Hepatotropic viruses: Is Roma population at risk?

Mrzljak, Anna; Bajkovec, Lucija; Vilibić-Čavlek, Tatjana

Source / Izvornik: **World Journal of Gastroenterology, 2021, 27, 143 - 151**

Journal article, Published version
Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

https://doi.org/10.3748/wjg.v27.i2.143

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:105:031964

Rights / Prava: Attribution-NonCommercial 4.0 International/Imenovanje-Nekomercijalno 4.0 međunarodna

Download date / Datum preuzimanja: **2025-02-28**

Repository / Repozitorij:

Dr Med - University of Zagreb School of Medicine Digital Repository

ISSN 1007-9327 (print)
ISSN 2219-2840 (online)

World Journal of *Gastroenterology*

World J Gastroenterol 2021 January 14; 27(2): 143-232

Published by Baishideng Publishing Group Inc

World Journal of Gastroenterology

Contents

Weekly Volume 27 Number 2 January 14, 2021

MINIREVIEWS

ORIGINAL ARTICLE

Basic Study

Case Control Study

Retrospective Cohort Study

Retrospective Study

Observational Study

Randomized Controlled Trial

World Journal of Gastroenterology

Weekly Volume 27 Number 2 January 14, 2021

Contents

ABOUT COVER

Stanislav Sitkin, MD, PhD, Associate Professor, Senior Researcher, Department of Internal Diseases, Gastroenterology and Dietetics, North-Western State Medical University named after I.I. Mechnikov, St. Petersburg 191015, Russia. drsitkin@gmail.com

AIMS AND SCOPE

The primary aim of *World Journal of Gastroenterology* (*WJG*, *World J Gastroenterol*) is to provide scholars and readers from various fields of gastroenterology and hepatology with a platform to publish high-quality basic and clinical research articles and communicate their research findings online. *WJG* mainly publishes articles reporting research results and findings obtained in the field of gastroenterology and hepatology and covering a wide range of topics including gastroenterology, hepatology, gastrointestinal endoscopy, gastrointestinal surgery, gastrointestinal oncology, and pediatric gastroenterology.

INDEXING/ABSTRACTING

The *WJG* is now indexed in Current Contents®/Clinical Medicine, Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports®, Index Medicus, MEDLINE, PubMed, PubMed Central, and Scopus. The 2020 edition of Journal Citation Report® cites the 2019 impact factor (IF) for *WJG* as 3.665; IF without journal self cites: 3.534; 5-year IF: 4.048; Ranking: 35 among 88 journals in gastroenterology and hepatology; and Quartile category: Q2.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Ji-Hong Liu*; **Production Department Director:** *Yun-Xiaojian Wu*; **Editorial Office Director:** *Ze-Mao Gong*.

NAME OF JOURNAL
World Journal of Gastroenterology

ISSN
ISSN 1007-9327 (print) ISSN 2219-2840 (online)

LAUNCH DATE
October 1, 1995

FREQUENCY
Weekly

EDITORS-IN-CHIEF
Andrzej S Tarnawski, Subrata Ghosh

EDITORIAL BOARD MEMBERS
http://www.wjgnet.com/1007-9327/editorialboard.htm

PUBLICATION DATE
January 14, 2021

COPYRIGHT
© 2021 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS
https://www.wjgnet.com/bpg/gerinfo/204

GUIDELINES FOR ETHICS DOCUMENTS
https://www.wjgnet.com/bpg/GerInfo/287

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH
https://www.wjgnet.com/bpg/gerinfo/240

PUBLICATION ETHICS
https://www.wjgnet.com/bpg/GerInfo/288

PUBLICATION MISCONDUCT
https://www.wjgnet.com/bpg/gerinfo/208

ARTICLE PROCESSING CHARGE
https://www.wjgnet.com/bpg/gerinfo/242

STEPS FOR SUBMITTING MANUSCRIPTS
https://www.wjgnet.com/bpg/GerInfo/239

ONLINE SUBMISSION
https://www.f6publishing.com

© 2021 Baishideng Publishing Group Inc. All rights reserved. 7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
E-mail: bpgoffice@wjgnet.com https://www.wjgnet.com

World Journal of Gastroenterology

Submit a Manuscript: https://www.f6publishing.com

World J Gastroenterol 2021 January 14; 27(2): 143-151

DOI: 10.3748/wjg.v27.i2.143

ISSN 1007-9327 (print) ISSN 2219-2840 (online)

MINIREVIEWS

Hepatotropic viruses: Is Roma population at risk?

Anna Mrzljak, Lucija Bajkovec, Tatjana Vilibic-Cavlek

ORCID number: Anna Mrzljak 0000-0001-6270-2305; Lucija Bajkovec 0000-0002-6727-1353; Tatjana Vilibic-Cavlek 0000-0002-1877-5547.

Author contributions: Mrzljak A and Vilibic-Cavlek T made contributions to the concept, design and writing of the manuscript; Bajkovec L was involved in writing the manuscript and creating the image; all authors approved the final manuscript.

