Infect Dis Ther (2023) 12:1937–1954
https://doi.org/10.1007/s40121-023-00849-3

REVIEW

Herpes Zoster Burden of Disease and Clinical Management in Turkey: A Comprehensive Literature Review

Selim Badur · Esin Senol · Alpay Azap · Cihan Yesiloglu · Alev Ozakay · Serdar Ozturk · Adriana Guzman-Holst

Received: May 24, 2023 / Accepted: July 14, 2023 / Published online: August 2, 2023

ABSTRACT

Introduction: Herpes zoster (HZ), or shingles, is caused by the reactivation of varicella zoster virus (VZV) and typically presents as an acute, painful dermatomal rash, but can lead to long-term, distressing complications such as postherpetic neuralgia (PHN). Increasing trends in HZ cases are evident globally among the aging population; however, reviews investigating the epidemiology and clinical management of HZ in Turkey are lacking. Therefore, a literature review of local studies in Turkey was conducted to identify the data available and identify gaps in the literature.

Methods: Literature searches were carried out in PubMed and local journals to retrieve published articles that reported surveillance data, seroepidemiology, patient outcomes, or clinical management related to HZ or VZV in Turkey until April 30, 2022. Studies included primary data reports, case studies, secondary data reviews, and epidemiological studies in healthy or at-risk populations; HZ was the primary focus of the review.

Results: No studies reported VZV or HZ epidemiological data at a national level. One large retrospective study in Istanbul reported that HZ incidence rates significantly increased in adults 18–44 years of age between 2011 and 2019. Four single-center studies reported the proportion of dermatological patients with HZ at 0.43–1.56%. PHN was the most common reported complication, occurring in 8–58.9% of patients with HZ. However, out of 39 identified case reports, HZ ophthalmicus was the most frequently reported complication. Two studies highlighted poor disease awareness and risk perception of HZ among Turkish citizens.

Conclusion: Overall, there were limited comprehensive epidemiological data on HZ in Turkey. However, the abundance of case studies on HZ complications indicates a strong disease presence and diverse clinical management in Turkey. Further research will be important to understand the impact of HZ, increase disease awareness, and support the introduction of new preventative strategies.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40121-023-00849-3.

Data reported in this manuscript were previously presented as an oral presentation at the KLİMİK 2023 congress (13–16 March, Belek-Antalya, Turkey).

S. Badur · C. Yesiloglu · A. Ozakay · S. Ozturk
GSK, Istanbul, Turkey

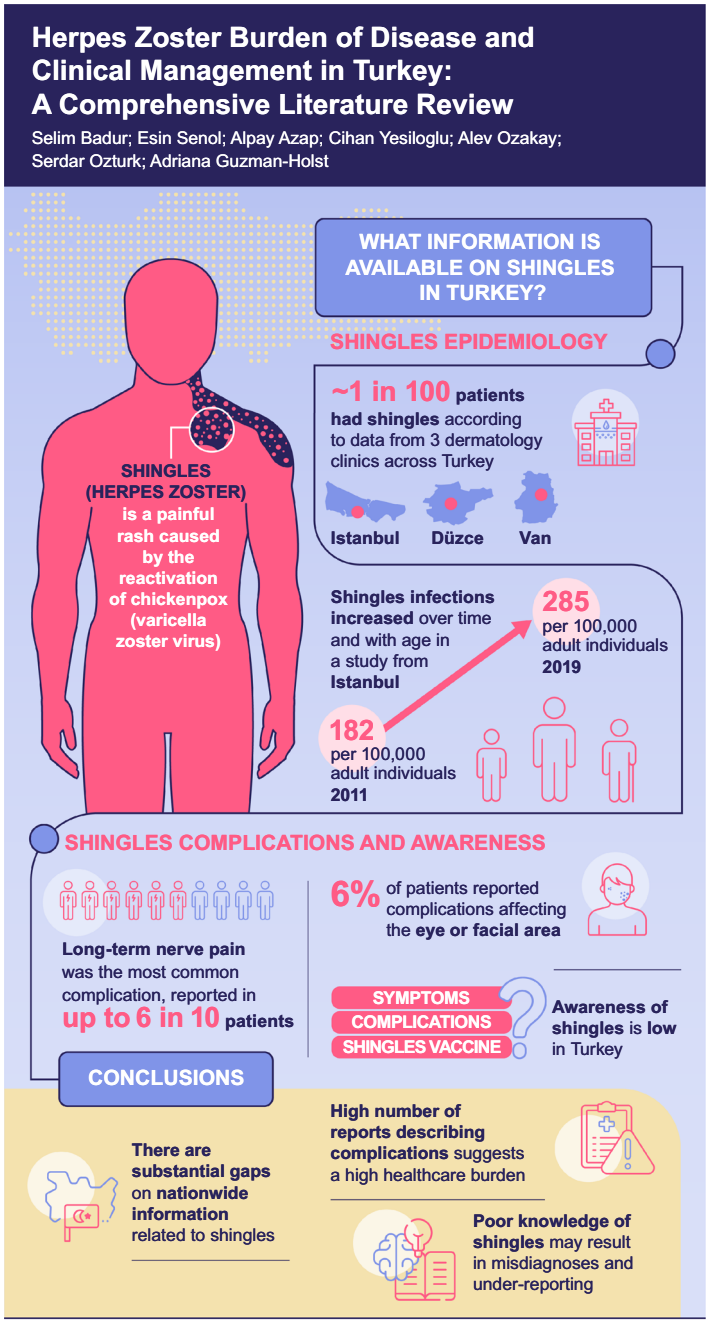
E. Senol
Gazi University, Ankara, Turkey

A. Azap
Ankara University, Ankara, Turkey

A. Guzman-Holst (✉)
GSK Vaccines, 20 Avenue Fleming, 1300 Wavre, Belgium
e-mail: adriana.x.guzman@gsk.com

Keywords: Chickenpox; Herpes zoster; Shingles; Turkey; Varicella zoster virus

Infographic



This infographic represents the opinions of the authors. For a full list of declarations, including funding and author disclosure statements, please see the full text online.

Key Summary Points

Why carry out this study?

Incidence of herpes zoster (HZ) is increasing worldwide with the aging population; however, there is a lack of comprehensive reviews addressing HZ burden of disease in Turkey.

In light of this, a literature review was conducted to summarize and critically appraise the available literature on the epidemiology and clinical management of HZ in Turkey.

What was learned from this study?

There were substantial gaps in the literature addressing nationwide incidence of HZ in Turkey and studies highlighted a lack of awareness of HZ symptoms, risks, and vaccination among citizens.

Multiple studies also reported an abundance of HZ-related complications such as postherpetic neuralgia and HZ ophthalmicus, which were more common among elderly individuals in Turkey.

Further research is needed to evaluate the burden of HZ in Turkey to increase disease awareness and inform future strategies for HZ prevention.

DIGITAL FEATURES

This article is published with digital features, including a graphical abstract, to facilitate understanding of the article. To view digital features for this article, go to https://doi.org/10.6084/m9.figshare.23685951.

INTRODUCTION

Varicella, or chickenpox, is caused by infection with varicella zoster virus (VZV) which typically occurs during early childhood. VZV can remain dormant in ganglionic sensory neurons for many years and subsequently reactivate to cause herpes zoster (HZ), or shingles [1, 2]. Individuals diagnosed with HZ experience an acute painful dermatomal rash, which can lead to a number of complications such as long-term nerve pain (postherpetic neuralgia, PHN), and in some cases can cause a stroke or blindness [2, 3]. To this end, HZ and its complications can severely impact patients' quality of life [2, 4].

The lifetime risk of HZ without vaccination is 20–30% in the general population [5]. However, the risk of HZ increases with declining cell-mediated immunity associated with age and in individuals with altered immune systems (e.g., human immunodeficiency virus [HIV] infection or immunosuppressive treatment) [2]. For example, incidence rates of HZ tend to sharply increase after 50 years of age [6]. Aging is also a predominant risk for developing HZ-related complications. PHN incidence rates dramatically increase from 1.6 cases per 100,000 individuals < 10 years old to 228.5 cases per 100,000 persons in patients ≥ 71 years old [7]. While HZ incidence is relatively lower in children, severe complications and related hospitalizations can also occur [8, 9]. However, data on HZ in children are relatively limited.

