Dermatological manifestations of the Coronavirus disease 2019 in children: a systemic review

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Abstract

Introduction: An increasing number of publications describing dermatoses associated with Coronavirus disease 2019 (COVID-19) have shown differences in the morphology and incidence of dermatoses in children compared to the general population.

Material and methods: Among 22 selected full-text articles, dermatoses associated with COVID-19 have been described in 196 children (average age: 12.57 years). Dermatoses were the only symptom in most patients (n = 134; 68.4%). RT-PCR tests of nasopharyngeal swabs confirmed SARS-CoV-2 infection in only 18 cases (n = 18/69; 26.1%).

Results: Dermatoses described include chilblain-like lesions (n = 173; 88.3%), maculopapular rash (n = 16; 8.2%), erythema multiforme-like lesions (n = 12; 6.1%), varicella-like exanthema (n = 1; 0.5%), and urticaria (n = 1; 0.5%).

Conclusions: This publication aims to summarise existing data on dermatoses and to draw attention to how identification of dermatological symptoms in paediatric patients can provide a quick and reliable indicator of COVID-19.

Key words: COVID-19, coronavirus, SARS-CoV-2, paediatric, skin lesion, chilblain-like.

Introduction

The first cases of COVID-19 caused by SARS-CoV-2 appeared in Wuhan, China in December 2019 and the World Health Organisation (WHO) officially declared a pandemic on 11 March 2020 [1].

The most common symptoms include fatigue, fever, dry cough, muscle pain, and dyspnoea. Clinical symptoms also include gastrointestinal symptoms: nausea, vomiting, diarrhoea, as well as other symptoms such as rhinitis, sore throat, and loss of smell and taste. In severe cases the patients may develop acute respiratory distress syndrome (ARDS), arrhythmia and septic shock [2, 3]. COVID-19 clotting disorders may lead to pulmonary embolism [4, 5] and ischaemic stroke [6].

However, studies worldwide have shown an increasing number of cases of skin lesions in patients with SARS-CoV-2 infections [7]. Galván Casas et al. [8] proposed a classification for skin lesions seen in the course of COVID-19 (based on 375 cases in paediatric and adult patients). The study identified maculopapular lesions (47%), pseudo-chilblain-like lesions (19%), urticaria lesions (19%), follicular lesions (9%) and reticular bruising/necrotic lesions (e.g. livedo reticularis, necrosis, and acral ischaemia) (6%) [8].

Although the basic symptoms of COVID-19 in children and adults are similar [9], the course of the disease in the paediatric population is more often mild or asymptomatic [10]. Thus, skin lesions may come to the forefront of the clinical picture of the disease.

However, there are some differences in the nature and incidence of individual dermatoses in adults and children.

Aim

This study aims to summarize data from publications on COVID-19-related skin lesions in the paediatric population.

Material and methods

Searching strategy

The systematic review was performed according to the Preferred Reporting Items for Systematic and Meta-Analysis (PRISMA) guidelines. The articles for this...
advances in dermatology and allergology

review were published or pre-print between 31 December 2019 and 1 June 2020 and can be found in PubMed and medRxiv. The following search phrases were used: “((COVID-19) OR (coronavirus) OR (Coronavirus disease) OR (SARS-CoV-2)) AND ((children) OR (paediatric)) AND ((skin) OR (Dermatology) OR (rash) OR (cutaneous))” as key words or MeSH terms. A number of 130 records were found through database searches. Duplicates and non-English language articles were excluded.

Studies selected were required to be cross-sectional studies, cohort studies, case reports, and case series of paediatric patients meeting clinical criteria for diagnosis of COVID-19 and/or children with RT-PCR-confirmed SARS-CoV-2 infection. From 43 potentially appropriate articles that underwent evaluation, 22 full-text articles were found to be suitable for analysis (review articles, hypothesis articles, and publications with duplicated patients were excluded).

Results

General overview (Table 1)

Clinical cases of 196 patients with skin lesions in the course of COVID-19 were analysed. The average age of patients was 12.57 years; most of them were male.

Extracutaneous symptoms of COVID-19 occurred only in 62 described patients. The most common were: fever, gastrointestinal symptoms, and cough.

Analysing all available data on clinical cases with general symptoms, these were preceded by skin lesions by 8.9 days on average. Only in 3 patients, dermatoses appeared before other COVID-19 symptoms and in another 3 at the same time.

RT-PCR tests from nasopharyngeal swabs were performed in 69 patients, 18 of whom were positive.

In the analysed articles the most frequently observed symptom was chilblain-like lesions (n = 173, 88.3%). Moreover, there were maculopapular rash (n = 16, 8.2%) and erythema multiforme-like lesions (n = 12, 6.1%). One case each of a child with varicella-like exantheme (0.5%) and urticaria (0.5%) were described.

Characteristics of skin lesions (Table 2)

Chilblain-like lesions

Vascular dermatoses in the form of acute ischaemic lesions were initially described in adult patients with severe SARS-CoV-2 infection [11]. The above changes are likely to result from clotting disorders and are associated with microthrombi formation, leading to pulmonary embolism, strokes, and disseminated intravascular coagulation [12, 13].

However, recently, an increasing number of paediatricians, particularly those from regions most affected by COVID-19, have reported the occurrence of chilblain-like dermatoses among patients who have never previously experienced perniosis or Raynaud symptoms [14–16]. These changes initially manifest as erythematous-bluish spots usually limited to the distal parts of the limbs, often with blisters, erosions and dry scab-covered ulcers. Upon healing, these lesions become spotted lesions [14, 17, 18].

Chilblain-like lesions

Pseudo-chilblain skin lesions occurred in 173 patients. The average age in this group of patients was 13.2 years and most of them were female. Dermatoses were most often located only on feet (143 patients). In 13 patients, lesions concerned only hands, in 13 cases both hands and feet. The average duration of skin lesions was 18.5 days; in 54.9% they were accompanied by the following symptoms: pruritus, pain, burning and coldness (Table 2).