Conflict-of-interest statement: No potential conflicts of interest.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: http://creativecommons.org/Licenses/by-nc/4.0/

Manuscript source: Invited manuscript

Specialty type: Gastroenterology and hepatology

Country/Territory of origin: Croatia

Anna Mrzljak, Department of Gastroenterology, University Hospital Merkur, Zagreb 10000, Croatia

Anna Mrzljak, Tatjana Vilibic-Cavlek, School of Medicine, University of Zagreb, Zagreb 10000, Croatia

Lucija Bajkovec, Department of Medicine, County Hospital Cakovec, Cakovec 40000, Croatia

Tatjana Vilibic-Cavlek, Department of Virology, Croatian Institute of Public Health, Zagreb 10000, Croatia

Corresponding author: Anna Mrzljak, MD, PhD, Associate Professor, Department of Gastroenterology, University Hospital Merkur, Zajčeva 19, Zagreb 10000, Grad Zagreb, Croatia. anna.mrzljak@gmail.com

Abstract

Roma people make up a significant ethnic minority in many European countries, with the vast majority living in Central and Eastern Europe. Roma are a vulnerable population group in social, economic, and political terms. Frequent migrations, life in segregated communities, substandard housing, poverty, and limited access to quality health care, including low immunization coverage, affect their health status and predispose them to various diseases, including viral hepatitis. Hepatitis A, B, and E are highly prevalent among Roma and mainly associated with low socioeconomic status. In contrast, hepatitis C does not seem to be more frequent in the Roma population. Enhanced efforts should be directed towards the implementation of screening programs, preventive measures, and treatment of viral hepatitis in Roma communities throughout Europe.

Key Words: Roma population; Hepatitis A virus; Hepatitis B virus; Hepatitis C virus; Hepatitis E virus; Europe

©The Author(s) 2021. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: Roma people constitute the most important transnational minority in Europe. They are a vulnerable population group in social, economic, and political terms. Low socioeconomic conditions and lack of quality health care predispose them to viral hepatitis, especially hepatitis A, B, and E. In the global attempt to eliminate viral hepatitis, Roma should be considered a high priority group for screening and treatment

Peer-review report's scientific quality classification
Grade A (Excellent): A
Grade B (Very good): B
Grade C (Good): 0
Grade D (Fair): 0
Grade E (Poor): 0

Received: October 25, 2020
Peer-review started: October 25, 2020
First decision: November 13, 2020
Revised: November 13, 2020
Accepted: November 29, 2020
Article in press: November 29, 2020
Published online: January 14, 2021

P-Reviewer: Schiff ER
S-Editor: Fan JR
L-Editor: A
P-Editor: Liu JH

based on the epidemiological and social context.

Citation: Mrzljak A, Bajkovec L, Vilibic-Cavlek T. Hepatotropic viruses: Is Roma population at risk? *World J Gastroenterol* 2021; 27(2): 143-151
URL: https://www.wjgnet.com/1007-9327/full/v27/i2/143.htm
DOI: https://dx.doi.org/10.3748/wjg.v27.i2.143

INTRODUCTION

Roma people are a distinct ethnic minority dispersed worldwide, with an estimated population of around 12 million. In Europe, they are the largest minority group (5.2 million), with the vast majority living in Central and Eastern Europe (Figure 1)[1-3]. However, the exact number is uncertain due to their nomadic life and historical lack of birth and death records[4]. Roma are a vulnerable population group in social, economic, and political terms. This vulnerability is manifested in widespread poverty, unemployment, illiteracy, lack of formal education, segregation in the educational system, and substandard housing[5,6]. Roma people have worse health status, higher infant mortality rates, shorter (10-15 years) life expectancy, and a higher prevalence of chronic diseases than the non-Roma[2,7,8]. Unhealthy habits, smoking, and lack of physical activity are common in Roma population[9,10]. Moreover, Roma experience difficulties accessing healthcare due to fear, lack of trust, and previous bad experiences with health providers[11]. Poor socioeconomic factors predispose Roma to a number of various infectious diseases, including viral hepatitis[6,12,13]. Moreover, many Roma believe in folk medicine and prefer home-made remedies, resulting in low immunization coverage and outbreaks of infectious diseases[4].

In the attempt of global elimination of viral hepatitis[14], preventive measures, linkage to care, and treatment process may be challenging in vulnerable populations. In this opinion review, we aim to summarize available data and address practical issues related to viral hepatitis in the European Roma population.

HEPATITIS A

According to the European Centre for Disease Prevention and Control[15], there were 11296 hepatitis A cases in 2019 in the European Union. The incidence of hepatitis A globally decreases, but it is still high in developing countries and among minorities living in low socioeconomic conditions in developed countries[16]. In low-income countries, almost 100% of older children and adults are seropositive[17]. As hepatitis A virus (HAV) is transmitted by person-to-person contact or through contaminated water and food[16], access to clean water and hygiene facilities contributes to the reduction of HAV prevalence[18]. Socioeconomic factors are the most important predictors of HAV infection. Better living standards, including higher incomes and higher education degrees, as well as better housing conditions, significantly decrease the risk of HAV infection[17]. Hepatitis A can be prevented with a vaccine that provides long-term immunity[16].

