

AN INCREASING SCABIES INCIDENCE IN CROATIA: A CALL FOR COORDINATED ACTION AMONG DERMATOLOGISTS, PHYSICIANS AND EPIDEMIOLOGISTS

VEČANJE POJAVNOSTI SKABIESA NA HRVAŠKEM: POZIV K USKLAJENEMU UKREPANJU DERMATOLOGOV, SPLOŠNIH ZDRAVNIKOV IN EPIDEMIOLOGOV

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ABSTRACT

Introduction: The aim of our study was to examine the scabies incidence in the Croatian population and to analyse potential related factors.

Keywords:

scabies, epidemiology, outbreaks, Croatia, neglected tropical diseases

Methods: This mixed ecological study is based on a retrospective medical record review. National data from communicable disease reports was sourced and analysed for an 11-year period (2007-2017), with more focus on the period 2014-2017. Descriptive statistics were used to calculate trends. Differences between the groups were studied using Chi-square test and Kendall's tau (τ) correlation coefficient. Levels of significance were set at $p < 0.05$ or $p < 0.01$.

Results: From 2007 to 2017, scabies infestation in Croatia increased by 6-fold, particularly affecting children and young adults (19 years or younger). In the period 2014-2017, border counties which are part of migration flows were the counties with the highest average scabies incidences. A linear trend of increase in the number of tourists, immigrants and scabies infestations was noted on the national level for the analysed period, although a significant association was not observed. Regarding outbreaks of scabies within institutions, more than 80% of outbreaks occurred in institutions for adults. In the capital, Zagreb, the crude incidence rate increased 3-fold between 2014 and 2017.

Conclusions: The increased incidence of scabies, large disparities between counties, and prolonged outbreaks within families due to under-recognition and misdiagnoses points to a need for increased awareness among health practitioners. To the best of our knowledge, this is the first recent epidemiologic analysis on this topic, not only in Croatia but within the wider geographic region as well.

IZVLEČEK

Uvod: Cilj naše študije je bil preučiti pojavnost skabiesa pri hrvaški populaciji in analizirati morebitne povezane dejavnike.

Ključne besede:

skabies, epidemiologija, izbruhi, Hrvaška, zanemarjene tropske bolezni

Metode: Ta mešana ekološka študija je temeljila na retrospektivnem pregledu zdravstvenih kartotek. Pridobili in analizirali smo nacionalne podatke iz poročil o nalezljivih boleznih za 11-letno obdobje (2007-2017), pri čemer smo se bolj osredotočili na obdobje 2014-2017. Za izračun trendov smo uporabili opisno statistiko. Razlike med skupinami smo preučili s testom hi-kvadrat in Kendallovim korelacijskim koeficientom tau (τ). Stopnja pomembnosti je bila nastavljena na $p < 0,05$ ali $p < 0,01$.

Rezultati: Od leta 2007 do 2017 se je pojavnost okužb s skabiesom na Hrvaškem povečala za šestkrat, pri čemer je bolezen prizadela zlasti otroke in mlajše odrasle (stare 19 let ali manj). V obdobju 2014-2017 so bila obmejna okrožja, ki so del migracijskih tokov, tista z najvišjo povprečno pojavnostjo skabiesa. V analiziranem obdobju je bil na nacionalni ravni opažen linearen trend povečevanja števila turistov, imigrantov in okužb s skabiesom, čeprav ni bilo opaziti pomembne povezanosti. Kar zadeva izbruhe skabiesa v zavodih, se jih je več kot 80 % zgodilo v zavodih za odrasle. V prestolnici Zagrebu se je groba incidenčna stopnja med letoma 2014 in 2017 povečala za trikrat.

Sklepi: Povečana incidenca skabiesa, velika neskladja med okrožji in dolgotrajni izbruhi v družinah zaradi premajhnega prepoznavanja in napačnih diagnoz kažejo na potrebo po večji ozaveščenosti zdravstvenih delavcev. Po naših podatkih je to prva epidemiološka analiza, ki je bila pred kratkim opravljena na to temo, ne samo na Hrvaškem, temveč tudi na širšem geografskem območju.

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1 INTRODUCTION

Scabies is a skin infestation caused by the mite *Sarcoptes scabiei* var. *hominis*. This disease most commonly presents as classic scabies with the intense, pruritic eruption at certain characteristic localizations such as the sides and webs of the fingers, wrists, axillae, areolae, and genitalia (1). The transmission of scabies usually happens through direct and prolonged skin-to-skin contact of at least ten minutes, thus scabies commonly occurs within the family and among people who live together or who are sexual partners. On the other hand, transmission via casual skin contact and fomites (clothing, bedclothes, or other objects) is rare (2-4). It is very difficult to contract scabies from brief, casual touching, like handshakes or hugs. A diagnosis is based on a patient's clinical picture and is confirmed by microscopic detection of the scabies mites, eggs, or faeces (5).

Epidemiological data shows that, as of 2015, scabies affects about 204 million people worldwide (2.8% of the population) (6). According to results from the Global Burden of Disease Study 2015, there was a 6.6% increase in the global incidence of scabies over the preceding 11-year period (2005 - 2015) (6). Recently published data confirm that scabies has a seasonal pattern, and most patients are infested in the winter and autumn (7).

