Journal homepage: www.fia.usv.ro/fiajournal
Journal of Faculty of Food Engineering,
Ştefan cel Mare University of Suceava, Romania
Volume XIX, Issue 3 - 2020, pag. 210 - 218

FOOD AND ENVIRONMENT SAFETY

ANALYSIS FOR THE DETERMINING FACTORS OF THE EVOLUTION OF *HEPATITIS A VIRAL* IN SUCEAVA COUNTY, ROMANIA, IN THE PERIOD 2018 - 2019

Paraschiva TOMĂSCU[1], Matei JARCĂU[2], Mihaela JARCĂU[3], Micşunica RUSU[3], Maria POROCH – SERIȚAN[3]*
[1]*OMNIS DENTAL MED S.R.L., Suceava, Romania*
[2]*Iuliu Haţieganu University of Medicine and Pharmacy, Cluj-Napoca, Romania*
[3]*Faculty of Food Engineering, Stefan cel Mare University, Suceava, Romania,* mariap@fia.usv.ro,
*Corresponding author
Received 15th July 2020, accepted 21st September 2020

Abstract: *The evolution of the hepatitis A virus is an important public health problem. This study was conducted in 2018 - 2019 and provides an analysis of the determinants regarding the evolution of hepatitis A virus (HAV) in Suceava County, Romania. The determining factors for the study were the subjects' place of residence and the source of the outbreak. It turned out that the main factor - the type of infectious outbreak - is mainly represented by variable educational communities and amounts to 56%, and the variability of home contacts is 42%. The distribution of the determining factor, according to which the source of the outbreak selects water as the predominant variable is 62%, followed by food 26%. These factors may play a significant role in the spread of hepatitis A among vulnerable populations.*

Keywords: *hepatitis A viral, place of residence, household type, the type of outbreak, source of outbreak*

1. Introduction

Hepatitis A virus (HAV) infection is still a major public health problem worldwide [1]. From the point of view of clinical manifestations, it varies from asymptomatic, subclinical forms of the disease, to forms with medium, severe or even fulminant evolution with acute hepatic insufficiency. Globally, only 1.5 million clinical cases of HAV are reported annually, while the infection rate is much higher [2]. In extremely endemic countries, almost all children become infected at an early age with mostly asymptomatic exposure, but acquire lifelong immunity [3, 4].

In 2017, 30 EU / EEA countries reported to TESSy (The European Surveillance System - a system for collecting, analyzing and disseminating data on communicable diseases) a number of 29307 confirmed cases (41% in Romania and 9% in Bulgaria). Cases occurred in all age groups, mainly in the 5 - 14 years (39%) and 25 - 44 years (19%) age groups. Cases in men were more common than in women, especially in the 15 - 24 and 25 - 44 age groups (male / female ratio of 1.3 and 1.2, respectively). The majority of reported infections were those with familial transmission (91%). For travel-related cases, the most common destinations were Syria, Morocco and Turkey [4, 5].

In 2018, 4560 suspected cases of HAV were registered nationally, of which 4436 cases were confirmed. County DSPs reported, in 2018, 157 outbreaks of acute hepatitis A viral, with a total number of 1799 cases of hepatitis A viral, of which

1456 cases were registered in the age group of 0 - 14 years. Of the 157 outbreaks: 89 were community outbreaks, 60 were family outbreaks and 8 were community outbreaks [6].

Hepatitis A virus (HAV) belongs to the genus *Hepatovirus*, a separate genus in the family *Picornaviridae* and it is small (27 nm), without an envelope, and consists of a single-stranded RNA with a positive polarity, including about 6500 nucleotides, which synthesizes a protein from cleavage of which by protease 3C results in structural proteins V1 - V4 [7, 8].

Infection with HAV occurs via person-to-person contact and is mainly acquired through faecal-oral transmission resulting from exposure to contaminated water and food [9] and physical agents [10]. HAV is stable at low pH, therefore gastric acidity does not destroy its viability [11]. It is resistant to drought, survives to frost, persists for months in fresh or salt water, which is why contaminated and eaten raw mollusks can transmit the virus. It maintains its infectivity in food for a few days. It is inactivated at temperatures above 60ºC, as well as formalin, ethanol, ultraviolet networks. The stability of the virus at various temperature and pH conditions allows it to spread and persist in the external environment with the possibility of spreading the infection [8, 12].