Authors of many publications show that patients with pseudo-chilblain-like lesions present mild or no symptoms of viral disease, and RT-PCR tests from the nasopharyngeal swabs are often negative. This is probably due to the delayed occurrence of skin lesions in the course of COVID-19 in children and young adults [15, 19–21].

In our analysis, extradermal symptoms appeared only in 44 out of 173 described patients and were preceded by chilblain-like lesions by 10.4 days on average. The most common symptoms were cough, gastrointestinal symptoms and fever.

Of the 49 RT-PCR tests performed from nasopharyngeal swabs, only 10 were positive for SARS-CoV-2 (Table 2). Kolivras et al. [22] presented a histopathological picture of chilblain skin lesions, in which they described the papillary oedema of the skin with perivascular lymphocytic infiltration together with diffuse necrotic keratinocytes in superficial layers of the epidermis. Microangiopathic changes may be caused by an increased reaction associated with increased type 1 interferon production, which occurs during SARS-COV-2 infection, especially in children and young adults. However, it may be a protective factor against the occurrence of a ‘cytokine storm’ and full COVID-19 [19, 22, 23].

Erythema multiforme-like lesions

Erythema multiforme-like dermatosis (n = 12/196) is another type of a skin lesion described in the publications we analysed. The mean age was 12.1 years, the lesions were more common in boys.

Erythema multiforme-like dermatoses were most often located on feet. Less commonly, they were found on hands, face, conjunctiva, lips, and in the oral cavity. The average duration of skin lesions was 16.7 days; 58.3% of them were accompanied by pruritus and pain. General symptoms associated with COVID-19 appeared in 5 out of 12 described patients and were preceded by erythema multiforme-like lesions by 21 days on average. The
| Study         | Year, country | Type of the study                  | Number of cases (paediatric/total in the study) | Age [years] | Sex (F/M) | History of dermatological conditions | Other chronic disorders | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|--------------|---------------|-----------------------------------|-----------------------------------------------|-------------|-----------|-------------------------------------|------------------------|--------------------------------------|----------------------------------------|--------------------------------------|-------------------------------|--------------------------------|--------------------------------|-----------------------------|-------------------------------------------------------------------|---------------------------------------------|
| Mazzotta et al. 2020, Italy | Retrospective, case report | 1/1                                   | 13 M No                                      | No          | No        | Chilblain-like                       | Feet                    | Pruritus and burning                  | NR Positive                          | No                                    | –                            | Fever, muscle pain, headache          | –                           | –                              | No                                        |
| Recalcati et al. 2020, Italy | Retrospective, cross-sectional study | 11/11                                | 14 F No                                      | No          | No        | Chilblain-like and erythema multiforme-like | Feet and hands          | No                                   | NR Negative                          | No                                    | –                            | –                              | –                           | Diffuse perivascular involvement of the dermis and hypodermis by a dense lymphoid infiltrate, with saving of the epidermis; Thickening of the vessel wall and activation of the endothelium with nuclear enlargement |
| 15 F                     | No          | No        | Chilblain-like                         | Hands      | No        | No                                   | No                      | Negative                           | No                                     | No                                    | No                            | –                              | No                           | No                          | No                                        |
| 15 F                     | No          | No        | Chilblain-like                         | Feet       | No        | Negative                           | No                      | Negative                           | No                                     | –                                    | No                            | –                              | No                           | No                          | No                                        |
| 18 F                     | No          | No        | Chilblain-like                         | Feet and hands | No        | Negative                           | No                      | Negative                           | No                                     | No                                    | No                            | No                              | No                          | No                          | No                                        |
| 13 F                     | No          | No        | Chilblain-like                         | Feet       | No        | No                                   | No                      | No                                 | No                                     | –                                    | No                            | Cough                         | No                          | No                           | No                                        |
| 16 M                     | No          | No        | Chilblain-like                         | Feet       | No        | No                                   | No                      | No                                 | No                                    | –                                    | No                            | No                              | No                          | No                           | No                                        |
| 13 M                     | No          | No        | Chilblain-like                         | Feet       | No        | No                                   | No                      | No                                 | No                                    | –                                    | No                            | –                              | No                          | No                           | No                                        |
| 15 M                     | No          | No        | Chilblain-like                         | Hands      | No        | No                                   | No                      | No                                 | No                                    | –                                    | No                            | No                              | No                          | No                           | No                                        |
| 14 M                     | No          | No        | Chilblain-like                         | Feet       | No        | Negative                           | No                      | Diarrhoea                           | +7                                    | No                                    | –                            | Fever                          | No                           | No                           | No                                        |
| 11 M                     | No          | No        | Chilblain-like and erythema multiforme-like | Hands     | No        | Negative                           | No                      | Fever                              | +21                                   | No                                    | –                            | Fever, rhinitis, headache, fatigue | No                          | No                           | No                                        |
| 14 M                     | No          | No        | Chilblain-like                         | Feet       | No        | No                                   | No                      | Fever                              | +21                                   | No                                    | –                            | Fever                          | No                           | No                           | No                                        |
### Table I. Cont.

