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SYMPTOMS OF POST-COVID ORAL HEALTH CONDITIONS AND THEIR INFLUENCE ON THE RISK OF DEVELOPING DENTAL PATHOLOGY

Abstract. Post-COVID syndrome is diagnosed if symptoms last longer than 3 weeks after the onset of the disease, and a chronic course of the disease is determined if symptoms persist for more than 12 weeks. The investigation considered patients' complaints and the presence of infection in the oral cavity following COVID-19 and, based on this, evaluated the influence of distant symptoms on the risk of developing dental pathology. All subjects were interviewed using the most commonly used questionnaire OHIP-14, which determines the level of quality of life related to dental health. The most frequent complaint was a feeling of dryness in the oral cavity, which was reported by 30.04 % of the subjects (1.64 % in the control group). More than 24.90 % of patients who had COVID-19 noted loss of taste sensation (in the control group – 1.64 %). Clinical oral examination of COVID-19 patients revealed such oral mucosal lesions as erythema, papules, vesicles, as well as periodontal and salivary gland disorders.

Keywords: coronavirus infection, post-covid syndrome, dental pathology, xerostomia, taste and smell perception, oral candidiasis

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СИМПТОМЫ ПОСТКОВИДНОГО СОСТОЯНИЯ РОТОВОЙ ПОЛОСТИ И ИХ ВЛИЯНИЕ НА РИСК РАЗВИТИЯ СТОМАТОЛОГИЧЕСКОЙ ПАТОЛОГИИ

Аннотация. При длительности постковидных симптомов более 3 недель от начала заболевания COVID диагностируют постковидный синдром, а при их длительности более 12 недель – хроническое течение заболевания. В ходе исследования учитывали жалобы пациентов и наличие инфекции в ротовой полости после перенесенного COVID-19 и на основе этого оценивали влияние отдаленных симптомов на риск развития стоматологической патологии. Все испытуемые были опрошены с помощью наиболее часто используемого опросника OHIP-14, определяющего уровень качества жизни, связанного со здоровьем зубов. Наиболее частыми были жалобы на чувство сухости в ротовой полости, которое предъявляли 30,04 % обследованных (в контрольной группе – 1,64 %). Более 24,90 % пациентов, переболевших COVID-19, отмечали потерю вкусовых ощущений (в контрольной группе – 1,64 %). При клиническом осмотре ротовой полости пациентов, перенесших COVID-19, выявлены такие поражения слизистой оболочки рта, как эритема, папулы, везикулы, а также заболевания периодонта и слюнных желез.

Ключевые слова: коронавирусная инфекция, постковидный синдром, стоматологическая патология, ксеростомия, восприятие вкуса и запаха, оральный кандидоз

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Introduction. Since the outbreak of COVID-19, many manifestations and outcomes of this viral disease have been described in various organs and systems (lungs, blood vessels, kidneys, brain, etc.) [1, 2].

Numerous oral symptoms have been described in patients with SARS-CoV-2 infection, and multiple mechanisms of oral injury in patients with COVID-19 have been discussed. However, to date, there are no characteristics of dental pathology in patients in the long-term period after undergoing COVID-19.

Interviewing patients is important to better understand and document oral manifestations associated with past COVID-19 [2–9].

It is now known that 10–30 % of patients who have had COVID-19, regardless of the severity of the coronavirus infection, have symptoms whose origin cannot be explained by an alternative diagnosis and affect many body systems. The duration of the post-COVID syndrome can reach several weeks or months. With a duration of more than 3 weeks from the onset of COVID-19, they speak of post-acute COVID-19 syndrome. If the duration of the symptoms is more than 12 weeks – about the chronic course. In the latter case, the phrase "long-covid syndrome" (long-covid) is increasingly mentioned in the literature. The maximum duration of the syndrome is unknown [10].

The likelihood of post-COVID syndrome is difficult to predict. Even patients with mild COVID-19 can develop severe post-COVID syndrome. The probability is also not related to age, a set of previous and concomitant diseases, social and psychological factors. Symptoms of post-covid syndrome may occur several weeks later, months after a seemingly recovery [11].

The cause of the development of the disease is viral and autoimmune mechanisms of damage to various organs and systems. At the same time, the presence of symptoms after an acute period does not at all mean the presence of a virus in the body [12, 13].