The population incidence of HAV infection is related to socio-economic conditions including density of housing, sanitation, quality of water [13] and income. Overall improvements of such conditions worldwide are leading to a shift of susceptibility to infection from early age to young and even older adults [14].

The aim of the present study conducted in 2018 - 2019 was to analyze the determinants of the evolution of HAV in Suceava County, Romania, as these factors are plausible to have consequences on the prevalence in susceptible people.

2. Materials and methods

2.1. Materials

Our study was performed on 50 subjects diagnosed with hepatitis A viral residing in Suceava County, with the date of clinical onset between 2018-01-01 and 2019-12-31. The epidemiological study of acute hepatitis A viral (HVA) was observational - longitudinal.

For each registered case, the sex, the age at onset of the jaundice syndrome, the place of residence, the type of household (apartment or courtyard house), the type of outbreak of infection, identified by epidemiological investigation were recorded as follows: *(a)* contact in the household with a hepatitis A patient; *(b)* attending an educational community (from kindergarten to university) or a community at work, if these circumstances had occurred within a period of up to 45 days before onset, the source of the infection (food, water, fruit and water + fruit) as well as the clinical manifestations of hepatitis A virus infection.

2.2. Statistical analysis

The programs used in the statistical analysis in order to validate and correlate the data from the study were:

- Microsoft Excel;
- SPSS 20.0 [15].

We analyzed the following outcome determining factors: sex, age, place of residence, household type, type of outbreak, source of outbreak, clinical manifestations.

Each variable (factor) was analyzed using the following tests:

- Pearson correlation to calculate statistical correlations;
- nonparametric chi-square test (χ^2-test);
- One Sample T-Test;
- significance threshold.

Statistical differences are obvious if the significance threshold is equal to $p < 0.05$, and the correlations are valid when the value of *r* tends to 0.9 - 1 when the value of *r* tends to 0 or -1 the correlations between the variables are negative [16].

3. Results and discussion

3.1. The sex of the subjects

From the distribution by sex (Figure 1) it is found that females predominate (58% F) compared to males (42% M), but there are no major statistical differences between the two sexes ($p = 0.2$).

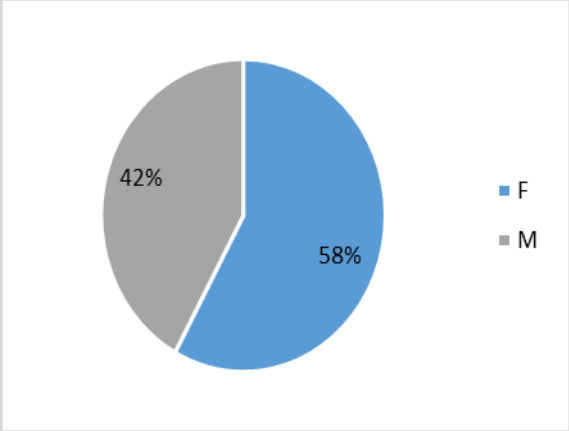

Figure 1. The distribution by *sex* of subjects infected with hepatitis A virus

Hepatitis A virus (HAV) infections are associated with considerable morbidity and mortality. From an epidemiological point of view, acute viral hepatitis A (HVA) shows wide variations in terms of endemicity, age at the time of infection and frequency of the disease. The clinical course of the disease may be influenced by the age and immune status of the host, ranging from asymptomatic infection to fulminant hepatitis [4, 17].

3.2. The age of the subjects

By distribution, we see that the highest incidence of viral hepatitis A infection in children aged 5 years old is 10%. Subjects 7, 12 and 15 years old, respectively, make up 8% in each group; at the age of 2 years old, 10 years old, 13 years old and 17 years old, 6% each, and at the age of 1 year, 9 years old, 14 years old, 18 years old, 21 years old and 25 years old, the incidence is 4% each. The least affected subjects were 3, 6, 11, 28, 29, 31, 37, 40, and 45 years old, which accounted for 2% (Figure 2).

The age of onset of the hepatitis A virus is also changing in adolescents and adults. This has led to a more symptomatic disease, because hepatitis A infection in children is usually asymptomatic, children under 6 often have no symptoms, this aspect being known as the paradox of the epidemiology of hepatitis A. The occurrence of this infection in older age groups may increase the severity of the disease and increase the risk of mortality [18].