| Study | Year, country | Type of the study | Number of cases (pediatric/total in the study) | Age [years] Median age: (n = 14.4 M (n = 18) | Sex F/M | History of dermatological conditions | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|-------|---------------|-------------------|-----------------------------------------------|-----------------------------------------------|---------|--------------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|----------------------------------|--------------------------------------|-------------------------------------|-----------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| Garcia-Lara et al. | 2020, Spain | Retrospective, Cross-sectional study | 27/27 | | | No | Chilblain-like (n = 25) | Feet (n = 20) | No (n = 18) | NR | IgM negative (n = 2) | Diarrhoea (n = 1) | NR | No |
| | | | | | | | Erythema multiforme-like (n = 2) | | | | | | | |
| | | | | | | | Hands (n = 6) | | | | | | | |
| | | | | | | | Both (n = 1) | | | | | | | |
| | | | | | | | Pain (n = 6) | | | | | | | |
| Colonna et al. | 2020, Italy | Retrospective, case series | 4/4 | 11 | F | No | Chilblain-like | Feet | Coldness and mild pain | 19 | Negative | Headache, rhinitis | + > 14 | No |
| | | | | 6 | F | No | Chilblain-like | Feet | Pruritus and pain | 5 | Negative | Fever | +10 | No |
| | | | | 5 | M | No | Chilblain-like | Feet and hands | Pain | 25 | Negative | Pneumonia (fever, cough, dyspnoea, fatigue, muscle pain) | +43 | No |
| | | | | 11 | F | No | Chilblain-like | Feet | Pain | > 20 | Negative | Fever | +10 | No |
| Piccolo et al. | 2020, Italy | Retrospective, cross-sectional study | 63/63 | Median age: 14 (n = 36) | M (n = 27) | No | History of autoimmune disorders | Chilblain-like | Feet (n = 54) | Pain (n = 17) | NR (n = 11) | IgM positive Gastrointestinal symptoms (n = 2), | Negative (n = 4) | Systemic symptoms preceded by cutaneous findings |
| | | | | | | | n = 6 patients (ANA positivity n = 1), with familial or personal history of coagulation defects n = 4 cases. | Hands (n = 4) | Pruritus (n = 17) | | | Cough, dyspnoea (n = 5) | | |
| | | | | | | | Both (n = 5) | Pain and pruritus (n = 13) | | | | | |
| | | | | | | | No (n = 16) | | | | | | |

