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Online extreme challenges putting children at risk: what we know to date
Online extreme challenges among teens

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INTRODUCTION: Extreme online challenges consist in taking part in challenges proposed on web and sharing the results in videos posted on social media. The use of social networks is widespread among the very young, giving easy access to potentially dangerous content with consequences on health.

EVIDENCE ACQUISITION: The aim of this literature review is to describe the most common challenges involving children and adolescents over the last 20 years. We focused on participants features (such as age, sex and psychological background) and health implications. The review included research articles and reviews published between 2000 and 2021. We used Pubmed, Scopus and Web of science as search engines.

EVIDENCE SYNTHESIS: Many types of online challenges emerged from the analysis of the literature. The most common challenges are those that lead to self-harm, which involve acts at risk of choking and challenges that potentially lead to suicide and ingestion of substances. The extreme challenge phenomenon is a public health issue that affects a vulnerable population, as it is young and susceptible to peer pressure influence. Participants often showed problematic personality traits, making them more likely to get involved in these behaviors.

CONCLUSIONS: It is necessary for parents, teachers and health workers to be aware of the spread of the online challenges, to improve prevention interventions in the age groups involved.

Key words: Extreme challenges; Dangerous online games; Social media; Adolescent development; Child development.

TEXT

Introduction

Challenges and risk-taking behavior are intrinsically part of the youth culture as means of seeking self-knowledge regarding their body and their emotions as well as identity construction [1]. Challenges among adolescents are not a new phenomenon but have always existed. However, in the past they spread more slowly by word of mouth. Nowadays due to social media platforms these challenges spread more rapidly and tend to occur in clusters. In the modern society, exposure to social media platforms and the Internet has changed the way people interact with the world and their peers. With the emergence and consolidation of the Internet, a new type of sociality has in fact been defined especially for the youngest. This new sociality is based on interactions that take place online, such as the creation of content shared on the web and that can be available in a few seconds by thousands of users. Young people are currently hyper-connected to the network and the desire to belong to the digital culture is also manifested through the construction of a favorable self-image geared to public acceptance. This also involves experiencing risky activities in which it is crucial to show courage and boldness, as long as they are actions that can arouse the interest of users. Therefore, at the basis of the participation in these challenges there is often an assumption: self-harm in exchange for an audience and approval. It is therefore critical to evaluate the influence of these new communication tools in the life of adolescents. As a matter of fact, teens (13-18 years) and tweens (8-12 years) tend to be extremely susceptible to outside influence and social media [2]. Susceptibility to peer pressure and the desire to belong to the peer group seem to be among the leading causes that promote participation in viral online challenges regardless of their dangerousness [3]. In fact, whether the challenge is dangerous or not, it is irrelevant in the choice of taking part in it: young people are motivated to participate driven by a desire for attention, because they tend to affirm themselves through the acceptance on social media platforms in which they seek the approval of the other. Adolescents engaging in online challenges associate higher risk challenges with the most favorable engagement of the audience [1-4]. As a matter of fact, online challenges are becoming increasingly dangerous in order to create higher shock in social media posts and

to gain more likes [2-5], as likes have the power to automatically generate a person's popularity and success. Online challenges are recorded and then posted on social media platforms to encourage others to take part in the same challenge [5]. Another factor to take into account when dealing with the role of social media and the Internet in the life of an adolescent is the responsibility they have in promoting self-harm and suicide thoughts contagion. As a matter of fact, a recent review highlights that an excessive internet use can promote self-harm and suicidal behavior. The reviewers argue that the Internet may normalize these practices by providing easy access to these images [6]. This is particularly dangerous for the most vulnerable subjects, who may have psychological, psychiatric or social risk factors and who may therefore be more susceptible to exposure to self-harm behavior. Internet in this way could exacerbate existing risks, so online manifestation of self-inflicted injury could be the demonstration of distress or felt pain that indicates the presence of an underlying problem.

Online challenges are therefore a global problem, precisely due to the fact that they are accessible to anyone through the web. In addition, they constitute a health problem as they intrinsically have a harmful and lethal potential. Moreover, they have a variable self-injurious potential to practitioners, which can range from minor and reversible injuries such as bruises to the risk of death.