The aim of the study – to determine dental complaints and manifestations in the oral cavity after suffering COVID-19 and their impact on the risk of dental pathology based on the definition of long-term symptoms.

Materials and research methods. Data on the examined patients were obtained from copies of the case histories of the outpatient clinic of therapeutic dentistry at the Tashkent State Dental Institute. All subjects were surveyed using the most commonly used questionnaire OHIP-14, which determines the level of quality of life associated with dental health. Informed consent was provided for each patient to participate in the research [14, 15].

The study involved 4 groups of patients:

1 (control group) – 122 patients who had not previously had COVID-19 with a negative result of PCR testing and no antibodies to SARS-CoV-2.

The main groups were formed from patients with a history of COVID-19 more than 12 weeks ago and with and/or without symptoms, complaints, and secondary damage to organs and systems. Patients were divided into 3 groups according to the clinical severity of the post-COVID state.

2 (main group) – 120 patients (asymptomatic course) – with a personal history of COVID-19, these patients had no complaints characteristic of past COVID-19, and indicators of systemic inflammation and blood coagulation were within the normal range.

3 (main group) – 82 patients, these patients had complaints typical of previous COVID-19 without activation of indicators of systemic inflammation and blood coagulation.

4 (main group) – 51 patients, patients had complaints characteristic of previous COVID-19, secondary damage to organs and systems, and activation of indicators of systemic inflammation and blood coagulation.

The tables present indicators of conjugation of ranks, which will make it possible to determine the influence and significance of each of the risk factors using risk calculations and odds ratios according to the Pearson chi square – χ^2 criteria.

Results and its discussion. The study took into account groups affected by the factor and determined the frequency of outcomes.

The most common complaint among the examined patients was a feeling of dryness in the oral cavity, which was presented by 30.04 % of the examined vs 1.64 % in the control group ($\chi^2 = 40.300$; $p \leq 0.001$); while in patients with complete clinical recovery (group 1), the frequency of xerostomia was 10.0 %; with complaints (group 2) – 34.15 % and laboratory confirmation of inflammation – this frequency was already 70.59 % ($\chi^2 = 41.368$; $p \leq 0.001$), which proves the correlation between dry mouth and the severity of the post-COVID state (Tab. 1).

The most important signs of COVID-19 are taste disturbances and reduced odor perception. Although these manifestations are considered a neurological problem, loss of taste is undoubtedly a dental problem as well. More than 24.90 % of patients who recovered from COVID-19 complained of loss of taste

sensations vs 1.64 % in the control group (χ^2 = 31.083; $p \leq 0.001$); at the same time, the prevalence of taste disorders increased progressively: 11.48; 26.82 and 52.97 % (χ^2 = 31.942; $p \leq 0.001$); the corresponding ratio of patients with impaired odor perception was 14.62 % vs 2.46 % (χ^2 = 12.784; $p \leq 0.001$; 8.43; 21.95 and 41.18 % (χ^2 = 20.839; $p \leq 0.001$) (Tab. 1).