3.3. Place of residence

Of the 50 subjects, it can be seen that only 14% (7 subjects) come from urban areas and a proportion of 86% (43 subjects) from rural areas (Figure 3). What makes the difference between rural and urban areas is the accessibility to information. People in the country are more prone to infections due to lack of education and lack of running drinking water, but also inadequate treatment of the water system - sewerage. Water transmits HAV, both by consuming it and by swimming in contaminated pools, unhygienically maintained and insufficiently chlorinated. Consumption of contaminated water usually causes epidemic explosive episodes, when a significant share of receptors is involved, but its intervention in inducing sporadic cases cannot be denied. Surface, groundwater or shallow waters are contaminated, with the possibility of discharging household fecal residues [19].

3.4. Household type

According to the household type determining factor, we observe the same

percentage distribution as the place of residence, so that 14% (7 subjects) live in an apartment building and 86% (43 subjects) in a courtyard building (Figure 4).

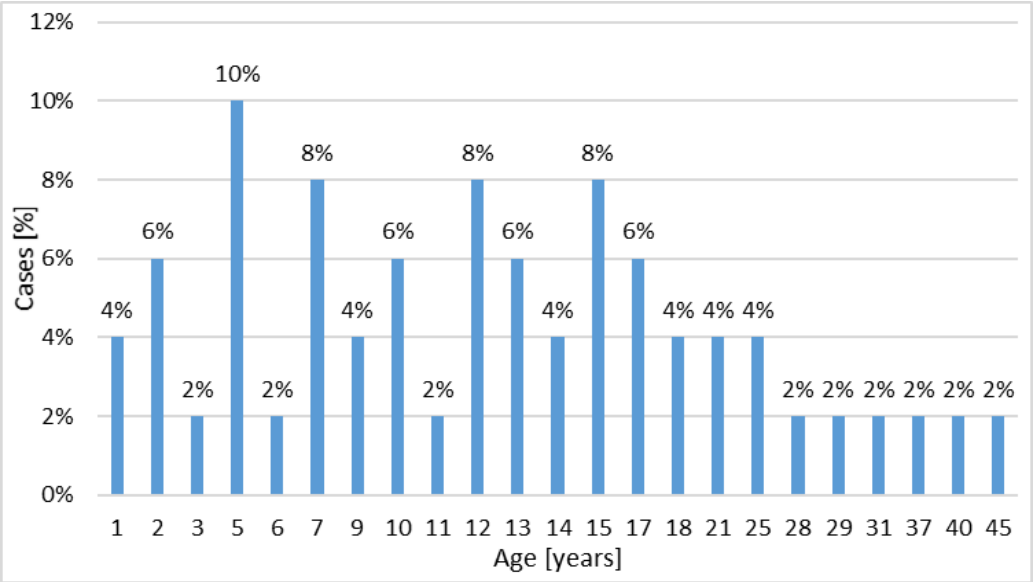

Figure 2. *Age* distribution of subjects infected with hepatitis A viral

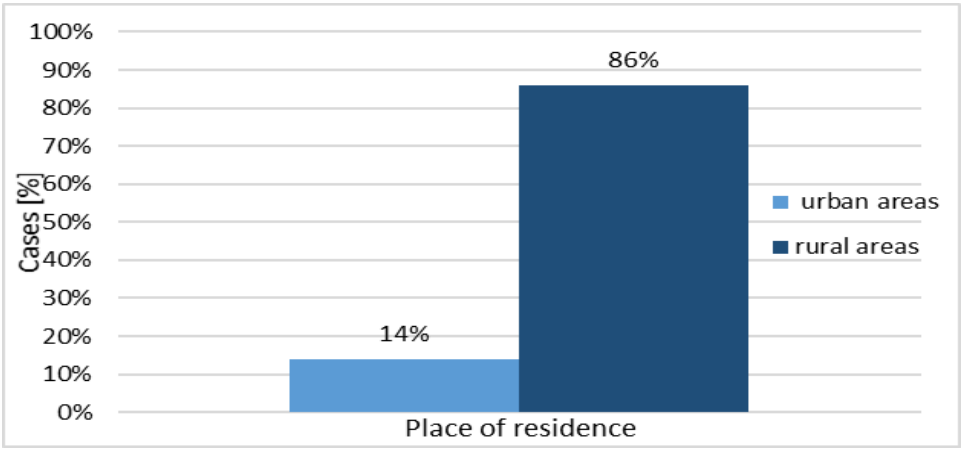

Figure 3. *Place of residence* distribution of subjects infected with hepatitis A viral

