RECORDS OF PHARMACEUTICAL AND BIOMEDICAL SCIENCES

Pattern of Hepatitis C Virus Infection in Arish City, North Sinai, Egypt

Hanaa Sakr [a], Osama Ali Zekry [b], Nashaat Kamal El-Qalagi [c]

[a] *Institute of Environmental Studies, Arish University, North Sinai, Egypt.;* [b] *Department of pediatrics, Faculty of Medicine, Suez Canal University;* [c] *Department of Tropical Medicine, Faculty of Medicine, Arish University*

Abstract

Hepatitis C virus (HCV) is one of Egypt's primary health challenges. Egypt accounts for more than 15% of the affected population. There have been significant strides toward disease progression, treatments for HCV infection, and new therapeutic and immunoprophylactic interventions for effective HCV elicitation. Our study aimed to evaluate the pattern of HCV infection in Arish city and implement an infection control program for the virus. We conducted both a descriptive cross-sectional study and a quasi-experimental one. From research we found that patients suffering from epidemic hepatitis were 44 patients, the recovery rate from the first stage was 56. 81%, the recovery rate of second stage was 31.81% and the rate of uncompleted treatment was 0.115%. We found that women respond to treatment more than men, and women adhere to the available treatment more than men. We found that the younger the age, from 20 to 40, the higher the response to treatment than for patients aged 40 to 60 or more. Through data and the calculation of BMI, we found that patients who are obese have a higher response to treatment than those who are overweight (average overweight, morbid obesity).

Introduction:

Hepatitis C virus (HCV) infection is emerging as one of the most important challenges in healthcare due to the synchrony and quasi-species nature of the virus. All over the world, more than 170,000,000 people suffer from chronic hepatitis C virus infection, with a mortality rate of more than 500,000 worldwide. Emerging pathophysiological evidence links hepatitis C virus infection with the risk of liver diseases such as cirrhosis and hepatocellular carcinoma **(Hashem et al., 2018)**. Viral hepatitis can be caused by various types of viruses, including Hepatitis A, B, C, D, E, and Hepatitis G viruses **(Chen et al., 2013)**. HCV infection is often symptomatic. The incubation time of HCV averages roughly 7 weeks. HCV is known as a silent killer because it cannot be detected at an early stage, resulting in the patient not receiving early treatment **(Hashem et al., 2018)**. Therefore, severe cirrhosis is linked to end-stage liver disease and hepatocellular carcinoma. Hepatocellular carcinoma is the most frequent kind of liver cancer that affects roughly 1–3% of HCV patients **(Stasi et al., 2020)**. Blood transfusion remains the main source of HCV virus transmission **(Elgharably et al., 2016)**. Unsanitary, poor, and hazardous injection practices, as well as the use of unsterile surgical instruments, are the most prominent factors and causes of HCV transmission worldwide. Sexual transmission happens but is less common **(Chen et al., 2013)**. The treatment strategy for hepatitis C virus illness is continually improving in order to provide long-term satisfaction, response, and virus elimination **(Farci, 2002)**. In 1986, the first medicine available was

interferon alpha 2b (**Farci, 2002)** and in 2014, sofobuvir became available at pricing suited to Egypt's economic situation (**Elgharably et al., 2016**). Combination treatment with Sofobuvir and Ribavirin increase the effect to eliminate the virus (**Dolatimehr et al., 2017**). The most common side effects observed in people taking treatment are tiredness, headaches, nausea, insomnia, depression, weakness, anemia, and birth defects (**Niwehy et al., 2018**). Patients with hepatitis C should avoid alcohol; weight gain and eating foods high in sugar and fat can cause fatty liver disease, which can also cause further liver damage (**Liver, 2023**). Sofobuvir can treat more than 95% of people with hepatitis C infection, lowering the risk of death from liver cancer and cirrhosis. It has fewer side effects than previously available therapy and can completely cure the disease in three months (**Liver, 2023**). The aim of the study was to measure the pattern of hepatitis virus (HCV) infection in Arish city, North Sinai government, Egypt, and to evaluate the protocol of management of HCV implemented in Arish virus unit centers at Arish General Hospital and Arish Health Insurance Unit.