T a b l e 1. **Complaints of patients who underwent COVID-19 (in %)**

Complaints	Control (n = 122)	Personal history of COVID-19 (V08.9)			Total patients (n = 253)
		Status after COVID-19 (V09.9)			
		Asymptomatic (n = 120)	Complaints typical of previous COVID-19 without activation of indicators of systemic inflammation and blood coagulation (n = 82)	Complaints characteristic of previous COVID-19, secondary damage to organs and systems, and activation of indicators of systemic inflammation and blood coagulation (n = 51)	
Dryness in the oral cavity	2/1.64	12/10.0	28/34.15	36/70.59	76/30.04
		χ^2 = 41.368; $p \leq 0.001$			χ^2 = 40.300; $p \leq 0.001$
Smell impairment	3/2.46	10/8.33	16/21.95	21/41.18	37/14.62
		χ^2 = 20.839; $p \leq 0.001$			χ^2 = 12.784; $p \leq 0.001$
Taste perception disorder	2/1.64	14/11.48	22/26.82	27/52.97	63/24.90
		χ^2 = 31.942; $p \leq 0.001$			χ^2 = 31.083; $p \leq 0.001$
Burning sensation in the oral cavity	4/3.28	7/5.83	10/12.20	17/33.33	34/13.44
		χ^2 = 14.039; $p \leq 0.01$			χ^2 = 9.204; $p \leq 0.001$
Difficulties with opening the mouth	3/2.46	8/6.56	10/12.20	15/29.41	35/13.84
		χ^2 = 13.214; $p \leq 0.01$			χ^2 = 11.695; $p \leq 0.001$
Smell from the mouth	80/65.57	110/90.16	80/97.56	51/100.0	243/96.05
		χ^2 = 155.962; $p \leq 0.001$			χ^2 = 63.976; $p \leq 0.001$
Facial pain	1/0.82	2/1.64	3/3.65	7/13.72	12/4.73
		χ^2 = 4.954; $p \geq 0.05$			χ^2 = 3.786; $p \geq 0.05$
Weakness of the chewing muscles	2/1.64	3/2.46	5/6.10	12/23.53	20/7.905
		χ^2 = 8.668; $p \leq 0.05$			χ^2 = 5.851; $p \leq 0.05$
Pain while eating and swallowing food	3/2.46	4/4.92	7/8.54	13/25.49	24/9.49
		χ^2 = 10.422; $p \geq 0.05$			χ^2 = 7.764; $p \leq 0.01$
1Hyperemia, swelling of the face and/or neck	1/0.82	4/4.92	5/6.10	10/19.61	19/7.50
		χ^2 = 7.980; $p \leq 0.05$			χ^2 = 7.297; $p \leq 0.01$

Dental complaints of patients in the post-COVID period had a diverse spectrum. Some patients (13.44 %) noted burning sensation in the oral cavity vs 3.28 % in the control group (χ^2 = 9.204; $p \leq 0.001$); difficulties with opening the mouth were found in 13.84 % vs 2.46 % (χ^2 = 11.695; $p \leq 0.001$); facial pain, respectively, in 4.73 % vs 0.82 % (χ^2 = 3.786; $p \geq 0.05$); weakness of masticatory muscles, respectively, in 7.905 % vs 1.64 % (χ^2 = 8.851; $p \leq 0.05$); for pain during eating and swallowing food, respectively, 9.49 % vs 2.46 % (χ^2 = 7.764; $p \leq 0.01$) and for flushing and swelling of the face and/or neck, 7.50 % of patients vs 0.82 of the control group (χ^2 = 7.297; $p \leq 0.01$) (Tab. 1). Thus, the presence of COVID-19 in history significantly increases the frequency of complaints.

At the same time, a significant influence of the nature of the clinical course of the post-COVID period on the frequency of registration of complaints was shown. Thus, the frequency of complaints of burning in the mouth increased from 5.83 % in patients without complications to 12.20 % in patients with complaints and reached 33.33 % in patients with laboratory-confirmed inflammation (χ^2 = 14.039; $p \leq 0.01$); the corresponding dynamics of difficulty opening the mouth was 6.56; 12.20 and 29.41 % (χ^2 = 13.214; $p \leq 0.01$); facial pain 1.64; 3.65 and 13.72 % (χ^2 = 4.954; $p \geq 0.05$); weakness of masticatory muscles, respectively, 2.46; 6.10 and 23.53 % (χ^2 = 8.668; $p \leq 0.05$); pain during eating and swallowing food 4.92; 8.54 and 25.49 % (χ^2 = 10.422; $p \geq 0.05$) and hyperemia and swelling of the face and/or neck 4.92; 6.10 and 19.61 % (χ^2 = 7.980; $p \leq 0.05$) (Tab. 1).

The most common complaint in the studied groups was a complaint of bad breath, which was experienced by 96.05 % of patients who underwent COVID-19 and 65.57 % of the control group (χ^2 = 63.976; $p \leq 0.001$); at the same time, 90.16 % of patients with an asymptomatic post-covid state complained of bad breath; 97.56 % of respondents with complaints and 100.00 % of patients with laboratory signs of inflammation (χ^2 = 155.962; $p \leq 0.001$) (Tab. 1).