Scabies infestation is more common in tropical regions (East Asia, Southeast Asia, Oceania, tropical Latin America, and South Asia), with prevalence estimates ranging from 0.2 to 71%, with the highest rates in the Pacific region and Latin America (8). Moreover, since European epidemiological studies are rare (8) and scabies is not a notifiable disease in many countries (2), it still represents a global and significant problem. Scabies is equally common in both sexes and among people of different ages, and is one of the three most common skin disorders in children (9, 10). However, lately there is growing data in the literature on the correlation between scabies incidence and population movements, particularly for refugees and asylum seekers coming to Western Europe, since they generally come from countries with a high prevalence of scabies (11, 12).

The direct effect of scabies on infected persons and its secondary effects on children, families, and communities worldwide is a strong impetus for advancing the agenda for global scabies control (13). Due to the important effects of this disease on global health, the World Health Organization's Department of Control of Skin Neglected Tropical Diseases (NTDs) has begun promoting the idea of a strategy for integrated scabies control and management (14).

In recent years there has been greater public discussion concerning the increased frequency of scabies in Croatia (15). Physicians and dermatovenerologists have seen this

increase reflected in their practices, although to date there have been no wider epidemiologic analyses on this topic.

The objective of this study was thus to examine the time trends in incidence rates of scabies in Croatia and its capital, as well as its geographical patterns, in order to provide researchers and policymakers in Croatia and the broader region with relevant epidemiological data in order to develop effective disease control strategies and reduce current socioeconomic inequalities in treatment of scabies.

2 METHODS

2.1 Study Design

This is mixed ecological study that makes us of exploratory studies of both spatial and temporal patterns.

2.2 Units of Observation

There are two types of units of observation included in this study. In an exploratory study of temporal patterns in Croatia a single year is the unit of observation, while in the exploratory study of temporal patterns of scabies occurrence in Zagreb in the present study the unit of observation is a month. In our exploratory study of spatial patterns, the unit of observation is a county and there are 21 units included in the research.

2.3 Sources of Data

We analysed data from communicable disease notifications for scabies cases in Croatia for the period between 2007 and 2017, with more detailed analysis by the counties, age, facility and month in the period from 2014 to 2017. No identifiable personal were used for this study, and the dataset used is not openly available.

Reporting communicable diseases is mandatory in Croatia and regulated by the Health Care Act, the Act on the Protection of the Population against Communicable Diseases, the list of communicable diseases the control and prevention of which is of interest to Croatia and the ordinance on the method of reporting communicable diseases (16-18). Licensed health care professionals and health care institutions are required to report selected communicable diseases through the standardized questionnaire to the epidemiology service (part of the Croatian network of public health institutes), which is finally received and stored at the Croatian Institute of Public Health. The routinely collected health data used in this study were sourced from the state-owned Croatian Institute of Public Health database. This nationally representative database is available only on request. Therefore, in order to address our research objectives, our multidisciplinary team (consisting of epidemiologists,

public health specialists and dermatovenereologists) utilized different mechanisms for sourcing and analysis of the data.

2.4 Methods of Data Analysis

A scabies case is defined as an individual whose skin scrapings reveal mites, mite eggs or mite faeces, or as an individual with typical clinical signs epidemiologically linked to laboratory-confirmed cases. The average annual incidence rate per 100,000 inhabitants in Croatia was calculated by county using data from The Census of Population, Households and Dwellings 2011 from the Croatian Bureau of Statistics (19). Age specific annual incidences, along with seasonal trends, were both calculated on the national level. We also analysed outbreak reports by number of recognized and reported outbreaks, duration and facilities involved. In addition, we analysed percentile changes in relative (per capita) number of tourists, immigrants and patients with scabies by counties. The change over time is represented by standardized regression coefficient (beta) - ranging from -1 (complete negative linear association) over 0 (no association) to 1 (complete positive linear association).

For the analyses, we used SPSS FOR WINDOWS ver. 20.0 (SPSS, Chicago, IL, USA). Descriptive statistics were used to process data, calculate trends and create tables and graphs. Differences between the counties in the number of patients with scabies, relative to county size (The Census of Population, Households and Dwellings 2011 from the Croatian Bureau of Statistics) (19) were studied using Chi-square test, while Kendall's tau (τ) correlation coefficient was used to calculate the correlations between the time changes in relative number of tourists, immigrants and patients with scabies by Croatian counties. Kendall's tau was used due to small sample size ($n=21$) and non-normality of the parameter distributions.

Levels of significance were set to $p<0.05$ or $p<0.01$.

3 RESULTS

3.1 Temporal Pattern of Scabies Incidence in Croatia, 2007-2017

Our results show an increasing trend in scabies incidence across Croatia between 2007 and 2017. The incidence rate increased 6-fold during that 11-year period, with the steepest increase in the last four years (2014-2017) (Figure 1).

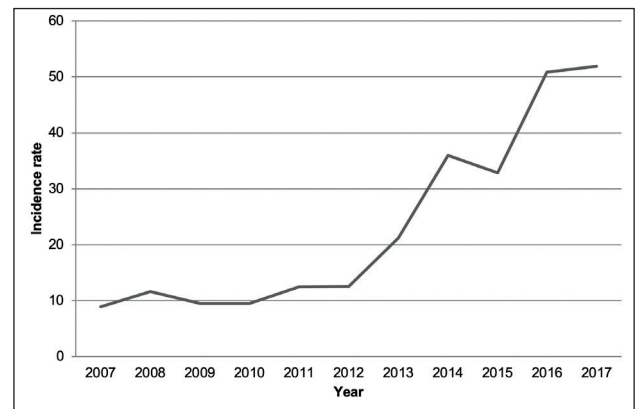


Figure 1. The scabies incidence rates in Croatia in the period 2007-2017.

