoir for HBV and HCV. It may progress to chronic liver disease (CLD) including hepatocellular carcinoma (HCC) **[63, 70].**

Both HBV and HCV are an important occupational hazard for medical waste handlers and chronically infected HBV and HCV carriers are able to transmit through contact with their blood and body fluids, which includes occupational exposure to their blood and body secretions. The current treatment for hepatitis B virus infection is not curable after the infection progress to chronic stage and very expensive for individuals in developing countries like Ethiopia. Thus, early screening of People who are at risk including medical waste handlers is mandatory **[27].**

Viral hepatitis is an inflammation of the liver due to viral infections and there are groups of viruses that affect the liver of which hepatitis B and C viruses are the causative agents of sever form of liver disease with high rate of mortality. Medical waste handlers who undergo collection, transportation, and disposal of medical wastes in the health institutions are at risk of exposure to acquire those infections that transmit mainly because of contaminated blood and other body fluids including injury with sharp instruments, splash to the eye or mucous membrane.

Generally, medical waste handlers who are working in collection, transportation, cleaning and disposal of medical wastes in health institutions have been consistently shown to have higher prevalence of HBV and HCV infection than non-clinical waste handlers that directly or indirectly have no contact with medical wastes **[54, 12].** The differences in hepatitis viruses infection rates may reflect disparities in the risk of exposure to infection **[4].**

1.2 Statement of the Problem

To prevent transmission and progression of the diseases in given community, proper community awareness about the diseases, including prevention, is important.

This study focuses on assessing:

- Awareness level of Adama and Asella cities residence towards HBV and/or HCV

The finding of this research would provide answer for the following research questions:

- To what level do the respondents understand about HBV and/or HCV and their prevention method in the study area?
- Which factors significantly affect the awareness level about hepatitis B and/or C infection in the study area?

1.3 Objective of the Study

1.3.1 The General Objective of the Study

To investigate the current level of awareness of hepatitis B and/or C viruses among residents of Adama and Asella cities.

1.3.2 Specific Objectives of the Study

- To investigate factors that may affect the awareness level of the residents.
- To assess the relationship between awareness level of respondents towards infectious diseases and explanatory variables

1.4 Significance of the Study

The outcome of this study could help:

- in understanding the level of awareness of respondents towards HBV and/or HCV.
- in identifying factors affecting the level of awareness and design appropriate interventions towards improving the awareness level.
- in health managers and planners to develop appropriate preventive services, allocate resources, decide on priorities and target certain populations.
- as a source of information to other researchers for further investigations.

2. LITERATURE REVIEW

2.1 Concepts and Definitions of Awareness

Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects, or sensory patterns. More broadly, it is the state or quality of being aware of something. In biological psychology, awareness is defined as a human's or an animal's perception and cognitive reaction to a condition or event. Awareness may also refer to public or common knowledge or understanding about a social, scientific, or political issue, and hence many movements try to foster "awareness" of a given subject, that is, "raising awareness". Examples include hepatitis awareness, multicultural awareness. Awareness can also define in terms of knowledge as which are the basic in all forms of knowledge in pure existence is defined as knowledge. One helps to define the other. The basis for all forms of knowledge is what we mean by awareness. Perception is how individuals view the world around them. What one perceives can be very different from the reality **[67].** What is common in all forms of perception is awareness. Awareness is a relative concept. An animal may be partially aware, may be subconsciously aware, or may be acutely unaware of an event. Awareness may be focused on an internal state, such as a visceral feeling, or on external events by way of sensory perception. Awareness provides the raw material from which animals develop subjective ideas about their experience.

2.2 Viral Hepatitis

Hepatitis is an inflammation of the liver, most commonly caused by a viral infection **[81].** Viral liver diseases are among the most important communicable disease worldwide different species of viruses, including Cytomegalovirus, Epstein-Barr, Herpes simplex, Adenovirus, Coxsackie virus, Mumps, Yellow fever, and other cause parenchymal hepatic inflammation, but the term viral hepatitis generally implies the five hepatotropic viruses: Hepatitis A, B, C, D and E virus**[67].**

Infections of HBV and HCV are by far the most prevalent, and their consequences can be serious. Long term chronic infection with one or both of these viruses is the most common cause of liver fibrosis and cirrhosis, leading to liver failure and hepatocellular carcinoma **[84].** According to the World Health Organization (WHO), 2 billion people have been infected with the hepatitis B virus (HBV), and more than 350 million have a chronic HBV infection **[83].** In

addition, it has been estimated that up to 3% of the world's population has been infected with hepatitis C virus (HCV), of which 170 million people are chronically infected, and an additional 3 to 4 million people are infected each year **[85].**

Liver diseases are common in Africa and account for high morbidity and mortality. Hospital based analysis indicate that acute viral hepatitis, chronic hepatitis, cirrhosis and hepatocellular carcinoma are responsible for at least 12% of medical admissions and over 20% of hospital mortality in many parts of Africa**[75].**

2.3 Sign and Symptoms Hepatitis Virus

Hepatitis is an inflammation of the liver characterized by malaise, joint aches, abdominal pain, vomiting 2-3 times per day for the first 5 days, defecation, loss of appetite, dark urine, fever, hepatomegaly (enlarged liver) and jaundice (citrus,yellowing of the eyes and skin). Some chronic form of Hepatitis show very few of these signs and are only present when the longstanding inflammation has lead to the replacement of liver cells by connective tissue; this disease processes is referred to as cirrhosis of the liver. Certain liver function tests can also indicate Hepatitis **[42].**

2.4 Chronic Liver Disease

Chronic liver disease (CLD) is a disease of the liver resulting from an inflammatory, infiltrative, immunologic, mechanical or metabolic injury to the liver, which has persisted for six or more months without complete resolution **[4].** It has different characteristics in terms of risk factors, incubation, latency, induction and the final state of the disease process. The most common CLDs are associated with chronic viral hepatitis, alcohol use and obesity; the least common are liver cancer and those due to certain genetic, autoimmune and vascular conditions or to drug toxicity [**15**].

Cirrhosis is the end-stage of every chronic liver disease. It is characterized by an asymptomatic stage, known as compensated cirrhosis, followed by a rapidly progressive phase where liver dysfunction occurs, called decompensate cirrhosis. The most severe evolution condition of the cirrhosis is the hepatocelllular carcinoma (HCC), also called, primary liver cancer. Liver biopsy has been the preferred tool in the evaluation and staging of the CLD. However, its invasive

nature and the development of other more accurate noninvasive alternatives have lead to a decrease on its usage for assessing the CLD. Among these alternatives, CLD staging based on ultrasound (US) data has proven to be a promising and safer alternative to biopsy **[67].**

Chronic liver disease is responsible for over 1.4 million deaths annually **[86]** and is characterized by permanent inflammatory processes that predispose to liver cancer and in particular hepatocellular carcinoma (HCC). In healthy liver, inflammatory processes stimulate growth and repair and restore normal liver architecture. However, if liver inflammation becomes chronic, the balance of damage versus regeneration in the liver is disrupted and can lead to the formation of excessive scar tissue, termed fibrosis. In the long-term, an exacerbation of fibrosis will lead to cirrhosis, which is characterized by abnormal liver architecture and function and is associated with a significant reduction in overall health and well-being. At cirrhotic stages, the liver damage is often irreversible or difficult to treat. Cirrhosis leads frequently to death from liver failure or due to hepatocellular carcinoma (HCC) **[60].**

2.5 Hepatitis B Virus

Hepatitis B virus (HBV) is a small DNA virus and belongs to a group of hepatotropic DNA viruses (hepadnaviruses). The virus consists of a nucleocapsid and an outer envelope composed mainly of three hepatitis B surface antigens (HBsAgs) that play a central role in the diagnosis of HBV infection. The nucleocapsid contains hepatitis B core antigen (HBcAg), a DNA polymerase reverse transcriptase, the viral genome as well as cellular proteins **[75].**

The viral genome of HBV is a partially double stranded circular DNA of approximately 3,200 base pairs that encodes four overlapping open reading frames. The S gene, which codes for HBsAg; two pre-S region genes (pre-S1 and pre-S2) that code for the hepatocyte receptor binding site; the C gene, which codes for HBcAg and HBeAg; the P gene, which codes for a DNA polymerase; and the X gene that activates viral and cellular promoters. Although HBV is a DNA virus, it replicates in a way similar to retroviruses, making an intermediate RNA transcript **[50].**

Natural history

Acute Hepatitis B Virus

The first encounter with HBV results in an acute hepatitis B infection and in the majority of it is asymptomatic. However, 20-30% of patients may exhibit symptoms of acute infection **[17].** Such as fever, malaise, anorexia, nausea followed by jaundice. In more than 95% of patients with acute HBV infection, the disease is self-limiting leading to complete recovery and life-long immunity [**24**]. However, in 1-5% of immune competent adults the disease may progress to chronic hepatitis B infection (CHB). The age of acquisition of the infection plays an important role in determining the course of the infection **[24]**. Up to 90% of those who acquire the infection during the perinatal period progress to CHB. Less than 1% of individuals with acute hepatitis B infection may develop fulminant hepatic failure that has high mortality rate reaching approximately 80% **[32].**

Chronic Hepatitis B Virus

Chronic hepatitis B infection is defined as persistence of high levels of HBsAg for 6 months or more following acute infection **[17].** The infection runs a long and variable clinical course, with different outcomes in terms of severity of the underlying liver disease and the extent of its progression **[6].**

Chronic active infection requires active HBV viral replication with presence of HBV DNA. Presence of HBsAg without detectable HBV DNA or HBeAg defines chronic carrier state. These patients usually have anti-HBeAg and normal liver chemistries. Small amounts of HBV DNA might be detected as long as HBsAg antigens are present. This indicates that presence of HBsAg could diagnose chronic infection without determining the presence or absence of HBV DNA, HBeAg or anti-HBeAg. Most patients with chronic hepatitis B are clinically asymptomatic. Some may have nonspecific symptoms such as fatigue **[6].**

In most instances, significant clinical symptoms will develop only if liver disease progresses to decompensated cirrhosis with jaundice, ascites, peripheraloedema, and encephalopathy accompany it accordingly, physical examination will be normal in most instances. In advanced

liver disease, there may be stigmata of chronic liver disease such as splenomegaly, spider angiomata, Caput medusae, palmar erythema, testicular atrophy, gynecomastia, etc **[27].**

Transmission

Transmission of hepatitis B virus results from exposure to infectious blood or body fluids containing blood such as saliva, nasopharyngeal washings, semen, menstrual fluid and vaginal secretions. Possible forms of transmission include sexual contact, blood transfusions, re-use of contaminated needles and syringes, and vertical transmission from mother to child during childbirth. Without intervention, a mother who is positive **[54].**e for HBV confers a 20% risk of passing the infection to her offspring at the time of birth. This risk is as high as 90% if the mother is also positive for HBeAg.

Prevention of hepatitis B

Several vaccines have been developed for the prevention of HBV infection. These rely on the use of one of the viral envelope proteins (hepatitis B surface antigen or HBV). The vaccine was originally prepared from plasma obtained from patients who had long-standing hepatitis B virus infection. However, currently, it is made using a synthetic recombinant DNA technology that does not contain blood products. One cannot be infected with hepatitis B from this vaccine **[54].**

The risk of vertical transmission to the new born can be drastically reduced from 20%- 90% to 5%-10% by administering to the newborn hepatitis B vaccine (HBV 1) and hepatitis B immune globulin (HBIG) within 12 hours of birth, followed by a second dose of hepatitis B vaccine (HBV 2) at 1-2 months and a third dose at and no earlier than 6 months (24 weeks). Since 2% of infants vaccinated will not develop immunity after the first three dose series, infants born to hepatitis B positive mothers are tested at 9 months for hepatitis B surface antigen (HBV) and the antibody to the hepatitis B surface antigen (anti-HBs); if post-vaccination test results indicate that the child is still susceptible, a second three dose series at (0, 1 and 6 months) is administered. If the child is still susceptible after the second series, a third series is not recommended **[86].**

Treatment of hepatitis B

Acute hepatitis B infection does not usually require treatment because most adults clear the infection spontaneously **[36].** Early antiviral treatment may only be required in less than 1% of patients, whose infection takes a very aggressive course (fulminant hepatitis) or who are immune compromised. On the other hand, treatment of chronic infection may be necessary to reduce the risk of cirrhosis and liver cancer. Chronically infected individuals with persistently elevated serum alanine aminotransferase, a marker of liver damage, and HBV DNA levels are candidates for therapy **[48].**

Global Epidemiology

Hepatitis B is one of the major diseases of humankind and is a serious global public health problem. Of the 2 billion people who have been infected with the HBV, more than 350 million have chronic (lifelong) infections. HBV infections result in 500,000 to 1.2 million deaths per year caused by chronic hepatitis, cirrhosis, and hepatocellular carcinoma **[12].** Hepatitis B surface antigen (HBsAg) positivity of more than 8% in a community is considered high. In countries, which include the Far East, parts of the Middle East, Sub-Saharan Africa and the Amazon Basin. In these regions, serologic evidence of prior HBV infection (anti-hepatitis B core antigen (anti-HBcAg) or anti-hepatitis B surface antigen (anti-HBsAg) positivity is present in the vast majority of individuals **[49].**