In our review we will describe the most common extreme challenges in which adolescents take part and we will highlight the most common outcomes of those challenges, as well as the possible profile of the participants. Finally, we will discuss the importance of prevention in this area. Different approaches are available: firstly, increase awareness and education so that youngsters know how to recognize and manage online risks; furthermore, the training of teachers and health professionals regarding the issue of online challenges is fundamental, as well as helping and empowering parents in order to guide their children in the world of the web.

Evidence acquisition

The present literature review included research articles and reviews published between 2000 and 2021.

We searched the following databases: PubMed, Scopus and Web of Science.

The key words used are: (blue whale challenge) OR (cinnamon challenge) OR (chocking game) OR (skullbreaker OR benadryl) OR (corona virus) OR (bird box) OR (kill selfie OR daredevilselfie) OR (knock out OR batmanning) OR (eyebolling) OR (condom snorting) OR (balconing) OR (straw OR big straw) OR (planking) OR (Jonathan Galindo) OR (MoMo) OR (Samara) OR (tide pods) OR (fire challenge) OR (eraser challenge) OR (salt AND ice challenge) OR (pull a pig) AND (challenge) AND (online OR social media OR YouTube OR tiktok). Some keywords didn't get results. These words refer to the most common online challenges among children and adolescents in developmental age.

We selected the articles with the keywords in the title for a screening by reading the abstract, to identify potentially relevant articles. We collected 82 articles eligible for a full text screening. After reading the full text, 33 articles not matching the inclusion criteria were excluded; therefore, 48 articles were included in this review (Table 1).

We included articles only if mentioning challenges posted on the Internet or social media, as well as articles useful for an in-depth understanding of the challenge dynamics and background. In addition, we selected only articles about extreme challenges in which the participants were < 18 years. As far as extreme challenges are concerned those have been defined as challenges that put the life or health of the participant at risk.

Authors	Year	Study design	Main outcomes
Harrower et al. 47	1999	Journal article	The Choking Game
Senanayake et al. 10	2006	Case report	The Choking Game
Urkin et al.43	2006	Editorial	Choking Game in adolescents
Le et al. 7	2007	Original article	Self strangulation games among children
Toblin et al. 8	2008	Review	Strangulation deaths from the Chocking Game
Ullrich et al. 11	2008	Case report	The Choking Game

Authors	Year	Study design	Main outcomes
CDC	2008	Web site	The Choking Game
Egge et al. 9	2010	Case report	The Choking Game
Linkletter et al. 22	2010	Original article	The Choking Game: participants' characteristics
McClave et al.45	2010	Original article	The Choking Game
Brausch et al. 18	2011	Original articles	Risk of suicidal ideation in adolescents
Ramowski et al. 17	2012	Original articles	Health risk in the Choking Game
Ramowski et al.	2012	Original article	Risk behaviors associated with participation in the Choking Game
Bernacki et al.44	2012	Original article	Choking game preventions strategies for parents
Deklotz et al.35	2013	Case report	Skin damages caused by the Eraser Challenge
Avery et al. 36	2013	Case report	Fire challenge report and analysis of YouTube video
Grant-Alfieri et al. 38	2013	Original article	Cinnamon Challenge
Isaacs et al. 39	2013	Journal article	Self- harm in adolescents
Re et al. 12	2015	Case report and Litterature review	The Choking Game
Albuhairan et al 13	2015	Case report	The Choking Game

Authors	Year	Study design	Main outcomes
Busse et al. 14	2015	Review	The Choking Game
Bosmia et al. 40	2015	Letter to the editor	Lung injuries caused by the Cinnamon Challenge
Ibrahim et al. 15	2016	Original article	The Choking Game
Defenderfer et al. 23	2016	Original article	The Choking Game on YouTube
To et al. 37	2016	Case report	Fire challenge: a case of Hispanic young girl in USA
Butler et al. 46	2016	Original article	The Choking Game
Chassiakos et al. 48	2016	Technical report	Digital media and children and adolescents
Guilheri et al. 19	2017	Review	The Choking Game: characteristics of asphyxial games
Soumitra et al 24	2018	Letter to the editor	Blue Whale Challenge
Khan et al. 26	2018	Letter to the editor	Blue Whale Challenge
Balhara et al.30	2018	Case report	Case of consultation and risk factors of the Blue Whale Challenge
Barbieri et al. 41	2018	Case report	NekNomination challenges increased numbers of hospitalizations due to alcohol intoxication
Bada et al. 3	2019	Review	Online suicide games
Villani et al. 6	2019	Original article	Online self-harm challenges