T a b l e 2. **The impact of previous COVID-19 on the risk of dental complaints**

Complaints	Relative risks	95 % CI	
		5 %	95 %
Dryness in the oral cavity	18.324	4.576	73.372
Smell impairment	5.947	1.871–18.907	
Taste perception	15.190	3.779–61.050	
Burning sensation in the oral cavity	4.099	1.488–11.291	
Difficulties with opening the mouth	5.626	1.765–17.931	
Smell from the mouth	1.465	1.285–1.670	
Facial pain	5.787	0.761–43.996	
Weakness of the chewing muscles	4.822	1.145–20.301	
Pain while eating and swallowing food	3.858	1.185–12.563	
Hyperemia, swelling of the face and / or neck	9.162	1.243–67.650	

As can be seen from Tab. 2, a history of COVID-19 significantly increases the risk of dental complaints. Thus, the risk of dryness in the mouth was 18.324 (95 % CI 4.576–73.372); impaired odor perception – 5.947 (95 % CI 1.871–18.907); taste disturbance, 15.190 (95 % CI 3.779–61.050); burning in the mouth – 4.099 (95 % CI 1.488–11.291); difficulty opening the mouth, 5.626 (95 % CI 1.765–17.931); bad breath, 1.465 (95 % CI 1.285–1.670); facial pain – 5.787 (95 % CI 0.761–43.996); masticatory muscle weakness – 4.822 (95 % CI 1.145–20.301); pain when eating – 3.858 (95 % CI 1.185–12.563) and flushing and/or swelling of the face – 9.162 (1.243–67.650).

During a clinical examination of the oral cavity of patients who underwent COVID-19, such lesions of the oral mucosa as erythema, papules, vesicles, etc. were found. Often these lesions were transitional elements from the initial lesions of the mucosa in the form of a spot to the developed forms in the form of bulls and/or vesicles and ulcers. A detailed analysis made it possible to differentiate these lesions.

Thus, the frequency of erythema in patients who underwent COVID-19 was 8.30 % vs 2.46 % in the control group (χ^2 = 4.584; $p \leq 0.05$; RR = 3.375; 95 % CI 1.027–11.099); the prevalence of petechiae, respectively, 12.65 % vs 2.46 % (χ^2 = 10.078; $p \leq 0.02$; RR = 5.144; 95 % CI 1.067–16.467); at the same time, the incidence of macular spots was 15.02 % vs 1.64 % (χ^2 = 15.465; $p \leq 0.001$; RR = 9.162; 95 % CI 2.247–37.356); and papules, respectively, 9.49 % vs 3.28 % (χ^2 = 4.590; $p \leq 0.0039$; RR = 2.893; 95 % CI 1.026–8.155); the frequency of pustules, respectively, 10.76 % vs 2.46 % (χ^2 = 7.543; $p \leq 0.007$; RR = 4.340; 95 % DI 1.343–14.026); bullous elements occurred 5.53 % vs 1.63 % (χ^2 = 3.056; $p \geq 0.080$; RR = 3.375; 95 % CI 0.779–14.619); the corresponding ratio of vesicles was 4.35 % vs 0.82 % (χ^2 = 3.38; $p \leq 0.07$; RR = 5.304; 95 % CI 0.693–46.620). In general, ulcerative lesions of the oral mucosa occurred in 14.23 % of patients in the post-COVID state and in 4.10 % of the examined control groups (χ^2 = 8.801; $p \leq 0.004$; RR = 3.472; 95 % CI 1.397–8.627) (Tab. 3, 4).

T a b l e 3. **Prevalence (in %) of the pathology of the oral mucosa and tongue in patients who have had COVID-19**