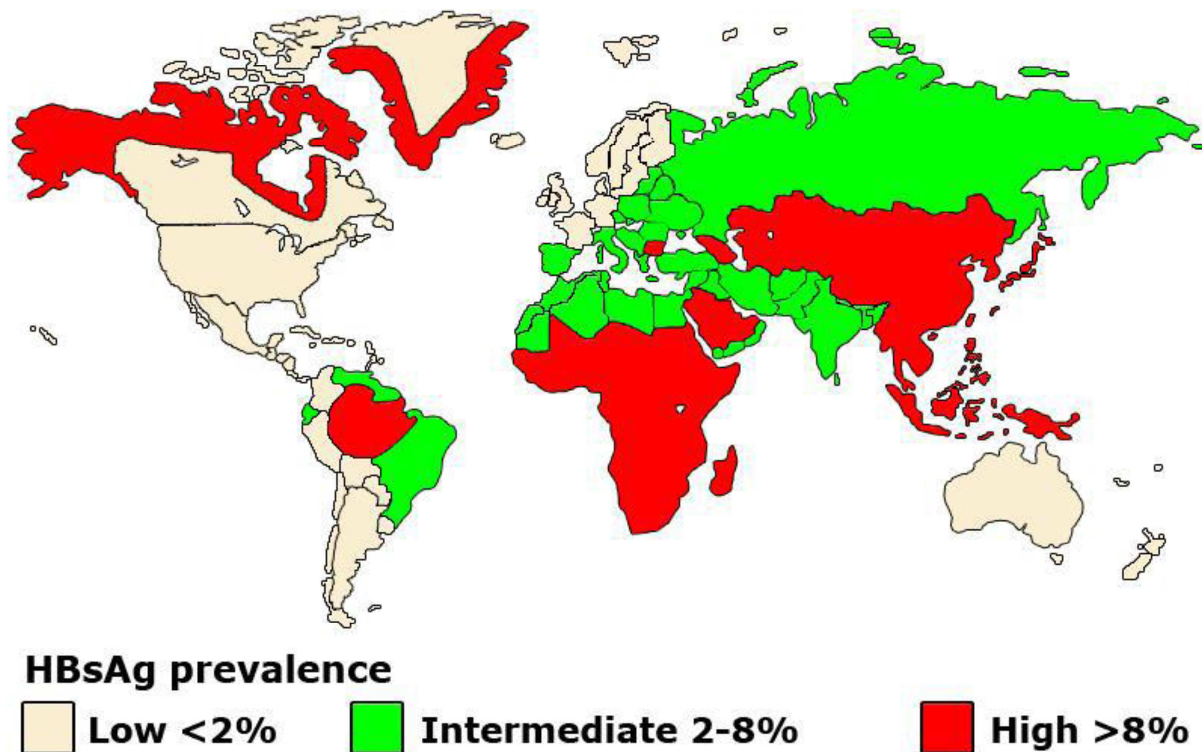

Figure 1: Estimated global prevalence of HBsAg virus infection

Countries like Japan, India, central Asia and the Middle East including Eastern and Southern Europe, as well as parts of South America, are all areas with intermediate (2% to 7% HBsAg positive) prevalence of chronic HBV infection. Low prevalence (<2% HBsAg positive) of chronic HBV is found in regions including the United States, Northern Europe, Australia, and the southern part of South America [**12].**

Approximately 45% of the world population lives in areas where chronic HBV infection is highly endemic (≥8% of the population are HBsAg-positive); 43% live in areas of intermediate endemicity (2-7% HBsAg-positive); and 12% live in areas of low endemicity (<2% HBsAg-positive) **[27].**

In Africa, infections with HBV play a major role in the etiology of most liver diseases. By country, estimated HBsAg seroprevalence ranges between 5% and 19%, and the total number of carriers may approach 58 million with as many as 12.5 million likely to die prematurely due to hepatitis B-induced liver disease **[49].**

In Ethiopia as in other Sub-Saharan Africa, the prevalence of liver disease is high. They account for 12% of the hospital admissions and 31% of the mortality in medical wards of Ethiopian hospitals **[75].** A nationwide sero-epidemiological study of hepatitis B markers prevalence was conducted in Ethiopia on 5,270 young males from all regions of the country. Overall prevalence rates were 10.8% for HBsAg and 73.3% for "at least one marker positive"; a remarkable geographical and ethnic variability of marker prevalence was observed, reflecting the wide differences existing in Ethiopia in socio-cultural environment and activities such as tribal practices and traditional surgery. Sexual practices and medical exposure also play some role as determinants of hepatitis B marker prevalence in Ethiopia **[3].**

Another community based seroprevalence study done in the capital city of Ethiopia; Addis Ababa has shown a 7% seroprevalence of HBsAg, higher in males than females. Overall HBV seroprevalence rose steadily to over 70% in 49 year olds. The age at which 50% had evidence of infection was around 20 years [**3**]. Similar study subjects of other countries, 44.6% HBsAg in India among chronic liver disease [26] 42.9% HBsAg in Ghana among HCC patients [25] and 36% HBsAg % and 24% among HCC patient in Zimbabwe **[49].**

2.6 Hepatitis C Virus

HCV is classified as the type member of the genus Hepacivirus within the virus family Flaviviridae **(61).** It measures 30 to 60 nm in diameter, with a positive-sense RNA genome and is enveloped. The genome of HCV encodes 10 proteins including 2 glycoproteins (E1, E2) that undergo variation during infection due to hyper variable regions within their genes **[10].**

HCV has been suggested to have six genotypes, which differ from each other by 31–33% at the nucleotide level and are further classified into several subtypes **[61]** the genotype 1, 2, and 3 appears to have a worldwide distribution and their relative prevalence varies from one geographic area to another. HCV genotype 4 appears to be prevalent in North Africa and the Middle East, and genotype 5 and 6 seems to be confined to 6 South Africa and Hong Kong respectively **[10].**

Transmission

There are multiple routes of transmission of HCV Since it is a blood-borne infection which is transmitted sexually and vertically and by iatrogenic, occupational, cultural and recreational activities. Unsafe transfusions and therapeutic injections and acupuncture are examples of iatrogenic transmission. Intravenous drug use, tattooing, scarification and ear-piercing are examples of recreational and cultural activities that may spread HCV. It may also be transmitted by needle-stick injuries **[45].**

Prevention

There is no vaccine against HCV. Research is in progress but the high mutability of the HCV genome complicates vaccine development [**70**]. In absence of a vaccine, all precautions to prevent infection of HCV should target reduction of transmission of the virus. The only means of protection are the implementation of universal precautions and safe injection practices. Screening and treatment of blood products is the only way to prevent transfusion-associated cases [**79**]. HCV carriers should be strongly discouraged from drinking alcohol because there is evidence that acts as a cofactor in developing more severe liver injury **[52].** Patients who do not have serologic evidence of immunity to hepatitis A and B should be vaccinated, especially since infection with the hepatitis A virus (HAV) in patients with chronic HCV may result in a more severe infection than in patients without HCV **[86].**

Treatment of Hepatitis C

Treatment of acute hepatitis is mainly supportive, consisting of bed rest and balanced diet with small frequent nitrous meals and hospitalization reserved only for cases of severs disease **[73].** The goal of treatment is to achieve a sustained viral response (SVR), as defined by the absence of viremia 6 month after stopping the medications; SVR is associated with improved histology and decreased risk of morbidities [**56**].

Epidemiology

Epidemiological studies of HCV are challenging since most cases of HCV infection are asymptomatic and indistinguishable clinically from other causes of hepatitis. A laboratory

diagnosis is therefore essential, but not always available, particularly in resource-limited settings. There are consequently few population-based epidemiological studies of HCV. Most studies are based on select high risk (e.g. intravenous drug users) or low risk (e.g. blood donor) populations, which either overestimate or underestimate the true prevalence respectively **[65].**

HCV is endemic worldwide, with an estimated global prevalence of 3%, which represents 170 million people. HCV is four to five times more prevalent than HIV globally and is the commonest chronic blood-borne infection in the United States three to four million people is infected by HCV every year **[69].**

There is great variation in the geographical distribution of HCV, with the highest prevalence in Africa and Asia, and lower prevalence in industrialized countries (Figure 2). Even within developing nations, there is great variation in prevalence. 0.9% in India and 3.2% in China, to the highest reported prevalence in Egypt of 22%. Some of this variation may be explained by differences in study and reporting methods. Actual differences in HCV prevalence may be due to variation in risk factors in different parts of the world. Injection drug use is the single most important risk factor in developed regions of the world. Unsafe therapeutic injections and blood transfusions are important risk factors in developing nations where these practices occur. Occupational, per natal and sexual exposure, and tattooing, body-piercing, acupuncture and scarification are other modes of HCV transmission. The relative contribution of these risk factors to the prevalence of HCV is poorly defined, particularly in developing regions of the world **[65].**

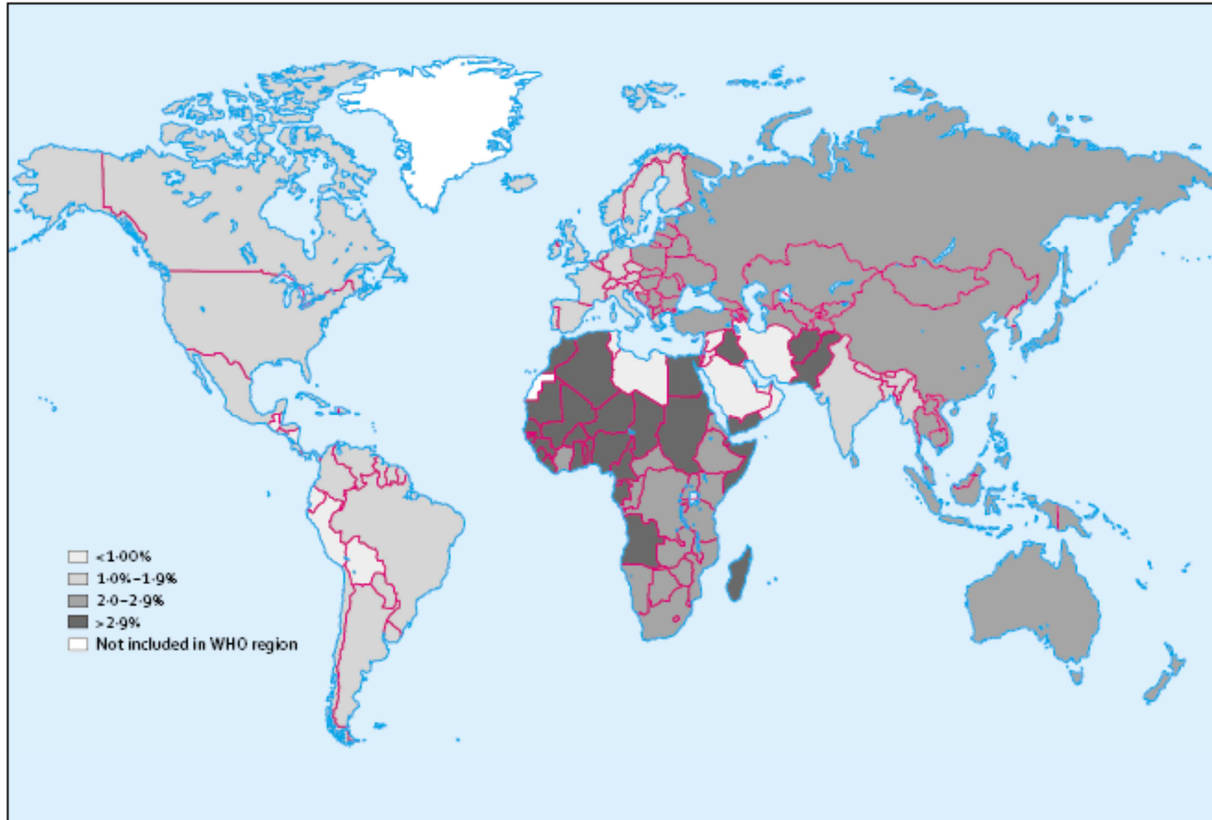

Figure 2: Estimated global prevalence of hepatitis C virus infection [41].

Sub-Saharan Africa has the highest prevalence of HCV (5.3%) among the WHO world regions. Within this region there are remarkable differences in prevalence: the central African region has the highest prevalence (6%), and Southern and East Africa, the lowest (1.6%). Cameroon has the highest national prevalence of 12% and South Africa the lowest (0.1%) among blood donors **[52].**

Limited data are available in Ethiopia. The overall seroprevalence of HCV in 1,580 Ethiopian subjects representing urban and rural populations was reported to be 2.0%**.** Most of the studies revealed a low overall prevalence of HCV infection. These include 0.3% in Health professionals [44]. 0.7% in 6361 consecutive blood donors [45]. 0.9% in inhabitants of Addis Ababa [46]. 1.3% in pregnant women attending antenatal clinic [**76]**. 1.7% in Tigray and Amahra regions **[29].**

2.7 General Burden of Hepatitis B and C Virus Worldwide

Hepatitis B and C viruses are worlds most common and serious infection disease. Approximately 30% of the world population, about 2 billion persons has serologic evidence of current or past HBV infection. Of these, an estimated 360-400 million have chronic HBV infection and WHO estimated 3 to 4 million new people are infected each year due to these viral infections. Between 600,000 and 1.2 million persons die each year from HBV related acute hepatitis, hepatocellular carcinomia (HCC, a form of liver cancer) and cirrhosis **[33, 69].** Persons with concomitant HIV infection are at even greater risk of HBV related cirrhosis, end-stage liver failer and HCC **[58].**

HBV and HCV is known to be highly infectious and associated with long-term morbidity and mortality. Globally, HBV causes about 1.2 million deaths per year due to various complications including chronic hepatitis, liver cirrhosis, and liver cancer **[47].** The virus is highly contagious and relatively easy to be transmitted from one infected individual to another by blood to blood contact, during birth, unprotected sex, and by sharing needles and has a relatively higher prevalence in the topics **[25].** It is estimated that about one third of the infected individuals have symptoms and/or biological evidence of hepatitis. The earlier the contamination, the higher the risk of chronic infection which is as high as 90% in infected infants. Chronic carriers have a high mortality rate due to complications.

Infection with HBV can be asymptomatic or can cause acute hepatitis. These conditions either resolve spontaneously with subsequent immunity or lead to a chronic infection that may be lifelong. Mother to child transimmtion of HBV at birth results in chronic infection in 90% of infants of mothers with hepatitis B surface antigen and approximately 10% of HBsAg- positive / HBeAg- negatve mothers. In the absence of vaccination, more than 20% of HBV related deaths are attributable to perinatal infection. Chronic infection develops in 80 – 90% of infants infected in the first year of life; this risk declines to 30-50% for children infected between 1 and 4 years ago. In adolescent and adults, HBV infection occurs through sexual transmission, exposure to infected blood products or contaminated needles and syringes, with 2-5% becoming chronically infected [**39**].