Over the past few decades, a trend of increasing HZ incidence is evident globally [6]. As the global population is undergoing a substantial growth in the proportion of the elderly (individuals aged ≥ 60 years expected to triple by 2100) [10], it is predicted that the global health burden associated with HZ will further increase [6]. Therefore, it is essential that local health policymakers are informed with the latest evidence on HZ burden of disease to guide vaccination programs and facilitate effective clinical management.

Several studies have investigated the epidemiology of VZV and HZ in different geographical regions [6]. However, to the best of our knowledge, there are no extensive literature reviews examining the burden imposed by HZ in Turkey. As of 2023, the population of Turkey is approximately 87 million [11]. Although Turkey currently exhibits a relatively young demographic (median age of citizens is 31.5 years), it is estimated that Turkey will experience a substantial demographic shift and expansion of the elderly population by 2050 [11, 12].

The main strategy to minimize the global health burden of VZV and HZ is through vaccination [13, 14]. According to a report in 2019, 36 countries had implemented universal varicella vaccination and in those countries, incidence rates of varicella markedly reduced in subsequent years following implementation [15]. Turkey has also introduced a mandated single-dose program in 2013 at 12 months of age [16]. The name of the vaccine provided by the importer is not currently indicated online by the Ministry of Health in Turkey; however, it has been reported that the vaccine strain must belong to clade 2 and include at least 1000 plaque forming units per dose [17]. Effective vaccines for HZ are readily available; however, many countries, including Turkey, currently do not include HZ vaccination within their national immunization programs [13, 18].

Given the mounting concerns regarding the incidence of HZ and potential impact among aging or immunocompromised populations, we conducted a review of available evidence on the epidemiology and clinical management of VZV and HZ in Turkey. Furthermore, we examined local studies on incidence rates, seroepidemiology, and case reports to identify any gaps present in the literature.

METHODS

Literature searches were performed in PubMed and in local journals in Turkey to retrieve published articles up until April 30, 2022. The defined geographical scope of the review was limited to Turkey and articles presented in English or Turkish were included.

The search strategy main string comprised the following terms: ("Herpes Zoster" [Mesh] OR "herpes zoster" OR "shingles" OR "zoster" OR "varicella zoster") AND ("Turkey"). Studies which reported surveillance data, seroepidemiology, patient outcomes, or clinical management related to HZ or VZV were included. As the primary focus of this review was HZ, any primary data reports, case study/series, secondary data reviews, and studies describing the incidence or prevalence of HZ in both healthy and at-risk populations were included. Eligible articles were manually reviewed for additional relevant articles using the previously published "snowballing" approach [19].

Articles outside the scope of VZV and HZ or unrelated to the population of Turkey were excluded, as well as research solely on VZV case definition and clinical management.

This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

RESULTS

Varicella Zoster Virus in Turkey

Varicella Incidence

Two publications were identified that reported varicella surveillance data in Turkey. One of these studies took place before the introduction of the single-dose varicella vaccine into Turkey's national immunization program in children aged 12 months in 2013 (between 2008 and 2010). This study reported that 824 children aged 0–15 years were hospitalized following VZV infection (73% with no prior health concerns) at 27 health care centers across Turkey; 25.7% were hospitalized as a result of primary VZV infection [20]. This study also reported that in children $\leq$ 15 years old, incidence of varicella-related hospitalization decreased with age, with the highest rate apparent in children $<$ 1 year of age (21.7–28.0 per 100,000 children) and the lowest rate in children

10–15 years of age (0.42–0.71 per 100,000 children) [20].

A second study compared varicella incidence at two hospitals residing in Istanbul before (2011–2012) and after (2018–2019) the inclusion of the varicella vaccine into Turkey's national immunization program (Table 1) [21]. Notably, annual varicella incidences significantly decreased from 290 to 24 per 100,000 children ≤ 5 years of age in 2011 and 2019, respectively. Indeed, from 2013 to 2018, varicella incidence decreased every year by an average of 39.3% (7.3–48.5%) in children ≤ 5 years of age. Similarly, among individuals aged 6–17 years of age, varicella incidences decreased from 853 per 100,000 in 2011 to 170 per 100,000 in 2019 [21].

VZV Seroprevalence

Four studies were identified which reported seroprevalence of VZV antibodies in Turkish populations [22–25]. Two studies published in 2005 and 2002 employed a 30-by-30 cluster sampling method to survey VZV seropositivity among individuals in a single province, Erzurum (N = 559), and in nine provinces of Turkey (Istanbul, Ankara, Izmir, Adana, Diyarbakır, Samsun, Erzurum, Trabzon, and Edirne; N = 4387) [22, 23]. Both studies reported increasing VZV seroprevalence with age. In the study including individuals from Erzurum only, VZV seropositivity was 16.67%, 57.58%, and 86.78–96.36% in children aged 1 year, 4 years, and ≥ 10 years old, respectively, compared to 20%, 40%, and 85–90% across the nine provinces (including Erzurum) [22, 23]. Among all participants under 30 years of age in both studies, positive VZV seroprevalence was detected in 77.8–78.0% [22, 23]. However, a third independent study of VZV seroprevalence in Izmir in 2011 (N = 590) found that only 25.5% of children 5 years of age and 71.5% of all included participants were seropositive for VZV [25].

In the two studies conducted in Erzurum and the nine provinces described above, no significant differences in VZV seroprevalence were found between rural and urban provinces of Turkey and most other sociodemographic variables (except educational level among 0–14 years) [22, 23]. However, another study published in 2013, which surveyed 2136 healthy individuals aged > 15 years, reported a significantly greater VZV seropositivity among urban (96.1%) compared with rural (90.8%) populations [24]. No difference in VZV seroprevalence was reported between male (95.2%) and female individuals (93.8%) [24].

Herpes Zoster in Turkey

HZ Incidence and Prevalence in the General Adult Population

The regions and cities of Turkey with available HZ epidemiological data identified in the literature search are depicted in Fig. 1. There were no nationwide data on the incidence of HZ in Turkey.

One large retrospective study was identified that reported HZ incidence rates based on data from two centers in Istanbul (Table 1; N = 1,090,803) [21]. Despite substantial reductions in the annual incidence of VZV in children < 17 years of age from 2011 to 2019, the annual incidence of HZ overall increased from 2011 to 2019 [21]. In patients > 17 years of age, the incidence of HZ significantly increased from 182 per 100,000 individuals in 2011 and to 285 per 100,000 individuals in 2019. The incidence of HZ also significantly increased in adults 18–44 years of age (208–303 per 100,000 adults in 2011 and 2019) [21]. However, no significant difference in the incidence of HZ between 2011 and 2019 was reported among adults aged 45–64 or ≥ 65 years old [21].

Most other sources on HZ epidemiology were derived from a single clinic or emergency department. Three studies were identified from independent dermatology clinics and one at an emergency department that reported the proportion of HZ cases among dermatological patients [26–29]. At the three dermatology clinics, the percentage of patients with HZ ranged from 0.43% in Van (N = 115 from 2007 to 2010) [27], 0.56% in Düzce (N = 312 from 1999 to 2010) [28], to 1.56% in Istanbul (N = 3386; 2015–2016) [26]. A fourth study at an emergency department in Istanbul during 2016 reported that 1.17% (N = 35) of dermatological

patients had HZ, representing 0.02% of all emergency cases [29]. Notably, two independent analyses of Turkish geriatric dermatology patients admitted between 2009 and 2014 ($N = 7412$) and 2013–2014 ($N = 300$) found that HZ was the most common viral-related skin disorder, representing 88% ($N = 385$) and 58.8% ($N = 17$) of viral infections, respectively [30, 31].

The impact of gender on the prevalence of HZ in Turkish citizens is unclear. Two retrospective studies of patients admitted to a hospital emergency department ($N = 35$; 2016) and a dermatology department ($N = 115$; 2007–2010) found that a greater proportion of patients with HZ were male (65.7% and 59.1%, respectively) [27, 29]. Another study, which investigated HZ infection in oncology patient records from 2009 to 2019 ($N = 100$), reported that HZ was significantly more common in male patients (58%; $p = 0.03$) [32]. However, one retrospective study conducted in a pain clinic reported that 54% of HZ cases were female ($N = 200$ from 2010 to 2019) [33], and two other retrospective studies reported close to equal proportions of male and female patients with HZ [28, 34]. Likewise, the large retrospective VARICOMP study of patient records from eight Turkish centers ($N = 1955$) reported almost equal proportions of male (48.4%) and female (51.6%) patients with HZ [35]. However, one of the studies reported differences in the proportions of male versus female patients within specific age strata [34]. Among individuals 26–-35 years of age ($N = 74$), HZ was significantly more prevalent in men who represented 67.6% of HZ cases ($p = 0.03$), whereas HZ was more prevalent in women (61.7%) aged 46–55 years ($N = 107$; $p = 0.012$) [34].