Pathology of the oral mucosa	Control (n = 122)	Personal history of COVID-19 (V08.9) / Status after COVID-19 (V09.9)			Total patients (n = 122)
		Asymptomatic (n = 120)	Complaints typical of previous COVID-19 without activation of indicators of systemic inflammation and blood coagulation (n = 82)	Complaints characteristic of previous COVID-19, secondary damage to organs and systems, and activation of indicators of systemic inflammation and blood coagulation (n = 51)	
Erythema	3/2.46	4/3.33	5/6.10	12/23.53	21/8.30
		$\chi^2 = 8.867$; $p \le 0.05$			$\chi^2 = 4.584$; $p \le 0.05$
Petechiae	3/2.46	6/5.00	11/13.41	15/29.41	32/12.65
		$\chi^2 = 13.484$; $p \le 0.01$			$\chi^2 = 10.078$; $p \le 0.02$
Macular spots	2/1.64	7/5.83	14/17.07	17/33.33	38/15.02
		$\chi^2 = 17.034$; $p \le 0.01$			$\chi^2 = 15.465$; $p \le 0.001$
Papules	4/3.28	5/4.17	7/8.54	12/23.53	24/9.49
		$\chi^2 = 10.087$; $p \le 0.01$			$\chi^2 = 4.590$; $p \le 0.0039$
Pustules	3/2.46	7/5.83	8/9.76	12/23.53	27/10.67
		$\chi^2 = 10.323$; $p \le 0.05$			$\chi^2 = 7.543$; $p \le 0.007$
Bullous elements	2/1.63	1/0.83	5/6.10	8/15.69	14/5.53
		$\chi^2 = 7.992$; $p \le 0.05$			$\chi^2 = 3.056$; $p \le 0.080$
Vesicles	1/0.82	2/1.64	3/3.66	6/11.76	11/4.35
		$\chi^2 = 4.447$; $p \le 0.05$			$\chi^2 = 3.38$; $p \le 0.07$
Ulcerative lesions	5/4.10	6/5.90	9/10.98	21/41.18	36/14.23
		$\chi^2 = 16.252$; $p \le 0.01$			$\chi^2 = 8.801$; $p \le 0.004$
Desquamative gingivitis	22/18.03	23/19.17	32/39.02	46/90.20	101/39.53
		$\chi^2 = 49.521$; $p \le 0.001$			$\chi^2 = 17.891$; $p \le 0.001$
Desquamative glossitis	14/11.48	18/15.00	28/34.15	32/62.75	78/30.83
		$\chi^2 = 34.853$; $p \le 0.001$			$\chi^2 = 17.891$; $p \le 0.001$
Villous tongue	8/6.56	19/15.83	27/32.93	33/64.71	79/31.23
		$\chi^2 = 35.558$; $p \le 0.001$			$\chi^2 = 16.654$; $p \le 0.001$
Oral candidiasis	15/12.30	24/20.0	29/35.37	45/88.24	98/38.74
		$\chi^2 = 44.544$; $p \le 0.001$			$\chi^2 = 27.338$; $p \le 0.001$
Herpetiform lesions	4/3.28	8/6.67	13/15.85	21/41.18	42/16.67
		$\chi^2 = 18.064$; $p \le 0.001$			$\chi^2 = 13.574$; $p \le 0.001$
Lichen planus	6/4.92	9/7.50	14/17.07	27/52.94	50/19.76
		$\chi^2 = 22.284$; $p \le 0.001$			$\chi^2 = 14.278$; $p \le 0.001$

T a b l e 4. **Impact of previous COVID-19 on the risk of developing oral pathology**

Nosology	Relative risks	95 % DI	
		5 %	95 %
Erythema	3.375	1.027	11.099
Petechiae	5.144	1.067	16.467
Macular spots	9.162	2.247	37.356
Papules	2.893	1.026	8.155
Pustules	4.340	1.343	14.026
Bullous elements	3.375	0.779	14.619
Vesicles	5.304	0.693	46.620
Ulcerative lesions	3.472	1.397	8.627
Desquamative gingivitis	2.214	1.473	3.307
1desquamative glossitis	2.687	1.587	4.547
Villous tongue	4.762	2.318	9.535
Oral candidiasis	3.150	1.913	5.187
Herpetiform lesions	5.022	1.843	13.684
Lichen planus	4.018	1.772	9.113

Noteworthy is the high incidence of desquamative gingivitis, equal to 39.53 % in patients in the post-covid state vs 18.03 % in the control group ($\chi^2 = 17.891$; $p \leq 0.001$; RR = 2.214; 95 % CI 1.473–3.307) and desquamative glossitis, respectively 30.83 % vs 11.48 % ($\chi^2 = 17.891$; $p \leq 0.001$; RR = 2.687; 95 % DI 1.587–4.547); and the corresponding frequency of such a symptom as a villous tongue was 31.23 % vs 6.56 % ($\chi^2 = 16.654$; $p \leq 0.001$; RR = 4.762; 95 % CI 2.318–9.535).