2.8 Burden of Hepatitis B Virus in Ethiopia

Ethiopia is a federal state divided into 9 administrative regions and 2 city councils covering about 1.1 million square kilometers. The total population of the country is projected to be more than 82 million**,** with more than 85% of the inhabitants living in rural areas.

In the recent times, viral hepatitis infection (HBV and others) has become the common and major causes of liver disease and posing grate health problems in Ethiopia. The importance of hepatitis B is illustrated by the fact that this infection is imposing a heavy burden on national economy and individual families due to considerable morbidity and mortality from both acute infection and chronic squeal including chronic active hepatitis, cirrhosis and hepatocellular carcinoma. The size diversity of the land topography of Ethiopia, the dispersion of much its population among vast rural areas, and the frequent lack of resources mean that acute identification of HBV carrier rate can be extremely difficult. Nevertheless, it is quite clear that Ethiopia falls into high endemicity category (HBsAg carrier rates 9-20% **) [78].**

In Ethiopia, the prevalence and endemicity of HBV is high according to world health organization estimation report**.** Therefore, hepatitis B virus infection causes a significant burden of acute and chronic disease in Ethiopia specifically among children and adults. However, due limited data available from Ethiopia studies, the number of HBV infection carriers, cases of disease rate and death were unspecified clearly at national level. Nevertheless, using 2005 surviving infants, estimates of markers of hepatitis B sero- prevalence was estimated to be 80%.

The prevalence of HBV acute and chronic infection was also limited and unknown at national level; it can be characterized by the detectable level of hepatitis B virus surface antigen (HBsAg) which is varied from region to region and area to area in the general population. In the study of hepatitis B virus markers conducted among Ethiopian Jews on arrival in Israel, a prevalence of HBsAg to be 11.5% **[26].**

In Ethiopia venous blood from 4736 individuals under 50 years of age from 1262 households, selected using stratified cluster sampling, was screened for HBV markers using commercial ELISAs. The prevalence of HBsAg was 7% and the prevalence was higher in males [9%] than females 5%. **[1].**

In the study of hepatitis B virus infection among medical waste handlers in Addis Abeba between May to July 2010, general information about participants was obtained using a pretest self-administered questionnaire, which had socio-demographic characteristics, knowledge about blood born infection such as HBV, understanding of universal precaution, history of immunization with HBV, and occupational exposure. In this study, the prevalence of HBV among medical waste handlers (hepatitis B surface Antigen) detected was 6.3%. Significant differences were observed in the detection rates of HBsAg in medical waste handlers compared to non medical waste handlers. About 19.8% were trained to handle medical waste and none was immunized against HBV.

In a study conducted in Gonder by Rahlenbeck (1997) among blood donors, the sero prevalence of hepatitis B surface antigen was 14.4%. In a study to assess seroprevalnce of HIV, hepatitis B infection and syphilis among street dwellers in Gonder city, the prevalence in females was 11.8% and on males was 27.1%.

[5] Conducted a study to determain the prevalence and risk factors of hepatitis B and C virus infections in patients with chronic liver disease in three public hospitals in Addis Ababa. The study was conducted on 120 clinically diagnosed chronic liver disease patients. HBsAg was detected in 35.8% patients clinically diagnosed to have chronic liver disease.

3. METHODOLOGY

3.1 Study Design

A cross-sectional study was conducted into Adama and Asella Towns among residents.

3.2 Sampling Design and Sample Size Determination

3.2.1 Sampling Design

Sampling methods are the scientific technique of selecting representative of the target population to provide the required estimation. The Sampling technique used for this data collection was two stage stratified random sampling technique, which involves the division of a population into smaller groups, known as strata in such a way that individuals in the same strata are assumed to be homogenous with respect to some characteristics, and simple random sampling method (SRSM) would be adopted as an appropriate sampling design for selecting a representative sample of the strata. Mintab produce the following random numbers between 1 and 21 were requested 1 3 4 6 8 13 14 and therefor kebele 01, 03, 04, 06, 08, 13 and 14 are chosen as strata at the second stage at Adama city and Mintab produce the following random numbers between 1 and 8 were requested 1, 2, 3 and therefor kebele 01, 02, 03 are chosen as strata at the second stage in Assela city. Simple random sampling is a probability-selecting scheme in which predetermined numbers of units from a population list are selected, so that each unit on that has an equal chance of being included in the representative sample population **[18].** In this study, the sampling frame would be a list of residents of Adama and Assela cities.

3.2.2 Data Collection

Primary data was collected using a questionnaire developed in such a way that the incorporated questions (statements) try to address the main objectives of the study. Randomly selected respondents of the city from each stratum enumerated door to door or face to face, responded to the questions. The questionnaire was prepared first in English and then translated in to Amharic. The Amharic version of the questionnaire was pre tested for clarity and acceptability. Then based on the finding from pre testing, some of the questions were modified and the corrected questionnaire was used to collect the data.

3.2.3 Sample Size Determination

The question of how large a sample should be arises early in the planning of any survey. This is an important question that should be considered seriously. Choosing a sample size larger than what is necessary means to waste resources, whereas a too small sample may not be of practical use for making good decision. The main objective is to obtain a desirable accuracy with minimum cost. The appropriate sample size used for this study is obtained using the following formula (Cochran, 1977):

$$n = \frac{\sum_{i=1}^{k} \frac{N_i^2 P(1-P)}{W}}{\frac{N^2 d^2}{Z^2} + NP(1-P)}$$

Where:

n = the required total sample size

N = the total number of households (targeted residents)

Z = the inverse of the standard normal cumulative distribution that corresponds to the 5 percent level of confidence (Z=1.96)

k = the total number of kebeles (strata).

N_i = the number of households in each kebeles.

W_i = the estimated proportion of Ni to N (each kebels households to total number of households)

p = the success probability

d = the level of precision (sampling error)

The probability of successes is considered to be 0.5 (P=0.5). The sampling error is defined as the difference between the parameter to be estimated and the corresponding statistic computed from the sample. The sampling error is called level of precision in sampling contexts and gives the researcher some idea relating to the accuracy of statistical estimates. The level of precision preferred for this study was 4 percent (i.e d=0.04) to minimize the cost during data collection. The desired sample size from the target population was 589 and 533 households for Adama and Assela cities respectively. With additional assumption of 10 percent non response rate, the total sample size becomes 648 and 586 households for Adama and Assela cities respectively. Using proportional allocation, the sub-sample size from each kebele is given in table 1 and 2 below.

Table 1: Sample size by kebele. (For Adama City)

S.N	Kebels	Total Number of households in each kebeles (Ni)	W_i	ni
1	01	5358	0.17	105
2	03	5554	0.18	107
3	04	6506	0.21	126
4	06	1873	0.06	37

5	08	2800	0.09	54
6	13	3210	0.11	58
7	14	5419	0.18	102
Total		30,720	1	589
Required total sample size				589

Table 2: Sample size by kebele. (For Assela City)

S.N	Kebels	Total Number of households in each kebeles (Ni)	W_i	ni
1	01	1307	0.27	145
2	02	1711	0.36	186
3	03	1807	0.37	202
Total		4825	1	533
Required total sample size				533

3.3 Study Variables

Variables considered in this study were selected based on literature reviews of previous studies.

Dependent Variable

The response variable for the ith respondents is represented by a random variable Y_i having two possible outcomes as aware (coded as 1) or not aware (coded as 0). Hence, the response variable of the ith responds Y_i where i=1, 2, 3, … , n is measured by a dichotomous variable as follow:

$$Y_i = \begin{cases} 1, \text{if the respondnt is aware} \\ 0, \qquad \text{otherwise} \end{cases} \tag{1}$$

Explanatory Variables

Predicting whether an event will or will not occur and identifying the variables in making prediction is an important step in carrying out the study.

Age (in year), Gender (Male, Female), marital status (Single, Not single), Religion (Orthodox, Catholic, Protestant, Muslim, Other), Accommodation (Alone, Not alone), Total family size in numbers (1-2, 3-4, >= 5), Participation in social forms, Reading Habit (Frequently, Sometimes,

Rarely), Use of Media (Frequently, Sometimes, Rarely), Educational level (Elementary and less, High school, Higher education), Monthly income in Birr, Employment Status.

3.4 Methods of Statistical Analysis

3.4.1 Classical Logistic Regression Model

Logistic regression is a statistical technique for predicting the probability of an event, given a set of predictor variables. The binary logistic regression procedure empowers one to select the predictive model for dichotomous dependent variables. It describes the relationship between a dichotomous response variable and a set of explanatory variables. The explanatory variables may be continuous or discrete. The logistic model, as a nonlinear regression model, is a special case of generalized linear models **[57]** where the assumptions of normality and constant variance of residuals are not satisfied. It is common to find, in an article using logistic regression, a table of estimated coefficients, estimated odds ratios and associated confidence limits for the odds ratio **[38].**

Unlike discriminate analysis, logistic regression does not have the requirement of independent variables to be normally distributed, linearly related, nor equal variance with in each group **[74].** Logistic regression has a peculiar property of easiness to estimate logit difference for data collection both retrospective and prospectively **[57].** The two main uses of logistic regression are predicting group memberships, since logistic regression calculate the probability of success over the probability of failer, and providing knowledge of the relationships and strengths among the variables.

Logistic regression can be used to predict the probability of the outcome of a response variable on the basis of continuous and/or categorical explanatory variables and to determine the magnitude of the effect of the explanatory variables on the response variable; to rank the relative importance of explanatory variables; to assess interaction effects; and to understand the impact of covariate control variables. The impact of predictor variables is usually explained in terms of odds ratios.

Logistic regression utilizes the maximum likelihood estimation method after transforming the dependent variable into a logit variable (the natural log of the odds of the dependent variable occurring or not). Logistic regression has many analogies to OLS regression: logit coefficients correspond to β coefficients in the logistic regression equation, the standardized logit coefficients correspond to beta weights, and a pseudo R^2 statistic is available to summarize the strength of the relationship. Unlike OLS regression, however, logistic regression does not assume linearity of relationship between the explanatory variables and the response variable, does not require normally distributed errors, does not assume homoscedasticity, and in general has less stringent requirements. It does, however, require that the observations are independent and that the independent variables are linearly related to the logit of the dependent variable. The predictive

success of the logistic regression can be assessed by looking at the classification table, showing correct and incorrect classifications of the dichotomous, ordinal, or polytomous dependent variable. Goodness-of-fit tests such as the likelihood ratio test are available as indicators of model appropriateness, as is the Wald statistic to test the significance of individual independent variables.

Assumptions of Logistic Regression

One advantage of the logistic regression is to give us relaxation and flexible assumptions. There are, however, other assumptions one should consider for the efficient use of logistic regression as detailed in **[37].**

- Logistic regression required meaningful coding of the variables.
- Logistic regression assumes a linear relationship between the log of odds and the independent variables.
- The dependent variable must be categorical and the groups must be mutually exclusive and exhaustive.
- Variances need not be the same within categories.
- The independent variables need not be interval, nor bounded, nor normally distributed, or nor of equal variance within each group and no multicolliearity assumed among predictors.
- Larger samples are needed than for linear regression because maximum likelihood coefficients are large sample estimates and MLE relies on large-sample asymptotic normality.
- A minimum of 50 cases per predictor is recommended; otherwise in small samples one may get high standard errors.
- Logistic regression assumes linearity of independent variables.

Model Description

Logistic regression model is used to investigate the effect of predictors on the probability of awareness of hepatitis B and/or C among respondents. The response variable is dichotomous and denoted by Y_i , i= 1, 2, . . . , n which is Bernoulli random variable with two possible values, Y_i = 1 with probability of aware $P_i = P(Y_i = 1/X_i)$ and $Y_i = 0$ with probability of not aware $1 – P_i = 1 - P(Y_i = 1/X_i)$.

Let Y_{nx1} be a dichotomous outcome random variable with categories 1 (aware) and 0 (not aware). Let $X_{nx(p+1)}$ denote the collection of p predicator variables of Y. Then, the conditional probability that respondents aware given that X set of predictor variables is denoted by $P\left(Y_i = 1/X_i\right) = P_i$

The expression P_i has the form:

$$P(Y_i = 1/X_i) = P_i = \frac{\exp^{(\beta_0 + \beta_1 x_{i1} + ,... + \beta_p x_{ip})}}{1 + \exp^{(\beta_0 + \beta_1 X_{i1} + \ldots + \beta_p x_{ip})}} \quad (2)$$

Where $P(Y_i = 1/X)$ is the probability that the respondent i is aware given set of predictors X and $\beta_0, \ldots, \beta_k$ are vector of unknown coefficients.

However, the relationship between the probability of ith respondent is aware and set of predictor variables are non-linear. In order to give meaningful interpretation, the probability of ith respondent is aware should be written as linear combination of predictors. This is computed using the link function of logit transformation of the probability of ith respondent aware is given by:

$$Logit(P_i) = \mathrm{Log}\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \beta_1 x_{i1} + \ldots + \beta_p x_{ip} \quad (3)$$

i= 1, 2, . . . , n where β_0 is the constant of the equation and $\beta 1, \beta 2, \ldots, \beta p$ are the coefficients of the predictor variables. The above equation is known as the logistic function. The coefficient of a continuous covariate is interpreted as the change in the log-odds of aware per unit increment in corresponding covariate. In case of categorical predictors' variables, it is interpreted as the log-odds of aware among the given category compared to the reference category.

Odds Ratio

The odds ratio is defined as the ratio of the probability of the occurrence of an event to non-occurrence of an event. The odds ratio (OR) is a popular measure of the strength of association between exposure and disease. In case of cohort study, the odds ratio is expressed as the ratio of the number of cases to the number of non-cases in the exposed and unexposed groups **[21].**

In binary logistic regression, odds ratio is the exponential of the estimated coefficient $\hat{\beta}$. For each continuous covariate. let say j, $exp(\hat{\beta})$ is the predicted change in odds of aware for a unit increase in predictor j variable. In case of categorical predictor variables, $exp(\hat{\beta})$ is the

predicted change in odds of aware given category of the predictor variable with respect to the reference category.

