

# Effects of slime toy poisoning in children and teenagers

## Efeitos da intoxicação por *slime* em crianças e adolescentes

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### ABSTRACT

**Objective:** The aim of this study was to identify which types of skin reactions are associated with slime toys and which of their ingredients are most frequently involved in cases of poisoning.

**Data source:** Between January and July 2021, articles were selected using PubMed, SciELO, and LILACS databases. The following descriptors were used: (dermatitis OR rash OR eczema OR inflammation) AND slime. Inclusion criteria were articles available in full, in either Portuguese, English, or Spanish, published between January 2000 and July 31, 2021, and articles reporting cases of contact dermatitis or eczema potentially or directly attributed to slime toys. Articles not meeting these criteria and duplicate texts in the databases were excluded.

**Data synthesis:** In total, 65 publications were identified, of which 16 were included in this review. This resulted in a total of 22 children (2 males, 20 females), aged between 4 and 13 years, who were reportedly intoxicated by slime toys, most of these being linked to homemade preparations. Studies reported the occurrence of contact or allergic dermatitis on hands, fingers, nails, forearms, and cheeks. The most allergenic and/or irritant ingredients included liquid detergent and soap. Additionally, patch tests identified positive reactions to methylisothiazolinone and methylchloroisothiazolinone, the preservatives used by chemical industries on preparation of glue, soap, detergents, etc.

**Conclusions:** Although slime toys might be important for improving motor development and parental relationships, homemade slime toy recipes include several allergenic and irritant ingredients which might be exposed to vulnerable children and cause intoxications. Therefore, homemade slime toys preparations should be used cautiously and under the supervision of adults.

**Keywords:** Dermatitis, allergic contact; Dermatitis, irritant; Play and playthings; Patch tests; Child.

### RESUMO

**Objetivo:** Identificar quais tipos de reações de pele e ingredientes do brinquedo *slime* estão frequentemente envolvidos em relatos de intoxicação.

**Fontes de dados:** Entre janeiro e julho de 2021, ocorreu a seleção dos artigos, utilizando-se as bases de dados: *United States National Library of Medicine* (PubMed), *Scientific Electronic Library Online* (SciELO) e Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS). Foram utilizados os seguintes descritores: (dermatitis OR rash OR eczema OR inflammation) AND slime. Incluíram-se artigos disponíveis na íntegra, em português, inglês ou espanhol, publicados entre janeiro de 2000 e 31 julho de 2021, que relatassem casos de crianças e adolescentes que apresentaram reação cutânea após a manipulação do brinquedo *slime*. Foram excluídos artigos sem aderência ao tema e textos duplicados nas bases de dados.

**Síntese dos dados:** Identificaram-se 65 publicações, sendo 16 utilizadas para a elaboração desta revisão. Isso resultou no total de 22 crianças (duas do sexo masculino, 20 do feminino), com idades entre quatro e 13 anos, que teriam sido intoxicadas por *slime*, a maioria dos casos ligado a preparações caseiras. Estudos relataram a ocorrência de dermatite de contato ou alérgica nas mãos, dedos, unhas, antebraços e bochechas. Os ingredientes mais alergênicos e/ou irritantes foram detergentes líquidos e sabão. Ademais, o *patch test* identificou reações positivas para metilisotiazolinona e metilcloroisotiazolinona, que são conservantes utilizados em produtos como cola, sabão, detergente, etc.

**Conclusões:** Ainda que o brinquedo *slime* seja importante para o desenvolvimento motor e das relações parentais, receitas caseiras incluem vários ingredientes alergênicos e irritantes, que podem ser expostos a crianças vulneráveis e causar intoxicações. Sendo assim, as preparações do *slime* devem ser feitas com cautela e sob supervisão de adultos.

**Palavras-chave:** Dermatite alérgica de contato; Dermatite irritante, Jogos e brinquedos; Testes do emplastro; Criança.