2. Methods:

2.1. Study design and place:

A descriptive, cross-sectional study was conducted. The quasi-experimental study was conducted in the center of treatment and follow-up of HCV patients in Arish city at both "Health Insurance and Arish General Hospital. In this work, the patient identification form of the Virus Center at Arish General Hospital was used to create a new questionnaire form (**Figure 1**) for the required data for each patient in order to obtain the results through which the research objectives are verified and realistic results are reached with the aid of the Hepatitis Virus Center and Health Insurance at Arish General Hospital. From this data that was collected about the patients, we were exposed to their weight and height, which were measured by their body mass index (BMI). From the equation (Du Bois), we can collect BMI and then compare the collected data with standard ranges of BMI (**Table 1**).

$$B.M.I = \frac{Weight\ of\ patient\ in\ Kg}{(Height\ of\ patient\ in\ cm)2}$$

2.2. Study setting:

The study was conducted at Centre of Hepatitis virus C and health insurance on 44 patients.

2.3. Patients:

All patient data were obtained from either the hepatitis virus center or health insurance, gender and age of patients was Obtain, Evaluation of patient weight and height to calculate body mass index, Knowing and recording data on receiving the required medication and the patient's adherence to treatment, Find out if the patient recovered from the first dose or if he relapsed and took the second dose.

2.4. Sample size:

Using the Kruskal-Wallis test formula and the Fisher exact test,

P-value >0.05

The result is not statistically Significant and hence don't reject the null hypothesis.

P-value <0.05

The result is statistically significant generally; reject the null hypothesis in favor of the alternative hypothesis.

2.5. Statically analysis.

The data was collected, coded, and entered into the computer via the Excel 2013 program. SPSS program (20) was used for data analysis. Data was analyzed and presented as numbers as percentage using tables and graphs With CI at 95%, BMI value was used, China square test were used.

2.6. Ethical Consideration:

Approval from the responsible authorities at Al-Arish Hospital, whether from the hepatitis virus center or health insurance, ensures the confidentiality of the data collected and does not transfer any data used outside of this study. Do not give or communicate any personal data about registered patients.

3. Results:

Our study showed that there were 44 patients suffering from hepatitis in the city of Arish between the Virus Center at Arish General Hospital and the Health Insurance Center in Arish.

3.1. Age:

The studied cases, according to age group, reveal that 17 patients (38.6%) had an age range of 20 to less than 40 years old, 17 patients (38.6%) had an age range of 40 to less than 60 years old, and 10 patients (22.8%) had an age range of 60 to 80 years old (Figure 2). The age distribution among response groups was determined using the Kruskal-Wallis test, the Fisher Exact test, and the P value, which shows that the relapse groups were the youngest patients among other groups but with a statistically insignificant difference (Table 1).

3.2. Gender:

Distribution of the studied cases according to gender reveals that; 59.1% of patients were males and 40.9% were females (figure 3) then gender distribution among response groups using Kruskal Wallis test used, Fisher Exact test and P value which show that males were higher among relapse group and patients who did not complete the course but with statistical insignificant difference (Table 1).

استمارة استبيان

أسم وحدة العلاج:

Case No: ☐

Sex:

Age:

Weight:

Height:

Body mass index (BMI):

Treatment state:

Treatment drugs:

☐

☐

☐

Complication:

Side effects:

The state of patient after treatment:

☐ Cured

☐ Morbidity

☐ Mortality

Figure 1: Questionnaire form

Table 1: Classification of B.M.I

BMI	Class
< 18.5	Under weight
18.5-24.9	Normal
25.0-29.9	Over weight
30.0-39.9	Obesity
>40	Extreme obesity

3.3. B.M.I:
Distribution of the studied cases according to B.M.I reveals that; 16 patients (36.4%) had normal weight, 18 patients (40.9%) were overweight, 7 patients (15.9%) were obese and 3 patients (6.8%) were morbid obese **(Figure 4)** the calculation were done according to BMI classification **(Table 3)** then B.M.I distribution among response groups using Kruskal Wallis test used, Fisher Exact test and P value which show that relapse group had the highest BMI among other groups but with statistical insignificant difference **(Table 1).**