Dense lymphocytic perivascular cuffing and periadnexal infiltration. Signs of vasculitis were evident in small to medium sized vessels with endothelial cell swelling and red blood cell extravasation. Fibrin thrombus was evident in superficial capillary
| Study                      | Year, country | Type of the study | Number of cases (paediatric/total in the study) | Age [years] | Sex [M/F] | History of dermatological conditions | Type of the study | Other chronic disorders | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|---------------------------|---------------|------------------|------------------------------------------------|-------------|-----------|-------------------------------------|-------------------|--------------------------|--------------------------------------|----------------------------------|--------------------------------------|-----------------------------|--------------------------------------|-------------------------------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| Landa et al. 2020, Spain  | Retrospective, case series | 2–6 | 15 | M | No | No | Chilblain-like | Feet | No | NR | Negative | IgM negative, IgG negative | No | – | No | – |
|                          |               |                  |                                              | 15 | F | No | No | Chilblain-like | Feet | No | NR | Positive | No | Rhinitis, diarrhoea | +7 | No |
| Tosti et al. 2020, Italy  | Retrospective, case series | 2–4 | 16 | F | AA Universalis | No | Chilblain-like | Feet | Pain | NR | No | No | Pharyngodynia | +14 | No |
|                          |               |                  |                                              | 18 | F | No | No | Chilblain-like | Feet | Pain and Pruritus | NR | No | No | – | No |
| Locatelli AG 2020, Italy  | Retrospective, case report | 1–1 | 16 | M | No | No | Chilblain-like | Feet and hands | No | > 20 | RT-PCR positive | No | Dysgeusia, diarrhoea | +3 | Oedema of the papillary dermis, superficial and deep lymphocytic infiltrate in a perivascular and strong perieccrine pattern; no signs of endothelial damage |
| Ramon-detta et al. 2020, Italy | Retrospective, case series | 3–7 | 4 | M | No | No | Chilblain-like | Feet | No | NR | NR | No | No | – | No |
|                          |               |                  |                                              | 9 | F | No | No | Chilblain-like | Feet | No | NR | No | – | No |
|                          |               |                  |                                              | 11 | M | No | No | Chilblain-like | Feet | No | NR | NR | No | No | – | No |
| Study | Year, country | Type of the study | Number of cases (paediatric/total in the study) | Age [years] | Sex (F/M) | History of dermatological conditions | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|-------|---------------|------------------|-----------------------------------------------|-------------|----------|--------------------------------------|--------------------------------------|-----------------------------------|------------------------------------|-----------------------------|--------------------------------|--------------------------------|-----------------------------|---------------------------------------------------------------------|----------------------------------|
| Ruggiero et al. 2020, Italy | Retrospective, case series | 33/33 | 15 F No NR | Chilblain-like | Feet | Burning and pain | 4 | No | No | No | – | No |
| | | | 12 F No NR | Chilblain-like | Feet | No | Pain | NR | No | No | Cough | NR | No |
| | | | 10 F No NR | Chilblain-like | Feet | No | Pain | NR | No | No | – | No |
| | | | 11 M No NR | Chilblain-like | Feet | No | Pain | NR | No | No | – | No |
| | | | 14 F No NR | Chilblain-like | Feet | Pruritus, pain | NR | No | No | – | No |
| | | | 12 F No NR | Chilblain-like | Feet | Pruritus, pain | NR | No | No | – | No |
| | | | 10 M No NR | Chilblain-like | Feet | No | Pain | NR | No | No | – | No |
| | | | 8 M No NR | Chilblain-like and Erythema Multiforme-like | Feet, face | Pruritus | NR | No | No | – | No |
| | | | 15 F No NR | Chilblain-like | Feet | Pruritus | NR | No | No | – | No |
| | | | 15 M No NR | Chilblain-like | Feet | No | Pain | NR | No | No | – | No |
| | | | 13 F No NR | Chilblain-like | Feet | Pruritus | NR | No | No | – | No |
| | | | 13 F No NR | Chilblain-like | Feet | Pruritus | NR | No | No | – | No |
| | | | 15 M No NR | Chilblain-like | Feet | Pain | NR | No | No | – | No |
| | | | 10 M No NR | Chilblain-like | Feet | No | Pain | NR | No | No | – | No |
| | | | 17 F No NR | Chilblain-like | Feet | Burning and pain | NR | No | No | – | No |
| | | | 14 M No NR | Chilblain-like | Feet | No | Pain | NR | No | No | – | No |
| | | | 17 M No NR | Chilblain-like | Hands | No | Pain | NR | No | No | – | No |
| Study Year | Type of the study | Number of cases (paediatric/total in the study) | Age [years] | Sex (F/M) | History of dermatological conditions | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|------------|------------------|-----------------------------------------------|-------------|-----------|--------------------------------------|-------------------------------------|---------------------------------|-----------------------------------|-------------------------|-------------------------------|--------------------------------|----------------------|--------------------------------------------------------------------------------|-----------------------------|
| 13 M       | No               | NR                                           | < 1 M       | No        | Chilblain-like                        | Feet                                | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 10 M       | No               | NR                                           | 10 M        | No        | Chilblain-like                        | Feet                                | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 14 M       | No               | NR                                           | 14 M        | No        | Chilblain-like                        | Hands                               | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 9 M        | No               | NR                                           | 9 M         | No        | Chilblain-like                        | Feet                                | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 13 M       | No               | NR                                           | 13 M        | No        | Chilblain-like                        | Feet                                | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 12 M       | No               | NR                                           | 12 M        | No        | Chilblain-like                        | Feet                                | Pain                            | NR                                | No                      | No                            | Pharyngodynia                        | NR                   | No                                                                            | No                          |
| 10 M       | No               | NR                                           | 10 M        | No        | Chilblain-like                        | Feet                                | Pruritus                         | NR                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 13 M       | No               | NR                                           | 13 M        | No        | Chilblain-like                        | Feet                                | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 5 M        | No               | NR                                           | 5 M         | No        | Chilblain-like                        | Feet                                | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 4 M        | No               | NR                                           | 4 M         | No        | Chilblain-like                        | Hands                               | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 9 F        | No               | NR                                           | 9 F         | No        | Chilblain-like                        | Feet                                | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 15 M       | No               | NR                                           | 15 M        | No        | Chilblain-like                        | Feet and hands                      | Burning and pain                 | NR                                | No                      | No                            | Fever                         | NR                   | No                                                                            | No                          |
| 9 M        | No               | NR                                           | 9 M         | No        | Chilblain-like                        | Feet                                | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 17 F       | No               | NR                                           | 17 F        | No        | Chilblain-like                        | Feet and hands                      | No                              | No                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| 11 F       | No               | NR                                           | 11 F        | No        | Chilblain-like                        | Feet                                | Pruritus                         | NR                                | No                      | No                            | –                               | No                   | No                                                                            | No                          |
| Study  | Year, country | Type of study | Number of cases (paediatric/total in the study) | Age [years] | Sex (F/M) | History of dermatological conditions | Type of the study | Number of cases (paediatric/total in the study) | Number of cases | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|--------|---------------|---------------|-----------------------------------------------|-------------|-----------|--------------------------------------|-----------------|-----------------------------------------------|----------------|----------------------------------------|-----------------------------------|---------------------------------|----------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|--------------------------------|--------------------------------|
| Guarneri et al. | 2020, Italy | Retrospective, case series | 3/3 | 14 M | No | No | Chilblain-like | Feet | Chilblain-like | Feet | Pruritus and burning | 14 | RT-PCR positive | No | No | – | No |
| | | | | 14 M | No | No | Chilblain-like | Feet | Pruritus and burning | 20 | RT-PCR positive | No | No | – | No |
| | | | | 18 M | No | No | Chilblain-like | Feet | Pruritus and burning | 10–15 | RT-PCR positive | No | fever | +2 | No |
| Papa et al. | 2020, Italy | Retrospective, case report | 1/1 | 11 F | No | No | Chilblain-like | Feet | Chilblain-like | Feet | Pain and pruritus | 15–20 | RT-PCR negative | No | No | – | No |
| | | | | | | | | | | | | | | | | | | | | | |
| Andina et al. | 2020, Spain | Retrospective, cross-sectional study | 22/22 | Median age: 12 (6–17) | M (n = 13) | No | ADHD (n = 5) | Only Chilblain-like (n = 18) | Feet and hands (n = 3) | Chilblain-like and erythema multiforme-like (n = 4) | Pruritus (n = 19) | Pain (n = 7) | 7–21 | RT-PCR n = 19; positive n = 1 negative n = 18 | No (n = 10) | + 0–7 (n = 4) | n = 6 (similar results) | Dense, superficial, and deep angiocentric and eccrinotropic lymphocytic infiltrate Papillary dermal oedema, vascular degeneration of the basal layer and lymphocytic exocytosis Endothelia of small vessels appear swollen Intense lymphocytic vascular reaction in dermal vessels Red cell extravasation and focal thrombosis (arrow) in papillary dermis capillaries |
| Study                  | Year, country | Type of the study | Number of cases (paediatric/total in the study) | Age (years) | Sex (F/M) | History of dermatological conditions | Other chronic disorders | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|-----------------------|---------------|-------------------|-----------------------------------------------|-------------|-----------|--------------------------------------|-------------------------|--------------------------------------|-------------------------------------|-------------------------------------|-----------------------------|----------------------------------------|--------------------------------------|----------------------------------|----------------------------------------------------------------------------------|----------------------------------|
| Diotallevi et al.     | 2020, Italy  | Retrospective, case series | 2/4                                            | 12          | F         | No                                    | No                      | Chilblain-like                       | Feet                                | No                                  | NR                         | RT-PCR positive                       | No                            | No                                    | -                                  | No                                |
|                       |               |                   |                                               | 8           | M         | No                                    | No                      | Chilblain-like                       | Feet                                | No                                  | NR                         | No                                       | No                            | No                                    | -                                  | No                                |
| García-Gil et al.     | 2020, Spain  | Retrospective, case report | 1/1                                            | 12          | M         | No                                    | NR                      | Erythema multiforme-like             | Feet                                | Pruritus                            | > 15                           | RT-PCR negative                      | IgM negative, IgG negative          | No                            | -                                  | Partial epidermal necrosis and perivascular lymphoid infiltrate in superficial and deep dermis; Microthrombi in capillaries in papillary dermis, with extravasation of red blood cells; Vasculitic changes only in relation to the lymphoid component (not in the thrombotic) |
| Janah et al.          | 2020, Morocco | Retrospective, case series | 1/2                                            | 17          | M         | No                                    | No                      | Erythema multiforme-like             | Hands                               | Pruritus                            | > 15                           | No                                       | No                            | Fever, rhinitis, headache             | +15                               | No                                |
| Labé et al.           | 2020, France | Retrospective, case report | 2/2                                            | 6           | M         | No                                    | No                      | Erythema multiforme-like             | Oral cavity, conjunctiva, feet and hands, face, lips | No                                  | > 15                          | RT-PCR one negative the other positive | No                            | Loss of appetite                      | NR                               | No                                |
| Study | Year, country | Type of the study | Number of cases (paediatric/total in the study) | Age [years] | Sex (F/M) | History of dermatological conditions | Other chronic disorders | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|-------|---------------|------------------|-----------------------------------------------|-------------|---------|-------------------------------------|---------------------------|-------------------------------------|-------------------------------------|------------------------------------|-----------------|----------------------------------------|-----------------------------|-----------------------------|------------------------------------------------|--------------------------|
| Yozgat et al. | 2020, Turkey | Retrospective, case report | 1/1 | 3 | M | No | No | Maculo-papular rash with desquamation; erythema of the lips, oral cavity, cracking of the lips | Generalized rash, lips, oral cavity, conjunctiva | NR | NR | RT-PCR negative | No | Fever | 0 | No |
| Verdoni et al. | 2020, Italy | Retrospective, observational cohort study | 10/10 | Median age: 7.5 (2–16) | F (n = 3) | No | NR | Maculo-papular rash; erythema or firm induration of hands and feet; erythema of the lips and/or oral cavity and/or cracking of the lips | Generalized rash (n = 8), feet and hands (n = 5), lips and oral cavity (n = 6) | NR | NR | RT-PCR positive (n = 2) | IgM negative (n = 7), IgG positive (n = 3), IgG negative (n = 2), IgG positive (n = 8) | Fever (n = 10), Conjunctivitis (n = 9), Diarrhoea (n = 6), Meningeal signs (n = 4), Fatigue (n = 1) | No |
| Study  | Year, country | Type of the study | Number of cases (paediatric/total in the study) | Age [years] | Sex (/F/M) | History of dermatological conditions | Other chronic disorders | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|--------|---------------|------------------|-----------------------------------------------|-------------|-----------|--------------------------------------|------------------------|-------------------------------------|------------------------------------|-------------------------------------|----------------------|-------------------------------|--------------------------------|-------------------------------|--------------------------------|-------------------------------------------------|
| Torrelo et al. | 2020, Spain | Retrospective, case series | 4/4 | 12 | M | No | NR | Chilblain-like and erythema multiforme-like | Upper and lower extremities, face | Pruritus | 7–14 | No | No | No | NR | Interface dermatitis with superficial and deep perivascular lymphocytic inflammation; Moderate exocytosis with vacular changes and spongiosis No necrotic keratinocytes Deep extension of the inflammatory infiltrate involving eccrine glands |
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| Study, Year, Country | Type of the study | Number of cases (paediatric/total in the study) | Age (years) | Sex (F/M) | History of dermatological conditions | Other chronic disorders | Morphological features of the lesions | Anatomical location of skin lesions | Symptoms associated with skin changes | Duration of skin changes | Nasopharyngeal swab RT-PCR test result | Serological test results for COVID-19 | Systemic symptoms of COVID-19 | Time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions – days | Histopathological examination |
|----------------------|-------------------|-------------------------------------------------|-------------|----------|--------------------------------------|------------------------|--------------------------------------|-----------------------------------|----------------------------------------|---------------------------|------------------------------------------|-------------------------------|---------------------------|--------------------------------------------------------------------------------|----------------------|
| Genovese et al. 2020, Italy | Retrospective, case report | 1/1 | 8 | F | No | No | Varicella-like exanthema | Trunk | No | 7 | No | No | Cough | +3 | No |
| Durmaz et al. 2020, Turkey | Retrospective, case series | 3/20 | 8 months | F | No | NR | Maculopapular rash (roseola-like) | Face, upper and lower extremities, trunk | No | 2 | RT-PCR positive | No | Fever | 0 | No |
| 11 | F | No | NR | Maculopapular rash | Face, upper and lower extremities, trunk | Pruritus | 5 | RT-PCR positive | No | No | – | No |
| 17 | F | No | NR | Maculopapular rash (drug related) | Face, upper and lower extremities, trunk | Pruritus | After HCQ termination | RT-PCR positive | No | No | – | No |
| Morey-Olivé et al. 2020, Spain | Retrospective, case series | 2/2 | 6 | M | No | Cholestatic liver disease of unknown aetiology | Maculopapular rash (erythematous, confluent) | Face, upper and lower extremities, trunk | No | 5 | RT-PCR positive | No | Fever (and worsening of the markers of cholestasis and cytolytic hepatitis) | + > 14 days | No |
| 2 months | F | No | NR | Urticaria | Face, upper and lower extremities, trunk | Pruritus | 9 | RT-PCR positive | No | Fever | 0 | No | No | No |
### Table 2. Summary of the clinical characteristics