Method of Estimation

The maximum likelihood and non-iterative weighted least squares are the two most competing estimation methods used in fitting logistic regression model **[38, 34, 19].** The maximum likelihood estimation method is appropriate for estimating the logistic model parameters due to this less restrictive nature of the underlying assumptions **[38].** Hence, in this study the maximum likelihood estimation technique was used to estimate the parameters of the model.

Consider the logistic model $P(y_i = 1/X_i) = e^{X_i\beta}/(1+e^{X_i\beta})$. Since the observed values of Y are independently distributed as Bernoulli random variables, the probability mass function is given by:

$$P(y_i / P_i) = \mathrm{P_i}^{y_i}(1-P_i)^{1-y_i}, where\ \mathrm{i} = 1, 2,\ ...., \mathrm{n} \tag{4}$$

Because of independency assumption in the observations, the maximum likelihood function of Y is the joint density function given by:

$$L(\beta / Y) = \prod_{i=1}^{n}\left[\frac{e^{X_i\beta}}{1+e^{X_i\beta}}\right]^{y_i}\left[\frac{1}{1+e^{X_i\beta}}\right]^{1-y_i} \tag{5}$$

The maximum likelihood estimates of the parameters are obtained by maximizing the log-likelihood function which is given by:

$$\log L(\beta / Y) = \sum\left\{y_i \log\left[\frac{e^{X_i\beta}}{1+e^{X_i\beta}}\right] + (1-y_i)\log\left[\frac{1}{1+e^{X_i\beta}}\right]\right\} \tag{6}$$

This is the kernel of the likelihood function to maximize. However, it is clumsy to differeniatite and so that can be simplified by taking its log. As a result, the logarithm is monotonic function, any maximum of the likelihood function will be also be a maximum of the log-likelihood function and vice-versa. Accordingly, the natural log to L, $\log L(\beta / Y) yields$ the log-likelihood function l which is:

$$l = \sum_{i=1}^{n} \left\{ y_i \left(X_i \beta \right) - \log\left(1 + e^{X_i \beta}\right) \right\} = \sum_{i=1}^{n} \left\{ y_i \left(\sum_{j=1}^{k} \beta_j x_{ij} \right) - \log\left(1 + \log\left(1 + e^{\sum_{j=0}^{k} \beta_j x_{ij}} \right) \right) \right\} \quad \textbf{(7)}$$

To get the critical points of the log-likelihood function l, set the first derivative with respect to each β_j equal to zero where $j = 0, 1, \dots, k$ that is,

$$l'(\beta) = \frac{\partial l(\beta)}{\partial \beta_j} = \sum_{i=1}^{n} \left\{ y_i x_{ij} - x_{ij} e^{\sum \frac{\beta_j x_{ij}}{1 + e^{\sum_{j=0}^{k} \beta_j x_{ij}}}} \right\} \quad \textbf{(8)}$$

Model Building and Variable Selection for Logistic Regression

When several explanatory variables (predictors) in the model, there are many potential models. Model selection for logistic regression faces the same issue as ordinary regression. The selection process becomes difficult when the number of explanatory variables increase, because of the increase in possible effect and interactions. In model selection there are two computing goals; the model should be enough to fit the data very well. On the other hand, it should be simple to interpret, smoothing rather than over fitting the data [**9].** Consequently, it is important to examine several possible models that allow the inclusion of many predictors and to choose a subset among them on the basis of subject matter and parsimony. In stepwise logistic regression, the forward or backward stepwise method utilized the likelihood ratio test (chi-square difference) to determine automatically which variables are added or dropped from the model. First, the selection process should begin with bivariate analysis of each variable. In this case, the parsons' chi-square and the likelihood ratio chi-square test were used for categorical predictor variables. Secondly, the selection of variables for binary logistic regression analysis will follow along with all variables of the known importance based on the results of the bivariate analysis. Stepwise selection used to specify which independent variables are entered in to the analysis. There are different methods; we can construct a variety of regression models from the same set of variables. In this study, forward selection (likelihood ratio) used with entry testing based on the significance of the score statistic, and removal testing based on the probability of a likelihood-ratio statistic with the maximum partial likelihood estimates.

Test of Overall Model Fit

After fitting logistic regression model or once a model has been developed through various steps in estimating the coefficients, there are several techniques involved in assessing the appropriateness, adequacy and usefulness of the model. First, the importance of each predictor's

variables will be assessed by carrying out statistical test of the significance of the coefficients. Then the overall goodness of fit of the model will be tested **[8].**

Goodness of the Fit of the Model

The goodness of fit or calibration of a model measure how well the model describes the response variable. Assessing goodness of fit of the model involves investigating how the values of predicted by the model close with that of observed values (**16).** The comparison of observed to predicted values using the likilhood function is based on the statstic called deviance.

$$D = -2\sum_{i=2}^{n}\left(y_i \log\left(\frac{\hat{p}}{y_i}\right) + (1-y_i)\log\left(\frac{1-\hat{p}}{1-y_i}\right)\right) \quad \textbf{(9)}$$

The purpose of assessing the significant of an independent variable, with the value of D is composed with and without the independent variable in the equation which as D= MO – ML where, MO deviance of model without explanatory variable and ML deviance of the model with explanatory variable. The goodness of fit D process evaluates predictors that are eliminated from the full model, or predictors and there interaction that are added to a smaller model. In general, as predictors are added or deleted, log-likelihood decreases or increase respectively. D has a chi-square distribution with degrees of freedom equal to the difference between the numbers of parameters estimated in the two models.

Likelihood-Ratio Test

An alternative and widely used approach to testing the significance of a number of explanatory variables is likelihood ratio test. This is appropriate for a variety of types of statistical model. [**7**] states that the likelihood ratio test is better than others, particularly if the sample size is small or the parameters are large. The test statistic is defined as two times the natural log of the ratio likelihood functions of two models evaluated as their maximum likelihood estimates (MLEs). The likelihood ratio test uses the ratio of the maximized value of the likelihood function for the full model (L_1) over the maximized value of the likelihood function for the reduced model (L_0). For each of the variables removed from the full model one at time, MLEs are computed and likelihood function L_0 is computed. Therefore, the likelihood-ratio test statistic is given by:

$$G^2 = -2\log\left(\frac{L_0}{L_1}\right) = -2\left\{\log(L_0) - \log(L_1)\right\} \quad \textbf{(10)}$$

Where, L_0 is the likelihood function of the null model and L_1 the likelihood function of the full model evaluated at the MLEs. This natural log transformation of the likelihood function yields

an asymptotically chi-square statistic. Then, G^2 is distributed with degree of freedom equal to the difference between the numbers of parameters estimated in the two models **[59].** It is useful to test the null hypothesis that all population logistic regression coefficients are zero except the constant one.

The Hosmer and Lemeshow Test Statistic

The final measure of model fit is the Hosemer and Lemeshow goodness of fit statistic, which measures the correspondence between the actual and predicted values of the dependent variable. Hosemer and Lemeshow test is used to test the overall model goodness of fit test. Hosmere and Lemeshow test is based on grouping cases in deciles in the sense that it is obtained by appling a chi-square test on a 2 by g contingency table. The contingency table is structured by cross classifying the dichotomous dependent variable with approximately g=10 groups in which the groups are formed by partitioning the predicted probabilities using the percentiles of the predicted event probability. It evaluate the goodness of fit by creating these 10 ordered groups of subjects and then compare the number actually in each observed group to the number of predicted by the logistic regression model. The 10 ordered groups are created based on their estimated probability in such that those with estimated probability below 0.1 from one group , and so on up to those with probability 0.9 to 1. Each of these categories are further divided into two groups based on the actual observed outcome variable (success, failure).

The expected frequencies for each of the cells are obtained from the model. If the model is good, most the subjects with success are classified in the higher deciles of risk and those with failer in lower deciles of risk and if the significance of test is less than 0.05, then the model does not adequately fit the data. Thus, the test statistic is a chi-square statistic with a desirable outcome of non significance, indicating that the model prediction dose not significantly differ from the observed. The Hosmer and Lemeshow statstic is given by:

$$\hat{C} = \sum_{k=1}^{g} \frac{(O_k - E_k)^2}{V_k}, \ \mathrm{E_k} = nP_k \text{ and } \mathrm{V_k} = nP_k(1 - P_k) \qquad \textbf{(11)}$$

Where g is the number of groups, O_k is the observed number of events in the Kth , E_k is the expected number of events in the Kth , and V_k is the variance correlation factor for the Kth. If the observed number of events differ from what is expected by the model, the statistic will be large and there will be evidence against the null hypotheses that the model is adequate to fit the data. This statistic has an appropriate chi-square distribution with (g-2) degree of freedom.

R^2 for Logistic Regression

In logistic regression, there is no true R^2 value as there is in OLS regression. However, because deviance can be thought of as a measure of how poorly the model fits (i.e., lack of fit between

observed and predicted values), an analogy can be made to sum of squares residual in ordinary least squares. The proportion of unaccounted for variance that is reduced by adding variables to the model is the same as the proportion of variance accounted for, or R^2

$$R^2{}_{\log istic} = \frac{-2LL_{Null} \text{ - 2LL}_{\text{k}}}{\text{- 2LL}_{\text{Null}}} \quad \textbf{(12)}$$

Where the null model is the logistic model with just the constant and the k model contains all the predictors in the model.

The Cox and Snell measure is based on log-likelihoods and considers sample size. The maximum value, that the Cox and Snell R^2 attain, is less than one. the Nagelkerke R^2 is an adjusted version of the Cox and Snell R^2 and covers the full range from 0 to 1, and therefore, it is often preferred. The Cox and Snell R square is computed as follows:

$$Cox \text{ and Snell Pseudo R}^2 = 1 - \left[\frac{\text{- 2LL}_{\text{null}}}{-2LL_K}\right]^{\frac{2}{n}} \quad \textbf{(13)}$$

Because this R-squared value cannot reach 1.0, Nagelkerke modified it. The correction increases the Cox and Snell version to make 1.0 a possible value for R squared **(38).**

$$Nagel\ker ke \text{ Psendo R}^2 = \frac{1 - \left[\frac{\text{- 2LL}_{\text{null}}}{\text{- 2LL}_{\text{k}}}\right]^{\frac{2}{n}}}{1 - \left[-2LL_{null}\right]^{\frac{2}{n}}} \quad \textbf{(14)}$$

The Wald test

A Wald test is used to test the statistical significance of each coefficient (β) in the model.

The statistic is defined as:

$$Z^2 = \left(\frac{\hat{\beta}_j}{SE(\hat{\beta}_j)}\right)^2 \rightarrow \chi_1{}^2 \text{, where j} = 1, 2, \ldots, \text{k} \quad \textbf{(15)}$$

The square of Z, Z^2, yields the Wald statistic with a chi-square distribution. However, several authors have identified problems with the use of the Wald statistic. **[59]** warns that for large coefficients, standard error is inflated, lowering the Wald statistic (chi-square) value. [**8]** states that the likelihood-ratio test is more reliable for small sample sizes than the Wald test.

3.4.2 Logistic Regression Diagnostics

Regression diagnostics were developed to measure various ways in which a regression relation might derive largely from one or two observations.

Residuals Analysis

Residual analysis for logistic regression is more difficult than the linear regression models because the responses take on only the values 0 and 1. Thus the ith ordinary residual will assume one of the two values as:

$$\hat{\varepsilon} = \begin{cases} 1-\hat{\pi}_i, \text{if } \mathrm{y_i} = 1 \\ -\pi, \text{ if } \quad \mathrm{y_i} = 0 \end{cases} \tag{16}$$

The ordinary residuals will not be normally distributed and, indeed their distribution under the assumption that the fitted model is correct is unknown. Plots of ordinary residuals against fitted values will generally be uninformative. In linear regression a key assumption is that the error variance does not depend on the conditional mean E(Y/X=x). However, in logistic regression, the errors follow a binomial distribution and, as a result, the error variance is a function of the conditional mean as V(Y/X)= $\pi(1-\pi)$. Hence, the ordinary residual can be made more comparable by dividing them by the estimated standard error of Yi which is known as Pearson residual denoted by $\mathrm{Pr_i}$ and defined as:

$$\mathrm{Pr}_i = \frac{Y_i - \hat{\pi}_i}{\sqrt{\hat{\pi}(1-\hat{\pi}_i)}} \tag{17}$$

The Pearson residuals are directly related to the Pearson chi-square goodness-off fit statistic. The square of Pearson residual measures the contribution of each binary response to the Pearson chi-square test statistic but the test statistic does not follow an approximate chi-square distribution for binary data without replicates. The Pearson residuals do not have unit variance since no allowance has been made for the inherent variation in the fitted value. A better procedure is to

further standardize the ordinary residuals by their estimated standard deviation that is called studentzed Pearson residuals. Then studentzed Pearson residuals Spr_i are defined as:

$$Spr_i = \frac{Y_i - \hat{\pi}_i}{\sqrt{\hat{\pi}_1 (1 - \hat{\pi}_i)(1 - h_{ii})}} = \frac{\Pr_i}{\sqrt{1 - h_{ii}}} \quad \textbf{(18)}$$

Where h_{ii} is the ith diagonal element of the nxn estimated hat matrix H. Studentized Pearson residuals are primarily helpful in identifying influential observations and those build in information about the influence of a case, whereas Pearson residuals do not. More influential cases with high leverages result in high studentized Pearson residuals. Studentized Pearson residuals approximately follow the standard normal distribution for large ($n \geq 30$) sample and it can be used as an approximate chi-square distribution **[64].**

Deviance residual is another type of residual. It measures the disagreement between any component of the log likelihood of the fitted model and the corresponding component of the log likelihood that would result if each point were fitted exactly. Since, the logistic regression uses the maximum likelihood principle; the goal in logistic regression is to minimize the sum of the deviance residuals. Deviance residuals can also be useful for identifying potential outliers or misspecified cases in the model. The deviance residual for the ith case is defined as the signed square root of the contribution of that case to the sum for the model deviance as:

$$dri = sign(y_i - \hat{\pi}_i)\{-2(Y_i - \log(\hat{\pi}_i) + (1 - \mathrm{Y_i})\log(1 - \hat{\pi}_i))\}^{\frac{1}{2}} \quad \textbf{(19)}$$

The standardized and deviance residuals are the most commonly used statistic in identifying points for which the model fits poorly. Observations with absolute standardized and deviance residual values in excess of 3 may indicate lack of fit **[64].**

Leverage Values

Detecting outliers is common practice and it is important to distinguish between two types of outliers. Outliers in the response variable represent model failure. Such observations are called outliers. Outliers with respect to the predictors are called lever-age points. They can affect the regression model, too. However, they may almost uniquely determine regression coefficients.