At the same time, patients in the post-COVID period showed a higher incidence of oral candidiasis – 38.74 % vs 12.30 % ($\chi^2 = 27.338$; $p \leq 0.001$; RR = 3.150; 95 % CI 1.913–5.187); herpetiform lesions of the oral mucosa – 16.67 % vs 3.28 % ($\chi^2 = 13.574$; $p \leq 0.001$; RR = 5.022; 95 % CI 1.843–13.684), as well as lichen planus mucosal tract – 19.76 % vs 4.92 % ($\chi^2 = 14.278$; $p \leq 0.001$; RR = 4.018; 95 % CI 1.772–9.113) (Tab. 3, 4).

Thus, in patients in the post-COVID period, a higher prevalence of pathology of the oral mucosa, mucous membrane of the tongue, and periodontium are recorded, while the presence of previous COVID-19 increases the risk of the detected pathology by 3.375–9.162 times (Tab. 3, 4).

Even though we did not find specific dental diseases, symptoms, or combinations of them for COVID-19, an increase in the prevalence of pathology was found in those who had coronavirus infection in the oral cavity, initiated by the general effect of intoxication and somatic pathology on the body.

In this connection, the association between the clinical characteristics of patients who underwent COVID-19 (assessed by levels of systemic inflammation and blood coagulation) and the severity and prevalence of dental pathology was investigated (see Tab. 3).

As can be seen from the data presented in Tab. 3, a significant correlation was established between the severity of clinical manifestations of the post-COVID period and the prevalence of dental pathology. Thus, the prevalence of erythema progressively increases from 3.33 % in asymptomatic patients to 6.10 % in patients with complaints and maximum – 23.53 % in patients with positive laboratory tests ($\chi^2 = 8.867$; $p \leq 0.05$); petechiae, respectively, 5.00; 13.41 and 29.41 % ($\chi^2 = 13.484$; $p \leq 0.01$); macula – 5.83; 17.07 and 33.33 % ($\chi^2 = 17.034$; $p \leq 0.01$); papules – 4.17; 8.54 and 23.53 % ($\chi^2 = 10.087$; $p \leq 0.01$); pustules – 5.83; 9.76 and 23.53 % ($\chi^2 = 10.323$; $p \leq 0.05$); bulla – 0.83; 6.10 and 15.69 % ($\chi^2 = 7.992$; $p \leq 0.05$); the prevalence of vesicles was 1.64; 3.66 and 11.76 % ($\chi^2 = 4.447$; $p \leq 0.05$); ulcerative lesions of the oral mucosa, respectively, 5.90; 10.98 and 41.18 % ($\chi^2 = 16.252$; $p \leq 0.01$); while the frequency of desquamative gingivitis left 19.17; 39.02 and 90.20 % ($\chi^2 = 49.521$; $p \leq 0.001$); desquamated glossitis 15.00; 34.15 and 62.75 % ($\chi^2 = 34.853$; $p \leq 0.001$); and villous tongue, respectively, 15.83; 32.93 and 64.71 % ($\chi^2 = 35.558$; $p \leq 0.001$); at the same time, the incidence of candidiasis of the oral mucosa increased from 20.00 to 35.37 and 88.24 % ($\chi^2 = 44.544$; $p \leq 0.001$); and the prevalence of herpetiform lesions from 6.67 to 15.85 and 41.18 % ($\chi^2 = 18.064$; $p \leq 0.001$); at the same time, a significant increase in the prevalence of OMM candidiasis was registered from 7.50 to 17.07 and 52.94 % ($\chi^2 = 22.284$; $p \leq 0.001$) (Tab. 3).

Conclusion. COVID-19 is a respiratory infection that manifests itself in other organs, independently or simultaneously with respiratory symptoms. One such organ is the oral cavity, where patients may develop lesions of the oral mucosa, periodontium, and salivary glands. These include COVID-19-specific bullous and/or erythematous lesions of the oral mucosa, candidiasis, tongue lesions, along with an increase in the prevalence of oral pathologies such as aphthous ulcers, stomatitis and glossitis – all of which are considered important early signs of the disease, as they may precede respiratory symptoms and are associated with more severe COVID-19 phenotypes. Moreover, patients with COVID-19 suffer from caries and periodontal disease to a greater extent than healthy controls. A positive correlation between dental pathology and COVID-19 indicates the need to organize its prevention and treatment.

Conflict of interests. The authors declare no conflict of interests.

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