Six studies were identified that reported the seasonal occurrence of HZ infection in Turkey. Data from geriatric patients at a dermatology outpatient clinic in Istanbul ($N = 3386$) reported the greatest proportion of HZ infections occurred in July (3.31%) and the lowest in October (0.40%) [26]. An emergency department in Istanbul ($N = 35$) also reported a higher proportion of HZ cases in July (57.1%); however, this study was conducted across only 3 months in 2016 (June, July, and August) [29]. A third study reported the greatest proportion of HZ cases in summer (27.5%) and the lowest in autumn (22%) [34], and a fourth study noted

Table 1 VZV and HZ incidence stratified by age and year in Istanbul, Turkey

Year	Incidence of VZV (per 100,000 patients)			Incidence of HZ (per 100,000 patients)					
	≤ 5	6–17	> 17	≤ 5	6–17	> 17	18–44	45–64	≥ 65
2011	290	853	52	9	19	182	208	141	181
2012	363	726	8	33	141	198	225	152	169
2013[a]	358	971	22	0	57	203	192	330	120
2014	193	392	5	6	33	196	227	138	213
2015	179	585	13	0	36	226	234	205	242
2016	130	543	6	18	41	229	244	227	193
2017	67	343	13	16	28	226	231	201	250
2018	22	216	8	27	43	241	249	261	199
2019	24*	170*	4	37	58	285*	303*	314	203

HZ herpes zoster, *VZV* varicella zoster virus

[a]Varicella vaccine introduced into the Turkish national immunization program

*Significantly different to the respective age strata for VZV or HZ incidence in 2011, $p < 0.05$. Data were sourced from Soysal et al. [21]

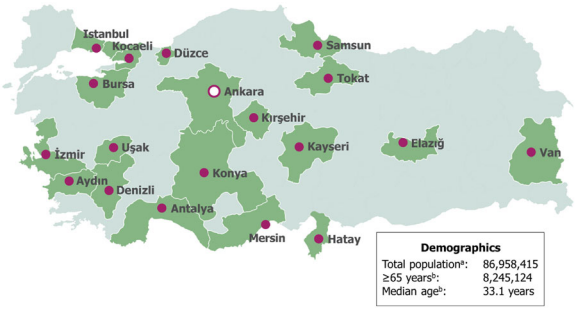


Fig. 1 Demographics of Turkey and the provinces with reports on HZ epidemiology, including studies of HZ in the general population and among patients with comorbidities; provinces with only case reports or series identified were not included. The locations of 8 centers in the VARICOMP study were not reported [35]; therefore, may not be represented in this figure. HZ incidence was only reported in Istanbul [21]. [a]Reported by Worldometer in 2023 [11]. [b]Reported by the Turkish Statistical Institute in 2021 [106]. *HZ* herpes zoster

that HZ cases were rare during winter and peaked in March (17.39%) [27]. Consistent with these data, Küçükçakır et al. [28] reported that the highest number of HZ admissions occurred during summer in 1999–2010 (30.77%). However, one study of 100 patients with cancer reported that autumn (30%) and winter (30%) had the highest proportion of HZ cases [32].

HZ and HIV/AIDS

Previous studies have shown that HZ is more prevalent among individuals with altered immune systems. In particular, patients with HIV/acquired immune deficiency syndrome (AIDS) are vulnerable to opportunistic diseases such as HZ [36]. Moreover, HZ can be more severe in patients with HIV [37], and these patients are also at a greater risk of dissemination [38]. One case study involving a 49-year-old Turkish man was identified, who presented with a recurrent, severely painful case of HZ, with no initially suspected risks, but was later diagnosed with HIV [39].

Six studies were identified from health clinics that reported HZ infections in patients with HIV/AIDS. In a clinic located in Bursa in 1997–2003, four cases of HZ were reported among 21 patients with HIV/AIDS (17–64 years of age) [40]. In a second clinic in Bursa, 78 HIV/AIDS cases (mean age 40.4 years) were reviewed across 1996–2012, and opportunistic diseases were reported in 29.4% of cases, five of which were HZ infection [41]. A third study in Istanbul reported that among 306 patients with HIV/AIDS (mean age 38.3 years) in 2006–2012, 111 experienced skin problems and 5.9% were due to HZ infection [42]. Likewise, a fourth study reported that of 179 HIV/AIDS patients at an outpatient clinic in Istanbul (mean age 39.1 years), 254 dermatoses were reported, with 69.3% of patients reporting at least one dermatosis. Of 81 patients who had infectious dermatoses (N = 115), HZ accounted for 7.8% of lesions [43]. The fifth study reported that 3.8% of 105 prospectively enrolled patients in Ankara with HIV (mean age 39.9 years) in 2015–2017 developed HZ [44]. The remaining study, conducted in Istanbul (N = 212; mean age 38.6 years), reported that HZ accounted for 12.4% of cases of opportunistic diseases in patients with HIV during 2002–2012 [45].

HZ and COVID-19

Since the global outbreak of SARS-CoV-2 (COVID-19), declared a pandemic in March 2020 [46, 47], multiple sources have highlighted the potential association with other diseases such as HZ; however, evaluations have been inconclusive [48, 49].

Two studies evaluated the impact of the COVID-19 pandemic on HZ infection trends in Turkey. One large, multicenter study (N = 164,878) conducted across 13 provinces noted that while dermatology admissions decreased by 77% from January to May 2020, the proportion of patients admitted with HZ significantly increased by 131%, whereas the frequency of more common skin conditions such as dermatitis, psoriasis, and acne remained stable [47]. Consistent with this, of 33 patients identified in outpatient dermatology clinics between May and December 2020 who were recently infected with COVID-19, eight patients developed HZ, with presentation occurring on average 10.75 weeks post-diagnosis with COVID-19 [50].

There was a lack of data examining the relationship between COVID-19 vaccination and HZ. Only two case studies in Turkey were identified. Two men aged 68 and 78 years old developed HZ 5 days after receiving a dose of the COVID-19 vaccine, and in both instances neither patient was receiving immunosuppressants, which may indicate susceptibility to HZ infection [51, 52].

HZ Complications and Clinical Management

Across multiple studies, it was reported that 13.2–21.4% of HZ cases resulted in any complication and overall, PHN was the most commonly reported complication (Table 2) [26–29, 31, 53–55]. However, the proportion of patients who developed PHN varied substantially across independent studies. For example, Atiş et al. (2017) reported that of 53 patients with HZ, 5.7% developed PHN, whereas Küçükçakır et al. (2012) reported that 21.47% of 312 patients with HZ developed PHN [26, 28], and a third, smaller retrospective study of 19 patients reported that 31.6% of patients developed PHN [53]. The highest proportion of patients with PHN was reported at a hospital in Bursa (N = 90), where PHN developed in 58.8% of patients [55].

Overall, while there was an absence of comprehensive, nationwide data on HZ incidence in Turkey, 39 case reports or series, detailing numerous HZ-related complications and accompanying treatment strategies, were identified ([56–94]; Supplementary Table 1). Among these case studies, HZ ophthalmicus (HZO), characterized by the reactivation of VZV in the ophthalmic nerve, affecting regions around the eye, was the most common complication described (12 out of 43 patients described) [60, 62, 64, 66, 70, 72, 76, 79, 80, 89, 91, 92]. Other reported HZ-related complications included PHN, Ramsay Hunt syndrome, segmental zoster paresis, VZV encephalitis, orbital apex syndrome, Ogilvie's, complex regional pain syndrome, Horner's syndrome, polymyalgia rheumatica, and brachial plexopathy, among others (Supplemental Table 1).