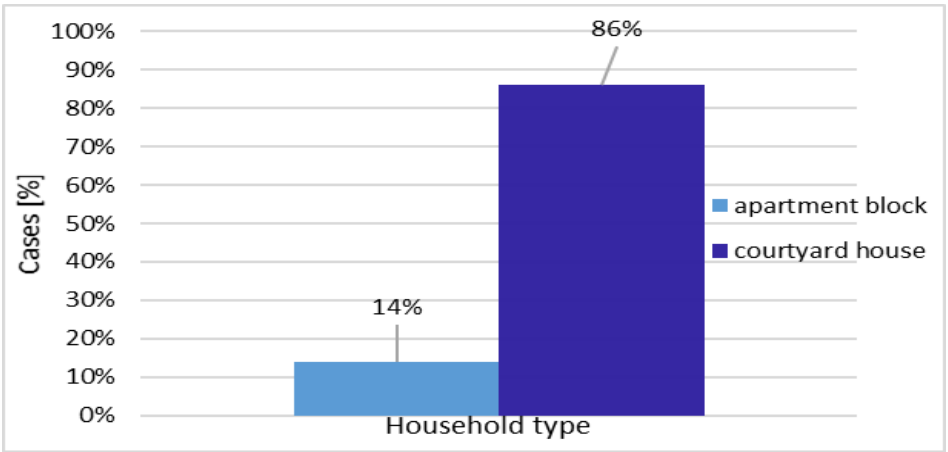

Figure 4. *Household type* of subjects infected with hepatitis A viral

There is a close link between the place of residence and the type of household, so that people living in the courtyard house and rural area have a higher probability of infection due to lack of drinking water [13] or by infecting their own wells with animal manure and lack of food hygiene.

The indirect mode of transmission is the most common and involves the circulation of HAV through water, food, various objects (dishes, toys, toiletries, etc.) or hands, contaminated with feces. Food contaminated by humans, flies, cockroaches, during their processing, processing or storage, can contribute to indirect transmission. This type of transmission is involved in the consumption of unprocessed food [9]. Of particular importance is the "seafood", which concentrates large amounts of HAV, their consumption can cause epidemics of various sizes, for example the Shanghai epidemic of 1988, with over 300000 diseases [8, 19].

The favorable factors of the epidemiological process of HAV are important in the evolution of morbidity, on the first places being placed the economic level and the deficient living conditions, the agglomeration, the promiscuity that facilitates and amplifies the interhuman contamination. These conditions, associated with deficiencies in hygiene and water and food supply [20] are factors that determine an increased frequency of HAV infections in preschool and school communities, construction sites, work camps, etc. Natural calamities such as floods, earthquakes, as well as wars, severe economic crises, pilgrimages, certain rituals, are other factors that favor-stimulate the epidemiological process of HAV [7].

3.5. The type of outbreak

According to the variable *type of outbreak*, we observe an approximately equal proportion in terms of the nature of the outbreak, so that 56% (28 subjects) acquired the infection in educational communities or in the workplace and 42% (21 subjects) in household contacts due to ingestion of contaminated food or water (Figure 5) [13, 21].

3.6. Source of outbreak

The determining factor represented by the *source of the outbreak* indicates the percentage as follows: 62% (31 subjects) became infected as a result of consuming contaminated water, 26% (13 subjects) as a result of ingesting contaminated food and the remaining 12% (6 subjects) due to an uncertain variable - contaminated (unwashed) fruit or polluted water with which the eaten fruit was washed (Figure 6). HAV being transmitted [22] primarily by faecal-oral route, either by person-to-person contact or by ingestion of contaminated food or water, contamination with HAV of a foodstuff may occur at any time during cultivation, harvesting, processing, preparation and distribution of the preparation. Recognizing food-based transmission using routine surveillance data can be difficult, as there are cases where patients may have difficulty remembering their food history in 2 to 6 weeks before illness.