Roma people are recognized as a high-risk group for HAV infection, in addition to migrants, travelers to endemic countries, and men who have sex with other men[19,20]. In Slovakia and Greece, the countries with a significant number of Roma residents, several hepatitis A outbreaks were reported over the last 15 years[16,19,21]. In the period between 2009 and 2018, 1193 cases of HAV infection were reported in Greece. Roma people accounted for approximately 20% of all infections, with 80.7% of cases affecting Roma children under 15 years old, whereas in the non-Roma population, the percentage of children was significantly lower (5.3%)[19]. Even though the HAV vaccine is mandatory for all children in Greece since 2008, the study from 2013 showed that only 22.6% of Roma children were vaccinated against HAV[22]. In the Roma population, both genders were equally affected, whereas in the non-Roma population, infection predominantly occurred in males. Almost half of HAV clusters (2009-2018) were reported in the Roma population, which accounts for the minority of the Greek population[19]. The study on the HAV outbreak in south-eastern Greece (2007) demonstrated that Roma are susceptible to HAV infection, which appears at an earlier

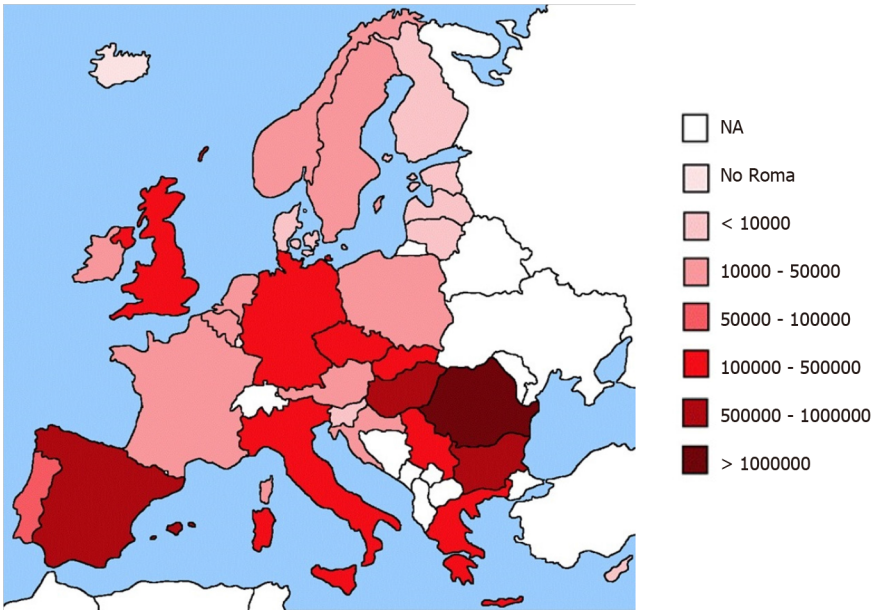

Figure 1 Distribution of Roma population in Europe according to the European Commission: Roma Health Report[1]. NA: No available data.

age than in non-Roma[16,20]. In Portugal, an outbreak of HAV was reported in 2005, which involved Roma children[23]. In 2008, there were 9 HAV outbreaks in Slovakia, and four of them took place in the districts predominantly inhabited by the Roma population. The biggest outbreak was registered in Lomnička village (298 cases), where 99% of the residents are Roma. Living conditions in the village, inadequate clean water supplies, and sewage systems predisposed the outbreak[21]. The only data on hepatitis A in Roma from the Czech Republic derives from the European Commission Roma Health Report (2014), stating two epidemics; one in 2009 and the other in 2010 when 30%-50% of Roma from all reported cases developed symptoms[1]. In the Czech Republic, the vaccination against HAV is easily accessible but not obligatory and not free. The HAV vaccination rates among Roma are estimated as low[1]. In the Plovdiv region in Bulgaria, 3911 cases of HAV were documented between 2005 and 2008, most of them associated with Roma. Notification rate in groups of respondents living in worse socioeconomic conditions, mostly Roma, was remarkably higher than in those living in good sanitary conditions[24]. In France, the hepatitis A outbreak involved a total of 492 cases over the 2008-2009 period, including eight clusters of cases among communities living in sites with poor sanitation[1]. A seroepidemiological study conducted in 1995 in San Sebastian, Spain, showed that 82.2% of Roma children were HAV seropositive compared to 9.3% of non-Roma children[25].

HAV infection in Roma differs from the non-Roma population in terms of the lower age of infection and equal distribution among genders[16,19]. The high prevalence is mainly due to poor socioeconomic factors, inadequate sanitary conditions, and sewage systems, contributing to easier transmission of the disease. Additionally, the vaccination coverage in Roma children is low[22,26,27]. In the attempt to lower the HAV incidence, better vaccination coverage and improvement of living conditions in Roma communities should be continuously and decisively implemented.

HEPATITIS B

Hepatitis B virus (HBV) infection has a chronic course and leads to fibrosis, cirrhosis, and hepatocellular carcinoma. The pattern of HBV transmission is vertical and horizontal by infected blood or sexual contact[28]. The HBV vaccine prevents HBV infection and has significantly decreased HBV-related mortality[29]. As HBV infection is associated with poor socioeconomic conditions[28,30], Roma living in communities with poor hygiene are predisposed to have a higher incidence of HBV infection[31,32].