The majority of case studies involved treatment with antivirals, with most receiving acyclovir (Supplemental Table 1). One case study that described an 84-year-old man who developed disseminated HZ, with a history of diabetes and cancer, was unresponsive to all antiviral therapy (acyclovir and valacyclovir) and later died, which may have been caused by resistance from long-term exposure during a previous case of HZ [82]. Other medications commonly listed included steroids, nonsteroidal anti-inflammatory drugs (NSAIDs), and analgesics (Supplementary Table 1).

Two studies reported potential treatment-emergent adverse events related to acyclovir treatment. The first was a case study involving a 76-year-old diabetic woman with hypertension, osteoporosis, and HZO who after 5 days of acyclovir treatment became disorientated and was diagnosed with syndrome of inappropriate antidiuretic hormone secretion, suspected from the exposure to acyclovir or VZV [80]. Whereas a second retrospective study of 19 patients with HZ reported that, out of 14 (73.7%) who received acyclovir, treatment was discontinued in two patients because of creatinine progression [53].

Valacyclovir was the second most commonly prescribed antiviral among case studies (Supplemental Table 1), consistent with a retrospective study reporting that, of 12 patients with non-disseminated HZ, 58% were treated with acyclovir, 33% with valacyclovir, and 8.3% with brivudine, while all patients with disseminated HZ received acyclovir [53]. One study reported that brivudine antiviral therapy led to quicker pain relief compared with valacyclovir and famciclovir; however, no comparisons were made to acyclovir [95].

Interestingly, a retrospective study of 90 patients reported that of patients > 65 years of age who developed PHN (N = 29), most had not received antiviral treatment (62.1%) [55]. Notably, while more HZ cases were evident in individuals < 65 years of age, HZ with PHN was more prevalent in those > 65 years of age [55].

Many HZ cases with complications occurred in individuals with one or more known susceptibilities. Diabetes mellitus was the most common reported comorbidity, representing 9 out of 43 patients described across cases studies and series in Turkey [56, 65, 67, 79, 80, 82, 90, 91]. Most cases involved individuals

Table 2 Studies reporting the prevalence of HZ complications in Turkey

References	Year	*N*	Mean age, years	Patients with complications (%)			
				Any	PHN	Ophthalmic involvement	Ramsay Hunt syndrome
Acar et al. [53]	2019–2020	19	68.5	NR	31.6	63.2	NR
Çeltek and Ünlü[a] [32]	2009–2019	100	64.1	NR	8	NR	NR
Acer et al. [54]	2015–2016	166	51.48	NR	27.7	6.02	NR
Atış et al. [26]	2015–2016	53	72.92	13.2	5.7	5.7	NR
Dogan et al. [29]	2016	35	42.45	14.3[b]	NR	NR	NR
Özkol et al. [27]	2007–2010	115	42.21	13	NR[c]	NR	NR
Küçükçakır et al. [28]	1999–2010	312	49.6	21.4	21.47	NR	0.64
Yürük et al. [55]	NR	90	58.8	NR	58.9	NR	NR

HZ herpes zoster, *NR* not reported, *PHN* postherpetic neuralgia

[a]Cohort was exclusively patients with cancer

[b]May be related to treatment only; statistic was calculated on the basis of the reported 85.7% of patients recovering from HZ infection without any complications with treatment

[c]PHN was the most common reported complication; no statistic was provided

aged ≥ 60 years; however, eight cases were reported in patients ≤ 30 years old [72, 75, 78, 83, 87, 89, 93]. One case detailed a 27-year-old kidney transplant recipient who developed HZ with Ramsay Hunt syndrome [83]. Three patients aged 19, 27, and 30 years old, with no prior indications of susceptibility, developed HZO with VZV encephalitis, isolated internal ophthalmoplegia (impaired pupil function) secondary to HZO, and a large necrotic ulcer (necrotic HZ), respectively [72, 89, 93]. Three case studies were reported in children aged 10, 11, and 12 years old. Two had no reported complications; however, one had developed Ramsay Hunt syndrome; none of the patients had any significant medical history [75, 87].

HZ Vaccine Awareness and Knowledge in Turkey

Nine studies were identified that addressed patient or physician knowledge and awareness of HZ infection and/or HZ vaccination in Turkey [96–104]. Collectively, these studies indicated that HZ awareness is low. For example, in a large survey of 8688 individuals ≥ 50 years of age conducted across 22 countries in 2006–2007, Turkey displayed the lowest awareness of HZ, with only 17% of Turkish participants aware of HZ in contrast with more than 96% of people who were surveyed in New Zealand, Brazil, and Malaysia [102]. Similarly, a study of 60 patients clinically diagnosed with HZ > 18 years of age in Turkey reported that overall patient knowledge of HZ was inadequate [101].

Three studies reported that individuals' awareness of HZ vaccines is also low in Turkey. Out of 543 patients aged ≥ 65 years admitted to outpatient clinics, 6.6% had previously heard of HZ vaccination [98]. A prospective study carried out at five centers in Turkey (*N* = 155) reported that 12.7% of individuals had knowledge of HZ vaccination [97], while another survey of 100 participants aged 19–63 years in Anatalya noted that only 1% had knowledge of HZ vaccination [96]. However, a survey of 263 Turkish family

Table 3 Studies reporting HZ, pneumococcal, and influenza vaccination prevalence in Turkey

Reference	Individuals vaccinated, *n* (%)			*N*	Mean age, years
	HZ	Pneumococcus	Influenza		
Sütlü and Til [104]	4 (0.8)	13 (2.7)	160 (32.8)	488	NR[a]
Kizmaz et al. [100]	6 (1.8)	14 (4.3)	71 (21.8)	326	71.59
İlhan and Bakkaloglu [99]	0 (0)	2 (0.7)	22 (8.2)	268	76.7

HZ herpes zoster

[a]Mean age was not reported; however, the surveyed individuals were aged ≥ 65 years.

physicians in 2014 revealed that 59.7% had knowledge of HZ vaccination and 65.7% would recommend the vaccine [103].

Three studies reported the proportion of individuals vaccinated for HZ in Turkey. Notably, all three studies reported markedly low HZ immunization rates, compared with pneumococcus and influenza (Table 3) [99, 100, 104]. For example, a study of 488 individuals ≥ 65 years of age diagnosed with a chronic disease reported that only 0.8% were vaccinated for HZ compared with 2.7% and 32.8% for pneumococcus and influenza, respectively [104].

DISCUSSION

While increasing trends of HZ incidence are evident globally [5, 6], to our knowledge there are no extensive literature reviews examining the burden imposed by HZ in Turkey. As a result, this review sought to critically evaluate and identify potential gaps in the available literature on HZ infection and clinical management in Turkey.

Two studies were identified that reported VZV incidence in Turkey, both before and after VZV introduction into the national immunization program. Decreasing trends in VZV infection post-introduction of universal varicella vaccination were reported, similar to global trends. For example, substantial reductions in VZV incidence and hospitalizations have been reported across North and South America and Europe following vaccine introduction [15]. We also found, across four studies, that VZV seroprevalence sharply increased with age in Turkey during childhood, with two studies reporting more than 85% seropositivity in children ≥ 10 years of age. Similarly, over 80% of children were seropositive by the age of 10 in 15 out of 16 European countries examined in a previous study [105].

There was a lack of data available regarding HZ infection for the broader Turkish population. Only one study was available which reported the annual incidence of HZ in Turkey for a large sample (confined to Istanbul) [21]. Critically, this study noted a rising annual incidence of HZ versus decreasing incidences of VZV, highlighting the need for further studies to be conducted across other provinces of Turkey. This trend of increasing cumulative incidence of HZ is in line with other studies reported worldwide, including in the USA, Canada, New Zealand, China, Taiwan, Sweden, and Germany [5].

On the other hand, there were four articles reporting HZ prevalence (0.43–1.56%) among dermatology patients in Turkey. Two studies reported that HZ was the most common viral-skin disorder among geriatric patients [30, 31]. However, since the majority of data on HZ prevalence were reported from clinical admissions, these values may underrepresent actual case numbers, as some individuals may not seek medical care. Moreover, of the centers reporting the incidence or prevalence of HZ, none were among the provinces with the highest proportion of elderly population, as reported in 2021 [106].

Some articles examined the number of HZ infections among vulnerable populations, in particular patients with HIV/AIDS or COVID-19. Based on data from Turkish health clinics, the number of HZ cases among patients with HIV/AIDS and COVID-19 was substantially higher than similar studies in the general population, consistent with increased susceptibility to HZ infection in immunocompromised patients [107]. However, fewer articles were found examining patients diagnosed with COVID-19 who subsequently developed HZ.