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## INTRODUCTION

Since antiquity, children's toys have been used for recreational and educational purposes.<sup>1</sup> It is well accepted that playing is not a frivolous task and is essential for the development of children and young individuals. Indeed, playing contributes to cognitive, emotional, physical, and social welfare, as well as promotes engagement between parents and children.<sup>2</sup> Among children's games, manual activities, such as manipulating toys and objects, require a high level of coordination and motor skills. Recently, however, recreational activities have become more "virtual," taking place through the screen of computers and smartphones, a process that has been intensified during the new coronavirus pandemic.<sup>3,4</sup> Indeed, the time spent by children on screens has increased while the time spent on traditional activities has reduced over the past decades, which might negatively affect the development of gross and fine motor skills.<sup>5,6</sup>

In parallel, digital media have boosted the dissemination of games and homemade toys, such as the case of the game "the floor is lava" and "the slime" toy, two famous contents in 2017 among children and teenagers. Slime is a viscous-elastic toy that became very popular among children and teenagers between 2017 and 2019.<sup>7,8</sup> The Internet boosted the popularization of slime, making readily available several homemade recipes with ingredients easily found at home but not exempt of toxicity. Nowadays, homemade recipes for slime preparation might contain various toxic, irritating, or allergenic compounds such as borax, boric acid, glues, creams, and various dyes.<sup>9</sup> In general, reactions to such compounds are local rather than systemic and these chemical compounds interact with the body through direct contact with hands, mouth, eyes, and nose.<sup>10</sup>

Despite the potential toxic effects of homemade slime, playing with it can be beneficial for child development. For instance, playing with slime can improve children's concentration and assist on the development of fine motor coordination due to its handling actions, such as pulling, pinching, or squeezing the toy. Additionally, by preparing it, children can understand basic concepts of quantity, relation of cause and effect, and chemical reactions. Finally, it can potentially strengthen parental bonds, since it might be an activity in which children can have fun and learn together with their parents.<sup>11,12</sup>

The popularization of slime and the broad access to recipes for its homemade preparation favored the increase of cases of contact dermatitis which might be associated with slime. Considering such reports of potential toxicity related to slime and the benefits of slime handling for the development of children, we performed a systematized review to identify which types of skin reactions are caused by slime and which of its ingredients are most frequently involved in case reports of poisoning in children.

## METHOD

From January 2000 to July 31, 2021, a total of 65 articles were identified from the initial search and were reviewed according to the following criteria: reporting of a case of contact dermatitis or eczema and contact dermatitis or eczema potentially or directly attributed to a slime toy. The narrative review was based on a systematic search on current literature published in the scientific databases SciELO – Brazil (Scientific Electronic Library Online), PubMed (US National Library of Medicine), and LILACS (Latin American and Caribbean Literature in Health Sciences). The criteria used for searching skin reactions associated with slime were as follows: (dermatitis OR rash OR eczema OR inflammation) AND slime, and the applied filters such that it included all English, Spanish, and Portuguese language articles published on patients aged 0–18 years. Articles not fitting the theme and duplicate texts found in the databases were excluded.

Two researchers independently searched for articles by accessing, at first, the title and abstract. Articles that did not fit the eligibility criteria and duplicate articles were excluded. Any disagreement between the two authors was resolved by a third reviewer. The full text of the remaining articles was accessed to assess inclusion in the work. Review articles were screened for other primary sources, but otherwise not included. For included articles, we collected data on study design, children age (ranging from 0 to 18 years), sex, slime toy ingredients (either from homemade or industrialized slime), site and type of reaction, suspected allergen, and whether the patient underwent allergy testing.

## RESULTS

A total of 65 studies were found on the initial search; among these, 60 were found in PubMed, 3 in LILACS, and 2 in SciELO databases (Figure 1).