They may also cause the standard errors of regression coefficients to be much smaller than they would be if the observation were excluded. Leverage is a term used in connection with regression analysis and, in particular, in analyses aimed at identifying those observations which have a large effect on the outcome of fitting regression models. Leverage points are those observations, if any, made at extreme or outlying values, of the independent variables such that the lack of neighboring observations means that the fitted regression model will pass close to that particular observation. Leverages values are given by:

$$H = \hat{W}^{\frac{1}{2}} X \left(X'\hat{W}X\right)^{-1} X'\hat{W}^{\frac{1}{2}} \quad \textbf{(20)}$$

Where h_{ii} is the ith diagonal element of the nxn estimated hat matrix H, whereby in logistic regression it is called hat diagonal or Pregibon leverage and measures the lever-age of an observation. More clearly leverage is a measure of the importance of an observation to the fit of the model. Here, $\hat{W}$ is the nxn diagonal matrix with elements $\hat{\pi}_i\left(1-\hat{\pi}_i\right)$, X is the $\mathrm{nx}\left(\mathrm{k}+1\right)$.

3.4.3 Influential Statistics

Cooks Distance

Cooks distance is designed to measure the shift in when a particular observation is omitted. It is a combined measure of the impact of that observation on all regression coefficients.

Cook's D_i statistic is defined as:

$$D_i = \frac{\left(\hat{\beta}_i - \hat{\beta}\right)'\left(X'X\right)\left(\hat{\beta}_i - \hat{\beta}\right)}{P_s^{2}} \quad \textbf{(21)}$$

Computationally, D_i is more easily obtained as:

$$D_i = \frac{r_i^{2}}{P}\left(\frac{h_{ii}}{1-h_{ii}}\right) \quad \textbf{(22)}$$

Where r_i is the studentized residual and h_{ii} is the ith diagonal element of H computed from the full regression and p is the number of unknown parameters. Notice that D_i is large if the standardized residual is large and if the data point is far from the cancroids of the X-space that is, if v_{ii} is large.

The Cook's distance statistic assesses the influence of individual cases and it is a measure of the change in the regression coefficient if an observation is deleted from the model.

Cook's distance considers the influence of the ith value on all n fitted values and not on the fitted value of the ith observation. It yields the shift in the estimated parameter from fitting a regression model when a particular observation is omitted. All distances should be roughly equal; if not, then there is reason to believe that the respective case(s) biased the estimation of the regression coefficients. Relatively large Cook statistics (or Cook's distance) indicate influential observations. This may be due to a high leverage, a large residual or their combination. There are different opinions regarding what cut-off values to use for spotting outliers. A simple operational guideline of $D_i > 1$ has been suggested **[64].** If Cook's distance of a case is greater than 1.0, then it is potential outlier.

DFBETAS

Cooks distance reveals the impact of the ith observation on the entire vector of the estimated regression coefficients. The influential observations for the individual regression coefficients are identified by $DFBETAS_{j(i)}$, j=0, 1, … , P. where each $DFBETAS_{j(i)}$ is the standardized change in β_j when the ith observation is deleted from the analysis. Thus,

$$DEBETAS_{j(i)} = \frac{\hat{\beta}_j - \hat{\beta}_{j(i)}}{S_i \sqrt{C_{jj}}} \qquad \textbf{(23)}$$

Where C_{jj} is the $(j+1)^{st}$ diagonal element from $(X^{'}X)^{-1}$. $DFBETAS_{j(i)}$ measures the change in $\hat{\beta}_j$ in multiples of its standard error. Although this looks like a t statistic, it should not be interpreted as a test of significance.

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics Results

4.1.1 Demographic Characteristics of the Respondents

The demographic characteristics of the respondents summarized and presented as follows.

Table 3: Summary of demographic variables for Adama and Assela

Variable	Category	Frequency		Percent	
		Adama	Assela	Adama	Assela
Age	18-30	298	271	46.0	46.2
	31-40	190	166	29.3	28.3
	41-50	124	155	19.1	19.6
	51-above	36	34	5.6	5.8
Gender	Male	369	335	56.9	57.2
	Female	279	251	43.1	42.8
Educational level	Elementary and less	225	204	34.7	34.8
	High school	256	228	39.5	38.9
	Higher education	167	154	25.8	26.3
Employment status	Unemployed	69	63	10.6	10.8
	Employed	468	425	72.2	72.5
	Self Employed	111	98	17.1	16.7
Monthly income	<=1500	141	131	21.8	22.4
	1501-5000	249	220	38.4	37.5
	5001-10000	152	137	23.5	23.4
	>10001	106	98	16.4	16.7
Marital status	Single	274	243	42.3	41.5
	No single	374	343	57.7	58.5
Religion	Orthodox	294	269	45.4	45.9
	Catholic	35	27	5.4	4.6
	Protestant	242	221	37.3	37.7
	Muslim	77	69	11.9	11.8
Accommodation	Alone	190	167	29.3	28.5
	Not alone	458	419	70.7	71.5
Total family size	1-2	179	160	27.6	27.3
	3-4	233	210	36.0	35.8
	>=5	236	216	36.4	36.9

All 648 and 586 participants in Adama and Assela cities respectively completed the questionnaire indicating that the response rate is 100%.

Regarding to gender, 56.9% and 57.2% of the respondents were male in Adama and Assela city respectively and almost 46.0 % and 46.2% were aged between 18-30 years. Only about 5.6% and 5.8% of respondents in Adama and Assela cities respectively were above 50 years old. About 57.7 % and 58.5% of the respondents were not single.

Only about 34.7% and 34.8% of the sample were elementary and less, 39.5% and 38.9% of the respondents were high school, and 25.8% and 26.3% were higher education in Adama and Assela cities respectively. About 72.2% and 72.5% of the respondents were employees and 17.1% and 16.7% were working in their own business activities while the remaining were unemployed in Adama and Assela cities respectively.

4.1.2 Respondents Characteristics

Table 4: Summary of respondents' characteristics for Adama and Assela

Variable	**Category**	**Frequency**		**Percent**	
		Adama	**Assela**	**Adama**	**Assela**
Participation in social forms	No	211	188	32.6	32.1
	Yes	437	398	67.4	67.9
Reading Habit	Frequently	183	166	28.2	28.3
	Sometimes	292	254	45.1	43.3
	Rarely	173	166	26.7	28.3
Use of Media	Frequently	332	296	51.2	50.5
	Sometimes	213	194	32.9	33.1
	Rarely	103	96	15.9	16.4

About 67.4% and 67.9% of the respondents in Adama and Assela cities has experience in participating in social forms. Only 28.2% and 28.3% of the respondents in Adama and Assela cities has a good experience of reading newspapers, magazines, pamphlet, poster etc. Almost 51.2% and 50.5% of the respondents in Adama and Assela cities follow mass media frequently.

Table 5: Summary of respondents sources of information regarding Hepatitis, Hepatitis B and/or C for Adama and Assela cities

Source of information	Frequency		Percent	
	Adama	Assela	Adama	Assela
Radio	112	101	17.3	17.2
TV	104	92	16.0	15.7
Pamp,fl,po,mag	140	125	21.6	21.3
from individuals	105	94	16.2	16
Other	78	69	12.0	11.8

The major source of information regarding Hepatitis, Hepatitis B and Hepatitis C was pamphlet, flyer, posters and magazines (21.6% and 21.3%) followed by radio (17.3% and 17.2%).

4.1.3 Hepatitis B and C Knowledge

Table 6: Summary of respondents' awareness regarding Hepatitis, Hepatitis B and/or Hepatitis C of Adama and Assela

Questions	Category	Frequency		Percent	
		Adama	Assela	Adama	Assela
Have you ever heard about Hepatitis or "yewefbesheta"?	No	114	107	17.6	18.3
	Yes	534	479	82.4	81.7
Have you ever heard about Hepatitis B or C virus?	No	337	314	52.0	53.6
	Yes	311	272	48.0	46.4
IsHepatitis viral disease	No	214	197	33.0	33.6
	Yes	326	286	50.3	48.8
Can Hepatitis B and C affect any age group?	No	76	65	11.7	11.1
	Yes	237	209	36.6	35.7
Are loss of appetite and dark urine the common symptoms of hepatitis B and C	No	111	95	17.1	16.2
	Yes	202	179	31.2	30.5
Are nausea, jaundice,vomiting,joint pain common symptoms of Hepatitis B or C?	No	95	79	14.7	13.5
	Yes	218	195	33.6	33.3
Do you think it is posssible to be infected by Hepatitis B or C and show no symptoms	No	125	108	19.3	18.4
	Yes	188	166	29.0	28.3
Can Hepatitis B and C be transmitted by close personal contact?	No	182	117	20.1	20
	Yes	130	156	28.1	26.6

Can Hepatitis B and C be transimmited by unsterilized syringes, needles and surgical instrument?	No	71	58	11.0	9.9
	Yes	242	216	37.3	36.9
Can Hepatitis B and C transmitted by contaminated blood?	No	73	67	11.3	11.4
	Yes	240	207	37.0	35.3
Can Hepatitis B and C be transimited by means blades of barber/ear and nose piercing?	No	177	156	27.3	26.6
	Yes	136	118	21.0	20.1
Can Hepatitis B and C be transmitted by unsafe sex?	No	153	131	23.6	22.4
	Yes	160	143	24.7	24.4
Can Hepatitis B and C be transmitted from mother to child during delivery?	No	148	127	22.8	21.7
	Yes	165	147	25.5	25.1
Are Hepatitis B and C curable/treatable?	No	65	53	10.0	9
	Yes	248	221	38.3	37.7
Can Hepatitis B and C self-cured by body own immune system?	No	251	54	9.6	9.2
	Yes	62	220	38.7	37.5
Do you share use of blades, tooth brusshes, tweezers, or razors?	No	303	267	46.8	45.6
	Yes	8	5	1.2	9
Are you aware that vaccination is available for Hepatitis B?	No	94	77	14.5	13.1
	Yes	217	195	33.5	33.3
Are you aware that there is no vaccination for Hepatitis C?	No	160	137	24.7	23.4
	Yes	150	134	23.1	22.9
Whom do you think shoud get Hepatitis B vacinated?	Adult & child	58	48	9.0	8.2
	All at any stage	251	224	38.7	38.2

Out of 648 and 586 participants in Adama and Assela cities respectively, 82.4% and 81.7% heard about Hepatitis and 48.0% and 46.4% heard about Hepatitis B and C.

About 33.6% and 33.3% of the respondents in Adama and Assela cities respectively knew that Nausea, Jaundice, Vomiting, joint pain and abdominal pain are symptoms of Hepatitis B and/or C viruses.

About 37.3% and 36.9% of the respondents in Adama and Assela cities respectively knew that use of unsterilized medical equipment's are transmission route of the diseases. More than 37% and 35.3% of the respondents knew that the diseases are transmitted by contaminated blood. The misconception that close personal contact for example living in the same household, sharing foods and drinks can spread Hepatitis B and C is shared by 28.1% and 26.6% of the respondents in Adama and Assela cities respectively.

Table 7: Summary of vaccination and testing experience of Adama and Assela cities residents

Questions	Category	Frequency		Percent	
		Adama	Assela	Adama	Assela
Have you ever been vaccinated against Hepatitis B?	No	212	187	32.7	31.9
	Yes	43	40	6.6	6.8
	Not Remember	51	40	7.9	6.8
Have you ever been tested for Hepatitis B or C?	No	194	164	29.9	28
	Yes	97	91	15.0	15.5
	Not Remember	15	12	2.3	2
If Yes, reason for testing	General heath check	10	10	1.5	1.7
	Feeling sick	79	73	12.2	12.5
	Pregnancy	2	2	0.3	0.3
	By chance	5	5	0.8	0.9
What do you recommend if you or someone is infected by Hepatitis B or C?	Go to health institution	297	261	45.8	44.5
	Go to traditional healer	13	10	2.0	1.7

There is a very low level of testing and vaccination rate among the respondents. Only 6.5% of the participants reported having been vaccinated against Hepatitis B and 15.1% of the participants reported previous testing for Hepatitis B or C. About 12.1% of the participant had previous testing due to feeling seek and 1.6% for general health cheek and 0.3% and 0.8% due to pregnancy and by chance respectively. Among the total participants 45.8% recommended going to health institution rather than to traditional healers when sick.

Table 8: Awareness level for Adama and Assela cities residents

Awareness level	Frequency		Percent	
	Adama	Assela	Adama	Assela
Not aware	351	323	54.2	55.1
Aware	297	263	45.8	44.9

The study revealed that only 45.8% of the sampled residents at Adama city and 44.9% at Assela city had awareness about Hepatitis B and/or C indicating that 54.2% not aware at Adama and 55.1 not aware at Assela city.