Several studies addressed the prevalence of HBV in Slovakia, where the Roma minority is very numerous. It is estimated that approximately 400000 Roma people live in Slovakia, which accounts for 7.5% of the Slovak population[8]. Their socio-

economic (lower education, unemployment, social benefits) and living conditions (lack of standard household facilities such as sewage system, water supply, flush toilet, bathroom or shower, electricity) are significantly worse compared with the majority[14]. In 2008-2009, a study was conducted in 9 districts of Eastern Slovakia, comparing districts with higher (> 5%) and lower (< 5%) Roma population. There was no significant difference in the overall prevalence of HBsAg (1.95% *vs* 1.62%). However, pregnant women showed a higher prevalence of HBV infection in districts with a higher Roma population (2.72% *vs* 0.98%)[33]. In addition, a cross-sectional epidemiological study on hepatitis B was conducted in 2011 among randomly sampled Roma and non-Roma populations. Roma population had a significantly higher prevalence of HBsAg (12.4% *vs* 2.8%) and anti-HBc (52.8% *vs* 15.9%) than the non-Roma population. Furthermore, HBsAg positive Roma population was more commonly HBV DNA positive compared to HBsAg positive non-Roma population (94.3% *vs* 70.0%). Tattooing, economic factors (unemployment, elementary education, poverty), and male sex were found to be risk factors for HBV positivity[34]. Furthermore, targeted testing in primary care demonstrated a high prevalence of HBV infection within the Slovak-Roma population in Sheffield, United Kingdom. The HBsAg positivity was found to be 9.4%, while 28% had evidence of cleared past HBV infection (anti-HBc positive)[35].

One Greek study (2002) analyzed the prevalence and risk factors of hepatitis B in Roma and non-Roma children who lived in a deprived suburb of Athens. Among Roma children, 22.0% were identified with evidence of past HBV infection (anti-HBc positive), of whom 4.2% were chronic carriers (HBsAg positive), whereas no past infection was detected among the non-Roma. The evidence of HBV vaccination (anti-HBs positive) was detected in only 13.6% Roma, but in 95.9% non-Roma children. Among possible risk factors, unfavorable living conditions, frequent residency change, lack of child insurance and primary healthcare delivery were significantly associated with HBV seroprevalence among Roma[36]. Although overall vaccination coverage in Roma children is low[22], it varies in different European countries. For instance, in Slovakia, 59.2% of Roma children are vaccinated against HBV[23]. In the Doctors of the World report (2011) the HBV vaccination coverage in Roma children under two years of age was 43.5%[37]. On the other hand, in the Czech Republic, 95% of Roma children are vaccinated for obligatory diseases, including HBV[1].

Tattooing, blood transfusions, drug use, and imprisonment carry a high risk for HBV and are more common in Roma people[38]. However, it is considered that sexual intercourse is more significant for horizontal transmission of HBV among Roma, since a minority of them use preventive methods against sexually transmitted diseases[34,38]. Vaccination against HBV is less common in Roma; it is not completed because of lack of compliance[38]. Lastly, the efficacy of HBV treatment in Roma is concerning, mainly due to non-compliance and poor availability of healthcare[34].

HEPATITIS C

Hepatitis C virus (HCV) is a widespread cause of acute and chronic hepatitis and a significant risk factor for liver cirrhosis and hepatocellular carcinoma. Around 71 million people worldwide are suffering from chronic hepatitis C infection[39]. It is a blood-borne virus, most commonly transmitted by contaminated needles (intravenous drug users), through blood transfusions or sexual intercourse[40,41]. Vertical transmission is also possible[39].

Some of the risky behaviors appear to be common among Roma. For instance, studies reported an increase in Roma women participating in sex work and a higher prevalence of injection drug use among Roma[3,42,43].

In 2010, a seroprevalence study on HCV was conducted among Roma youth aged 15–24 years in two cities in Serbia-Belgrade (the nation's capital and largest city with 1.2% of residents estimated to be Roma) and Kragujevac (the fourth largest city in Serbia with up to 14% Roma by estimates). Although some of the risk factors were highly prevalent (intravenous drug use, 0.5%-3%; experience with sex workers, 5%-10%; tattooing in non-sterile conditions, 2%-14%; the use of a condom with a constant partner, 1%-25%), only four of 240 (1.7%) participants tested positive for HCV antibodies. Two reported intravenous drug use and three reported having a tattoo[44].

Similar results were found in Slovakia among 441 Roma with HCV seropositivity of 0.7% (1.5% in the general population). Predisposing factors for HCV were tattooing, blood transfusions, and having more sexual partners[32]. In a study conducted among students of two elementary schools in Greece (2002), none of the 118 Roma children

involved were positive for HCV antibodies[36]. According to these studies, HCV infection is not as frequent as other hepatitis viruses among Roma.

HEPATITIS E

Hepatitis E virus (HEV) is an emerging viral disease, with 20 million infection cases and 55000 deaths worldwide. Its prevalence is higher in developing countries; however, lately, it has been recognized as a significant cause of hepatitis in resource-rich countries[45]. HEV can be transmitted through contaminated water; however, food-borne, blood transfusion-related transmission by gained significant attention in recent decades[45,46].

The data about HEV among Roma in Europe are scarce and conducted only in Slovakia. The Roma population's HEV prevalence ranged from 21.5% to 45.5%, and the only significant risk factor appeared to be the consumption of raw meat[47,48].

CONCLUSION

In 2016, the World Health Organization adopted the first Global Health Sector Strategy on Viral Hepatitis, calling for its elimination as a public health threat. The strategy presented a target for 2030–of reducing new hepatitis B and C infections by 90% and mortality by 65%[14]. Roma constitute the most important transnational minority in Europe and a highly vulnerable population affected by viral hepatitis. Based on their epidemiological and social context, living conditions, lack of access to clean water, safe food, and medical services to maintain effective infection control measures, Roma should be considered a high priority group in managing viral hepatitis.