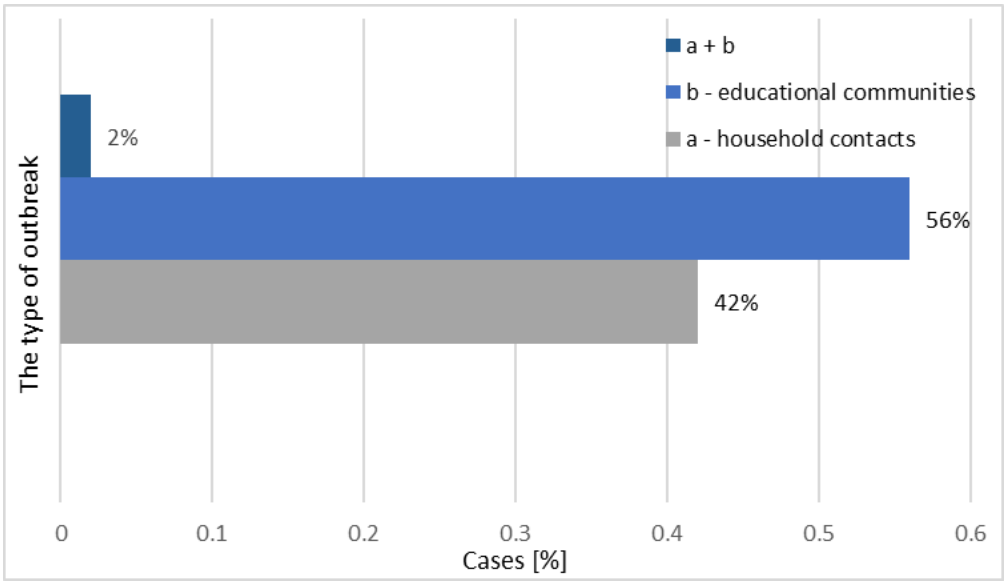

Figure 5. *The type of outbreak* of subjects who were infected with hepatitis A viral

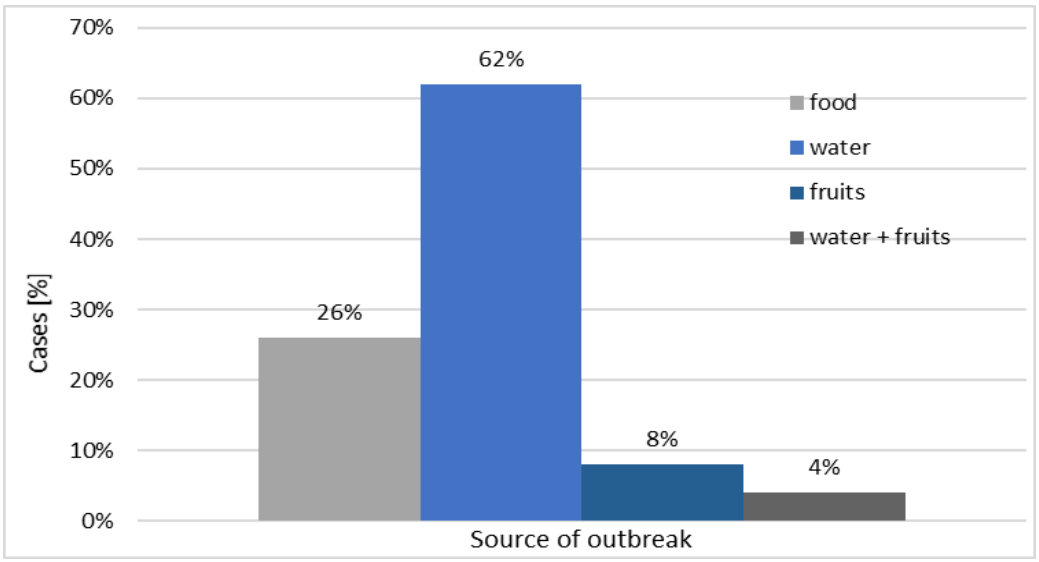

Figure 6. *Source of outbreak* of subjects who were infected with hepatitis A viral

3.7. Clinical manifestations

From the distribution of subjects it was found that 68% (34 subjects) of subjects had abdominal pain, 62% (31 subjects) had a decrease in appetite and vomiting, 60% (30 subjects) had nausea, 54% (27 subjects) had headache and jaundice and 52% (26 subjects) had diarrhea (Figure 7).