| Parameter                                                                 | General data |
|---------------------------------------------------------------------------|--------------|
| Total number of cases                                                     | 196          |
| Mean age [years] (range)                                                 | 12.57 (2 months–18 years) |
| Sex                                                                       | Male, n (%) 107 (54.6) |
|                                                                           | Female, n (%) 89 (45.4) |
| Morphological features of the lesions – n (% of all cases)                |              |
| Chilblain-like                                                             | 173 (88.3)   |
| Maculopapular rash                                                        | 16 (8.2)     |
| Erythema multiforme-like                                                  | 12 (6.1)     |
| Varicella-like exanthema                                                  | 1 (0.5)      |
| Urticaria                                                                 | 1 (0.5)      |
| Anatomical location of skin lesions – n (% of all cases)                  |              |
| Feet                                                                      | 177 (91.7)   |
| Hands                                                                     | 45 (23.3)    |
| Trunk                                                                     | 16 (8.3)     |
| Arms, forearms                                                            | 15 (7.8)     |
| Thighs, shins                                                            | 15 (7.8)     |
| Face                                                                      | 10 (5.2)     |
| Lips                                                                      | 9 (4.7)      |
| Oral cavity                                                               | 9 (4.7)      |
| Conjunctiva                                                               | 3 (1.6)      |
| Mean duration of skin lesions [days]                                      | 17.2 (2–25)  |
| Symptoms associated with skin lesions – n (% of all cases)                |              |
| Pruritus                                                                  | 62 (31.6)    |
| Pain                                                                      | 57 (29.1)    |
| Burning                                                                   | 7 (3.6)      |
| Coldness                                                                  | 1 (0.5)      |
| No                                                                        | 95 (48.5)    |
| Nasopharyngeal swab RT-PCR test result (n = 69), n (%)                    |              |
| Positive                                                                  | 18 (26.1)    |
| Negative                                                                  | 51 (73.9)    |
| Systemic symptoms of COVID-19 – n (% of all cases)                        |              |
| Fever                                                                      | 28 (14.4)    |
| Gastrointestinal symptoms                                                | 20 (10.3)    |
| Cough                                                                     | 18 (9.3)     |
| Conjunctivitis                                                            | 9 (4.6)      |
| Rhinitis                                                                  | 8 (4.1)      |
| Dyspnoea                                                                  | 6 (3.1)      |
| Headache                                                                  | 4 (2.1)      |
| Meningeal signs                                                           | 4 (2.1)      |
| Fatigue                                                                   | 3 (1.5)      |
| Pharyngodynia                                                             | 2 (1.2)      |
| Muscle pain                                                               | 2 (1.0)      |
| No                                                                        | 134 (68.4)   |