Screening is of particular importance as data on viral hepatitis prevalence in European Roma are scarce and limited to specific regions (Table 1). In Roma, hepatitis B prevalence is high, and mother-to-child transmission is likely a major mode of transmission and early childhood infection based on low vaccination. In addition, the fecal-oral and/or food-borne hepatitis (HAV and HEV) are more common in Roma than in the non-Roma population. In contrast, HCV infection does not seem to be more frequent in Roma.

The challenges in the Roma population are high. However, in the attempt to improve Roma's health and reduce health inequalities, viral hepatitis screening programs, facilitated linkage to care with access to affordable antivirals and vaccines should be continuously implemented through Roma communities. Effectively combating viral hepatitis may also reduce maternal and child mortality, as the mortality from non-communicable diseases. This strategy and its far-fetched implications may alleviate poverty and facilitate further development in terms of managing sanitation and water, reducing inequality in access to services, and promoting non-discrimination.

All European countries approved the WHO strategy, and now we have just one decade left to reach the goals and fulfill these promises.

Table 1 The epidemiology of hepatitis A, B, C and E among Roma population in Europe

Region	Year	Population, *N*	(Sero) Prevalence	Acute cases/outbreaks	Ref.
Northeastern Greece	2007	124 inhabitants of Xanthi, Rodopi and Evros, mostly Roma		54% males, 46% females, age 2–17 yr	Vantarakis *et al*[16], 2010
Greece	2004–2013	295 Roma/995 confirmed cases		Median age 5.9 yr; 2007 outbreak: 139 cases, 82% Roma	Mellou *et al*[20], 2015
Greece	2009-2018	240 Roma/1193 confirmed cases		51.2% males, 80.4% < 15 years old, median age 7 yr; 20 clusters recorded among Roma; 2013: Greatest outbreak, 112 cases among Roma	Mellou *et al*[19], 2020
Athens, Greece	1999-2013	467 children hospitalized with hepatitis A, age 0-14 yr		HAV hospitalization rates *per* 1000 admissions, among Roma: 233.1 (1999-2008), 54.3 (2009-2013)	Papaevangelou *et al*[27], 2016
Western Athens, Greece	2002	216 children from two elementary schools, 118 Roma	Anti-HAV IgG: Roma children 98%, non-Roma children 33%		Michos *et al*[36], 2008
Slovakia	2008	667 cases reported to Epidemiological Information System database		536 cases in "low hygienic standards" areas; considered Roma; 4/9 outbreaks in areas with mostly Roma population; Lomnička outbreak (99% Roma population): 298 cases, 297 < 18 years old	Hrivniaková *et al*[21], 2009
South Bulgaria	2005-2008	3911 patients with hepatitis A treated in Clinics of Infectious Diseases, Plovdiv		Incidence rate in group living in poor hygienic conditions (mostly Roma): 450.66/100000; Outbreak in Stolipinovo quarter (2006); 1004 cases, mostly Roma	Stoycheva *et al*[24], 2011
San Sebastian, Spain	1995	73 Roma, age 2-16 yr	Total anti-HAV 82.2 %, total anti-HAV 50% in children 2-5 yr, total anti-HAV 92.7% in children > 5 yr		Cilla *et al*[25], 1995
Eastern Slovakia (9 regions)	2008-2009	59279 serum samples (13798were part of the pregnancy screening)	HBsAg overall 2.18%-9.07%; pregnant women 0.82%-4.13%		Kristian *et al*[33], 2013
Eastern Slovakia	2011	452 Roma, adult population	HBsAg 12.4%; anti-HBc 52.8%; HBV DNA 94.3%		Drazilova *et al*[34], 2018
Sheffield, United Kingdom	2007-2013	436 Slovak-Roma adult population	HBsAg 9.4%; anti-HBc 28%		Gregory *et al*[35], 2014
Western Athens, Greece	2002	118 Roma children	HBsAg 4.2%; anti-HBs 13.6%; anti-HBc 22.0%		Michos *et al*[36], 2008
Serbia (Belgrade and Kragujevac)	2010	240 Roma, age 20-24 yr	Anti-HCV 1.7%		Djonic *et al*[44], 2013
Eastern Slovakia, Košice region	2011	441 Roma, age 18-55 yr	Anti-HCV 0.7%		Veselíny *et al*[32], 2014
Western Athens, Greece	2002	216 children from two elementary schools, age 5-15 yr, 118 Roma	Anti-HCV 0%		Michos *et al*[36], 2008
Eastern Slovakia	2011	195 Roma living in Roma settlements, age 18-55 yr	Total anti-HEV 21.5%, highest in Roma men–29.4%		Halánová *et al*[47], 2018
Košice, eastern	2018	175 patients hospitalized in Department of	Total anti-HEV 45.5%		Paraličová *et al*[48],

Slovakia	Infectology and Travel Medicine, age 19-94 yr, 11 Roma	2020

HAV: Hepatitis A virus; HBV: Hepatitis B virus; HCV: Hepatitis C virus; HEV: Hepatitis E virus.