3.4. Response to treatment:
Distribution of the studied cases according to response to treatment reveals that; 56.8% of patients showed response to treatment, While 31.8% of patients showed relapse and 11.4% did not complete the course **(Table 2)**, **(Figure 5)**, and **(Figure 6)**.
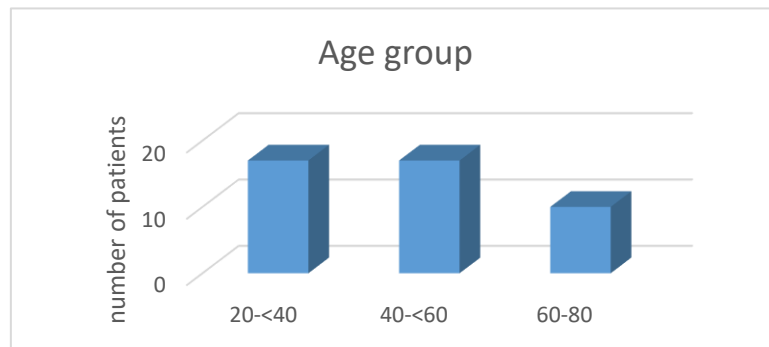
Figure 2: Distribution of the studied cases according to age group
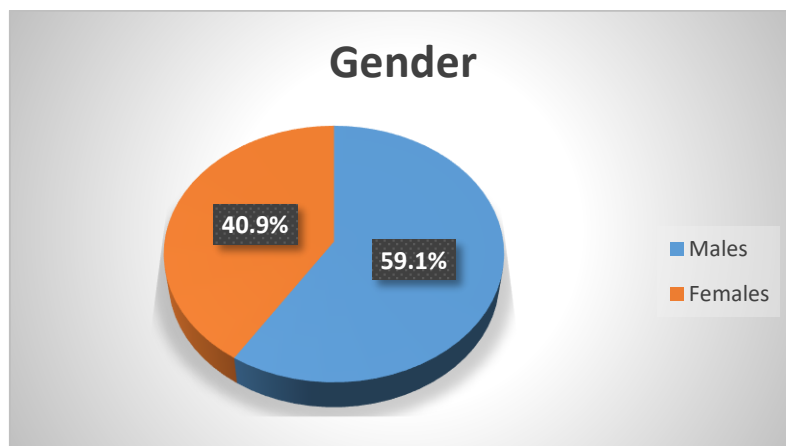

Figure 3: Distribution of the studied cases according to gender
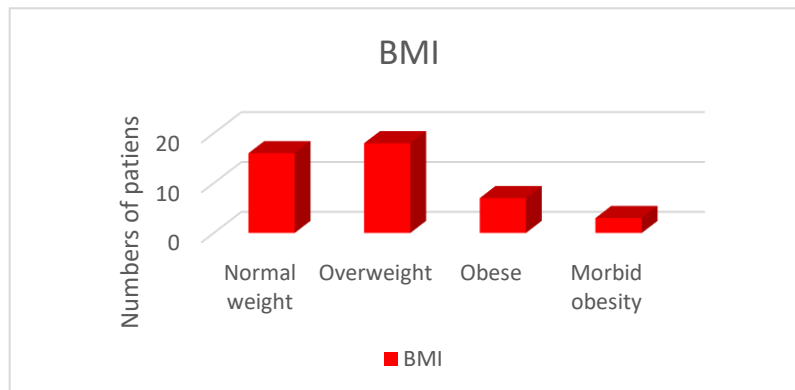

Figure 4: Distribution of the studied cases according to BMI

4. Discussion:

Hepatitis C virus (HCV) infection has increased by an estimated 2.8% over the last ten years, making it a global public health concern **(Mohd Hanafiah et al., 2013; Petruzziello et al., 2016).** China, Pakistan, Nigeria, Egypt, India, and Russia together accounted for more than half of total infections **(Gower et al., 2014).** An estimated 119 million adult people worldwide suffer from chronic HCV infection; each year, 3-4 million new infections and 350–500 thousand fatalities due to complications from HCV are reported **(Craun, 2015).**