Several studies had described cases of HZ with complications, often involving vulnerable populations, indicating that while epidemiological data relating to complications is lacking, a substantial proportion of patients with HZ experience complications throughout Turkey. PHN was the most reported complication, while HZO was a common trend observed among case reports in the region. Diabetes mellitus was the most common comorbidity among HZ case reports, with many accompanied by hypertension. This is consistent with a systematic literature review and meta-analysis of studies on the risk of HZ in individuals with diabetes mellitus that reported these individuals are at a higher risk of developing HZ, which is further increased with age [108].

It has been hypothesized that the introduction of national varicella vaccination programs may restrict the amount of VZV exposure within the population, eliminating opportunities to boost VZV immunity, and therefore exacerbating the incidence and global health impact of HZ [21, 109]. For this reason, a childhood varicella vaccination program has not yet been introduced in the UK [110]. However, there is limited and confounding evidence to support this, and no studies were identified in Turkey to corroborate this hypothesis.

It should be noted that varicella vaccines themselves can cause HZ. A previous study demonstrated that 46% of HZ cases in vaccinated children were caused by vaccine-strain VZV, with an additional 2% of cases caused by potential vaccine-strain/wild-type virus recombinants [111]. HZ incidence reported in the current review may thus include cases caused by vaccination. While the frequency and severity of vaccine-induced HZ are lower than those caused by wild-type infection, severe cases of vaccine-induced HZ have been reported [112]. Additionally, Turkey currently administers the varicella vaccine as a single dose, despite two doses being recommended for licensed live attenuated varicella vaccines [113, 114]. Therefore, it is plausible that the current single-dose program may impact HZ presentation versus a two-dose program. However, no studies examining the epidemiology of vaccine-induced HZ in Turkey were identified and therefore further research on this topic is needed.

The main strategy for the prevention of HZ is vaccination [13, 14]. Licensed HZ vaccines are currently available for HZ (e.g., zoster vaccine live and recombinant zoster vaccine), which have shown significant efficacy in improving quality of life and reduced burden of disease in older individuals [2, 5]; however, HZ vaccines are not currently widely implemented globally [13]. Furthermore, HZ vaccination is not universally available in Turkey [18], and reflecting this, few Turkish individuals were aware of the vaccine and Turkish populations had poor knowledge of the symptoms, cause, and risks of HZ.

CONCLUSIONS

Overall, while there are existing single-center studies reporting epidemiology of HZ in dermatology clinics and among immunocompromised patient subpopulations, there remains a gap in the literature on the nationwide incidence and burden of HZ in the general population in Turkey, potentially reflecting that HZ is not a notifiable disease. As a result of the reported inadequate knowledge of HZ infection and susceptibilities described in Turkey, HZ may be at risk of misdiagnosis and hence the patient pathway needs to be subject to future investigation. Additionally, the abundance of case studies reporting complications arising from HZ infection suggests substantial health care resource utilization for patients with HZ in Turkey. Therefore, the scarceness of epidemiological data presents a key area for future research to increase disease awareness and risk

perception, and inform strategies for HZ prevention in Turkey.

ACKNOWLEDGEMENTS

Author Contribution. Substantial contributions to study conception and design: Selim Badur, Cihan Yesiloglu, Alev Ozakay, Serdar Ozturk, Adriana Guzman-Holst; substantial contributions to analysis and interpretation of the data: Selim Badur, Cihan Yesiloglu, Alev Ozakay, Serdar Ozturk, Adriana Guzman-Holst; drafting the article or revising it critically for important intellectual content: Selim Badur, Cihan Yesiloglu, Esin Senol, Alpay Azap, Alev Ozakay, Serdar Ozturk, Adriana Guzman-Holst; final approval of the version of the article to be published: Selim Badur, Cihan Yesiloglu, Esin Senol, Alpay Azap, Alev Ozakay, Serdar Ozturk, Adriana Guzman-Holst.

Funding. This study was sponsored by GlaxoSmithKline Biologicals SA (Study identifier VEO-000420). Support for third-party writing assistance for this article was fully funded by GSK in accordance with Good Publication Practice (GPP 2022) guidelines (https://www.ismpp.org/gpp-2022). The rapid service fee was also funded by GSK.

Medical Writing/Editorial Assistance. The authors acknowledge Bella Dragova, GSK, Belgium for publication management. The authors also thank Costello Medical for editorial assistance and publication coordination, on behalf of GSK, and acknowledge Samuel Shields, Costello Medical, UK for medical writing and editorial assistance based on authors' input and direction.

Data Availability. All data generated or analyzed during this study are included in this published article. Most of the cited peer-reviewed publications of this study are available via PubMed, and the gray literature was derived from resources available in the public domain.

Ethical approval. This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

Conflict of Interest. Selim Badur, Cihan Yesiloglu, Adriana Guzman-Holst: employee of the GSK group of companies; Serdar Ozturk: employee and stock owner of the GSK group of companies; Alev Ozakay: employee of the GSK group of companies at the time the study was conducted; Esin Senol, Alpay Azap: no conflicts of interest to disclose. A summary of the results from this review were previously presented at KLİMİK 2023, Belek-Antalya, Turkey.

REFERENCES

1. Hope-Simpson RE. The nature of herpes zoster: a long-term study and a new hypothesis. Proc R Soc Med. 1965;58(1):9–20.

2. Harbecke R, Cohen JI, Oxman MN. Herpes zoster vaccines. J Infect Dis. 2021;224(12 Suppl 2): S429–42. https://doi.org/10.1093/infdis/jiab387.

3. Arvin AM. Varicella-zoster virus. Clin Microbiol Rev. 1996;9(3):361–81. https://doi.org/10.1128/cmr.9.3.361.

4. Curran D, Schmidt-Ott R, Schutter U, Simon J, Anastassopoulou A, Matthews S. Impact of herpes zoster and postherpetic neuralgia on the quality of life of Germans aged 50 or above. BMC Infect Dis. 2018;18(1):496. https://doi.org/10.1186/s12879-018-3395-z.

5. van Oorschot D, Vroling H, Bunge E, Diaz-Decaro J, Curran D, Yawn B. A systematic literature review of herpes zoster incidence worldwide. Hum Vaccin Immunother. 2021;17(6):1714–32. https://doi.org/10.1080/21645515.2020.1847582.

6. Kawai K, Gebremeskel BG, Acosta CJ. Systematic review of incidence and complications of herpes zoster: towards a global perspective. BMJ Open. 2014;4(6): e004833. https://doi.org/10.1136/bmjopen-2014-004833.

7. Thompson RR, Kong CL, Porco TC, Kim E, Ebert CD, Acharya NR. Herpes zoster and postherpetic neuralgia: changing incidence rates from 1994 to 2018 in the United States. Clin Infect Dis. 2021;73(9):e3210–7. https://doi.org/10.1093/cid/ciaa1185.

8. Grote V, von Kries R, Rosenfeld E, Belohradsky BH, Liese J. Immunocompetent children account for the majority of complications in childhood herpes zoster. J Infect Dis. 2007;196(10):1455–8. https://doi.org/10.1086/522631.

9. Kang DH, Kwak BO, Park AY, Kim HW. Clinical manifestations of herpes zoster associated with complications in children. Children. 2021;8(10):845. https://www.mdpi.com/2227-9067/8/10/845.

10. United Nation, Department of Economic and Social Affairs, Population Division. World Population prospects: the 2012 revision. New York: United Nations, Department of Economic and Social Affairs, Population Division; 2013:4.

11. Worldometer. Turkey population. https://www.worldometers.info/world-population/turkey-population/. Accessed July 25, 2023.

12. Turkish Statistical Institute. Elderly statistics, 2014, vol. 7. Ankara: Turkish Statistical Institute; 2015.

13. Pan CX, Lee MS, Nambudiri VE. Global herpes zoster incidence, burden of disease, and vaccine availability: a narrative review. Ther Adv Vaccines Immunother. 2022;10:25151355221084536. https://doi.org/10.1177/25151355221084535.

14. Patil A, Goldust M, Wollina U. Herpes zoster: a review of clinical manifestations and management. Viruses. 2022;14(2):192. https://doi.org/10.3390/v14020192.