REFERENCES

1 European Commission: Roma Health Report [Internet]. 2014 [cited 2020 Oct. 25]. Available from: https://ec.europa.eu/health/sites/health/files/social_determinants/docs/2014_roma_health_report_en.pdf

2 **Sepkowitz KA**. Health of the world's Roma population. *Lancet* 2006; **367**: 1707-1708 [PMID: 16731250 DOI: 10.1016/S0140-6736(06)68746-1]

3 **Hajioff S**, McKee M. The health of the Roma people: a review of the published literature. *J Epidemiol Community Health* 2000; **54**: 864-869 [PMID: 11027202 DOI: 10.1136/jech.54.11.864]

4 **Vivian C**, Dundes L. The crossroads of culture and health among the Roma (Gypsies). *J Nurs Scholarsh* 2004; **36**: 86-91 [PMID: 15098424 DOI: 10.1111/j.1547-5069.2004.04018.x]

5 **European Union Agency for Fundamental Rights**. Roma and travellers in six countries [Internet]. 2020 [cited 2020 Oct. 25]. Available from: https://fra.europa.eu/sites/default/files/fra_uploads/fra-2020-roma-travellers-six-countries_en.pdf

6 **Jarcuska P**, Bobakova D, Uhrin J, Bobak L, Babinska I, Kolarcik P, Veselska Z, Madarasova Geckova A; HEPA-META team. Are barriers in accessing health services in the Roma population associated with worse health status among Roma? *Int J Public Health* 2013; **58**: 427-434 [PMID: 23546390 DOI: 10.1007/s00038-013-0451-8]

7 **Rosicova K**, Madarasova Geckova A, van Dijk JP, Kollarova J, Rosic M, Groothoff JW. Regional socioeconomic indicators and ethnicity as predictors of regional infant mortality rate in Slovakia. *Int J Public Health* 2011; **56**: 523-531 [PMID: 20976517 DOI: 10.1007/s00038-010-0199-3]

8 **Sedláková D**. Low socioeconomic status and unhealthy lifestyle lead to high morbidity in young Roma of East Slovakia. *Cent Eur J Public Health* 2014; **22** Suppl: S3-S5 [PMID: 24847606 DOI: 10.21101/cejph.a4008]

9 **Babinská I**, Gecková AM, Jarcuska P, Pella D, Mareková M, Stefková G, Veselská ZD; HepaMeta Team. Does the population living in Roma settlements differ in physical activity, smoking and alcohol consumption from the majority population in Slovakia? *Cent Eur J Public Health* 2014; **22** Suppl: S22-S27 [PMID: 24847610 DOI: 10.21101/cejph.a3897]

10 **Petek D**, Rotar Pavlic D, Svab I, Lolić D. Attitudes of Roma toward smoking: qualitative study in Slovenia. *Croat Med J* 2006; **47**: 344-347 [PMID: 16625703]

11 **Shaaf M**. Roma Health Mediators: Successes and Challenges [Internet]. 2011 [cited 2020 Oct. 25]. Available from: https://www.opensocietyfoundations.org/publications/roma-health-mediators-successes-and-challenges#publications_download

12 **Janicko M**, Senajová G, Drazilová S, Veselíny E, Fedacko J, Siegfried L, Kristian P, Virág L, Pella D, Mareková M, Gecková AM, Kalanin P, Jarcuska P, Halánová M; HepaMeta Team. Association between metabolic syndrome and hepatitis B virus infection in the Roma population in eastern Slovakia: a population-based study. *Cent Eur J Public Health* 2014; **22** Suppl: S37-S42 [PMID: 24847613 DOI: 10.21101/cejph.a3900]

13 **Gecková AM**, Babinská I, Bobáková D, Veselská ZD, Bosáková L, Kolarcik P, Jarcuska P, Pella D,

Halánová M; HepaMeta Team. Socioeconomic characteristics of the population living in Roma settlements and their association with health and health-related behaviour. *Cent Eur J Public Health* 2014; **22** Suppl: S57-S64 [PMID: 24847616 DOI: 10.21101/cejph.a3903]

14 **World Health Organization**. Global health sector strategy on viral hepatitis, 2016–2021 [Internet]. 2016 [cited 2020 Oct. 25]. Available from: https://apps.who.int/iris/bitstream/handle/10665/246177/WHO-HIV-2016.06-eng.pdf?sequence=1

15 **European Centre for Disease Prevention and Control**. Surveillance Atlas of Infectious Diseases [Internet]. 2020 [cited 2020 Oct. 6]. Available from: https://atlas.ecdc.europa.eu/public/index.aspx

16 **Vantarakis A**, Nearxou A, Pagonidis D, Melegos F, Seretidis J, Kokkinos P, Zarkadis I, Parasidis T, Alamanos Y. An outbreak of hepatitis A in Roma populations living in three prefectures in Greece. *Epidemiol Infect* 2010; **138**: 1025-1031 [PMID: 19941688 DOI: 10.1017/S0950268809991257]

17 **Jacobsen KH**, Wiersma ST. Hepatitis A virus seroprevalence by age and world region, 1990 and 2005. *Vaccine* 2010; **28**: 6653-6657 [PMID: 20723630 DOI: 10.1016/j.vaccine.2010.08.037]

18 **Jacobsen KH**. Globalization and the Changing Epidemiology of Hepatitis A Virus. *Cold Spring Harb Perspect Med* 2018; **8**: a031716 [PMID: 29500305 DOI: 10.1101/cshperspect.a031716]

19 **Mellou K**, Chrysostomou A, Sideroglou T, Kyritsi M, Georgakopoulou T, Tsiodras S, Hadjichristodoulou C. Epidemiology of hepatitis A in Greece in the last decade: management of reported cases and outbreaks and lessons learned. *Epidemiol Infect* 2020; **148**: e58 [PMID: 32052723 DOI: 10.1017/S0950268820000382]