Within the 2014-2017 period, the highest average incidences in Croatia were recorded among children younger than 4 years old, preschool and elementary school children aged 5-9 years and adolescents of ages 15-19 (Table 1). From 2014 to 2017, we observed a total of 106 outbreaks of scabies within families and within adult foster care homes, nursing homes and other facilities throughout Croatia. Health care professionals and assistants were among those infected.

3.2 Temporal Pattern of Scabies Incidence in Zagreb, 2014-2017

In the City of Zagreb, the crude incidence rate increased 3-fold between 2014 and 2017 (Figure 2, Table 2), compared with the same period in Croatia. The majority of cases were recorded during winter and autumn.

Table 1. The scabies incidence rates by age group in Croatia in the period 2014-2017.

Year	Age								
	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	>60
2014	79.92	75.37	64.57	61.43	31.96	18.99	26.24	23.72	31.41
2015	81.33	81.74	50.98	57.74	32.68	21.40	20.02	20.40	24.82
2016	94.97	95.44	79.01	97.88	49.75	38.14	36.50	37.32	38.78
2017	110.01	98.87	87.93	124.50	60.47	33.83	29.27	34.32	34.61
Average	91.56	87.85	70.62	85.39	43.72	28.09	28.01	28.94	32.41

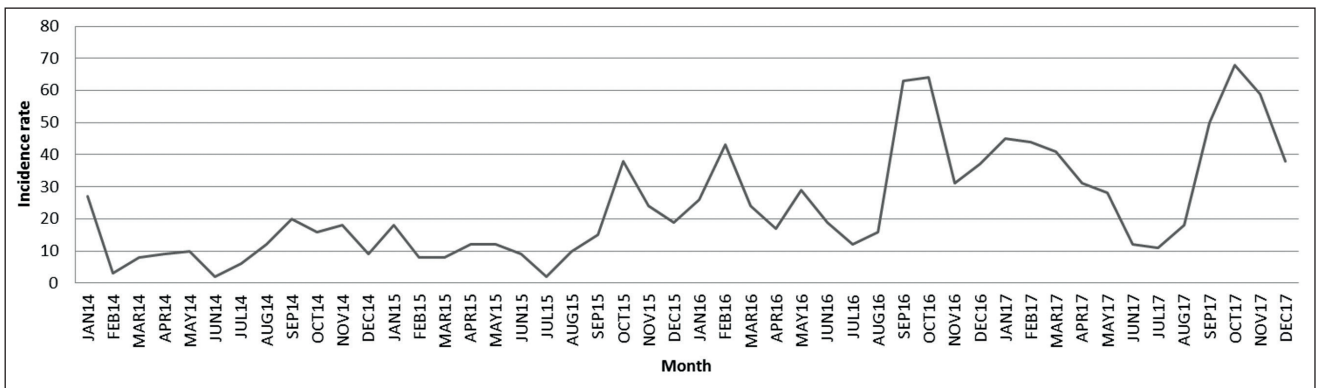


Figure 2. The scabies incidence rates by month in the City of Zagreb, Croatia in the period 2014-2017.

3.3 Spatial Pattern of Scabies Incidence by County and its Relationship to Migration and Tourism

Between 2014-2017, large discrepancies were observed at the county level, with some counties continuously having notably higher incidence rates (Sisak-Moslavina, Vukovar-Srijem, Osijek-Baranja and Međimurje County) or lower rates (Varaždin and Bjelovar-Bilogora County)

than the national rate during the same period. In 2017, 2,224 cases were reported in Croatia, corresponding to a crude incidence rate of 51.90/100,000. Notably, four counties (Sisak-Moslavina, Vukovar-Srijem, Osijek-Baranja and Međimurje County) had almost twice the national incidence rate for 2017 (Table 2, Figure 3).

Table 2. The scabies incidence rates by county in Croatia in the period 2014-2017.

	Year			
	2014	2014	2014	2014
Sisak-Moslavina County	43.49	29.58	118.88	109.60
Vukovar-Srijem County	81.88	93.03	118.09	98.59
Osijek-Baranja County	46.55	55.08	96.71	95.73
Brod-Posavina County	45.40	75.04	94.59	20.81
Međimurje County	60.63	97.54	62.39	80.84
Virovitica-Podravina County	30.65	60.12	128.48	56.58
City of Zagreb	17.34	22.53	48.23	53.54
Lika-Senj County	41.24	39.27	35.34	49.09
Zadar County	18.23	26.47	17.06	52.94
Koprivnica-Križevci County	44.12	41.53	18.17	46.72
Karlovac County	83.79	20.17	29.48	42.67
Požega-Slavonia County	39.73	7.69	38.44	35.88
Dubrovnik-Neretva County	48.14	39.16	51.40	39.16
Zagreb County	18.61	20.82	30.28	38.48
Istria County	20.67	13.46	22.59	36.53
Krapina-Zagorje County	21.07	27.84	71.49	34.61
Šibenik-Knin County	28.34	12.80	22.86	32.00
Split-Dalmatia County	45.29	32.98	39.14	33.42
Primorje-Gorski Kotar County	48.95	19.24	22.96	21.95
Varaždin County	22.73	6.82	7.39	15.35
Bjelovar-Bilogora County	17.53	5.84	21.71	27.55
Croatia	36.00	32.90	50.60	51.90