15. Varela FH, Pinto LA, Scotta MC. Global impact of varicella vaccination programs. Hum Vaccin Immunother. 2019;15(3):645–57. https://doi.org/10.1080/21645515.2018.1546525.

16. Wolfson LJ, Daniels VJ, Pillsbury M, et al. Cost-effectiveness analysis of universal varicella vaccination in Turkey using a dynamic transmission model. PLoS ONE. 2019;14(8): e0220921. https://doi.org/10.1371/journal.pone.0220921.

17. Devlet malzeme ofisi. Suçiçeği aşisi teknik şartnamesi. https://www.dmo.gov.tr/Files/IhaleDosyalari/15224/15224-2-teknik%20%C5%9Fartname.pdf. Accessed July 10, 2023.

18. World Health Organization. Vaccination schedule for Türkiye. https://immunizationdata.who.int/pages/schedule-by-country/tur.html. Accessed July 07, 2022.

19. Wohlin C. Guidelines for snowballing in systematic literature studies and a replication in software engineering. In: Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering. London: Association for Computing Machinery; 2014:Article 38.

20. Dinleyici EC, Kurugol Z, Turel O, et al. The epidemiology and economic impact of varicella-related hospitalizations in Turkey from 2008 to 2010: a nationwide survey during the pre-vaccine era (VARICOMP study). Eur J Pediatr. 2012;171(5):817–25. https://doi.org/10.1007/s00431-011-1650-z.

21. Soysal A, Gönüllü E, Yıldız İ, Karaböcüoğlu M. Incidence of varicella and herpes zoster after inclusion of varicella vaccine in national immunization schedule in Turkey: time trend study. Hum Vaccin Immunother. 2021;17(3):731–7. https://doi.org/10.1080/21645515.2020.1788861.

22. Alp H, Altınkaynak S, Ertekin V, Kılıçaslan B, Giiraksin A. Seroepidemiology of varicella-zoster virus infection in a cosmopolitan city (Erzurum) in the eastern Turkey. Health Policy. 2005;72(1):119–24. https://doi.org/10.1016/j.healthpol.2004.03.008.

23. Kanra G, Tezcan S, Badur S. Varicella seroprevalence in a random sample of the Turkish population. Vaccine. 2002;20(9–10):1425–8. https://doi.org/10.1016/s0264-410x(01)00459-5.

24. Kose S, Mandiracioglu A, Senger SS, et al. Seroprevalence of varicella-zoster virus in the prevaccine era: a population-based study in Izmir. Turkey J Infect Public Health. 2013;6(2):115–9. https://doi.org/10.1016/j.jiph.2012.10.003.

25. Koturoglu G, Kurugol Z, Turkoglu E. Seroepidemiology of varicella-zoster virus and reliability of varicella history in Turkish children, adolescents and adults. Paediatr Perinat Epidemiol. 2011;25(4):388–93. https://doi.org/10.1111/j.1365-3016.2010.01180.x.

26. Atiş G, Aydinİlknur E, Altunay I. Herpes zoster in geriatric patients: Clinical course and complications. Turk Geriatri Dergisi. 2017;20(3):172–7.

27. Özkol HU, Bilgili SG, Karadağ AS, Altun F, Çalka Ö. Türkiye'nin Doğusundaki Herpes Zoster Tanılı 115 Hastanın Klinik ve Demografik Özelliklerinin Değerlendirilmesi. Turk J Dermatol. 2013;7:201–5. https://doi.org/10.4274/tdd.1627.

28. Küçükçakır O, Aliağaoğlu C, Turan H, et al. 1999–2010 yılları arasında kliniğimizde takip edilen herpes zoster olgularının retrospektif değerlendirilmesi. Türkderm. 2012;46:186–90. https://doi.org/10.4274/turkderm.93265.

29. Dogan S, Bildik B, Karaboga T, Kalafat UM, Yesiltas I, Ozucelik DN. Evaluation of patients diagnosed with herpes zoster in emergency departments. Res J Life Sci Bioinform Pharm Chem Sci. 2019;5(1):195–202.

30. Kartal D, Çınar SL, Akın S, Ferahbaş A, Borlu M. Skin findings of geriatric patients in Turkey: a 5-year survey. Dermatol Sin. 2015;33(4):196–200. https://doi.org/10.1016/j.dsi.2015.04.001.

31. Yavuzcan G. Prevalence of skin disorders among geriatric patients in the Black Sea region of Turkey. J Exp Clin Med. 2022;39(2):327–33. https://doi.org/10.52142/omujecm.39.2.4.

32. Çeltek NY, Ünlü U. Evaluation of zona zoster cases occuring in cancer diagnosed patients. TJFMP. 2020;14(6):646–50. https://doi.org/10.21763/tjfmpc.766986.

33. Bilen A. Evaluation of patients with postherpetic neuralgia admitted to pain clinic. Klimik Derg. 2020;33(1):52–4. https://doi.org/10.5152/kd.2020.10.

34. Ozturk S, Akoglu EU, Arikan EE, Agalar C. Menopausal transition may affect the onset of herpes zoster: an update on herpes zoster vaccine. Ann Med Res. 2021;28(8):1515–9. https://doi.org/10.5455/annalsmedres.2020.09.961.

35. Senol E, Azap A, Kutlu SS, et al. Demographical and clinical evaluation of herpes zoster in Turkey: a retrospective multicentre study, the VARICOMP adult study [Congress Abstract P0060]. The 28th European Congress of Clinical Microbiology and Infectious Diseases. 2018.

36. Ku H-C, Tsai Y-T, Konara-Mudiyanselage S-P, Wu Y-L, Yu T, Ko N-Y. Incidence of herpes zoster in HIV-infected patients undergoing antiretroviral therapy: a systematic review and meta-analysis. J Clin Med. 2021;10(11):2300.

37. Glesby MJ, Moore RD, Chaisson RE. Clinical spectrum of herpes zoster in adults infected with human immunodeficiency virus. Clin Infect Dis. 1995;21(2):370–5. https://doi.org/10.1093/clinids/21.2.370.

38. Duman ZTO, Akoglu G. Disseminated herpes zoster infection in a splenectomized patient. Our Dermatol Online. 2018;9(4):456–7. https://doi.org/10.7241/ourd.20184.27.

39. Etgu F. Recurrent herpes zoster as a sign of HIV infection. Mid Black Sea J Health Sci. 2021;7(1):150–3.

40. Akalin H, Heper Y, Yilmaz E, et al. Retrospective analysis of 21 HIV/AIDS cases. Mikrobiyol Bult. 2005;39:339–43.

41. Akin H, Bölük G, Akalin H, et al. HIV/AIDS: retrospective analysis of 78 cases. Klimik Dergisi. 2012;25(3):111–6. https://doi.org/10.5152/kd.2012.31.

42. Altuntaş Aydin Ö, Kumbasar Karaosmanoğlu H, Korkusuz R, Özeren M, Özcan N. Mucocutaneous manifestations and the relationship to CD4 lymphocyte counts among Turkish HIV/AIDS patients in Istanbul. Turkey Turk J Med Sci. 2015;45(1):89–92. https://doi.org/10.3906/sag-1308-3.

43. Mustafayev K, Mete B, Kutlubay Z, et al. Dermatological lesions among people living with HIV in Turkey. Int J STD AIDS. 2022;33(1):55–62. https://doi.org/10.1177/09564624211043711.

44. Gunes R, Külcü Çakmak S, Yorulmaz A. Mucocutaneous manifestation of HIV and the correlation with CD4 count and viral load: a prospective study from Turkey. Turkiye Klinikleri J Dermatol. 2020;30(3):88–94. https://doi.org/10.5336/dermato.2020-79035.

45. Yardimici AC, Fincanci M. The relationship between the opportunistic diseases and viral load and CD4+ T cell count in patients with HIV infection. Klimik Dergisi. 2015;28(1):28–34. https://doi.org/10.5152/kd.2015.06.

46. Coronavirus disease 2019 (COVID-19) Situation Report – 163. World Health Organization; 2020.

47. Kartal SP, Çelik G, Sendur N, et al. Multicenter study evaluating the impact of COVID-19 outbreak on dermatology outpatients in Turkey. Dermatol Ther.

2020;33(6): e14485. https://doi.org/10.1111/dth.14485.