Hepatocellular carcinoma (HCC), liver cirrhosis, and chronic hepatitis are mostly caused by HCV around 55%–85% of those with HCV infection **(Craun, 2015).**
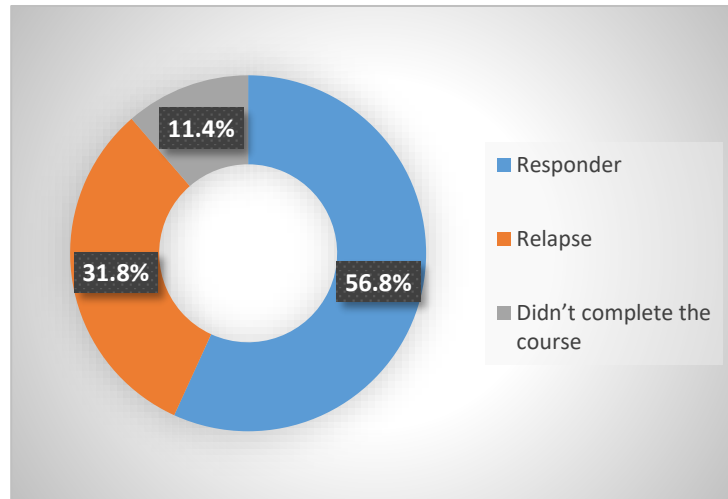
Figure 5: Distribution of the studied cases according to response to treatment
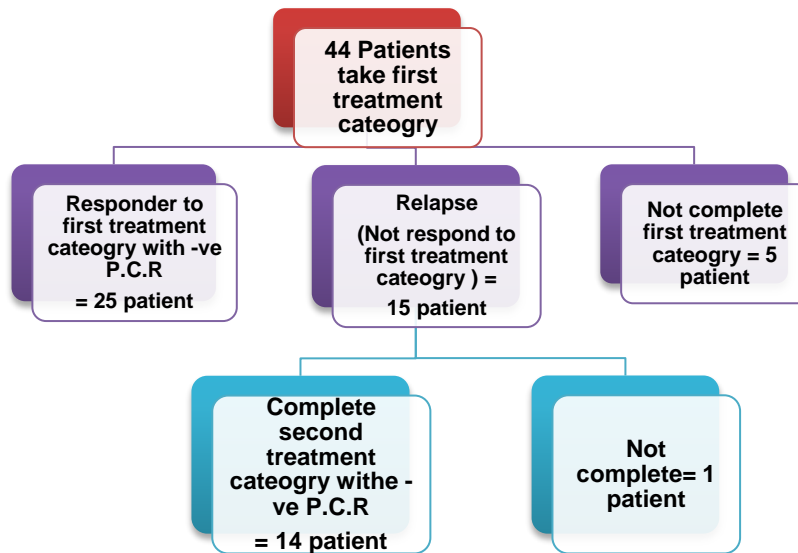

Figure 6: Distribution of the studied cases according to response to treatment

Following the national anti-HCV treatment program's introduction in 2008, which was expanded to include DAA therapy in 2014, as well as the execution of the biggest HCV mass screening and treatment campaign globally in 2018(**Elbahrawy et al., 2021**). In Egypt, HCV infection has always been a public health concern since its inception. Following schistosomiasis, it assumed the burden of liver disease. From the beginning of its history, HCV infection has existed in Egypt in a special way and will likely persist until it is eradicated, perhaps soon. In order to design an infection control program against viral infection, the purpose of this research was to evaluate the pattern of HCV infection in Arish city. According to the current study's findings,

56.8% of patients responded to therapy, relapsed in 31.8% of cases, and stopped the course of treatment in 11.4% of cases. The age range in our research was 25–78 years old (mean 46.95 years).Ten patients (22.8%) were between the ages of 60 and78, while 17 patients (38.6%) were between the ages of 20 and less than 40, and 17 patients (38.6%) were between the ages of 40 and less than 60. In terms of gender, we discovered that 40.9% of patients were female and 59.1% of patients were male. In Egypt in 2015, the percentage of people aged 15 to 59 who had HCV was much lower than it was in 2008 (14%), which suggests that the number of new infections in this age range had decreased dramatically. In the 15–59 age range, the overall HCV seroprevalence was 10%, with a viremic prevalence of 7%.