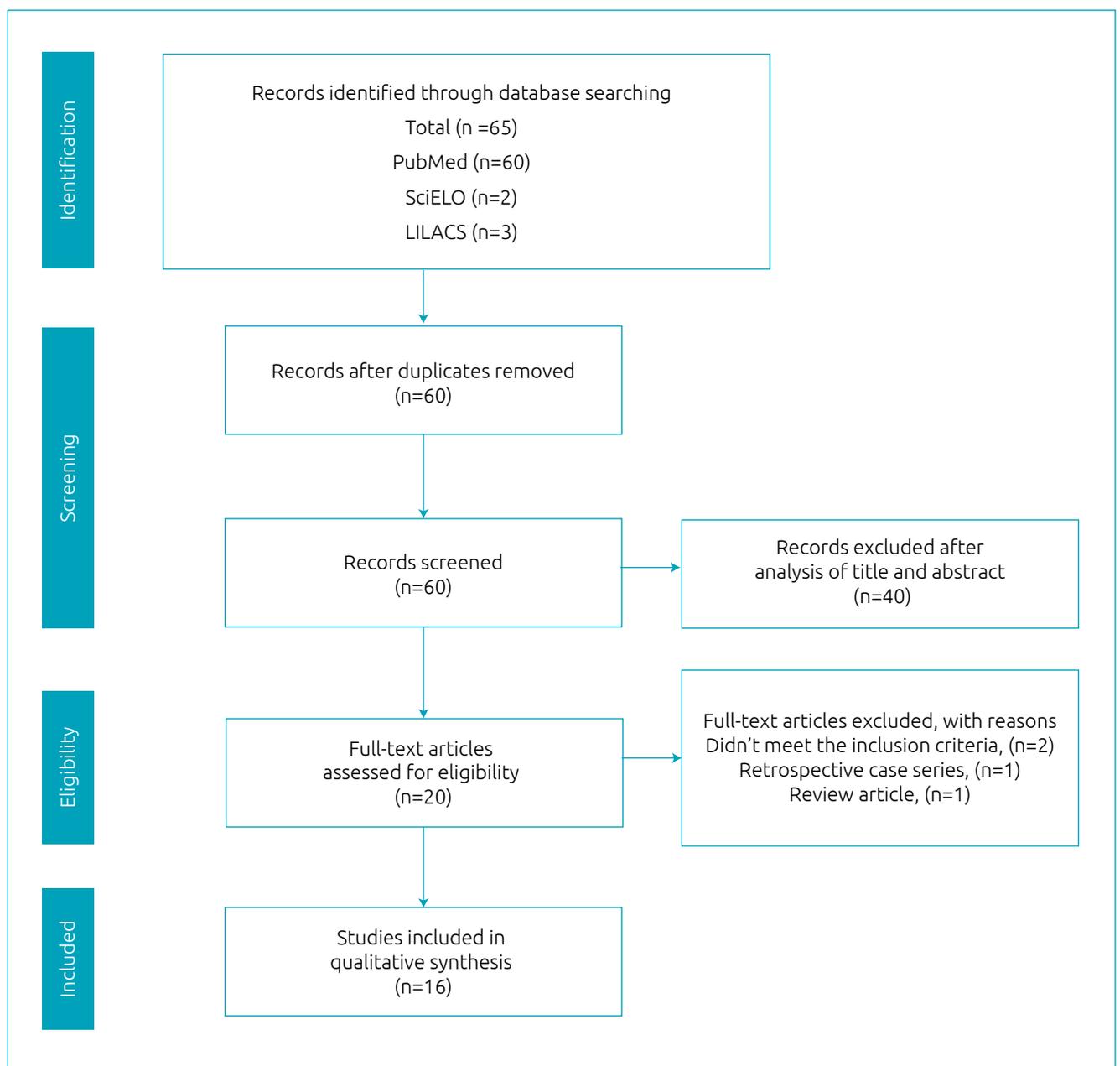
All reports are recent and included seven studies from 2018, five from 2019, and four from 2020 (Tables 1 and 2).<sup>13-28</sup> Among them, seven are from the United States, whereas the remaining are from France, Belgium, Brazil, Switzerland, Turkey, Canada, Spain, and Tunisia, published during the period between 2000 and 2021. From the selected 16 studies, 5 reported more than one case of intoxication while the remaining studies reported only a single case. A total of 20 females and 2 males, aged between 4 and 13 years, presented some type of skin reaction. It was possible to observe a higher prevalence of children with allergic contact dermatitis (ACD) or irritant contact

dermatitis (ICD), affecting mainly hands, fingers, nails, forearms, and cheeks.

The reports of intoxication involved mainly the manipulation of homemade slime preparations, their ingredients being water, boric acid, glue, polyvinyl acetate glue, shaving creams, borax, sodium hypochlorite (bleach), dyes, sodium bicarbonate, detergents, washing soap, shampoo, and glitters. Some of the ingredients used for homemade slime preparation are often associated with cases of allergy and skin irritation, in particular, detergents, polyvinyl acetate glue, and liquid soap. In contrast, in most cases where reactions were due to contact with commercial slime, it

was not possible to identify its ingredients. The only study able to identify the general ingredients used in a commercial slime preparation reported polyvinyl alcohol, glycerin, borax, ethyl paraben, deionized water, and various dyes on its composition.