Table 9: Association between the outcome variable and explanatory variables in both cities

Variable	Category	Not Aware		Aware		Total		Pearsons chi-square & Sig		LR & Sig (Assela)
		Adama	**Assela**	**Adama**	**Assela**	**Adama**	**Assela**	**Adama**	**Assela**	
Age	18-30	176	165	122	106	298	271	21. .000	30.613 0.00	21.711 .000 (30.851) (0.000)
	31-40	113	104	77	62	190	166			
	41-50	51	45	73	70	124	115			
	51-above	11	9	25	25	36	34			
Gender	Male	176	163	193	172	369	335	14.4 .000	13.2 0.000	14.547 .000 (13.302) (0.000)
	Female	175	160	104	91	279	251			
Educational level	Elementary and less	176	168	49	36	225	204	111.78 .000	127.05 0.0	117.494 .000 (135.568) (0.000)
	High school	134	120	122	108	256	228			
	Higher education	41	35	126	119	167	154			
Employment status	Unemployed	52	49	17	14	69	63	18.757 .000	20.079 0.000	19.487 .000 (21.025) (0.000)
	Employed	252	233	216	192	468	425			
	Self employed	47	41	64	57	111	98			
Monthly income in Birr	<=1500	117	112	24	19	141	131	114.458 .000	120.05 0.000	122.420 .000 (129.685) (0.000)
	1501-5000	151	137	98	83	249	220			
	5001-10000	63	57	89	80	152	137			
	>10001	20	17	86	81	106	98			
Marital status	Single	184	169	90	74	274	243	32.250 .000	34.934 0.000	32.694 .000 (35.573 (0.000)
	Not single	167	154	207	189	374	343			
Religion	Orthodox	168	160	126	109	294	269	5.280 .152	6.979 0.073	5.279 .152 (6.974) (0.073)
	Catholic	14	11	21	16	35	27			
	Protestant	124	111	118	110	242	221			
	Muslim	45	41	32	28	77	69			
Accommodation	Alone	135	122	55	45	190	167	30.875 .000	30.368 .000	31.729 .000 (31.418) (.000)
	Not alone	216	201	242	218	458	419			
Total family size	1-2	134	124	45	36	179	160	50.591 .000		52.335 .000
	3-4	123	113	110	97	233	210			

	>=5	94	86	142	130	236	216	(52.994) (0.000)	(55.287) (0.000)
Participated in social forums	No	125	118	86	70	211	118	3.246 .072 (6.542) (0.061)	3.260 .071 (6.6) (0.064)
	Yes	226	205	211	193	437	398		
Reading habit	Frequently	44	35	139	131	183	166	157.938 .000 (167.125) (0.000)	176.324 .000 (188.342) (0.000)
	Sometimes	151	136	141	118	292	254		
	Rarely	156	152	17	14	173	166		
Use of media	Frequently	108	94	224	202	332	296	136.448 .000 (141.328) (0.000)	145.698 .000 (153.601) (0.000)
	Sometimes	152	141	61	53	213	194		
	Rarely	91	88	12	8	103	96		

This analysis was done to examine the association between the outcome variable with each predictor variables. It was calculated by cross tabulating each predictor variables against the outcome variables using chi square and likelihood ratio test. It can be seen in Table 9 that the predictors variables like age, gender, educational level, employment status, monthly income, marital status, accommodation, total family size, reading habit, use of media had significant association with outcome variables using both chi-square and likelihood ration tests for both cities. Participation in social forms and religion had no significant association with the outcome variables.

4.2 Analysis of Binary Logistic Regression

4.2.1 Assessing the Model

The overall significance was tested using the model chi-square test, which is derived from the likelihood of observing the actual data under the assumption that the model has been correctly specified. The hypothesis to be tested in relation to the overall fit of the model is:

H_0: The fitted model is adequate
H_1: The fitted model is not adequate

Table10: Dependent Variable Encoding

Original Value	Internal Value
Not aware	0
Aware	1

Table 11: Omnibus Tests of Model Coefficients for Adama and Assela cities

	Chi-square		df		Sig.	
	Adama	Assela	Adama	Assela	Adama	Assela

Step 1							
Step 1	Step	295.949	312.519	19	19	.000	.000
	Block	295.949	312.519	19	19	.000	.000
	Model	295.949	312.519	19	19	.000	.000

An omnibus test model coefficient is an important method to test the model adequacy. As we can see in Table 11, the result of omnibus tests of the model coefficients had a chi-square value of 295.949 for Adama city and 312.519 for Assela city at 19 degree of freedom for both cities , which was significant at level of significance, α= 0.05. This indicates that the independent variables predict the dependent variable, awareness of residents at Adama and Assela cities towards Hepatitis B and/or C, well and the model was good fit.

Table12: Model Summary for Adama and Assela cities

Step	-2 Log likelihood		Cox & Snell R Square		Nagelkerke R Square	
	Adama	Assela	Adama	Assela	Adama	Assela
1	597.864	493.695	.367	.413	.490	.553

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

R^2 is an analogous statistic in logistic regression to the coefficient of determination R^2 in linear regression, but not a close analogous. The model summary provided the same approximation of R^2 statistics in logistic regression (Table 12). Cox and Snells R-square attempts to imitate (reproduce) multiple R-square based on likelihood. In this study, Cox and Snell R-square indicate that 36.7 % and 41.3% of the variation in response variable, awareness of residents at Adama and Assela cities towards Hepatitis B and/or C, explained by its predictor variables in both cities respectively. Negelkerke R-square in the model summary Table 12 is 49.0% for Adama and 55.3% for Assela city, indicating there is a relationship of 49.0% and 55.3% between the predictors and the dependent variable for Adama and Assela cities respectively. That is 49.0% and 55.3% of awareness of residents at Adama and Assela cities respectively towards Hepatitis B and/or C, was explained by the explanatory variables.

Table13: Hosmer and Lemeshow Test for Adama and Assela cities

Step	Chi-square		df		Sig.	
	Adama	Assela	Adama	Assela	Adama	Assela
1	7.379	5.225	8	8	.496	.733

The desirable outcome of non-significance indicates that the model prediction dose not significantly differ from the observed. Hosmer and Lemeshow statistic has chi-square value of 7.379 and P-value of 0.496 for Adama city and 5.225 and P-value 0.733 for Assela city, which means that Hosmer and Lemeshow test is not significant and therefore our model is quite a good fit (Table 13). Because P value exceeds 0.05 level of significance, we may conclude that there is no difference between the observed and predicted model value. This indicates that the fitted model is good.

Table14: Contingency Table for Hosmer and Lemeshow Test for Adama and Assela cities

		Awareness level = Not aware				Awareness level = Aware				Total	
		Observed		Expected		Observed		Expected			
		Adama	Assela	Adama	Assela	Adama	Assela	Adama	Assela	Adama	Assela
Step 1	1	64	58	63.37	58.10	1	1	1.625	0.85	65	59
	2	60	56	60.35	56.09	5	3	4.644	2.9	65	59
	3	57	54	55.26	52.67	8	5	9.740	6.329	65	59
	4	45	44	47.87	45.80	20	15	17.129	13.19	65	59
	5	36	35	39.92	38.4	29	24	25.072	20.58	65	59
	6	36	33	30.42	28.9	29	27	34.579	31.04	65	60
	7	19	21	22.67	20.2	46	38	42.326	38.76	65	59
	8	21	16	16.55	13.0	44	43	48.445	45.98	65	59
	9	10	4	9.89	7.0	54	55	54.107	51.91	64	59
	10	3	2	4.66	2.6	61	52	59.334	51.32	64	54

An alternative, to model chi-square test, is the Hosmer and Lemeshow test which divides the subjects into 10 ordered groups of subjects and then compare the number actually in each group observed to the number predicted by the logistic regression model.

In table 15, the first column indicates the number of 0's and 1's that are observed in the dependent variable (awareness level). The predicted values of the dependent variable based on the full logistic regression model are also displayed. The values show how many cases are correctly predicted (269 and 256 cases in Adama and Assela cities respectively are observed to be 0 and are correctly predicted to be 0; 226 and 203 cases at Adama and Assela cities respectively are observed to be 1 and are correctly predicted to be 1), and how many cases are not correctly predicted (82 and 67 cases are observed to be 0 but are predicted to be 1; 71 and 60 cases are observed to be 1 but are predicted to be 0). The overall percentage gives the overall percent of cases that are correctly predicted by the full model. Overall, our predictions were correct 495 out of 648 cases for an overall success rate of 76.4% for Adama city and 459 out of 586 cases for an overall success rate of 78.3% for Assela city.

Table 15: Classification table for Adama and Assela city

Observed		Predicted		
		Awareness level		Percentage corrected
		Not Aware	Aware	
Awareness level	Not aware	269 256	82 67	76.6 79.3
	Aware	71 60	226 203	76.1 77.2
Overall Percentage				76.4 78.3

Table16: Variables in the final logistic regression equation for Adama city

	B	S.E	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Ag			3.526	3	.317			
Ag(1)	-.188	.250	.566	1	.452	.828	.507	1.353
Ag(2)	.375	.303	1.533	1	.216	1.456	.803	2.637
Ag(3)	.215	.535	.161	1	.688	1.240	.434	3.540
Gender(1)	-.251	.216	1.350	1	.245	.778	.509	1.188
Edulv			11.254	2	.004*			
Edulv(1)	.141	.263	.288	1	.592	1.151	.688	1.928
Edulv(2)	.973	.314	9.576	1	.002	2.646	1.429	4.900
Empl			2.118	2	.347			
Empl(1)	-.339	.478	.504	1	.478	.712	.279	1.818
Empl(2)	.078	.490	.026	1	.873	1.082	.414	2.826
Montlyincome			7.444	3	.049*			
Montlyincome(1)	.728	.408	3.178	1	.035	2.070	.930	4.608
Montlyincome(2)	.919	.438	4.408	1	.036	2.508	1.063	5.917
Montlyincome(3)	1.305	.486	7.194	1	.007	3.686	1.421	9.562
Marilstu(1)	.038	.255	.022	1	.883	1.038	.630	1.712
Accom(1)	.466	.292	2.535	1	.111	1.593	.898	2.825
Totalf			6.077	2	.048*			
Totalf(1)	.458	.309	2.202	1	.138	1.581	.863	2.894
Totalf(2)	.797	.327	5.934	1	.015	2.219	1.169	4.215
Read			35.971	2	.000*			
Read(1)	-.679	.239	8.083	1	.004	.507	.317	.810
Read(2)	-2.145	.358	35.968	1	.000	.117	.058	.236
usemedi			25.805	2	.000*			
usemedi(1)	-1.040	.225	21.291	1	.000	.353	.227	.550
usemedi(2)	-1.204	.379	10.077	1	.002	.300	.143	.631
Constant	-.448	.447	1.006	1	.316	.639		

From table 16 we see that only five predictor variables were selected by the model, that is educational level, monthly income, total family size, reading habit and use of media. All the variables selected by the model have significant effect on the outcome variable. The variable in the equation model has several important elements; Wald statistic and equation are also

presented in Table 16. The Wald statistic has a Chi-square distribution. The way to assess Wald is to take the significance values and if less than 0.05 reject the null hypothesis as the variable does make a significant contribution. In this case we note that educational level, monthly income, total family size, reading habit and use of media contributed significantly to the prediction with P-value .004, .049,0.048, 0.000, 0.000 which are less than 0.05 level of significance, respectively (Table 16).

The results indicate that, for instance, odds of awareness for respondents with high school level of education increased by the factor 1.151 as compared with respondents with elementary and less level of education. The value 0.141 shows an increase in log odds of respondents with high school educational level. The value 0.973 indicates an increase in log odds of respondents with higher educational level; the odds ratio $e^{0.973}$= 2.646 means that the odds of awareness increases by a factor 2.646 for respondents with higher educational level compared to the reference category.

Table 17: Summary of the results of multiple logistic regression model for Assela city.

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Ag			8.350	3	.039*			
Ag(1)	-.296	.284	1.083	1	.298	.744	.426	1.299
Ag(2)	.624	.337	3.428	1	.064	1.866	.964	3.611
Ag(3)	.706	.631	1.252	1	.263	2.026	.588	6.982
Gender(1)	-.219	.242	.820	1	.365	.803	.500	1.290
Edulv			13.894	2	.001*			
Edulv(1)	.368	.297	1.540	1	.215	1.446	.808	2.587
Edulv(2)	1.252	.347	12.990	1	.000	3.498	1.770	6.911
Empl			3.704	2	.157			
Empl(1)	-.817	.545	2.249	1	.134	.442	.152	1.285
Empl(2)	-.276	.550	.251	1	.617	.759	.258	2.233
Montlyincome			6.988	3	.042*			
Montlyincome(1)	.902	.463	3.795	1	.051	2.464	.995	6.103
Montlyincome(2)	1.066	.492	4.685	1	.030	2.903	1.106	7.618
Montlyincome(3)	1.411	.542	6.786	1	.009	4.102	1.418	11.860
Marilstu(1)	.234	.286	.668	1	.414	1.264	.721	2.215
Accom(1)	.248	.328	.571	1	.450	1.282	.673	2.439
Totalf			3.304	2	.049*			
Totalf(1)	.457	.345	1.748	1	.042	1.579	.802	3.108
Totalf(2)	.657	.361	3.303	1	.039	1.929	.950	3.917
Read			37.754	2	.000*			
Read(1)	-.931	.263	12.544	1	.000	.394	.235	.660
Read(2)	-2.459	.403	37.286	1	.000	.086	.039	.188
usemedi			22.322	2	.000*			
usemedi(1)	-.999	.248	16.284	1	.000	.368	.227	.598
usemedi(2)	-1.484	.451	10.842	1	.001	.227	.094	.549
Constant	-.139	.511	.074	1	.786	.871		

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From table 17, we see that only sex predictor variables were selected by the model, that is Age, educational level, monthly income, total family size, reading habit and use of media. All the variables selected by the model have significant effect on the outcome variable. The way to assess Wald is to take the significance values and if less than 0.05 reject the null hypothesis as the variable does make a significant contribution. In this case, we note that age, educational

level, monthly income, total family size, reading habit and use of media contributed significantly to the prediction with P-value 0.039, 0.001, 0.042, 0.049, 0.000, 0.000 which are less than 0.05 level of significance, respectively (Table 17).