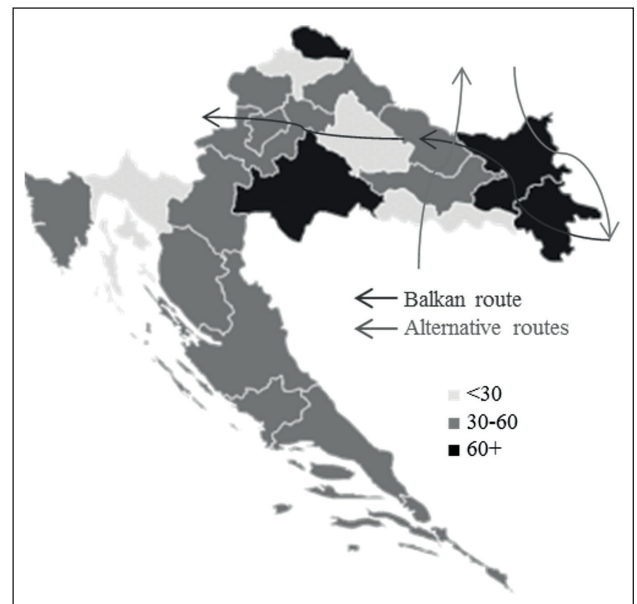


Figure 3. Scabies incidence by county and migration flows, Croatia, 2017. Migration flows data available from Arsenijević et al. 2017 (20) and Arsenijević et al. 2018 (21).

On average, around 40% of outbreaks in the observed period (2014-2017) lasted for several months due to late recognition and diagnosis, particularly among families. Regarding outbreaks of scabies within institutions, more than 80% were in institutions for adults and nearly half of them were recognized and resolved within one month. In Zagreb during the same period we detected 13 outbreaks, two-quarters within families. During autumn 2016, the first outbreak of scabies in an asylum centre (as part of the migrant crisis) was epidemiologically investigated and resolved within three months.

In each of the observed years (2014-2017) there was a large difference in scabies incidence among counties. According to this statistical analysis of available data, the scabies incidence was not evenly distributed among counties, and this irregular distribution was statistically significant. Thus, some counties significantly deviated from the expected epidemiological data. In the 2014 $\chi^2=416.95$, $df=20$, $p<0.01$; in 2015 $\chi^2=679.44$, $df=20$, $p<0.01$, in 2016 $\chi^2=919.71$, $df=20$, $p<0.01$, and in 2017 $\chi^2=556.14$, $df=20$, $p<0.01$. The largest discrepancy between the observed and theoretically expected cases of scabies in 2014 were found in Karlovac County ($fo=104$, $ft=46.4$), in 2015 in Vukovar-Srijem County ($fo=167$, $ft=59$), in 2016 in Varaždin County ($fo=13$, $ft=89.1$) and in 2017 in Vukovar-Srijem County ($fo=177$, $ft=93.2$).

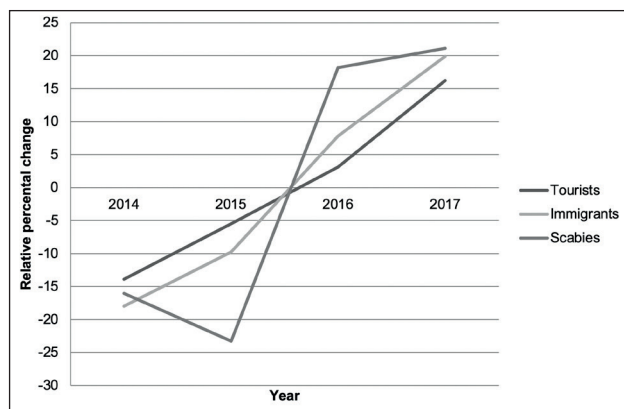


Figure 4. Relative percental dynamics of number of tourists, immigrants, and scabies over the four-year period in Croatia.

Figure 4 represents the percentile change in relative (per capita) number of tourists, immigrants and patients with scabies in Croatia. An almost linear trend of increase can be observed for the number of tourists and immigrants. On the other hand, for the number of patients with scabies, there is a small decrease from 2014 to 2015, then sharp increase from 2015 to 2016, followed by relative stability from 2016 to 2017.

Table 3. Linear approximation of change over time (2014 - 2017) in relative number (per capita) of tourists, immigrants and patients with scabies by counties.

County	Tourists	Immigrants	Scabies
Zagreb County	1.00	0.99	0.92
Krapina-Zagorje County	0.99	0.91	0.74
Sisak-Moslavina County	0.89	0.99	0.92
Karlovac County	0.99	0.96	-0.57
Varaždin County	0.96	0.92	-0.49
Koprivnica-Križevci County	0.88	0.98	-0.46
Bjelovar-Bilogora County	0.93	0.96	0.64
Primorje-Gorski Kotar County	1.00	0.95	-0.70
Lika-Senj County	0.97	0.72	0.15
Virovitica-Podravina County	0.59	0.99	0.70
Požega-Slavonia County	0.97	0.95	0.26
Brod-Posavina County	0.93	0.94	0.96
Zadar County	0.98	0.93	0.48
Osijek-Baranja County	0.98	0.99	0.99
Šibenik-Knin County	0.96	-0.03	0.25
Vukovar-Srijem County	0.99	0.78	0.85
Split-Dalmatia County	0.99	0.96	-0.51
Istria County	1.00	0.97	0.64
Dubrovnik-Neretva County	0.98	0.18	-0.01
Međimurje County	0.65	1.00	0.00
City of Zagreb	0.99	0.95	0.98
Croatia	0.99	0.99	0.92

The results in Table 3 show that the change in the relative number of tourists over observed time period is positive in all counties. In most of the counties the trend is almost linear (close to 1). The time trend of the relative number of immigrants by counties is also positive in most of the Croatian counties. The exceptions are Šibenik-Knin County, with no change ($\beta=-.033$), and Dubrovnik-Neretva County with a small and insubstantial change ($\beta=-.181$). However, the trend of change in the relative number of patients with scabies is not uniform, and varies greatly across the counties - from an evident increase (i.e. Osijek-Baranja County - $\beta=.990$) to relative stability (i.e. Međimurje County - $\beta=-.003$) to a substantial decrease (i.e. Primorje-Gorski Kotar County - $\beta=-.704$).