Unfortunately, most of the studies did not inform the occurrence of previous episodes of atopic dermatitis. The studies that reported patch tests being carried out identified positive reactions for methylisothiazolinone (MI), methylchloroisothiazolinone/methylisothiazolinone (MCI/MI), methyl-dibromoglutaronitrile (MDBGN), and paraben mix (methyl paraben and ethyl paraben).



**Figure 1.** PRISMA flow diagram to selected studies

## DISCUSSION

According to the analysis of studies found in the current literature, it was possible to identify several reports of skin reactions induced by slime toys, especially those classified as ACD or ICD. The clinical diagnosis of ACD and ICD is difficult as these conditions cause lesions that often mimic other skin diseases that are common in children.<sup>29</sup> ACD is an inflammatory skin disease caused by a type IV hypersensitivity reaction, the immune response occurring in previously sensitized individuals with a latency period of 48–96 h.<sup>30</sup> On the contrary, ICD is a skin reaction caused by contact with corrosive substances and usually leads to symptoms within a period of 48 h after exposure.<sup>30,31</sup>

Given that the risks associated with the development of skin reactions and immune responses are very unique between individuals,<sup>32</sup> the severity and clinical evolution of intoxications caused by slime varied from severe cases of difficult management to milder cases<sup>13,14,18,20,23</sup> of good resolution.<sup>15,26,27</sup>

It is noteworthy that individuals who have suffered from previous episodes of atopy are more likely to develop atopic dermatitis and present more severe or intense ACD or ICD symptoms.<sup>32,33</sup> Despite this, most studies did not inform the existence of previous episodes of atopy. Furthermore, it is well known that mildly corrosive substances can potentially damage the skin of children, as it is more fragile and sensitive in comparison to the skin of adults. Also, the severity of

**Table 1.** Summary of articles included in this review: age and sex of the patients, presence of atopy, site, and type of reaction

Author, year, country	Age and Sex	Atopy	Site of allergic reaction	Type of reaction
Zhang et al. <sup>13</sup> (2019), USA	10, F	N/I	Distal dorsal and palmar fingers	ACD
Kondratuk et al. <sup>14</sup> (2019), USA	12, F	Yes	Dorsal right hand and wrist	Chronic dermatitis
	13, F	N/I	Both palms	Contact dermatitis
Heller et al. <sup>15</sup> (2019), USA	7, F	N/I	Both palms	ICD
	10, F	N/I	Both palms	ICD
Ducharme et al. <sup>16</sup> (2018), France	7, M	No	Fingertips	Eczema
Gittler et al. <sup>17</sup> (2018), USA	9, F	N/I	Palmar surfaces of both hands and volar fingertips	Pruritic dermatitis
Aerts et al. <sup>18</sup> (2018), Belgium	11, F	No	Palmar vesicular	Severe vesicular dermatitis
	9, M	Yes	Hands	Vesicular dermatitis
Piazza et al. <sup>19</sup> (2018), Brazil	11, F	N/I	Dorsal region of the six fingers	Contact dermatitis
Tehrany et al. <sup>20</sup> (2019), Switzerland	12, F	No	Both palms and extension to the forearms and face	Eczema
	11, F	Yes	Hands	Severe dermatitis
Anderson et al. <sup>21</sup> (2019), USA	11, F	Yes	Hands and cheeks	Atopic dermatitis
Salman et al. <sup>22</sup> (2019), Turkey	9, F	No	Hand, fingers, and periunguim	Dermatitis
	12, F	N/I	Both palms	Dermatitis
	10, F	N/I	Hands, on the sides of fingers	Eczema
Mainwaring et al. <sup>23</sup> (2019), USA	11, F	Yes	Bilateral palms and fingers	Dyshidrotic eczema, ICD, and ACD
Kong and Lam <sup>24</sup> (2019), Canada	10, F	N/I	Palmar surfaces of hands and fingertips	Contact dermatitis
Pessotti et al. <sup>25</sup> (2020), Brazil	9, F	Yes	Palmar surface	ACD
Córdoba et al. <sup>26</sup> (2021), Spain	10, F	No	Palms, interdigital folds, dorsal, and sides of the hands	ACD
Saad et al. <sup>27</sup> (2020), Tunisia	13, F	N/I	Face (cheeks) and hands	ACD
Brazen et al. <sup>28</sup> (2020), USA	4, F	N/I	Hands and thighs	Pruritic rash