48. Algaadi SA. Herpes zoster and COVID-19 infection: a coincidence or a causal relationship? Infection. 2022;50(2):289–93. https://doi.org/10.1007/s15010-021-01714-6.

49. Diez-Domingo J, Parikh R, Bhavsar AB, Cisneros E, McCormick N, Lecrenier N. Can COVID-19 increase the risk of herpes zoster? A narrative review. Dermatol Ther (Heidelb). 2021;11(4):1119–26. https://doi.org/10.1007/s13555-021-00549-1.

50. Temiz SA, Kutlu Ö. The development of dermatologic diseases in patients recovered from COVID-19. Dermatol Ther. 2021;34(2):e14791. https://doi.org/10.1111/dth.14791.

51. Bostan E, Yalici-Armagan B. Herpes zoster following inactivated COVID-19 vaccine: a coexistence or coincidence? J Cosmet Dermatol. 2021;20(6):1566–7. https://doi.org/10.1111/jocd.14035.

52. Aksu SB, Öztürk GZ. A rare case of shingles after COVID-19 vaccine: is it a possible adverse effect? Clin Exp Vaccine Res. 2021;10(2):198–201. https://doi.org/10.7774/cevr.2021.10.2.198.

53. Acar A, Yoldaş A, Karaarslan I, et al. Retrospective evaluation of clinical features in hospitalized herpes zoster patients. Ege Tıp Dergisi. 2022;61(1):58–63. https://doi.org/10.19161/etd.1085700.

54. Acer E, Erdoğan HK, Bulur I, Acar EM. Evaluation of demographic and clinical characteristics of 166 patients with herpes zoster in the Kırşehir region. Turkderm Arch Dermatol Venerol. 2018;52:95–9.

55. Yürük D, Yildiz Tabakoğlu A. Is postherpetic neuralgia an inevitable end in elderly cases with herpes zoster? An evaluation of age-related risk factors in the development of postherpetic neuralgia. Turk Geriatri Dergisi. 2021;24(1):41–9. https://doi.org/10.31086/tjgeri.2021.198.

56. Afşar Sİ, Uzunkulakoğlu A, Karataş M. Brachial plexopathy associated with herpes zoster infection: report of two cases and review of the literature. J PMR Sci. 2016;19:55–7.

57. Aktaş İ, Akgün K, Gündüz OH. Axillary mononeuropathy after herpes zoster infection mimicking subacromial impingement syndrome. Am J Phys Med Rehabil. 2008;87(10):859–61. https://doi.org/10.1097/PHM.0b013e318186bb95.

58. Alpay K, Yandt M. Herpes zoster and Ogilvie's syndrome. Dermatology. 1994;189(3):312. https://doi.org/10.1159/000246870.

59. Araz C, Aşkin S, Yılmaz C. Herpes zoster brachial plexopathy: direct steroid injection. Turk Neurosurg. 2017;27(4):662–4. https://doi.org/10.3390/jcm10112300.

60. Aydin E, Balikoglu-Yilmaz M, Imre SS, Koc F, Kazanci L, Ozturk AT. A rare patient with orbital apex syndrome, anterior uveitis, and necrotizing scleritis due to herpes zoster ophthalmicus. J Craniofac Surg. 2016;27(8):e750–2. https://doi.org/10.1097/scs.0000000000003098.

61. Bahadir C, Kalpakcioglu AB, Kurtulus D. Unilateral diaphragmatic paralysis and segmental motor paresis following herpes zoster. Muscle Nerve. 2008;38(2):1070–3. https://doi.org/10.1002/mus.21042.

62. Bakbak B, Çelebi ARC, Şener C. Horner's syndrome following herpes zoster ophthalmicus. Turk Norol Derg. 2009;15:82–4.

63. Bakılan F, Ösken S, Ekim A. Complex regional pain syndrome after herpes zoster: a case report. Turk J Osteoporos. 2018;24:63–6. https://doi.org/10.4274/tod.55477.

64. Balcı K, Utku U, Özbek B. Herpes zoster ophthalmicus with sixth cranial nerve palsy: a case report. Turk J Neurol. 2008;14(5):350–2.

65. Balta S, Talu GK. Segmental zoster paresis of the lower extremity: case report. Agri. 2021. https://doi.org/10.14744/agri.2021.70846.

66. Büyükdemirci A, Yüksekkaya E, Cesur S, Kaya-Kılıç E, Ataman-Hatipoglu C, Kınıklı S. Encephalitis following herpes zoster ophthalmicus. Klimik Dergisi. 2020;31(2):157–60. https://doi.org/10.5152/kd.2018.37.

67. Çevik B, Kurt S, Aksoy D, Ünaldi HK, Günal Ö, Solmaz V. Polyradiculitis and transverse myelitis secondary to herpes zoster in a liver transplant patient. Noro Psikiyatr Ars. 2013;50:193–4. https://doi.org/10.4274/npa.y6848.

68. Çınar N, Sahin S, Okluoglu T, Batum K, Karşıdağ S. Herpes radiculopathy case presenting first with motor involvement. Eur J General Med. 2011;8(3):219–23.

69. Erden E, Öztürk GT, Ersöz M. Herpes zoster infection presenting as neurogenic bladder dysfunction. Turk J Phys Med Rehabil. 2017;63(2):199. https://doi.org/10.5606/tftrd.2017.905.

70. Eren E, Kaynar L, Doganay M. Severe herpes zoster ophtalmicus in an immuncompromised patient. Erciyes Med J. 2018;40(4):240–1. https://doi.org/10.5152/etd.2017.0118.

71. Erol B, Avci A, Eken C, Ozgok Y. Urinary retention, erectile dysfunction and meningitis due to sacral herpes zoster: a case report and review of the literature. Urol Int. 2009;82(2):238–41. https://doi.org/10.1159/000200807.

72. Eskiizmir G, Uz U, Taşkiran E, Unlü H. Herpes zoster oticus associated with varicella zoster virus encephalitis. Laryngoscope. 2009;119(4):628–30. https://doi.org/10.1002/lary.20111.

73. Demir CF, Akalın Y, Berilgen S. Occipital neuralgia following thoracic herpes zoster: case report. Agri. 2011;23(4):179–80. https://doi.org/10.5505/agri.2011.87699.

74. Gurel MS, Savas S, Bilgin F, Erdil D, Leblebici C, Sarikaya E. Zosteriform pemphigoid after zoster: Wolf's isotopic response. Int Wound J. 2016;13(1):141–2. https://doi.org/10.1111/iwj.12423.

75. Kansu L, Yilmaz I. Herpes zoster oticus (Ramsay Hunt syndrome) in children: case report and literature review. Int J Pediatr Otorhinolaryngol. 2012;76(6):772–6. https://doi.org/10.1016/j.ijporl.2012.03.003.

76. Kavalci C, Findik M, Muratoglu M. A rare case in emergency: herpes zoster ophtalmicus. J Case Reports Med. 2019;8(4):1–2. https://doi.org/10.25149/jcrm.v8i3.203.

77. Kayayurt K, Yavasi O, Bilir O, Ersunan G, Giakoup B. A case of Ramsay hunt syndrome with atypical presentation. Turk J Emerg Med. 2014;14(3):142–5. https://doi.org/10.5505/1304.7361.2014.82788.

78. Keskinruzgar A, Demirkol M, Ege B, Aras M, Ay S. Rare involvement of herpes zoster in the mandibular branch of the trigeminal nerve: a case report and review of the literature. Quintessence Int. 2015;46(2):163–70. https://doi.org/10.3290/j.qi.a32814.

79. Kocaoğlu G, Utine CA, Yaman A, Men S. Orbital apex syndrome secondary to herpes zoster ophthalmicus. Turk J Ophthalmol. 2018;48(1):42–6. https://doi.org/10.4274/tjo.02256.

80. Kucukardali Y, Solmazgul E, Terekeci H, Oncul O, Turhan V. Herpes zoster ophthalmicus and syndrome of inappropriate antidiuretic hormone secretion. Intern Med. 2008;47(5):463–5. https://doi.org/10.2169/internalmedicine.47.0629.

81. Kulakli F, Kulakli S, Ilhanli İ, Aslan A, Uysal E, Çelik C. Polymyalgia rheumatica after herpes-zoster. Arch Rheumatol. 2018;33(4):494–5. https://doi.org/10.5606/ArchRheumatol.2018.6859.