Table 2: Comparison of age, gender and BMI among response group

Age	Responder N=25	Relapse N=14	Didn`t complete N=5	P-value
Mean ± SD Median(Range)	48.7±12.8 51(26-76)	43.4±16.3 39(25-78)	48.2±15.1 43(31-66)	0.388#
Age groups				
20-<40	8(32%)	7(50%)	2(40%)	
40-<60	10(40%)	6(42.9%)	1(20%)	0.322$
60-80	7(28%)	1(7.1%)	2(40%)	
Gender	**Responder N=25**	**Relapse N=14**	**Didn`t complete N=5**	**P-value**
Males	14(56%)	8(57.1%)	4(80%)	
Females	11(44%)	6(42.9%)	1(20%)	0.750$
BMI	**Responder N=25**	**Relapse N=14**	**Didn`t complete N=5**	**P-value**
Mean ± SD Median(Range)	26.4±5.2 25.6(19.1-43.8)	29.4±8.9 27.9(19.9-51.1)	28.4±4.4 27.7(23.4-34.6)	0.429#
BMI groups				
Normal weight	11(44%)	4(28.6%)	1(20%)	0.611$
Overweight	10(40%)	6(42.9%)	2(40%)	
Obese	3(12%)	2(12.3%)	2(40%)	
Morbid obese	1(4%)	2(12.3%)	0(0%)	

#Kruskal Wallis test used.

$Fisher Exact test used.

P-value >0.05 (The result is not statistically Significant and hence don't reject the null hypothesis)

P-value <0.05 (The result is statistically Significant generally, reject the null hypothesis in favour of the alternative hypothesis).

Adult male HCV seroprevalence was 12.4% with a viremic prevalence of 9.8%, while adult female HCV seroprevalence was 8.1% with viremia of 5.5% **(Abdel-Gawad et al., 2023)**. A recent study showed statistically significant decline in anti-HCV prevalence among the general population has been reported **(Elbahrawy et al., 2021)**. While a recent large-scale national study done in 2018–19 indicated a decreased percentage of HCV prevalence (4.6%), earlier research conducted between 2015 and 2017 reported a higher rate of HCV prevalence (14.5%–25.9%). The dramatic drop in the prevalence rate of HCV reported by **(Waked et al., 2020)**. The majority of the included patients (66.3%) were under 45. In fact, according to a few other studies, the HCV pandemic in Egypt mostly impacted people over the age of 60. The decrease in the anti-HCV prevalence rate among Egyptian general populations may be ascribed to advancements in blood screening and infection control protocols implemented in the last twenty years, in addition to the nationwide treatment initiative and its efficaciousness as a preventive intervention **(Ayoub & Abu-Raddad, 2017)**.According to another study, prevalence decreased significantly in all age groups between 2008 and 2015. However, the frontier governorates did not show any significant change, possibly due to the small sample size (n < 200) **(Negro, 2014)**. Reasons beyond reduction may be related to ageing of the reservoir group, better infection control strategies, the directly acting antiviral drugs (DAAs) evolution **(Estes et al., 2015)**. The primary risk factor for Egypt's high HCV prevalence is parenteral antischistosomal therapy (PAT) programs. Approximately 60% of the individuals were estimated to get infected in hospitals and clinics **(Yahia, 2011)**. The findings of a meta-analysis, which analyzed and compared all HCV risk variables worldwide and in Egypt, are summarized as follows: Socio-demographic risk factors, and older age is a major risk factor over the globe. Poor education, high-risk occupations, and male gender pose a somewhat higher risk in Egypt. In Egypt, living in rural regions is a danger, although in other nations it is a protective factor **(El-Ghitany et al., 2014)**. In the current study, patients had mean BMI of 27.6± 6.5 kg\m2 ranged from 19.1 to 51.1. We found that 16 patients (36.4%) had normal weight, 18 patients (40.9%) were overweight, 7 patients (15.9%) were obese and 3 patients (6.8%) were morbid obese. We found that relapse group had the highest BMI among other groups but with statistical insignificant difference. High BMI has been linked to higher levels of fibrosis and steatosis **(Hu et al., 2004; Younossi et al., 2004)**, insulin resistance **(Ortiz et al., 2002; Patton et al., 2004)**, and increased systemic inflammatory responses