M: male; F: female; N/I: not informed; ACD: allergic contact dermatitis; ICD: irritant contact dermatitis.

**Table 2.** Summary of articles included in this review: slime ingredients and type, potential allergens, and dermatologic tests

Author, year, country	Slime ingredients	Slime type	Allergens in potential	Dermatologic test
Zhang et al. <sup>13</sup> (2019), USA	Glue, shaving cream, and contact lens solution	Homemade	MCI/MI	Patch test
Kondratuk et al. <sup>14</sup> (2019), USA	Homemade nonborax slime	Homemade	N/I	N/I
	N/I	N/I	N/I	N/I
Heller et al. <sup>15</sup> (2019), USA	Tide with bleach, glue, and water, as well as marker for color	Homemade		N/I
	Glue, baking soda, shaving cream, contact lens solution, and food coloring	Homemade	N/I	N/I
Ducharme et al. <sup>16</sup> (2018), France	Polyvinyl alcohol, glycerin, borax, ethyl paraben, deionized water, and various dyes	Manufactured	MCI/MI	Patch test
Gittler et al. <sup>17</sup> (2018), USA	N/I	Homemade	N/I	N/I
Aerts et al. <sup>18</sup> (2018), Belgium	Textile glue, household detergents, and (food) colorants	Homemade and manufactured	MCI/MI, MDBGN	Patch test
	N/I	Manufactured	Paraben mix (methyl and ethyl paraben)	Patch test
Piazza et al. <sup>19</sup> (2018), Brazil	N/I	Homemade	N/I	N/I
Tehrany et al. <sup>20</sup> (2019), Switzerland	Liquid laundry detergent, special glue, contact lens solution, home fragrance, and shaving foam	Homemade	MCI/MI, slime	Patch test
	Liquid detergent, shaving foam, special glue, and glitters	Homemade	MCI/MI, liquid detergent	Patch test
Anderson et al. <sup>21</sup> (2019), USA	Laundry detergent, liquid dish soap, shampoo, and hand cream	Homemade	MCI/MI	Patch test
Salman et al. <sup>22</sup> (2019), Turkey	Dishwashing liquid (main allergenic ingredient)	Homemade	MCI/MI	Patch test
	Polyvinyl acetate glue (main allergenic ingredient)	Homemade	MCI/MI	Patch test
	Liquid soap (main allergenic ingredient)	Homemade	MCI/MI	Patch test
Mainwaring et al. <sup>23</sup> (2019), USA	White glue, glitter, shaving cream, artificial food color, and borax	Homemade	MCI/MI, Quaternium-15	Patch test
Kong et al. <sup>24</sup> (2019), Canada	Sodium borate (main allergenic ingredient)	Homemade	N/I	N/I
Pessotti et al. <sup>25</sup> (2020), Brazil	Body moisturizer, boric acid water, glue, baking soda, blue food dye, and shaving foam	Homemade and manufactured	MCI/MI	Patch test
Córdoba et al. <sup>26</sup> (2021), Spain	Liquid detergent (main allergenic ingredient)	Homemade	MCI/MI	Patch test
Saad et al. <sup>27</sup> (2020), Tunisia	Laundry detergent, glue, and food coloring.	Homemade	MCI/MI	Patch test
Brazen et al. <sup>28</sup> (2020), USA	N/I	N/I	N/I	Not tested

MCI/MI: methylchloroisothiazolinone/methylisothiazolinone; MDBGN: methylidibromoglutaronitrile; N/I: not informed.

the reactions can be directly proportional to the preexisting skin conditions, concentration of irritating compound, and time of exposure.<sup>34</sup>