20 **Mellou K**, Sideroglou T, Papaevangelou V, Katsiaflaka A, Bitsolas N, Verykouki E, Triantafillou E, Baka A, Georgakopoulou T, Hadjichristodoulou C. Considerations on the current universal vaccination policy against hepatitis A in Greece after recent outbreaks. *PLoS One* 2015; **10**: e0116939 [PMID: 25590132 DOI: 10.1371/journal.pone.0116939]

21 **Hrivniaková L**, Sláciková M, Kolcunová S. Hepatitis A outbreak in a Roma village in eastern Slovakia, August-November 2008. *Euro Surveill* 2009; **14**: 19093 [PMID: 19161727]

22 **Papamichail D**, Petraki I, Arkoudis C, Terzidis A, Smyrnakis E, Benos A, Panagiotopoulos T. Low vaccination coverage of Greek Roma children amid economic crisis: national survey using stratified cluster sampling. *Eur J Public Health* 2017; **27**: 318-324 [PMID: 27694159 DOI: 10.1093/eurpub/ckw179]

23 **Rodrigues L**, Pista A, Oliveira A, Agua-Doce I, Manita C, Paixão MT. Molecular epidemiology of hepatitis A virus in a group of Portuguese citizens living in Lisbon area. *J Med Virol* 2007; **79**: 483-487 [PMID: 17387747 DOI: 10.1002/jmv.20851]

24 **Stoycheva M**, Vatev N, Petrov A, Venchev C, Atanasova M. Epidemiological Study of Hepatitis A in Plovdiv Region – Bulgaria, 2005-2008. *World J Vaccines* 2011; **1**: 162-168 [DOI: 10.4236/wjv.2011.14017]

25 **Cilla G**, Perez-Trallero E, Marimon JM, Erdozain S, Gutierrez C. Prevalence of hepatitis A antibody among disadvantaged gypsy children in northern Spain. *Epidemiol Infect* 1995; **115**: 157-161 [PMID: 7641829 DOI: 10.1017/s0950268800058210]

26 **Stojanovski K**, McWeeney G, Emiroglu N, Ostlin P, Koller T, Licari L, Kaluski DN. Risk factors for low vaccination coverage among Roma children in disadvantaged settlements in Belgrade, Serbia. *Vaccine* 2012; **30**: 5459-5463 [PMID: 22776215 DOI: 10.1016/j.vaccine.2012.06.072]

27 **Papaevangelou V**, Alexopoulou Z, Hadjichristodoulou C, Kourlamba G, Katsioulis A, Theodoridou K, Spoulou V, Theodoridou M. Time trends in pediatric hospitalizations for hepatitis A in Greece (1999-2013): Assessment of the impact of universal infant immunization in 2008. *Hum Vaccin Immunother* 2016; **12**: 1852-1856 [PMID: 27141813 DOI: 10.1080/21645515.2016.1151589]

28 **Polaris Observatory Collaborators**. Global prevalence, treatment, and prevention of hepatitis B virus infection in 2016: a modelling study. *Lancet Gastroenterol Hepatol* 2018; **3**: 383-403 [PMID: 29599078 DOI: 10.1016/S2468-1253(18)30056-6]

29 **Zanetti AR**, Van Damme P, Shouval D. The global impact of vaccination against hepatitis B: a historical overview. *Vaccine* 2008; **26**: 6266-6273 [PMID: 18848855 DOI: 10.1016/j.vaccine.2008.09.056]

30 **Nardone A**, Anastassopoulou CG, Theeten H, Kriz B, Davidkin I, Thierfelder W, O'Flanagan D, Bruzzone B, Mossong J, Boot HJ, Butur D, Slaciková M, Panait ML, Hellenbrand W, DE Melker H, Sobotová Z, Icardi G, Andrews N, Pebody RG, VAN Damme P, Kafatos G, Miller E, Hatzakis A. A comparison of hepatitis B seroepidemiology in ten European countries. *Epidemiol Infect* 2009; **137**: 961-969 [PMID: 19102797 DOI: 10.1017/S0950268808001672]

31 **Babinska I**, Veselska ZD, Bobakova D, Pella D, Panico S, Reijneveld SA, Jarcuska P, Jarcuska P, Zezula I, Geckova AM; HEPA-META team. Is the cardiovascular risk profile of people living in Roma settlements worse in comparison with the majority population in Slovakia? *Int J Public Health* 2013; **58**: 417-425 [PMID: 23564005 DOI: 10.1007/s00038-013-0463-4]

32 **Veselíny E**, Janicko M, Drazilová S, Siegfried L, Pastvová L, Schréter I, Kristian P, Viág L, Jarcuska P, Valková I, Cáriková K, Senajová G, Fedacko J, Pella D, Mareková M, Gecková AM, Jarcuska P; HepaMeta Team. High hepatitis B and low hepatitis C prevalence in Roma population in eastern Slovakia. *Cent Eur J Public Health* 2014; **22** Suppl: S51-S56 [PMID: 24847615 DOI: 10.21101/cejph.a3902]

33 **Kristian P**, Veselská ZD, Paralicová Z, Jarcuska P, Virág L, Valková I, Schréter I. Regional and ethnic aspects of viral hepatitis B among pregnant women. *Cent Eur J Public Health* 2013; **21**: 22-25 [PMID: 23741894]