such as high tumor necrosis factor (TNF) **(Zampino et al., 2013)**, all of which unfavorably affect the treatment outcome. On the other hand, weight loss has been reported during PEG-IFN/RBV therapy in 11%–29% of patients **(Fried, 2002; Fried et al., 2002; Manns et al., 2001; Pawlotsky et al., 2015)**, which is associated with better treatment response **(Chung et al., 2010; Rodriguez-Torres et al., 2010; Suwantarat et al., 2010)**. According to BMI levels, HCV patients who are severely obese (BMI = 30-39.9) react better to sofobuvir combined with Ribavirin, representing the majority of patients in the study. Patients with obesity and BMI = 30-39.9 had a higher or better response to therapy, accounting for 40.9%. In another research, individuals with SVR to DAA therapy experienced a 1.93% (±11.30%) rise in BMI **(Chang, 2016)**. In another study showing that SVR secondary to DAA treatment was associated with weight gain in a cohort of veterans treated for HCV **(Do et al., 2017)**. Another study by Schlevogt and his colleagues demonstrated that 44% of treated subjects had weight gain at long-term follow-up after HCV clearance **(Schlevogt et al., 2016)**. The reason for such mechanisms leading to an increase in BMI with DAA treatment is unclear. It may be related to the improvement of psychological state, i.e., an increase in appetite or taste sensation with a clearance of HCV **(Musialik et al., 2012)**. Another explanation is that successful treatment is associated with a reduction in inflammatory cytokines and TNF-alpha, both of which act as cofactors in weight loss **(Omar et al., 2017; Villani et al., 2016)**. This study revealed a statistically insignificant difference between the relapse group and patients who did not complete the course, with a higher proportion of males. Additionally, the relapse group consisted of the youngest patients in comparison to the other groups, but the difference was statistically insignificant. Egypt has the greatest prevalence of HCV globally. 4% of individuals aged 15–59 years were found to have an active infection, while 6% of them had a positive hepatitis C antibody test result. In the majority of age groups, men had a higher prevalence of hepatitis C than women. This discovery was consistent with the findings of this meta-analysis in all studies conducted on the general population **(Abdel-Gawad et al., 2023)**. In 2008, the EDHS reported that the seroprevalence of HCV antibodies was 14.7% among the adult population aged 15–59 years, with a national viremic prevalence of 9.7%. Males had a higher seroprevalence of HCV antibodies than females in all age groups studied. In the same vein, the findings of this meta-analysis indicated that the prevalence of HCV viremia was substantially higher in males than females among adults. This

Table 3: Distribution of the studied cases according to response to treatment

Response	No.	%
Responder	25	56.8
Relapse	14	31.8
Didn't complete the course	5	11.4

disparity may be attributed to the fact that males are more susceptible to the burden of schistosomiasis disease, which is why they were the primary focus of the parenteral antischistosomal therapy (PAT) campaign, which was designed to mitigate the risk of transmission of parenteral viruses, such as HCV. Additionally, the lifestyle of males increases their susceptibility to a variety of risk factors for the transmission of HCV **(M. El-Adly et al., 2020; Mohamoud et al., 2013).** HCV infection is thought to be eliminated globally in the next 15–20 years. Although it is an achievable target in Egypt, it has to be focused on three strategies; prevention of new infections, screening and cure current infection. The potential challenges have to be understood and promptly managed **(Estes et al., 2015).**

5. Conclusion:

In conclusion, the present study results found that 56.8% of patients showed a response to treatment, while 31.8% of patients showed a relapse, and 11.4% did not complete the course. Relapse was higher among males, the youngest group with a higher BMI. Combination therapy of sofobuvir and ribavirin increases the response rate. This study revealed that 39 patients out of 44 patients showed a response, i.e., 90.9%, as depicted by the negative result of P.C.R. Female patients showed a better response as compared to males. Some high-risk groups are neglected in terms of screening and treatment. This underestimates the problem's magnitude and ignores a considerable reservoir.

6. Recommendation:

According to these findings, the current study recommended to provide an evidence that identify the pattern of hepatitis C virus infection and its personal characteristic before starting treatment through health education sessions and simple Arabic brochures in health insurance outpatient clinic and liver centre that provide healthy lifestyle measure with regard to nutrition adherence to treatment, physical activity, personal hygiene and medication management, Increase

patient's awareness about adverse reaction of Sofobuvir combination therapy through health education classes provided by the healthcare team, especially nurses and encouraging the patient to change his lifestyle, Additional studies should focus on examining the rules of community health nurses in implementing the follow up plan in hepatitis and health insurance centers, Provision of adequate public health infrastructure, Sustainability of political and societal will support in addition , and national and international organizations support, Strengthening and maintenance of strict infection control measures, Training programs for health staff to increase their awareness and improve their performance during dealing with HCV patients.

7. Conflict of interest:

None of the authors have any conflicts of interest.

8. References:

Abdel-Gawad, M., Nour, M., El-Raey,F., Nagdy , H., EL-Kassas , M , (2023). Gender differences in prevalence of hepatitis C virus infection in Egypt: a systematic review and meta-analysis. Scientific Reports, 13(1), 2499.