The onset of the disease is usually sudden with fever, malaise and abdominal discomfort. Jaundice is the predominant symptom. Symptoms can last from one to two weeks to several months. In 15% (7 subjects) of cases, recurrent hepatitis lasting up to one year occurs.

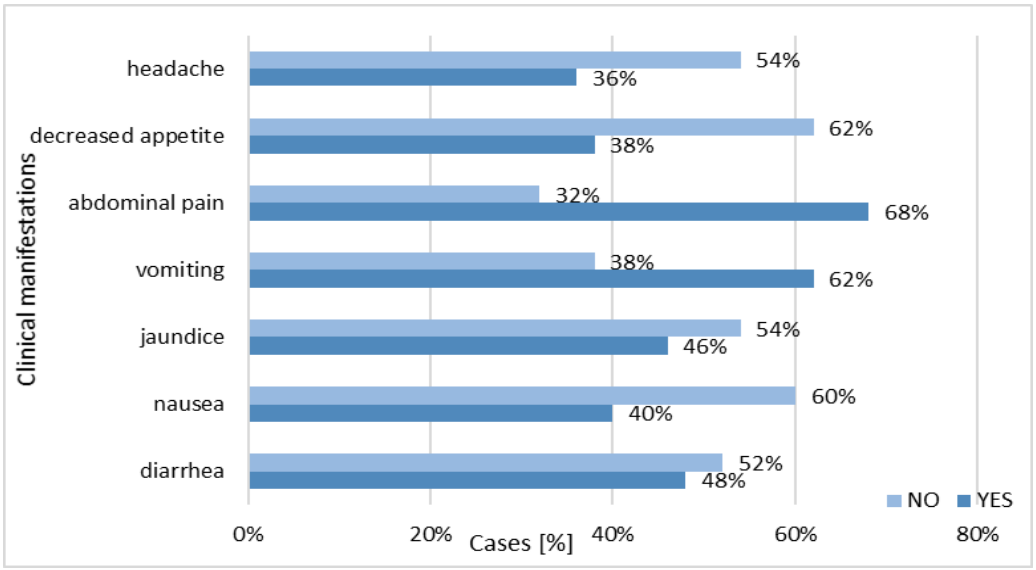

Figure 7. *Clinical manifestations* of subjects who were infected with hepatitis A viral

The determinants of the evolution of hepatitis A viral are represented by the place of residence of the subjects and the source of the outbreak, so that a close link was found in the case of infections between the two variables of the two factors. According to the percentage distribution, 86% (43 subjects) of the infected subjects live in rural areas. From the application of non-parametric tests (chi-square (χ^2-test)), but also of parametric ones (One-Sample Test) it is found that there are statistical differences between the two place of residence of the subjects ($p < 0.05$). The distribution by type of household shows that those who live in the courtyard house predominate 86% (43 subjects). By applying the non-parametric tests (chi-square (χ^2-test)), but also the parametric ones (One-Sample Test), differences are found from a statistical point of view between the two types of housing ($p < 0.05$).

By applying the chi-square test (χ^2-test) we notice that there are statistical differences between the variables of the type of infection outbreak ($p < 0.05$). The predominant variable of the type of infection outbreak was represented by the educational communities or in the workplace communities 56% (28 subjects). We can therefore conclude that more than half of these subjects became infected with the hepatitis A virus in the educational community (kindergarten and up to university) or in a community at work, if these circumstances had occurred in a interval up to 45 days before onset.

The distribution on the determining factor the source of outbreak highlights as predominant the variable - water with 62% (31 subjects) followed by the variable - food with 26% (13 subjects). It is found by applying non-parametric tests (chi-square (χ^2-test)), but also parametric ones (One-Sample Test) that there are differences from a statistical point of view between these variables of the source of outbreaks ($p < 0.05$)

Applying the Pearson correlation it was found that there is a correspondence between the place of residence and the source of outbreak ($r = 0.2$), but also between the place of residence and the type of outbreak ($r = 0.4$), which means that the place of residence can influence both sources, as well as the types of outbreak.