The results indicate that, for instance, odds ratio of age group obtained in table 17 using the reference category of age group 18-30. The value -0.296 shows a decrease in log odds of age group 31-40; the odds ratio $e^{-0.296}$= 0.744 means that the odds of awareness decreases by a factor 0.744 for respondents with age group 31-40 compared to the reference category. The value 0.624 indicates an increase in log odds of age group 41-50; the odds ratio $e^{0.624}$= 1.866 means that the odds of awareness increases by a factor 1.866 for respondents with age group 41-50 compared to the reference category. The value 0.706 indicates an increase in log odds of age group 51-above; the odds ratio $e^{0.706}$= 2.026 means that the odds of awareness increases by a factor 2.026 for respondents with age group 51-above as compared to the reference category.

4.3 Diagnostic Checking

Detection of outliers and influential cases and corresponding treatment is a very crucial task of any modeling exercise. A failure to detect outliers and hence influential cases can have severe distortion on the validity of the inferences drawn from such modeling exercise. It would be reasonable to use diagnostics to check if the model is adequate or not. The main focus here will be to detect outliers and influential cases that have a substantial impact on the fitted logistic regression model through appropriate graphical methods.

The diagnostic test results for detection of outliers and influential cases are given in Table 18 below. A check of the standardized and deviance residuals reveals that all have values less than absolute value of 3 indicating the absence of outliers in the model. In addition, there are no large values of an analog of the Cook's distance ($Di<1$) which means that there are no influential cases having an effect on the model and there are no high values of DFBETAS which means that there are no influential observations for the individual regression coefficients. Therefore, we can accept the model as adequate.

Table 18: Descriptive statistics of diagnostic tests for Adama and Assela cities

	Sample size		Minimum		Maximum	
	Adama	Assela	Adama	Assela	Adama	Assela
Analog of Cook's influence statistics	648	586	0.0004	.00001	0.34026	.48882
Leverage value	648	586	0.0349	.00219	0.11263	.12793
Standard residual	648	586	-2.2521	-2.29530	2.95216	3.22928
Deviance value	648	586	-2.2351	-2.27004	2.94553	3.22491

DFBETA for constant	648	586	-0.0861	-.12974	0.12775	.14901
DFBETA for age(1)	648	586	-0.0401	-.05824	0.05099	.06277
DFBETA for age(2)	648	586	-0.0465	-.06424	0.06251	.06895
DFBETA for age(3)	648	586	-0.2172	-.32980	0.10352	.12124
DFBETA for Gender(1)	648	586	-0.0382	-.03950	0.02877	.03651
DFBETA for Educational level(1)	648	586	-0.0376	-.05621	0.05404	.07183
DFBETA for Educational level(2)	648	586	-0.0591	-.07091	0.0726	.08572
DFBETAfor employment status(1)	648	586	-0.107	-.12135	0.14057	.19332
DFBETAfor employment status(2)	648	586	-0.1105	-.12957	0.12720	.13527
DFBETAformonthly income(1)	648	586	-.11769	-.16636	.07968	.10853
DFBETAformonthly income(2)	648	586	-.11585	-.16604	.08165	.11027
DFBETAformonthly income(3)	648	586	-.09833	-.13933	.09115	.13250
DFBETAformarital status(1)	648	586	-.03748	-.04600	.04676	.05691
DFBETAforaccommodatio n(1)	648	586	-.07214	-.08981	.04883	.06750
DFBETA for total family size(1)	648	586	-.06049	-.07544	.06061	.07804
DFBETA for total family size(2)	648	586	-.06628	-.07992	.06278	.07802
DFBETA forreading(1) habitDFBETA forreading(1) habit	648	586	-.03094	-.03733	.03528	.04408
DFBETA forreading habit(2)	648	(586)	-.04131	-.04837	.08537	.10174
DFBETAfor use of media(1)	648	(586)	-.02438	-.03195	.03113	.03690)
DFBETAfor use of media(2)	648	(586)	-.07526	-.08727	.10507	.15915

4.4 Discussion of Results

The study has tried to assess awareness of residents of Adama and Assela cities towards Hepatitis B and/or C. Hepatitis B and C viruses' infections are a serious health problem worldwide. It has significant burden on the health services especially in developing countries with limited resources.

In this study, educational level, monthly income, total family size, reading habit and use of media had shown statistically significant association for both Adama and Assela cities respondents and one significant variable is added, age, for Assela city respondents. Awareness about the disease and vaccination among the respondents were 45.8% and 6.6% for Adama city residents and 44.9% and 6.8% for Assela city residents respectively. Educated individuals were more aware about availability of vaccine for Hepatitis B virus. Those individuals who read newspaper, magazines, pamphlet, and follows mass media were more aware about Hepatitis B and/or C and its vaccination. Some of these finding were in line with other studies done in Coastal eastern India (Misra et al, 2012). Educational level and uses of media had shown statistically significant variables in this study, and this finding is comparable with the results of the study done in Coastal eastern India. In this study, sources of information regarding the disease were TV, radio, pamphlet, flyers, and magazines. This finding is comparable with the results of the study done in Coastal eastern India.

In this study, age, educational level, monthly income, total family size, reading habit and use of media had shown statistically significant association, however the study done in Quetta, Pakistan, the only variable significantly associated with knowledge of the respondents was area of residents. Poor knowledge was apparent in response to questions relating symptoms and transitions of the diseases. This finding is consistent with studies in Qutta, Pakistan.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The main objective of this study was to investigate the current level of awareness about Hepatitis B and/or C viruses among Adama and Assela cities residents. Primary data were collected using questionnaire. Classical logistic regression was used to analyze the data.

The study revealed that only 45.8% and 44.9% of the sampled residents at Adama and Assela cities respectively had awareness about Hepatitis B and/or C indicating that 54.2% and 55.1% not aware about the diseases. Although 33.5% and 33.3% of the respondents on Adama and Assela cities respectively were aware about availability of vaccine for Hepatitis B, only 6.6% and 6.8% of the respondents are vaccinated for Hepatitis B. Knowledge regarding Hepatitis B and/or C transismition, prevention, symptoms and occurrence among the respondent was low. The educated especially those who read Newspaper, Magazines, pamphlet, flayers and use Media were found to be more aware about the diseases and availability of vaccine. The results indicate lack of understanding of the basis of infection, control and prevention of transimmtion of Hepatitis B and/or C.

The classical logistic regression results shows that the variables significantly influencing awareness of residents at Adama and Assela cities towards Hepatitis B and/or C were educational level, monthly income, reading habit, uses of media and age is obtained as a significant variable at Assela city.

5.2 Recommendations

Based on the previous part of the significant predictor variables, the following recommendations are made to improve awareness of residents at both cities towards infectious disease.

Only about 45.8% and 44.9% of the respondents at Adama and Assela cities respectively are aware about the infectious disease while the rest are not aware. Thus, awareness campaigns should be enhanced to increases the knowledge of the public on Hepatitis B and/or C infections with emphasis on its mode of transition and measures to reduce the risk of controlling the viruses (practicing safe sex and avoiding of sharing infection needles, toothbrushes, or shaving razors). The public should be aware of the potential risk when getting use of blades of barber/ body piercing in place where adequate disinfection procedures might not be available or practiced. The most effective means of preventing Hepatitis B infection is through vaccination, thus educational interventions are need to promote Hepatitis B and/or C screening and increase vaccination coverage. It is important to develop educational strategies, seminars and public talks with special attention to person of lower educational levels, since they may not be aware of the importance of Hepatitis B and C screening and vaccination. To increase awareness of infectious diseases

mainly Hepatitis B and C, adoption of collaborative care where government health agencies, physicians, heath workers and mass Medias should work together to educate the masses about Hepatitis B and C and its vaccination. Awareness on that Hepatitis B and C can affect any age group is low. Thus the government health agencies, mass Medias, physicians and health workers, should inform the community that Hepatitis B and C infections can affect any age group and can persists for one's whole life despite the best available therapies and that the infected person may remain asymptomatic and undiagnosed for long periods, and the diseased person may develop chronic complication like liver failure and liver cancer.

Emphasis should especially be laid on awareness campaigns to educate the public that Hepatitis B is vaccine preventable disease. Empowering the people by providing them ample education and targeting at least one member of each family to have adequate information about Hepatitis B and C can help in managing and controlling the infections.

5.3 Limitations of the Study

There are certain limitations that must be considered in interpreting the results of this study. The study was conducted in two cities and there for results of the research are not representative of the entire population of Ethiopia. The analysis was based on cross sectional data, and the finding should be interpreted with caution given the nature of the associations that limited us from drowning definitive causal conclusions about the observed relationship between independent characteristics and the outcome measured.

Awareness of respondents was determined based on the mean score aggregated over 19 items. Respondents who scored above the mean value were categorized as aware and those scored below mean value were categorized as not aware and this is not standard to say same one is aware or not aware so caution must be taken when interpreting the results.

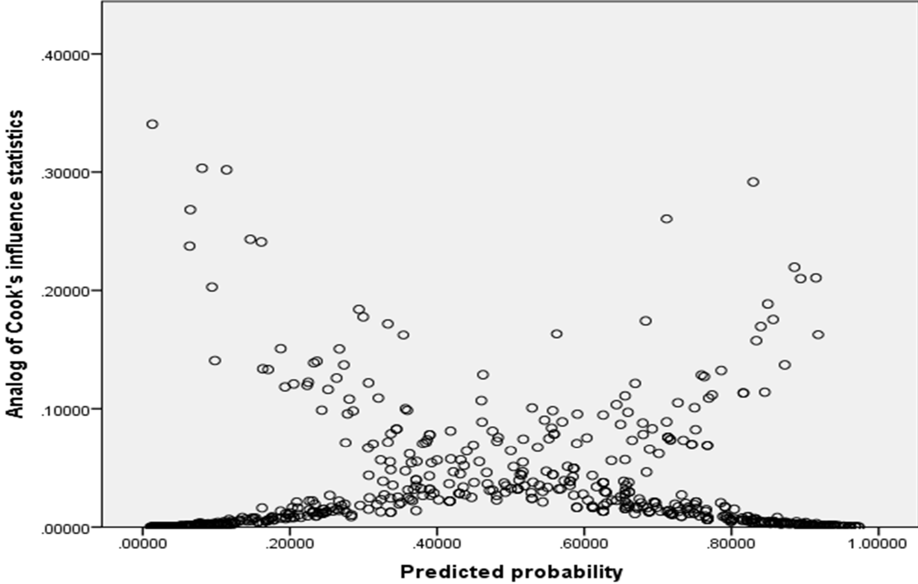
Appendix A

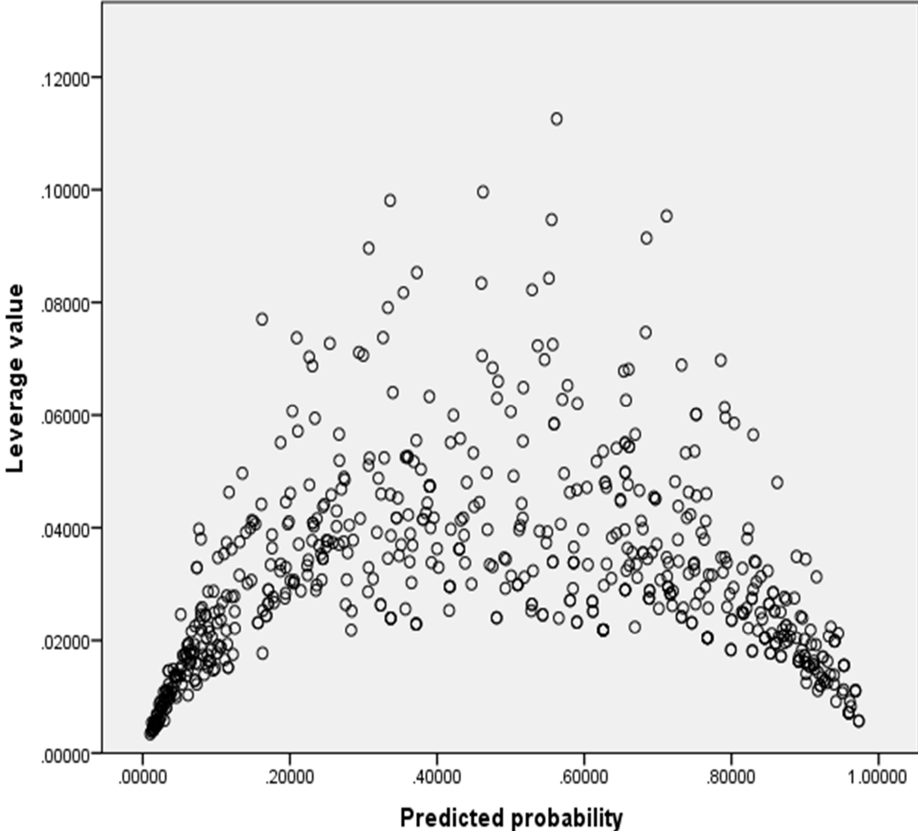
Table 19: Categorical Variables Coding for Adama and Assela cities