Ayoub, H. H., & Abu-Raddad, L. J. (2017). Impact of treatment on hepatitis C virus transmission and incidence in Egypt: A case for treatment as prevention. Journal of Viral Hepatitis, 24(6), 486–495.

Chang, M.-L. (2016). Metabolic alterations and hepatitis C: From bench to bedside. World Journal of Gastroenterology, 22(4), 1461.

Chen, E. Y., North, C. S., Fatunde, O., Bernstein, I., Jain, M. K. (2013). Knowledge and attitudes about hepatitis C virus (<scp>HCV</scp>) infection and its treatment in <scp>HCV</scp> mono-infected and <scp>HCV</scp>/<scp>HIV</scp> co-infected adults. Journal of Viral Hepatitis, 20(10), 708–714.

Abdel-Gawad, M., Nour, M., El-Raey,F., Nagdy , H., EL-Kassas , M , (2023). Gender differences in prevalence of hepatitis C virus infection in Egypt: a systematic review and meta-analysis. *Scientific Reports*, *13*(1), 2499.

Ayoub, H. H., & Abu-Raddad, L. J. (2017). Impact of treatment on hepatitis C virus transmission and incidence in Egypt: A case for treatment as prevention. *Journal of Viral Hepatitis*, *24*(6), 486–495.

Chang, M.-L. (2016). Metabolic alterations and hepatitis C: From bench to bedside. *World Journal of Gastroenterology*, *22*(4), 1461.

Chen, E. Y., North, C. S., Fatunde, O., Bernstein, I., Jain, M. K. (2013). Knowledge and attitudes about hepatitis C virus (<scp>HCV</scp>) infection and its treatment in <scp>HCV</scp> mono-infected and <scp>HCV</scp>/<scp>HIV</scp> co-infected adults. *Journal of Viral Hepatitis*, *20*(10), 708–714.

Chung, R. T., Poordad, F. F., Hassanein, T., Zhou, X., Di Bisceglie, A. M. (2010). Association of host pharmacodynamic effects with virologic response to pegylated interferon alfa-2a/ribavirin in chronic hepatitis C. *Hepatology (Baltimore, Md.)*, *52*(6), 1906–1914.

Craun, K. J. (2015). Mapping benefits from updated ifsar data in Alaska: improved source data enables better maps. *Fact Sheet*. US Geological Survey.

Do, A., Esserman, D., Tate, J. P., Njei, B., Justice, A. (2017). Weight Change After Receipt of Direct-Acting Antiviral Agents for Hepatitis C. *Gastroenterology*, *152*(5), S1163.

El-Zanaty, F. (2015). Ministry of Health and Population [Egypt], El-Zanaty and Associates [Egypt], ICF International, Egypt health issues survey 2015. *Ministry of Health and Population, ICF International Cairo, Rockville*.

El-Ghitany, E. M., Abdel Wahab, M. M., Abd ElWahab, E. W., Hassouna, S., & Farghaly, A. G. (2014). A comprehensive hepatitis C virus risk factors meta-analysis (1989–2013); Do they differ in Egypt? *Liver International*, *35*(2), 489–501.

Elbahrawy, A., Ibrahim, M. K., Eliwa, A., Alboraie, M.,Aly, H. H. (2021). Current situation of viral hepatitis in Egypt. *Microbiology and Immunology*, *65*(9), 352–372.

Elgharably, A., Gomaa, A. I., Crossey, M. M., Norsworthy, P. J.,Taylor-Robinson, S. D. (2016). Hepatitis C in Egypt - past, present, and future. *International Journal of General Medicine*, *10*, 1–6.

Estes, C., Abdel-Kareem, M., Abdel-Razek, W., Abdel-Sameea, E.,Waked, I. (2015). Economic burden of

hepatitis C in Egypt: the future impact of highly effective therapies. *Alimentary Pharmacology & Therapeutics*, *42*(6), 696–706.

Farci, P. (2002). Choo QL, Kuo G, Weiner AJ, Overby LR, Bradley DW, Houghton M. Isolation of a cDNA clone derived from a blood-borne non-A, non-B viral hepatitis genome [Science 1989;244:359–362]. *Journal of Hepatology*, *36*(5), 582–585.