Given that the sources of outbreak were represented by the variables food / fruit and water, they will be correlated with the appearance of symptoms in the subjects. The strongest correlation found was between source and nausea symptom (r = 0.5). There was a correlation for each of the symptoms and the source of outbreak, but these are not all statistically significant. The only symptoms that were statistically suggestive were nausea ($p < 0.001$) and abdominal pain ($p = 0.008$).

The present study aims to highlight the importance of prevention in areas at high risk of endemicity at regional level by implementing information systems on risk exposure for viral hepatitis A infection and the consequences that society may have by the outbreak.

4. Conclusion

In conclusion, this study provides a summary of the evaluation on the evolution of hepatitis A viral in Suceava County in the period 2018 - 2019, depending on the determining factors.

Hepatitis A viral is a major public health problem and it is plausible that the determinants have consequences for the prevalence in susceptible individuals.

The subjects' place of residence and the source of the outbreak are the determining factors of the study. The determining factor - the type of outbreak is predominantly represented by the variable educational communities 56% (28 subjects), while the variable household contacts is 42% (21 subjects). The distribution of the determining factor, the source of the outbreak, highlights as predominant the variable - water with 62% (31 subjects) followed by food with 26% (13 subjects).

Reducing the transmission of viral hepatitis A can be achieved by defining and raising awareness of specific critical points of infection and requires a good understanding of how population-related disease / diseases caused by pathogens with "gateway" to the digestive tract can occur.

The hygienic, sanitation, decontamination; mass vaccination campaigns; avoiding the transmission through water or food contaminated with HAV, achievable by ensuring the potability of the water and the observance of the hygienic conditions in the public alimentation units; population education on hygienic skills in families, the community, which requires a hygienic culture and continuous training are important strategies in preventing and combating the emergence and spread of HAV.

5. References

[1]. JOO IL K., YUN S.K., YOUNG K.J., OH S.K., YEON S.K., YANG S.K., DUCK J.C., ȘI JU H.K., *Factors influencing the severity of acute viral hepatitis A*, Korean Journal Hepatology, 16(3): 295–300, (2010)

[2]. WHO *Position paper on hepatitis A vaccines*. Wkly Epidemiol Rec, 87:15, (2012)

[3]. CHAKRAVARTI A., BHARARA T., *Epidemiology of Hepatitis A: Past and Current Trends*, 2019 - https://www.intechopen.com/books/hepatitis-a-and-other-associated-hepatobiliary-diseases/epidemiology-of-hepatitis-a-past-and-current-trends accesat 11/07/2020

[4]. FRANCO E., MELELEO C., SERINO L., SORBARA D., ZARATTI L., *Hepatitis A: Epidemiology and prevention in developing countries*, World J Hepatol, 4(3): 68-73, (2012)

[5]. DSP Suceava, Ministry of Health, National Institute of Public Health, Regional Center for Public Health, Timisoara, Campaign *"World Hepatitis Day"* (ZMH) 2019 July 28, (DSP Suceava, Ministerul Sănătăţii, Institutul Naţional de Sănătate Publică, Centrul Regional de Sănătate Publică, Timişoara, *Campania "Ziua Mondială de luptă împotriva Hepatitei"* (ZMH) 28 iulie 2019) - https://www.dspsv.ro/uploads/PromovareaSanatatii/Hepatita%202019/Analiza_Hepatite_2019.pdf, accesat 11/07/2020

[6]. Ministry of Health, National Institute of Public Health, *Activity Report* 2018, (Ministerul Sănătăţii, Institutul Naţional de Sănătate Publică, *Raport de activitate* 2018) - https://www.insp.gov.ro/index.php/informatii-