#### Chilblain-like lesions (n = 173)

| Parameter                                                                 | General data |
|---------------------------------------------------------------------------|--------------|
| Total number of cases                                                     | 173          |
| Mean age (range) [years]                                                 | 13.2 (6 months–18 years) |
| Sex                                                                       | Male, n (%) 79 (45.7) |
|                                                                           | Female, n (%) 94 (54.3) |
| Anatomical location of skin lesions – n (% of all cases)                  |              |
| Only feet                                                                 | 143 (82.7)   |
| Only hands                                                                | 13 (7.5)     |
| Both feet and hands                                                       | 13 (7.5)     |
| Face                                                                      | 2 (20)       |
| Mean duration of skin lesions (range) [days]                              | 18.5 (4–25)  |
| Symptoms associated with skin lesions – n (% of all cases)                |              |
| Pruritus                                                                  | 57 (32.9)    |
| Pain                                                                      | 56 (32.4)    |
| Burning                                                                   | 7 (4.0)      |
| Coldness                                                                  | 1 (0.6)      |
| No                                                                        | 78 (45.1)    |
| Nasopharyngeal swab RT-PCR test result (n = 49), n (%)                    |              |
| Positive                                                                  | 10 (20.4)    |
| Negative                                                                  | 39 (79.6)    |
| Systemic symptoms of COVID-19 – n (% of all cases)                        |              |
| Cough                                                                     | 17 (9.8)     |
| Gastrointestinal symptoms                                                | 13 (7.5)     |
| Fever                                                                     | 11 (6.4)     |
| Rhinitis                                                                  | 7 (4.0)      |
| Dyspnoea                                                                  | 6 (3.3)      |
| Headache                                                                  | 3 (1.7)      |
| Fatigue                                                                   | 3 (1.5)      |
| Pharyngodynia                                                             | 2 (1.2)      |
| Muscle pain                                                               | 2 (1.2)      |
| No                                                                        | 129 (74.6)   |

Mean time from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions [days] 10.4 (2–28)
The most common symptoms were fever and gastrointestinal symptoms. RT-PCR tests from nasopharyngeal swabs were performed in a majority of the patients from this group \( (n = 8) \), positive results for SARS-CoV-2 were found only in 2 children (Table 2).

Torrelo \textit{et al.} and Andina \textit{et al.} [19, 24] presented an interesting description of 4 children aged 11–17 years who had erythema multiforme-like lesions in addition to chilblain-like lesions on the feet (in 4 patients) and hands (in 2 patients). The subjects had never before experienced such symptoms, had not taken new medications, and had not received vaccinations during the previous 30 days, and did not have any symptoms of or exposure to herpes virus, Epstein-Barr virus, varicella, adenovirus, cytomegalovirus, or orf. RT-PCR testing for SARS-CoV-2 was positive in only 1 of the patients; another had contact with a family member with suspected infection; 3 had mild symptoms of COVID-19 a few days before the appearance of skin lesions. Histopathological examination performed in 2 patients did not show an erythema multiforme characteristic picture, but immunohistochemistry was positive for SARS-CoV/SARS-CoV-2 spike protein. Oral corticosteroids have been administered in 1 patient and topical corticosteroids were used in another.

Table 2. Cont.

| Parameter | General data |
|-----------|--------------|
| Maculopapular rash \( (n = 16) \) | |
| Total number of cases | 16 |
| Mean age (range) [years] | 7.22 (8 months – 17 years) |
| Sex | |
| Male, \( n \) (%) | 9 (56.3) |
| Female, \( n \) (%) | 7 (43.7) |
| Anatomical location of skin lesions – \( n \) (% of all cases) | |
| Feet | 16 (100) |
| Hands | 16 (100) |
| Arms, forearms | 14 (87.5) |
| Thighs, shins | 14 (87.5) |
| Trunk | 14 (87.5) |
| Lips | 8 (50) |
| Oral cavity | 8 (50) |
| Face | 6 (37.5) |
| Conjunctiva | 2 (12.5) |
| Mean duration of skin lesions (range) [days] | 9.3 (2–25) |
| Symptoms associated with skin lesions – \( n \) (% of all cases) | |
| Pruritus | 2 (12.5) |
| Burning | 7 (4.0) |
| No | 14 (87.5) |
| Nasopharyngeal swab RT-PCR test result \( (n = 16) \) – \( n \) (%) | |
| Positive | 6 (37.5) |
| Negative | 10 (62.5) |
| Systemic symptoms of COVID-19 \( (n = 16) \) – \( n \) (%) | |
| Fever | 14 (87.5) |
| Conjunctivitis | 9 (56.3) |
| Gastrointestinal symptoms | 6 (37.5) |
| Meningeal signs | 4 (25) |
| Fatigue | 1 (6.3) |
| No | 2 (12.5) |
| Mean from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions (range) [days] | 3.5 (1–15) |