82. Kurtaran B, Paydaş S, Candevir A, Kömür S, Salih Zeki Aksu H. Disseminated herpes zoster infection in a patient with lymphoma. Turk J Med Sci. 2009;39(3):479–82. https://doi.org/10.3906/sag-0803-6.

83. Ozel L, Toros SZ, Unal E, et al. Ramsay Hunt syndrome with atypical progress in a renal transplant recipient: a case report. Exp Clin Transplant. 2011;9(6):413–6.

84. Öztop P, Saraçgil Coşar SN, Ümit Yemişci O, Varol Üre RS. Complex regional pain syndrome associated with herpes zoster: a case report. Turk J Rheumatol. 2011;26(3):254–7. https://doi.org/10.5152/tjr.2011.040.

85. Samanci Y, Samanci B. A case of herpes zoster infection mimicking carpal tunnel syndrome. Neurol India. 2019;67(1):272–3. https://doi.org/10.4103/0028-3886.253607.

86. Soydas Turan B, Bozkurt MF. Unusual presentation of herpes zoster infection mimicking soft tissue metastases of breast cancer on 18F-FDG PET/CT imaging. Clin Nucl Med. 2021;46(8):669–70. https://doi.org/10.1097/rlu.0000000000003580.

87. Temizkan R, Unal N, Engin M, Kiliçaslan Ö, Kocabay K. Herpes zoster infection in early adolescence: two case reports and review of the treatment approach. Family Pract Palliat Care. 2020;5(2):58–61. https://doi.org/10.22391/fppc.514033.

88. Terzi R, Yılmaz Z. A brachial plexus lesion secondary to herpes zoster: a case report. Turk J Phys Med Rehab. 2013;59:69–72. https://doi.org/10.4274/tftr.57625.

89. Top Karti D, Aktert D, Celebisoy N. Isolated internal ophthalmoplegia secondary to herpes zoster ophthalmicus: a rare case report. Neuroophthalmol. 2019;44(2):118–20. https://doi.org/10.1080/01658107.2019.1618343.

90. Unal B, Ahıska YC, Uslu N, Avcı S. Herpes zoster affecting the lower extremity in an older patient: a clinical image. Lupine Online J Med Sci. 2018;2(3):190–1. https://doi.org/10.32474/LOJMS.2018.02.000144.

91. Yalcinbayir O, Yildiz M, Gunduz GU, Gelisken O. Herpes zoster ophthalmicus and lateral rectus palsy in an elderly patient. Case Rep Ophthalmol. 2011;2(3):333–7. https://doi.org/10.1159/000334236.

92. Yalçınbayır Ö, Gelişken Ö, Yılmaz E. Unilateral optic neuritis in a case of herpes zoster ophthalmicus. Neuroophthalmology. 2009;33(6):339–42.

93. Yorulmaz A, Hazar Tantoğlu B, Artüz F. Necrotic herpes zoster in an otherwise healthy patient.

J Turkish Acad Dermatol. 2015. https://doi.org/10.6003/jtad.1593c4.

94. Yýlmaz S, Köseolu HK, Yücel E. Transverse myelitis caused by varicella zoster: case reports. Braz J Infect Dis. 2007;11(1):179–81. https://doi.org/10.1590/s1413-86702007000100040.

95. Yaldiz M, Solak B, Kara RO, Cosansu N, Erdem MT. Comparison of famciclovir, valaciclovir, and brivudine treatments in adult immunocompetent patients with herpes zoster. Am J Ther. 2018;25(6):e626–34. https://doi.org/10.1097/mjt.0000000000000436.

96. Asik Z, Cakmak T, Bilgili P. Knowledge, attitudes and behaviors of adults about adult vaccinations. Turk Aile Hek Dergi. 2013;17(3):113–8. https://doi.org/10.2399/tahd.13.55265.

97. Bayraktar-Ekincioglu A, Kara E, Bahap M, Cankurtaran M, Demirkan K, Unal S. Does information by pharmacists convince the public to get vaccinated for pneumococcal disease and herpes zoster? Irish J Med Sci. 2022;191:2193–200. https://doi.org/10.1007/s11845-021-02778-x.

98. Erdogdu HI, Catak B. Influenza, pneumococcal and herpes zoster vaccination rates amongst people aged 65 years and older and related factors. Turk Geriatri Dergisi. 2018;21(4):498–506. https://doi.org/10.31086/tjgeri.2018.54.

99. İlhan B, Bakkaloglu O. Vaccination rates in geriatric outpatient clinic in Gaziantep Dr. Ersin Arslan training and research hospital. Med Bull Haseki. 2019;57:75–8. https://doi.org/10.4274/haseki.galenos.2019.4794.

100. Kizmaz M, Kumtepe Kurt B, Çetin Kargin N, Döner E. Influenza, pneumococcal and herpes zoster vaccination rates among patients over 65 years of age, related factors, and their knowledge and attitudes. Aging Clin Exp Res. 2020;32(11):2383–91. https://doi.org/10.1007/s40520-019-01423-z.

101. Nazik S, Nazik H, Gül F, Demir B. Herpes Zoster Hastalarının Hastalıkları ile İlgili Tutum ve Beklentileri. Firat Med J. 2016;21:137–40.

102. Paek E, Johnson R. Public awareness and knowledge of herpes zoster: results of a global survey. Gerontology. 2010;56(1):20–31. https://doi.org/10.1159/000240046.

103. Revanli RA, Yüceer C, Şenol E, et al. Awareness and attitude of family physicians about human papilloma virus and herpes zoster vaccines. Klimik Dergisi. 2015;29(1):15–20. https://doi.org/10.5152/kd.2016.04.

104. Sütlü S, Til A. Immunization status and factors affecting individuals aged 65 years and above with chronic diseases who are registered with family physicians in Burdur Province. Turk Geriatri Dergisi. 2021;24(1):71–8. https://doi.org/10.31086/tjgeri.2021.201.

105. Bollaerts K, Riera-Montes M, Heininger U, et al. A systematic review of varicella seroprevalence in European countries before universal childhood immunization: deriving incidence from seroprevalence data. Epidemiol Infect. 2017;145(13):2666–77. https://doi.org/10.1017/s0950268817001546.

106. Turkish Statistical Institute. Elderly statistics, 2021. https://data.tuik.gov.tr/Bulten/Index?p=Elderly-Statistics-2021-45636&dil=2. Accessed Sep 01, 2022.

107. Chen SY, Suaya JA, Li Q, et al. Incidence of herpes zoster in patients with altered immune function. Infection. 2014;42(2):325–34. https://doi.org/10.1007/s15010-013-0550-8.

108. Huang CT, Lee CY, Sung HY, Liu SJ, Liang PC, Tsai MC. Association between diabetes mellitus and the risk of herpes zoster: a systematic review and meta-analysis. J Clin Endocrinol Metab. 2022;107(2):586–97. https://doi.org/10.1210/clinem/dgab675.

109. Brisson M, Gay NJ, Edmunds WJ, Andrews NJ. Exposure to varicella boosts immunity to herpes-zoster: implications for mass vaccination against chickenpox. Vaccine. 2002;20(19):2500–7. https://doi.org/10.1016/S0264-410X(02)00180-9.

110. Joint Committee on Vaccination and Immunisation Varicella Sub-Committee. Minute of the meeting on 19 June 2015. https://app.box.com/s/vdlafy8wm4t5asq2qyfpc4dw6fzeyypf/file/149454406336. Accessed Jun 17, 2022.

111. Weinmann S, Chun C, Schmid DS, et al. Incidence and clinical characteristics of herpes zoster among children in the varicella vaccine era, 2005–2009. J Infect Dis. 2013;208(11):1859–68. https://doi.org/10.1093/infdis/jit405.

112. Moodley A, Swanson J, Grose C, Bonthius DJ. Severe herpes zoster following varicella vaccination in immunocompetent young children. J Child Neurol. 2019;34(4):184–8. https://doi.org/10.1177/0883073818821498.

113. Varivax Summary of Product Characteristics. https://www.medicines.org.uk/emc/files/pil.5582.pdf. Accessed Jul 10, 2023.

114. Varilrix Summary of Product Characteristcs. https://www.medicines.org.uk/emc/product/1676/smpc/print. Accessed Jul 10, 2023.

Publisher's Note