publice/send/7-informatii-publice/722-raport-insp-2018, accesat 11/07/2020
[7]. FEINSTONE S.M., KAPIKIAN A.Y., PURCELL R.H., *Detection by immune electron microscopy of a viruslike antigen associated with acute illness*, Science, 182, 1026 – 1036, (1973)
[8]. IVAN A., *Treatise on the epidemiology of communicable diseases*, Polirom Publishing House, Iaşi, (2002), (*Tratat de epidemiologie a bolilor transmisibile*, Editura Polirom, Iaşi, (2002))
[9]. AMARIEI S., GUTT G., POROCH-SERIŢAN M., VIZITIU A., *Biocip optic pentru avertizarea degradării cărnii de porc şi de vită*, RO Patent 128634 (B1), 2017/11/29
[10]. SATTAR S.A., JASON T., BIDAWID S., FARBER J. *Foodborne spread of hepatitis A: Recent studies on virus survival, transfer and inactivation.* Can J Infect Dis, 11:159–163, (2000)
[11]. SCHOLZ E., HEINRICY U, FLEHMIG B., *Acid Stability of Hepatitis A Virus*, J Gen Virol., 70 (Pt 9):2481-5, (1989))
[12]. BABEŞ V., BERCA C., *Acute viral hepatitis. Diagnostic, etiological and epidemiological guide*, Facla Publishing House, Timişoara, 159 – 171, (1988), (*Hepatitele virale acute. Ghid diagnostic, etiologic şi epidemiologic*, Editura Facla, Timişoara, 159 – 171, (1988))
[13]. BÂRLĂ F**.**, CIORNEI (DUDICI) L**.,** POROCH – SERIŢAN M**.**, *Microbial contamination of the drinking water distribution system in Suceava country, Romania – three years of monitoring (2010-2012)***,** Journal of Faculty of Food Engineering, Ştefan cel Mare University of Suceava, Romania, Volume XII, Issue 4, 316 – 321, (2013)
[14]. LEMON S.M., OTT J.J., VAN DAMME P., SHOUVAL D., *Type A viral hepatitis: A summary and update on the molecular virology, epidemiology, pathogenesis and prevention*, Journal of Hepatology, 68, 167–184, (2018)
[15]. www.-ibm.com/support/docviw.wss?uid=swg24038510, accesat 11/05/2020
[16]. SPINEI L. LOZAN O., BADAN V., *Biostatistics*, "Nicolae Testemitanu" State University of Medicine and Pharmacy; School of Management in Public Health, Chisinau, (2009), (*Biostatistica, Universitatea de Stat de Medicină şi Farmacie „Nicolae Testemiţanu"*; Şcoala de Management în Sănătate Publică, Chişinău, (2009))
[17]. HORVAT M. M., PhD THESIS – ABSTRACT, *Clinical - immunological correlations in the evolution of acute viral hepatitis*, "IULIU HAŢIEGANU" UNIVERSITY OF MEDICINE AND PHARMACY CLUJ-NAPOCA, DOCTORAL SCHOOL, (TEZĂ DE DOCTORAT – REZUMAT, *Corelaţii clinico-imunologice în evoluţia hepatitelor acute virale*, UNIVERSITATEA DE MEDICINĂ ŞI FARMACIE "IULIU HAŢIEGANU" CLUJ-NAPOCA, ŞCOALA DOCTORALĂ), accesat 11/07/2020
[18]. MICHAELIS K., POETHKO-MÜLLER C., KUHNERT R., STARK K., FABER M., *Hepatitis A virus infections, immunisations and demographic determinants in children and adolescents*, Germany, Scientific Reports, 8:16696, DOI:10.1038/s41598-018-34927-1, (2018), www.nature.com/scientificreports, accesat 11/07/2020
[19]. HUTIN Y.J., POOL V., CRAMER E.H., NAINAN O.V., WETH J., WILLIAMS I.T., GOLDSTEIN S.T., GENSHEIMER K. F., BELL B.P., SHAPIRO C.N., ALTER M.J., MARGOLIS H.S., *A multistate foodborn outbreak of hepatitis A*; N. Engl. J. Med., 340, 595 – 602, (1999)
[20]. BÂRLĂ F., POROCH – SERIŢAN M., SĂVUŢ (STRATON) V.D., *Incidence of food contamination with Staphylococcus Aureus in Suceava county, Romania*, Journal of Faculty of Food Engineering, Ştefan cel Mare University of Suceava, Romania Volume XII, Issue 1, 89 – 94, (2013)
[21]. FIORE A.E., *Hepatitis A Transmitted by Food*, Clinical Infectious Diseases, 38 (5), 705–715, (2004)
[22]. HU X., COLLIER M.G., XU F., *Hepatitis A Outbreaks in Developed Countries: Detection, Control, and Prevention, Foodborne pathogens and disease*, 17(3), 166 – 171, (2020)