The correlations between trends of the relative number of tourists and relative number of patients with scabies was $\tau=-.052$ ($p=.878$), and between those of the relative number of immigrants and relative number of patients with scabies was $\tau=.153$ ($p=.345$). These insignificant ($p>.05$) correlations indicate that time trends of relative change in number of tourists or immigrants by counties are unrelated to the time trends of relative change in number of patients with scabies in the respective counties.

4 DISCUSSION

4.1 Summary of the Most Important Findings

According to our research and the obtained data, our initial suspicion on the increasing trend in scabies incidence in Croatia was confirmed on the national level in this study. Thus, in the period between 2007 and 2017, a 6-fold increase of the scabies incidence rate was found, and the steepest increase was in the last four years of the analysed period. Most of the scabies cases were among children and adolescents. These results indicate the need to raise awareness among health care providers, especially those working with children and adolescents with itches, with the aim not to misdiagnose scabies.

Concerning the possible associations among scabies incidence, tourists and immigrants, we confirmed an increasing number of tourists and immigrants in the period 2014-2017. However, time trends of the relative change in number of tourists and immigrants by counties were not related to the relative change of scabies infestations. Although statistical significance was not present, the highest scabies incidence rates were recorded in Međimurje and Vukovar-Srijem counties, which indicates moderate influence of the proximity of the border and influence of movements of people on scabies outbreaks. Concerning seasonal variations of scabies, our data for the City of Zagreb (monitored over a period of four years, 2014-2017) showed that infestation counts multiplied in winter and autumn months, thus confirming an influence of seasonal trends on scabies outbreaks. Therefore, our results may be a basis for the planning of further preventive measures.

4.2 Comparison of Study Findings with Reports in the Literature

According to the data in the literature, worldwide, scabies affects an estimated 100 million people across all continents and countries. Regardless, scabies is not a priority on the global health agenda, even though interest in the disease is increasing (11). However, outbreaks and management vary from country to country, and thus priority and management do as well (22).

Several trends and related factors have been found to be important for scabies outbreaks. Thus, a strong connection among scabies, migration and travel has been reported (11, 12, 15, 23). Since scabies moves with people, mass migration due to political and socioeconomic factors can promote its spread, as seen recently with the influx of asylum seekers arriving in Western Europe from high-prevalence countries (11, 12). Since scabies is transmitted by close person-to-person contact, it is logical that outbreaks have been reported in reception centres for asylum seekers across Europe (11). Previous studies claim that immigrants are at a higher risk of

acquiring common communicable diseases compared to the native Western European population (23). Although most refugees in Croatia are only in transit, refugee and migration flows can still have an impact on the occurrence of scabies in the country. A recent study suggested that scabies cases rose at the time when refugees and migrants were intensively coming from the Middle East to Western Europe via the Southeastern European route (Turkey-Greece-Serbia-Croatia-Slovenia-Austria) (15). Data presented in this study supports this observation, since an approximately 6-fold increase in scabies incidence was confirmed in Croatia between 2007-2017. According to our results, local geography could have a great influence on this, as indicated by the increased scabies incidence in areas close to the borders with Serbia and Bosnia and Herzegovina, and those along refugee migration routes. Late recognition and the delay of proper treatment, along with an increase in regular and irregular migration from neighbouring countries with high incidence rates of scabies (Bosnia and Herzegovina, Kosovo, Serbia), likely caused this upward trend in scabies cases in Croatia during this time.

According to data from Germany, the prevalence of scabies is higher among refugees than in the general population; however, the risk of outbreaks themselves is not high (24). Recent analysis of the health status and disease burden of unaccompanied asylum-seeking adolescents in Germany (cross-sectional pilot study) showed the highest prevalence of infestation in sub-Saharan Africans (86.7%), including the highest prevalence of parasites in general (46.7%), with a higher disease burden among females (25). Similar results were obtained by Kortas et al., who found a total of 47.7% of the subjects with scabies infestations originated from Afghanistan and 25.0% from Eritrea (26). Consequently, there is a need for thorough medical and psychological screenings after the arrival of such individuals in order to reduce the individual disease burden and risk of infestation for others. It is also necessary to lower barriers to health care access for unaccompanied asylum-seeking minors and allow for need-specific health care and prevention (27).

Significantly, another possible cause for the increase could be Croatia's 2013 admission into the European Union and the consequent increase in travel to the country (23). An important, related factor could be the increase in Croatia's tourism rate over the last few years, which might indicate the influence of travel and tourism on the scabies rate. Our results indicate linear increases in the number of tourists, immigrants and scabies infestations on the national level for the analysed period, although with no statistically significant association. According to a previous study of skin disorders among travellers returning from tropical and non-tropical countries, more than 20% of all such disorders were caused by arthropods

and about 50% by infectious pathogens (27). As such, pre-travel consultations should include specific prophylaxis and consider the most common risk factors for each destination (28).