| Parameter | General data |
|-----------|--------------|
| Erythema multiforme-like lesions \( (n = 12) \) | |
| Total number of cases | 12 |
| Mean age (range) [years] | 12.1 (6–17) |
| Sex | |
| Male – \( n \) (% of all cases) | 9 (75) |
| Female – \( n \) (% of all cases) | 3 (25) |
| Anatomical location of skin lesions – \( n \) (% of all cases) | |
| Only feet | 7 (58.3) |
| Only hands | 2 (16.7) |
| Both hands | 2 (16.7) |
| Face | 2 (16.7) |
| Lips | 1 (8.3) |
| Oral cavity | 1 (8.3) |
| Conjunctiva | 1 (8.3) |
| Mean duration of skin lesions (range) [days] | 16.7 (14–21) |
| Symptoms associated with skin lesions – \( n \) (% of all cases) | |
| Pruritus | 5 (41.7) |
| Pain | 2 (16.7) |
| No | 5 (41.7) |
| Nasopharyngeal swab RT-PCR test result \( (n = 6) \) – \( n \) (%) | |
| Positive | 2 (25) |
| Negative | 6 (75) |
| Systemic symptoms of COVID-19 \( (n = 6) \) – \( n \) (%) | |
| Cough | 1 (16.7) |
| Gastrointestinal symptoms | 2 (16.7) |
| Fever | 2 (16.7) |
| Cough | 1 (16.7) |
| Rhinitis | 1 (16.7) |
| Headache | 1 (16.7) |
| No | 2 (33.3) |
| Mean from the onset of non-cutaneous COVID-19 symptoms to the onset of skin lesions [days] | 21.0 (15–28) |
er. Skin lesions disappeared without complications in all patients within one to 3 weeks [19, 24].

García-Gil et al. [25] in their publication presented a clinical case of a 12-year-old boy with erythema multiforme-like skin changes which presented as purple erythematous lesions and vesicular blisters.

Histopathological examination of skin lesions revealed partial epidermal necrosis and perivascular lymphoid infiltrate in superficial and deep dermis, microthrombi of the papillary dermis accompanied by extravasation of red blood cells, thickening of the vessel wall, and activation of the endothelium with nuclear enlargement. The authors of the publication emphasized the similarity of the histopathological image of erythema multiforme-like lesions (pauci-inflammatory thrombotic vasculopathy) to vascular lesions occurring in adult patients with severe COVID-19. This suggests that SARS-CoV-2 may be an etiological factor in the development of acute vascular lesions in children despite often negative test results confirming the infection.

**Maculopapular changes**

The clinical picture of patients with maculopapular lesions was quite diverse. In the analysed articles, 16 cases of children with maculopapular exanthema (8.2%) were described. The average age of patients in the analysed articles was 7.22 years, the changes were more frequent in boys. In all described clinical cases, the changes concerned hands and feet. Moreover, in 14 patients a generalized rash on whole upper and lower extremities and trunk was found.

The average duration of the exanthema was 9.3 days. Only itching was described among the accompanying symptoms. The most frequently described general symptoms of COVID-19 were: fever, conjunctivitis and gastrointestinal symptoms. Extracutaneous symptoms in this group of patients appeared on average 3.5 days before the occurrence of maculopapular rash. RT-PCR tests of nasopharyngeal swabs were performed in all children in analysed clinical cases, most of the results were negative (Table 2).

Bursal Duramaz et al. [26] described two clinical cases of patients with confirmed SARS-CoV-2 infection who did not require systemic treatment. In an 8-month-old infant, an erythematous rash of the face and trunk resembling roseola was found. These skin changes and a fever appeared and subsided simultaneously. An 11-year-old girl presented with a puritic, morbiliform rash on the face and back. The changes disappeared spontaneously after 5 days.

The course of COVID-19 among paediatric patients is often asymptomatic or has few symptoms [27, 28]; thus, systemic treatment is less frequently used compared to in the adult population.

However, Bursal Duramaz et al. [26] described a case report of a 17-year-old female patient experiencing a drug eruption on day 3 of hydroxychloroquine use. Erythematous and maculopapular changes occurred on the face and limbs with slight itching. Symptoms disappeared upon termination of hydroxychloroquine treatment.

Morey-Olivé et al. [29] described an interesting clinical case of a 6-year-old boy with cholestatic liver disease of unknown aetiology. Two weeks after a slight fever, elevated bilirubin and hepatic transaminases in blood, the patient had a positive result of RT-PCR smear test for the presence of SARS-CoV-2. After the next 48 h an itchy, non-smelling, generalised, dewy sediment appeared. Skin lesions persisted in the boy for a total of 5 days, were not accompanied by any symptoms associated with COVID-19 and upon their subsidence, liver parameters normalised. Interestingly, no SARS-CoV-2 was detected in the liver extract.

However, in 3 of the publications we analysed [30–32], the erythematous and papular lesions occurred in the form of a generalised rash with subsequent epidermal exfoliation with often accompanying erythema or firm induration of hands and feet, erythema of the lips or oral cavity, and cracking of the lips.

In addition, the patients were found to have additional symptoms characteristic of Kawasaki’s disease, namely fever, coronary artery abnormalities, hypotension and/or elevated inflammatory markers.