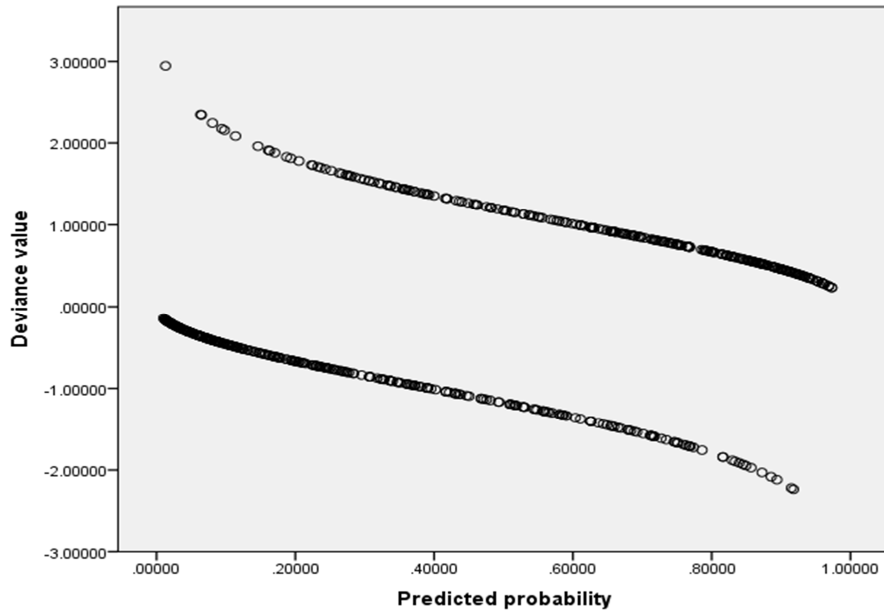
		Frequency	Parameter coding		
			(1)	(2)	(3)
Monthely income	<=1500	141	.000	.000	.000
	1501-5000	249	1.000	.000	.000
	5001-10000	152	.000	1.000	.000
	>10001	106	.000	.000	1.000
Age	18-30	298	.000	.000	.000
	31-40	190	1.000	.000	.000
	41-50	124	.000	1.000	.000
	51-above	36	.000	.000	1.000
Total family size	1-2	179	.000	.000	
	3-4	233	1.000	.000	
	>=5	236	.000	1.000	
educleve	Elementary and less	225	.000	.000	
	High school	256	1.000	.000	
	Higher education	167	.000	1.000	
Employment status	Unemployed	69	.000	.000	
	Employed	468	1.000	.000	
	Self Employed	111	.000	1.000	
Reading habit	Frequently	183	.000	.000	
	Sometimes	292	1.000	.000	
	Rarely	173	.000	1.000	
Use of media	Frequently	332	.000	.000	
	Sometimes	213	1.000	.000	
	Rarely	103	.000	1.000	
Marital status	Single	274	.000		
	Not single	374	1.000		
Accommodation	Alone	190	.000		
	Not alone	458	1.000		
Gender	Male	369	.000		
	Female	279	1.000		

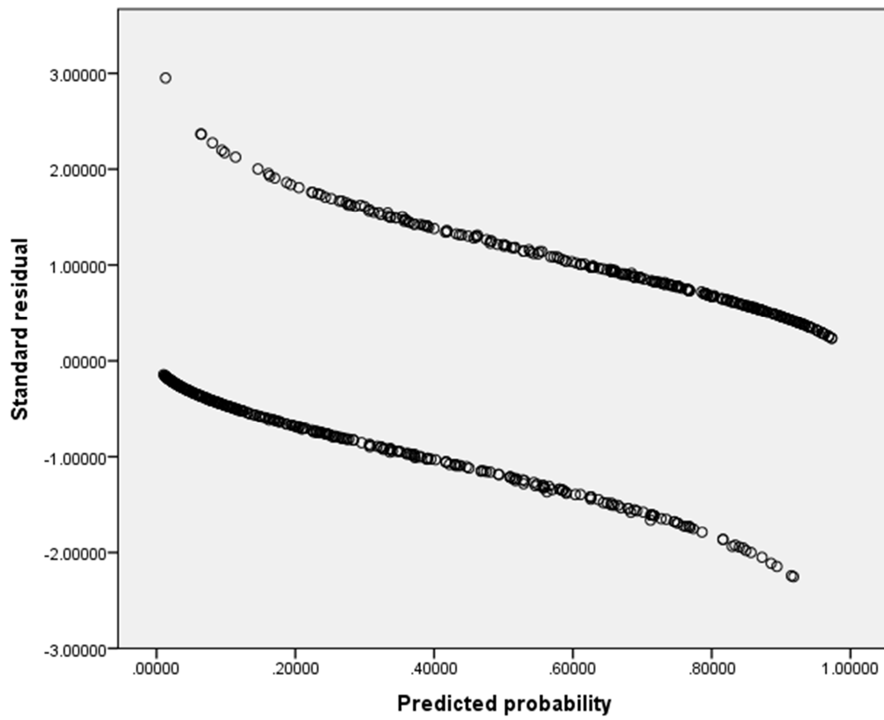
Appendix B:

Scatter plots for diagnostic checking for Adama city

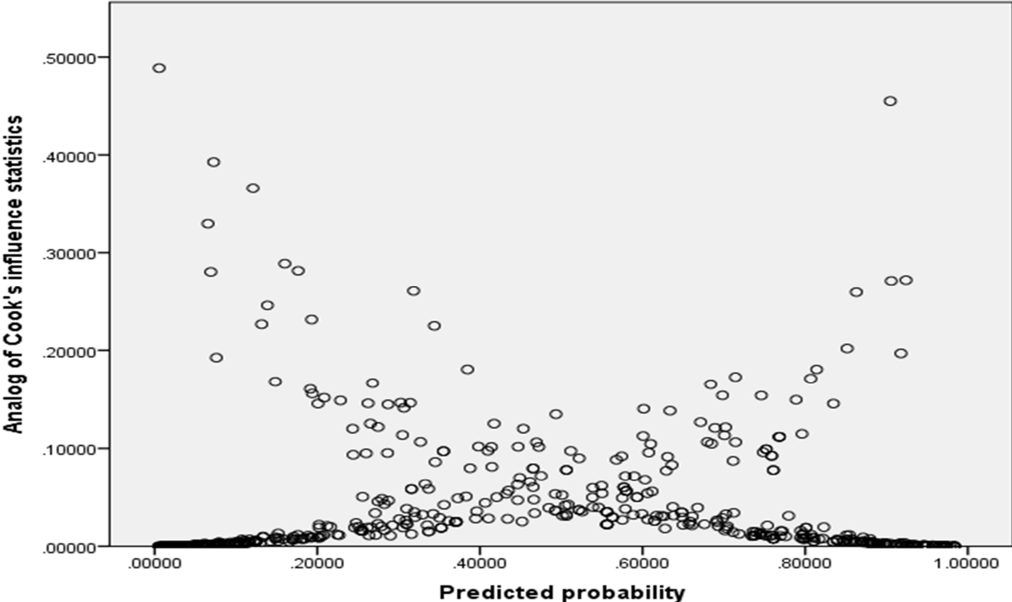


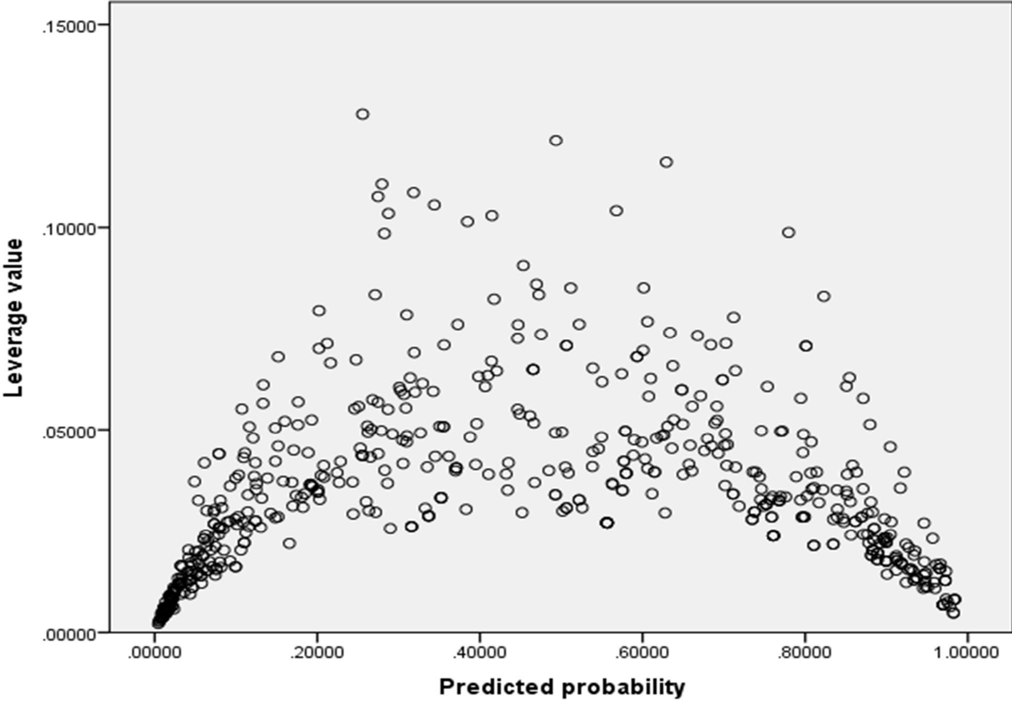


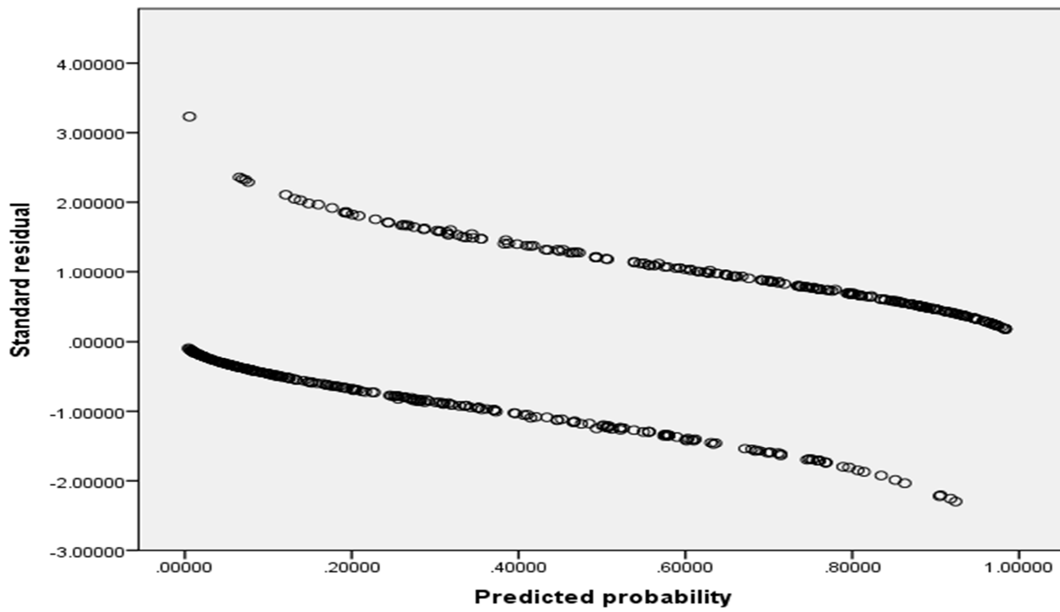

3.00000
2.00000
1.00000
.00000
-1.00000
-2.00000
-3.00000
Deviance value
.00000
.20000
.40000
.60000
.80000
1.00000
Predicted probability

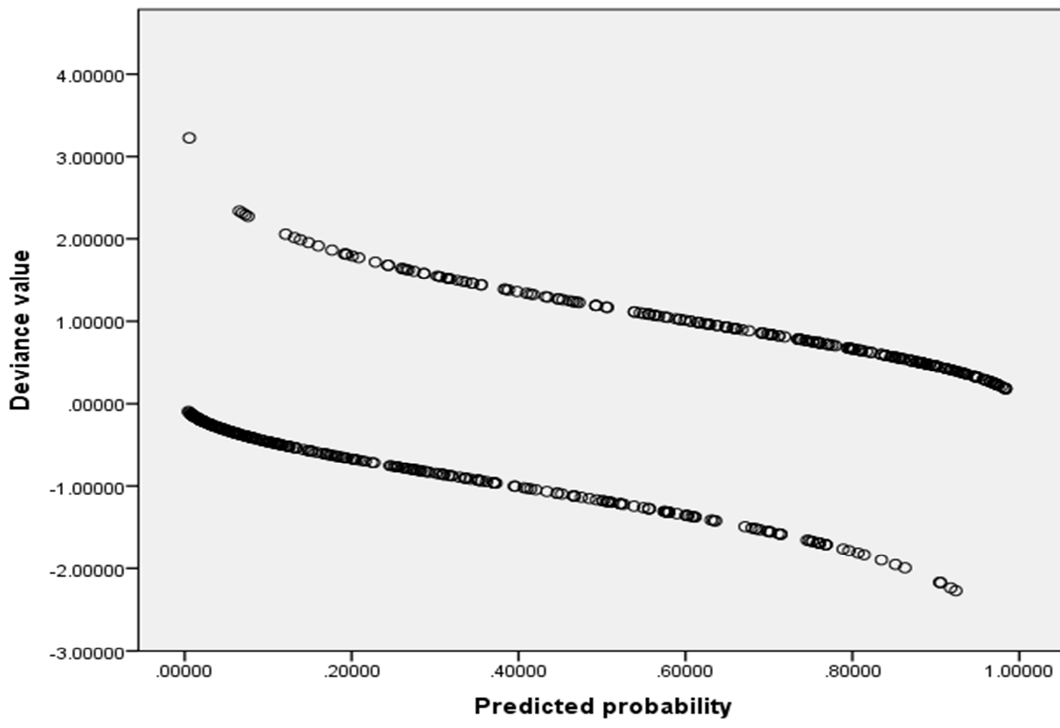

3.00000
2.00000
1.00000
.00000
-1.00000
-2.00000
-3.00000
Standard residual
.00000
.20000
.40000
.60000
.80000
1.00000
Predicted probability

Appendix C: Scatter plots for diagnostic checking for Assela city






Standard residual
4.00000
3.00000
2.00000
1.00000
.00000
-1.00000
-2.00000
-3.00000
.00000
.20000
.40000
.60000
.80000
1.00000
Predicted probability


Deviance value
4.00000
3.00000
2.00000
1.00000
.00000
-1.00000
-2.00000
-3.00000
.00000
.20000
.40000
.60000
.80000
1.00000
Predicted probability

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