Moreover, close contact among young people during travel, concerts and festivals can influence scabies rates. Large summer concerts and festivals have become popular in Croatia in recent years, and it is possible that casual sex and poor hygiene in these crowded conditions contribute to incidence rates (29). This corresponds to our results, as they have confirmed that young people predominated among scabies patients. More public attention should thus be directed to the prevention of scabies among youth, especially due to their lifestyles. Appropriate hygiene in overcrowded places, such as mass gathering events, is also important. According to a previous retrospective analysis (data from 145 countries) of the infection burden from inadequate water, sanitation and hygiene in low- and middle-income settings, there is a need for better risk reduction, including the provision of reliable piped water, treatment of community sewage and awareness of hand hygiene (30).

Seasonal variations should be also mentioned, since a connection between scabies occurrence and weather conditions and the seasons was observed (31). According to previously published data, scabies infestations are especially common in winter (31). Thus, Liu et al. monitored the influence of temperature on scabies incidence and observed that, overall, the incidence of scabies was negatively correlated with temperature but positively correlated with humidity (30). Our results support the seasonal character of scabies, as the majority of cases were recorded during winter, but also in autumn (Zagreb). It is possible that increased scabies infestation in winter is a result of closer contact between people in indoor environments. It should also be considered that scabies cases are often reported weeks or even months after the patient has contracted it. For example, a case is only reported in winter months when the patient first sees their physician, when the symptoms are troublesome enough, but the infestation could actually have started in the summer or autumn, coinciding with the patient's travel during vacation.

Considering the data in the literature, it is also important to mention an increased risk for outbreaks at nursing homes and extended-care facilities since elderly persons tend to develop crusted scabies due to disease- or medication-related immunosuppression (24, 32). According to a previous smaller study conducted in the City of Zagreb, 10% of scabies cases were found in medical health personnel, predominantly in those working in nursing homes and psychiatric wards (33). In our study, we found a prominent number of scabies outbreaks within families, adult foster care homes, nursing homes and other

facilities throughout Croatia. Our results indicate a need for increased caution and preventive measures for these populations and settings. Since health care professionals and assistants were among those infected, focus should be also on appropriate hygienic measures while working with patients.

Unfortunately, although scabies is a major public health problem and causes a significant disease burden worldwide, there are no agreed-upon international diagnostic guidelines (34). Thus, we can mention that due to the frequent setting of the diagnosis based only on the clinical picture, it is difficult to know the real number of scabies cases. Thompson et al. found that only 56% of clinical trials in medical databases specified which clinical findings were used for diagnosis (predominantly rash, rash distribution, pruritus and mite burrows) (35). According to their findings, parasitological testing was used in 63% of trials, more frequently in clinic-based than in field studies, and nearly one-quarter of trials (24%) did not perform diagnostic methods at all, which can lead to the further spread of scabies. However, in field conditions, the psychological and physical profiles of scabies patients may help in the early recognition of scabies, which is very useful, especially at peripheral care centres (36).

4.3 Limitations and Strengths of the Study

This retrospective, observational study, based on the official data presents the first national research regarding scabies incidence in Croatia, with findings based on the obligatory report data collected from all health care institutions in Croatia (for the years between 2007 and 2017). To the best of our knowledge, this is the first recent epidemiologic analysis on this topic, not only in Croatia but within the wider geographic region as well.

However, the limitation of this study is the lack of detailed data regarding the trend of scabies incidence throughout the years, since health care providers who send the report about communicable disease do not always answer all the questions in the report form. Therefore, we provided a more detailed analysis for the City of Zagreb (the capital of Croatia), since it accounts for one-quarter of whole Croatian population and has the highest number of hospitals and medical professionals at the national level. This study also found a possible impact of changes in the Croatian population, for example due to migration. In addition, we could only assume that health care providers reported all the scabies cases for the analysed period, although this might not have happened.

4.4 The Importance of the Study for Public Health and Other Professions in Croatia

The importance of this study is to emphasize the need for the implementation of existing standardized guidelines

with the aim early recognition and timely reporting of scabies. Furthermore, despite a universal health care system that provides mandatory health insurance for all residents, there is some inequality in health status in Croatia, similar to as in neighbouring countries such as Slovenia (37).

Late recognition of scabies by physicians also presents a problem, and is likely linked to the country's previously low rate - some medical doctors had not even seen scabies cases before, so did not think to suspect this infestation. It should also be remembered that some infected persons can have false negative results, leading to problems in practice when patients are treated ineffectively (38). When initial cases of scabies go undetected, these infected persons are then not able to prevent the spread of the disease in their immediate environments. Furthermore, there are many examples of non-compliance with treatment in practice. It is thus necessary to train general practitioners and medical staff on the early recognition, proper and timely diagnostics and notification of first cases. Special attention should be directed to the age groups with increased occurrence of scabies, such as children and adolescents. In addition, knowledge of basic hygienic measures is necessary from early childhood, and should be provided by kindergarten teachers (39), parents and other members of society. The epidemiology service has an important role in identifying contacts and applying preventive measures, stressing the necessity of conducting therapy and scabies management. Likewise, epidemiologists can do this only if they receive timely notification of the first sporadic case or early notification of an outbreak. Therefore, coordinated efforts between different sectors and collaboration among a range of health care providers (dermatologists, physicians and epidemiologists) is crucial (40).