Labé et al. [31] presented a clinical case of a 3-year-old patient hospitalized for 8 days of high fever, whose mother was diagnosed with SARS-COV-2 infection 3 weeks earlier. The patient was described as generalized exanthema with desquamation of the extremities, bilateral palmar oedema, glossitis, and cervical lymphadenopathy. Laboratory tests showed an increase in inflammation parameters.

Although the result of the RT-PCR swab test for SARS-CoV-2 was negative, the ground-glass opacities and consolidation in the right posterobasal area clearly supported the diagnosis of COVID-19. According to the authors, the clinical case presented in the publication suggests that SARS-CoV-2 infection may be the trigger for Kawasaki-like disease [31].

In April 2020, there were reports from Europe and North America about a severe form of Paediatric Inflammatory Multisystem Syndrome (PIMS) sharing common features with other paediatric inflammatory conditions including: Kawasaki disease (KD), staphylococcal and streptococcal toxic shock syndromes, bacterial sepsis and macrophage activation syndromes. A possible temporal association of PIMS with SARS-CoV-2 infection has been proposed as some paediatric patients have tested positively for SARS-CoV-2 infection using either polymerase chain reaction (PCR) or serological testing [30–34].

The initial definition of the Paediatric Inflammatory Multisystem Syndrome temporally associated with SARS-CoV-2 infection [35, 36] based on a document published by the WHO on 15 May 2020 [37] covers children and...
adolescents under 19 years of age with a fever lasting 3 days or more, presenting at least two of the following symptoms:

- rash or non-purulent, bilateral conjunctivitis or symptoms of mucocutaneous inflammation signs (oral, hands, or feet),
- hypotension or shock,
- features of myocardial dysfunction, pericarditis, valvular inflammation, or coronary artery abnormalities,
- coagulopathy,
- acute gastrointestinal symptoms.

Additionally, diagnosis requires elevated inflammatory markers, exclusion of other infectious causes of presented symptoms, and either confirmation of COVID-19 or probable contact with an infected individual [37].

PIMS-TS symptoms are similar to those of KD, including persistent fever and coronary artery damage; however, relatively older children are typically affected [38, 39]. Verdoni et al. pointed out a significant increase in the incidence of KD symptoms in the Italian Bergamo area since the beginning of the SARS-COV-2-related pandemic, particularly a 30-fold increase in the incidence of Kawasaki-like disease between 18.02.2020 and 20.04.2020. Compared to patients admitted before February 2020, only in the group of children hospitalized after the beginning of coronavirus epidemic, KD shock syndrome and features of macrophage activation syndrome were reported [30].

While the aetiology of KD is still not fully understood, available studies suggest that the disease may be due to abnormal regulation of the immune system in response to the infectious agent. This inappropriate immune response is most probably genetic as indicated by the limited number of cases of children with KD in the course of infectious diseases. A hypothesis to explain the aetiology of PIMS-TS has yet been put forward [40, 41].

Patients with PIMS-TS symptoms require immediate hospitalization. Treatment of this disease is similar to that of KD. First-line treatment is high-dose intravenous immunoglobulin (IVIG) (2g/kg) to reduce the risk of coronary artery damage. Additionally, acetylsalicylic acid, corticosteroids, and anti-TNF monoclonal antibodies may be used to reduce inflammation [42].

Other skin lesions

Among the analysed publications, single clinical cases of children with papulovesicular skin changes and urticaria were presented.

Varicella-like exanthema

Genovese et al. [43] presented a description of an 8-year-old girl, hospitalized due to varicella-like exanthema lasting for 3 days and a positive RT-PCR result from nasopharyngeal swabs for SARS-CoV-2 (in the patient and her closest family). In the history, the patient had smallpox a year earlier.

On admission, disseminated papular, papular-bladder lesions with a tendency to crack and scab formation in the area of the torso skin were found. The skin lesions were accompanied by only a slight cough, which occurred 3 days before the onset of the skin lesions, and a fever, which occurred on the 2nd day of dermatosis. Laboratory tests were all within normal range except for slight thrombocytopenia. Skin lesions and general ailments disappeared without any treatment within 7 days.

Urticaria

Urticaria is a rare disease in childhood (3.4% UK, 4.4% Germany, 5.4% Denmark) and the risk of transformation into a chronic form is negligible (0.1–0.3%) [44–46]. Scientific studies show that viral infections can also be an aetiologic factor in urticaria [47, 48].

Morey-Olivé et al. [29] described a clinical case of a 2-month-old girl with itchy acute urticaria skin lesions lasting 4 days and accompanied by a slight fever. The girl had contact with two people with confirmed SARS-CoV-2 infection. The urticaria initially occurred on the face and upper limbs and subsequently spread to the trunk and lower limbs. The palms and soles remained free of lesions and no angioedema was found. After oral symptomatic treatment, all symptoms disappeared within 5 days.

Conclusions

An increasing number of publications regarding skin lesions in the course of COVID-19 are describing skin lesions occurring in children. The preceding examples show that both the morphology and prevalence of particular dermatoses in the course of COVID-19 is different in children compared to these found in adults.

In many cases, skin lesions are the only visible manifestation of the disease in the paediatric population, and RT-PCR tests from nasopharyngeal swabs and serological tests confirming SARS-CoV-2 infection may be negative. However, the histopathological picture of acute chilblain-like lesions and erythema multiforme-like lesions in children shows similarity to vascular lesions in adult patients with severe COVID-19.

While symptoms in the paediatric population are typically mild, there is an increasing number of reports of severe COVID-19 in the form of multi-systemic inflammatory disease resembling an incomplete picture of Kawasaki disease, most probably related to SARS-CoV-2 infection.

Case reports of clinical skin lesions in the course of COVID-19 in children indicates that there is a need for large, comprehensive studies confirming the characteristics and prevalence of dermatoses associated with SARS-CoV-2 infection. Precise and rapid diagnosis, includ-
ing skin lesions, may prove to be crucial for rapid medical intervention to prevent further spread of the disease, especially in the paediatric population, where skin lesions may be the only manifestation of COVID-19.

Conflict of interest

The authors declare no conflict of interest.

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