34 **Drazilova S**, Janicko M, Kristian P, Schreter I, Halanova M, Urbancikova I, Madarasova-Geckova A,

Marekova M, Pella D, Jarcuska P; HepaMeta Team. Prevalence and Risk Factors for Hepatitis B Virus Infection in Roma and Non-Roma People in Slovakia. *Int J Environ Res Public Health* 2018; **15**: 1047 [PMID: 29789486 DOI: 10.3390/ijerph15051047]

35 **Gregory A**, Vedio A, Stone B, Green S, Bronsdon C. Targeted testing in primary care demonstrates high prevalence of hepatitis B infection within the Slovak-Roma population in Sheffield, UK. *J Viral Hepat* 2014; **21**: e138-e139 [PMID: 25056611 DOI: 10.1111/jvh.12287]

36 **Michos A**, Terzidis A, Kalampoki V, Pantelakis K, Spanos T, Petridou ET. Seroprevalence and risk factors for hepatitis A, B, and C among Roma and non-Roma children in a deprived area of Athens, Greece. *J Med Virol* 2008; **80**: 791-797 [PMID: 18360892 DOI: 10.1002/jmv.21134]

37 **Medicines du Monde**. Rapport d'enquête sur la couverture vaccinale des populations rroms rencontrées par les équipes de Médecins du Monde en France [Internet]. 2011 [cited 2020 Oct. 25]. Available from: https://fnasat.centredoc.fr/doc_num.php?explnum_id=208

38 **Drazilova S**, Kristian P, Janicko M, Halanova M, Safcak D, Dorcakova PD, Marekova M, Pella D, Madarasova-Geckova A, Jarcuska P, HepaMeta Team. What is the Role of the Horizontal Transmission of Hepatitis B Virus Infection in Young Adult and Middle-Aged Roma Population Living in the Settlements in East Slovakia? *Int J Environ Res Public Health* 2020; **17**: 3293 [PMID: 32397342 DOI: 10.3390/ijerph17093293]

39 **World Health Organization**. Hepatitis C [Internet]. 2020 [cited 2020 Oct. 12]. Available from: https://www.who.int/news-room/fact-sheets/detail/hepatitis-c

40 **Cavlek TV**, Margan IG, Lepej SZ, Kolaric B, Vince A. Seroprevalence, risk factors, and hepatitis C virus genotypes in groups with high-risk sexual behavior in Croatia. *J Med Virol* 2009; **81**: 1348-1353 [PMID: 19551819 DOI: 10.1002/jmv.21530]

41 **Vilibic-Cavlek T**, Kucinar J, Kaic B, Vilibic M, Pandak N, Barbic L, Stevanovic V, Vranes J. Epidemiology of hepatitis C in Croatia in the European context. *World J Gastroenterol* 2015; **21**: 9476-9493 [PMID: 26327756 DOI: 10.3748/wjg.v21.i32.9476]

42 **Iraurgi I**, Jiménez-Lerma JM, Landabaso MA, Arrazola X, Gutiérrez-Fraile M. Gypsies and drug addictions. Study of the adherence to treatment. *Eur Addict Res* 2000; **6**: 34-41 [PMID: 10729741 DOI: 10.1159/000019007]

43 **Casals M**, Pila P, Langohr K, Millet JP, Caylà JA; Roma Population Working Group. Incidence of infectious diseases and survival among the Roma population: a longitudinal cohort study. *Eur J Public Health* 2012; **22**: 262-266 [PMID: 21217119 DOI: 10.1093/eurpub/ckq204]

44 **Djonic D**, Djuric M, Bassioni-Stamenic F, McFarland W, Knezevic T, Nikolic S, Zivkovic V, Vallabhaneni S. HIV-related risk behaviors among Roma youth in Serbia: results of two community-based surveys. *J Adolesc Health* 2013; **52**: 234-240 [PMID: 23332490 DOI: 10.1016/j.jadohealth.2012.05.012]

45 **European Association for the Study of the Liver**. EASL Clinical Practice Guidelines on hepatitis E virus infection. *J Hepatol* 2018; **68**: 1256-1271 [PMID: 29609832 DOI: 10.1016/j.jhep.2018.03.005]

46 **Mrzljak A**, Dinjar-Kujundzic P, Jemersic L, Prpic J, Barbic L, Savic V, Stevanovic V, Vilibic-Cavlek T. Epidemiology of hepatitis E in South-East Europe in the "One Health" concept. *World J Gastroenterol* 2019; **25**: 3168-3182 [PMID: 31333309 DOI: 10.3748/wjg.v25.i25.3168]

47 **Halánová M**, Veseliny E, Kalinová Z, Jarčuška P, Janičko M, Urbančíková I, Pella D, Dražilová S, Babinská I; HepaMeta Team. Seroprevalence of Hepatitis E Virus in Roma Settlements: A Comparison with the General Population in Slovakia. *Int J Environ Res Public Health* 2018; **15**: 904 [PMID: 29751522 DOI: 10.3390/ijerph15050904]

48 **Paraličová Z**, Halánová M, Schréter I, Kalinová Z, Novotný M, Sekula J, Paralič J, Kristian P. Seroprevalence of hepatitis E among hospitalized patients in Slovakia: first report. *Cent Eur J Public Health* 2020; **28**: 70-73 [PMID: 32228821 DOI: 10.21101/cejph.a5346]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com

© 2021 Baishideng Publishing Group Inc. All rights reserved.