4.5 Possibilities for Future Research in the Field

This study opens a new perspective on the transmission dynamic for this important but neglected communicable disease. Further research should be focused on the relationship between scabies incidence and other factors, such as tourism, both in Croatia and elsewhere. More attention should be directed to the research of scabies incidence in those countries with an increased number of movements, especially those with a rapidly growing annual number of tourists and migrants. In addition, wider epidemiological studies should be conducted internationally in order to compare trends among countries and regions. More research on scabies in clinical practice is recommended, with the focus on other possible related factors on scabies outbreaks and misdiagnosing of this disease.

5 CONCLUSION

The increased incidence of scabies, large disparities between counties, and prolonged outbreaks within families due late recognition and misdiagnoses points to a need for increased awareness among health practitioners on the occurrence of scabies in Croatia. For this, timely collaboration among general practitioners, health care professionals in resident and nursing homes, dermatologists and epidemiologists is crucial. The provision of timely diagnostics and treatment is a necessity, along with strict adherence to infestation control measures. Patient follow-ups and the prophylactic treatment of household members, patients, and staff who have had prolonged skin-to-skin contact with scabies cases is crucial in order to avoid outbreaks.

DISCLOSURE STATEMENT

The authors have no conflicts of interest to declare.

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ETHICAL APPROVAL

No identifiable human data were used for this study, and the dataset used is not openly available.

REFERENCES

1. Anderson K, Anderson LE, Glanze WD. Mosby's medical, nursing, & allied health dictionary. 4th ed. New York: Mosby-Year Book, 1994.
2. Fuller LC. Epidemiology of scabies. *Curr Opin Infect Dis.* 2013;26:123. doi: 10.1097/QCO.0b013e32835eb851.
3. Heukelbach J, Feldmeier H. Scabies. *Lancet.* 2006;367:1767. doi: 10.1016/S0140-6736(06)68772-2.
4. Chosidow O. Clinical practices. Scabies. *N Engl J Med.* 2006;354:1718. doi: 10.1056/NEJMc052784.
5. Hengge UR, Currie BJ, Jager G, Lupi O, Schwartz RA. Scabies: a ubiquitous neglected skin disease. *Lancet Infect Dis.* 2006;6:769-79.
6. GBD 2015 Disease and Injury Incidence and Prevalence, Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet.* 2016;388:1545-602. doi: 10.1016/S0140-6736(16)31678-6.
7. Amato E, Dansie LS, Grøneng GM, Blix HS, Bentele H, Veneti L, et al. Increase of scabies infestations, Norway, 2006 to 2018. *Euro Surveill.* 2019;24(23):190020. doi: 10.2807/1560-7917.ES.2019.24.23.190020
8. Romani L, Steers AC, Whitfeld MJ, Kaldor JM. Prevalence of scabies and impetigo worldwide: a systematic review. *Lancet Infect Dis.* 2015; 15:960-7. doi: 10.1016/S1473-3099(15)00132-2.
9. World Health Organization. Scabies. Geneva: WHO, 2015. Accessed April 1st, 2020 at: https://www.who.int/neglected_diseases/diseases/scabies/en/.