Fried, M. W., Shiffman, M. L., Reddy, K. R., Smith, C.,Yu, J. (2002). Peginterferon Alfa-2a plus Ribavirin for Chronic Hepatitis C Virus Infection. *New England Journal of Medicine*, *347*(13), 975–982.

Gower, E., Estes, C., Blach, S., Razavi-Shearer, K., & Razavi, H. (2014). Global epidemiology and genotype distribution of the hepatitis C virus infection. *Journal of Hepatology*, *61*(1), S45–S57.

Hashem, M., Zaghla, H., Zakaria, Z., Allam, W. R.,Waked, I. (2018). High spontaneous clearance of symptomatic iatrogenic acute hepatitis C genotype 4 infection. *Journal of Medical Virology*, *90*(12), 1841–1847.

Liver, E. A. for the S. of the. (2023). Corrigendum to 'EASL recommendations on treatment of hepatitis C: Final update of the series' [J Hepatol 73 (2020) 1170–1218]. *Journal of Hepatology*, *78*(2), 452.

M. El-Adly, A., Wardany, A., & F. M. Morsy, M. (2020). PREVALENCE AND RISK FACTORS FOR HEPATITIS C VIRUS INFECTION AMONG GENERAL POPULATION IN LUXOR GOVERNORATE, EGYPT. *Al-Azhar Medical Journal*, *49*(1), 33–44.

Mohd Hanafiah, K., Groeger, J., Flaxman, A. D., & Wiersma, S. T. (2013). Global epidemiology of hepatitis C virus infection: New estimates of age-specific antibody to HCV seroprevalence. *Hepatology*, *57*(4), 1333–1342.

Musialik, J., Suchecka, W., Klimacka-Nawrot, E., Petelenz, M.,Błońska-Fajfrowska, B. (2012). Taste and appetite disorders of chronic hepatitis C patients. *European Journal of Gastroenterology & Hepatology*, *24*(12), 1400–1405.

Negro, F. (2014). Epidemiology of hepatitis C in Europe. *Digestive and Liver Disease*, *46*, S158–S164.

Niwehy, E. El, Hany, A., Mohamed, A., Moubarak, E., Amer, H. (2018). Assessment of Quality of Life of Hepatitis C Patients Treated By Sovaldi Drug in Viral Hepatitis Treatment Center in Ismailia Fever Hospital, Egypt. *Journal of Liver*, *07*(04).

Omar, H., El Akel, W., Elbaz, T., El Kassas, M., El Shazly, Y. (2017). Generic daclatasvir plus sofosbuvir, with or without ribavirin, in treatment of chronic

hepatitis C: real-world results from 18 378 patients in Egypt. *Alimentary Pharmacology & Therapeutics*, *47*(3), 421–431.

Ortiz, V., Berenguer, M., Rayon, J. M., Carrasco, D., & Berenguer, J. (2002). Contribution of obesity to hepatitis C-related fibrosis progression. *The American Journal of Gastroenterology*, *97*(9), 2408–2414.

Rodriguez-Torres, M., Sulkowski, M. S., Chung, R. T., Hamzeh, F. M., & Jensen, D. M. (2010). Factors associated with rapid and early virologic response to peginterferon alfa-2a/ribavirin treatment in HCV genotype 1 patients representative of the general chronic hepatitis C population. *Journal of Viral Hepatitis*, *17*(2), 139–147.

Schlevogt, B., Deterding, K., Port, K., Kirschner, J.,Wedemeyer, H. (2016). Weight gain after IFN-free cure of chronic hepatitis C: A potential concern? *Journal of Hepatology*, *2*(64), S750.

Suwantarat, N., Tice, A. D., Khawcharoenporn, T., & Chow, D. C. (2010). Weight loss, leukopenia and thrombocytopenia associated with sustained virologic response to Hepatitis C treatment. *International Journal of Medical Sciences*, *7*(1), 36–42.

Younossi, Z. M., McCullough, A. J., Ong, J. P., Barnes, D. S.,Ferguson, R. (2004). Obesity and Non-Alcoholic Fatty Liver Disease in Chronic Hepatitis C. *Journal of Clinical Gastroenterology*, *38*(8), 705–709.

Zampino, R., Marrone, A., Restivo, L., Guerrera, B.,Adinolfi, L. E. (2013). Chronic HCV infection and inflammation: Clinical impact on hepatic and extra-hepatic manifestations. *World Journal of Hepatology*, *5*(10), 528–540.