This research highlighted that several potentially toxic, allergenic, or irritating products were used as ingredients for the preparation of homemade slime, including borate acid, polyvinyl acetate glue, sodium bicarbonate, borax, bleach, soap, and shampoo, among others. Previous study carried out by Marrero-Alemán et al.<sup>35</sup> reported the presence of high concentrations of allergenic or irritating compounds, such as isothiazolinones, in cleaning products. From a total of 34 products collected, 35.5% of the products analyzed for MI research had concentrations above tolerated limits by the European Commission (>15 ppm or 0.0015%).<sup>35</sup> In contrast, in Brazil, the maximum concentration allowed for MI is 100 ppm (0.01%), while for mixtures of MI and MCI (Kathon CG) substances the maximum authorized concentration is 15 ppm (0.0015%).<sup>36</sup>

The patch test is the gold standard diagnostic method for identifying susceptibility to contact dermatitis.<sup>28</sup> Interestingly, most studies have reported that individuals affected by slime presented a positive response for MCI and MI, which are preservatives widely used for the preparation of cosmetic and cleaning products. Previous studies have shown that the prevalence of contact allergy in response to MCI and MI is around 1.5% in the general population.<sup>37</sup> However, Mortazavi et al. have demonstrated exacerbated response for allergens in female children and teenagers; 39 (76.47%) cases involving females vs. 12 (23.52%) cases involving males.<sup>38</sup> In addition, Rodrigues et al. have demonstrated the incidence of positive response to patch test when the challenge is carried out with substances such as nickel, cobalt, fragrances, paraben, and thimerosal is higher in females.<sup>39</sup> Zafrir et al. performed a series of patch tests on children suspected of having ACD and found that females showed significantly more positive reactions (n=197; 78.2% of positive results) than males (n=147; 21.8% of positive results). In this same study, the authors were also able to observe a greater presence of positive results for MI/MCI in females (n=13; 10 females vs. 3 males).<sup>40</sup>

A possible hypothesis for explaining the findings described above was raised by the study conducted by Corrêa-Fissmer et al., which suggested that females are more susceptible for developing contact dermatitis because they consume more cosmetics and hygiene products. In addition, the authors claim that females have higher exposure to allergenic substances and, in general, they are more tempted to seek medical care than males.<sup>41</sup>

The limitations of this narrative review are mainly related to the reduced number of studies on the current literature

reporting cases of skin reactions associated with slime in children and adolescents. Indeed, the present review was based on data collected from few case reports published in scientific database; perhaps, a higher incidence might be present. However, it has not been reported in the literature due to the sub-notification of cases. Besides, all studies found on literature are case reports, which contain a significant variability in the description of cases. Additionally, many of such studies lack relevant data that would be important for further conclusions. For instance, the presence of atopy was not reported in 50% of the cases (11 children), while the performance of dermatological tests was not reported in 31.8% of the cases (7 children).

Taken altogether, such limitations did not allow us to compile those studies and describe our findings as a systematic review. Despite the limitations mentioned above, we foresee that our narrative review is important to highlight the potential intoxication triggered by slime for encouraging further clinical studies to investigate this problem more deeply.

## CONCLUSION

The present narrative review of the current literature between 2000 and 2021 has highlighted that homemade slime might trigger skin reactions, mostly classified as ACD and ICD. Furthermore, the studies have shown that most of reported skin reactions involved female children and teenagers. The ingredients often used for homemade slime preparation (e.g., detergents, polyvinyl acetate) contain MCI and MI, which are frequently associated with positive response in patch tests in individuals affected by slime. In conclusion, homemade slime toy recipes include several allergenic and irritant ingredients which might be exposed to vulnerable children, leading to intoxications. Therefore, homemade slime toys preparations should be used cautiously and under the supervision of adults.

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## Conflict of interests

The authors declare there is no conflict of interests.

## Authors' contributions

*Study design:* Oliveira RTD, Barioni ÉD. *Data collection:* Oliveira MJS, Bezerra MVE, Lima GS. *Data analysis:* Oliveira MJS, Bezerra MVE, Rocha GHO. *Manuscript writing:* Oliveira MJS, Bezerra MVE. *Manuscript revision:* Loiola RA, Rocha GHO, Oliveira RTD, Barioni ÉD. *Study supervision:* Barioni ÉD.

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