10. Vos T, Flaxman AD, Naghavi M, Lozano R, Michaud C, Ezzati M, et al. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380:2163-96. doi: 10.1016/S0140-6736(12)61729-2.
11. Stamm LV, Strowd LC. Ignoring the "Itch": the global health problem of scabies. *Am J Trop Med Hyg*. 2017;97:1647-9. doi: 10.4269/ajtmh.17-0242.
12. Beeres D, Omansen TF, Heidema A, Cornish D, Vonk M, Stienstra Y. Scabies amongst asylum seekers: prevalence and effect of the scabies hygiene programme. European congress of clinical microbiology and infectious diseases, Amsterdam, 2016. Accessed April 1st, 2020 at: http://www.escmid.org/escmid_publications/escmid_elibraty/?q=scabies&L=0&x=0&y=0.
13. Engelman D, Kiang K, Chosidow O, McCarthy J, Fuller C, Lammie P, et al. Members of the International Alliance for the control of scabies. Toward the global control of human scabies: introducing the international alliance for the control of scabies. *PLoS Negl Trop Dis*. 2013;7:e2167. doi: 10.1371/journal.pntd.0002167.
14. Mitja O, Marks M, Bertran L, Kollie K, Argaw D, Fahal AH, et al. Integrated control and management of neglected tropical skin diseases. *PLoS Negl Trop Dis*. 2017;11:e0005136. doi: 10.1371/journal.pntd.0005136.
15. Lugović-Mihić L. The increase in Croatia's scabies incidence: how did refugees and traveling contribute? *Travel Med Infect Dis*. 2019;pii:S1477-8939(19)30033-X. doi: 10.1016/j.tmaid.2019.02.002.
16. Zakon o zdravstvenoj zaštiti. *Narodne novine*. 100/2018.
17. Croatian Parliament. Zakon o izmjenama i dopunama Zakona o zaštiti pučanstva od zaraznih bolesti. *Narodne novine*. 130/2017.
18. Ministry of Health. Pravilnik o načinu prijavljivanja zaraznih bolesti. *Narodne novine*. 23/1994.
19. Croatian Bureau of Statistics. The census of population, households and dwellings 2011. Accessed April 8th, 2020 at: <https://www.dzs.hr/hrv/censuses/census2011/censuslogo.htm>.
20. Arsenijević J, Schillberg E, Ponthieu A, Malvisi L, Wael AEA, Argenziano S, et al. A crisis of protection and safe passage: violence experienced by migrants/refugees travelling along the Western Balkan corridor to Northern Europe. *Confl Health*. 2017;11:6.
21. Arsenijević J, Burtscher D, Ponthieu A, Severy N, Contenta A, Moissain S, et al. "I feel like I am less than other people": Health-related vulnerabilities of male migrants travelling alone on their journey to Europe. *Soc Sci Med*. 2018;209:86-94.
22. Goldstein BG, Goldstein AO. Scabies: epidemiology, clinical features, and diagnosis. In: Ofori AO, editor. *UpToDate*. Waltham (MA): UpToDate, 2019. Accessed April 8th, 2020 at: <https://www.uptodate.com/contents/scabies-epidemiology-clinical-features-and-diagnosis>.
23. Limina RM, Baitelli G, Marcantoni C, Covolo L, Festa A, Speziani F, et al. Frequency of infectious diseases in immigrants in a western European country: a population-based study. *J Immigr Minor Health*. 2015;17:66-75. doi: 10.1007/s10903-013-9888-3.
24. Sunderkötter C, Feldmeier H, Fölster-Holst R, Geisel B, Klinke-Rehbein S, Nast A, et al. S1 guidelines on the diagnosis and treatment of scabies - short version. *J Dtsch Dermatol Ges*. 2016;14:1155-67. doi: 10.1111/ddg.13130.
25. Marquardt L, Krämer A, Fischer F, Prüfer-Krämer L. Health status and disease burden of unaccompanied asylum-seeking adolescents in Bielefeld, Germany: cross-sectional pilot study. *Trop Med Int Health*. 2016;21:210-8. doi: 10.1111/tmi.12649.
26. Kortas AZ, Polenz J, von Hayek J, Rüdiger S, Rottbauer W, Storr U, et al. Screening for infectious diseases among asylum seekers newly arrived in Germany in 2015: a systematic single-centre analysis. *Public Health*. 2017;153:1-8. doi: 10.1016/j.puhe.2017.07.011.
27. Karimkhani C, Colombara DV, Drucker AM, Norton SA, Hay R, Engleman D, et al. The global burden of scabies: a cross-sectional analysis from the global burden of disease study 2015. *Lancet Infect Dis*. 2017;17:1247-54. doi: 10.1016/S1473-3099(17)30483-8.
28. Herbinger KH, Siess C, Nothdurft H, Von Sonnenburg F, Löscher T. Skin disorders among travellers returning from tropical and non-tropical countries consulting a travel medicine clinic. *Trop Med Int Health*. 2011;16:1457-64. doi: 10.1111/j.1365-3156.2011.02840.x.
29. Jeličić P, Capak K, Poljak V, Novosel IP, Vučina VV. Scabies in Croatia - epidemic or media sensation. In: 26th Scientific and educational seminar with international participation DDD and ZUPP 2014: disinfection, disinsection, deratization and protection of stored agricultural products. Split, 2014:151-8.
30. Liu JM, Wang HW, Chang FW, Liu YP, Chiu FH, Lin YC, et al. The effects of climate factors on scabies: a 14-year population-based study in Taiwan. *Parasite*. 2016;23:54. doi: 10.1051/parasite/2016065.
31. Prüss-Ustün A, Bartram J, Clasen T, Colford JM, Cumming O, Curtis V, et al. Burden of disease from inadequate water, sanitation and hygiene in low- and middle-income settings: a retrospective analysis of data from 145 countries. *Trop Med Int Health*. 2014;19:894-905. doi: 10.1111/tmi.12329.
32. Buczek A, Pabis B, Bartosik K, Stanislawek IM, Salata M, Pabis A. Epidemiological study of scabies in different environmental conditions in central Poland. *Ann Epidemiol*. 2006;16:423-8. doi: 10.1016/j.annepidem.2005.06.058.
33. Kosanović Ličina ML, Quiaios A, Tešić V, Domingues J, Sá N. The profile of scabies patients in Zagreb. *Psychiatr Danub*. 2014;26:533-6.
34. Bhat SA, Mounsey KE, Liu X, Walton SF. Host immune responses to the itch mite, *Sarcoptes scabiei*, in humans. *Parasit Vectors*. 2017;10:385. doi: 10.1186/s13071-017-2320-4.
35. Thompson MJ, Engelman D, Gholam K, Fuller LC, Steer AC. Systematic review of the diagnosis of scabies in therapeutic trials. *Clin Exp Dermatol*. 2017;42:481-7. doi: 10.1111/ced.13152.
36. Nair PA, Vora RV, Jivani NB, Gandhi SS. A study of clinical profile and quality of life in patients with scabies at a rural tertiary care centre. *J Clin Diagn Res*. 2016;10:WC01-5. doi: 10.7860/JCDR/2016/20938.8703.
37. Zadnik V, Guillaume E, Lokar K, Žagar T, Primic Žakelj M, Launoy G, et al. Slovenian version of the European deprivation index at municipality level. *Zdr Varst*. 2018;57:47-54. doi: 10.2478/sjph-2018-0007.
38. Walton SF, Currie BJ. Problems in diagnosing scabies, a global disease in human and animal populations. *Clin Microbiol Rev*. 2007;20:268-79. doi: 10.1128/CMR.00042-06.
39. Slabe D, Fink R, Dolenc E, Kvas A. Knowledge of health principles among professionals in Slovenian kindergartens. *Zdr Varst*. 2016;55:185-94. doi: 10.1515/sjph-2016-0024.
40. Chandler DJ, Fuller LC. A Review of scabies: an infestation more than skin deep. *Dermatology*. 2019;235:79-90. doi: 10.1159/000495290.