Authors	Year	Study design	Main outcomes
Mukhra et al.27	2019	Letter to the editor	Effects of the Blue Whale challenge on teenagers
Ouellette et al. 20	2019	Original article	The Choking Game on YouTube
Lupariello et al. 25	2019	Review	Blue Whale Challenge and self-harm
Sumner et al. 28	2019	Original article	Public health awareness of suicide game and social media post
Narayan et al. 29	2019	Case report	Blue Whale Challenge: the case of young boy in India
Deslandes et al 1	2020	Original article	Self-harm challenges on YouTube
Bhattacharya et al.32	2020	Case Report	Blue Whale Challenge origin and participants characteristics
Prechtl et al.33	2020	Original articles	Internet challenges
Bréhin et al.34	2021	Case report	Skin damages caused by the Ice and Salt Challenge
Ruiz-Villaverde et al.31	2021	Case report	Skin ulcer caused by the Blue Whale Challenge
Young et al. 2	2021	Review	Social media challenges and their effects on the skin
Kriegel et al. 5	2021	Review	Internet challenges
Chater et al. 21	2021	Review	Intentional asphyxiation and addictive properties
Khasawneh et al 42	2021	Original article	Characteristics of the participants in Cinnamon Challenge and Ice Bucket Challenge

Table 1: *Summary of the 48 articles included in the review.*

Evidence synthesis

Many types of online challenges emerged from the analysis of the literature. In the following paragraphs we report the most common challenges that lead to self-harm, which involve acts at risk of choking and challenges that potentially lead to suicide and ingestion of substances.

The choking game

“Choking game” is just one of the many names by which a choking practice widespread among young people globally is known. It involves causing asphyxia by exerting pressure on the neck with the hands or with different types of binding means (ropes, scarves, belts..) in order to reduce oxygenation to the brain. The goal is to experience the effect of fleeting euphoria caused by hypoxia and the sensation of imminent loss of consciousness that causes a sense of vertigo, a sort of "sensory earthquake", which is perceived as pleasant and encourages the repetition of such behaviors. This type of activity can be practiced both in groups and alone, so strangulation can be self-induced or provoked by others [7-8].

Although this "game" was also practiced in the past, in more recent years it was shed light on its danger through several case report of deaths or near-fatal events relating to children who took part in it and it has become more widely known also due to the effects of social media [9-13]. In a previous systematic review, it was determined that the prevalence among young people is between 5% and 11% [14]. The age is very variable, from 9 to 19 years, with a peak at 13, both females and males but with a prevalence of the seconds (2:1) [12]. A CDC study of 82 deaths likely due to the choking games that occurred between 1995 and 2007 found that 86.6% of deaths were male and 95.7% of deaths occurred while the participant was alone [8]. In fact, in the absence of other people, the risk of death increases because in the event of loss of consciousness the subject is unable to stop the pressure on the neck [14-15].

Some research has shown that participation in the choking games is more common among young people who experience other risk behaviors (e.g. substance abuse) and have a poor mental health status [16-17]. In particular, an association has been demonstrated between

self-suffocation and non-suicidal self-harm (NSSI): their combination leads to a greater tendency to engage in other risk behaviors, including suicide [18]. Especially those who participate alone have a higher risk in terms of mortality and morbidity as they have a higher rate of suicidal ideation and a worse state of mental health [15].

Choking game is a dangerous activity that can lead to death and can cause even permanent injuries, both physical, caused by the fall following loss of consciousness, and neurological as a result of cerebral hypoxia, such as chronic headache, amnesia, convulsions up to stroke [11-19-20]. Furthermore, such practices may be addictive [21].

Practices of self-suffocation have become more and more frequent among adolescents and this can also be determined by their exposure to videos in which such practices are carried out and which are published on the Internet. The number of these videos is growing over the years and they are viewed millions of times [22-23]. Although a causal association has not been demonstrated between the use of YouTube and participation in the choking game, this platform has allowed the global spread of videos of this type and their easy access could normalize dangerous behavior among young people [20]. It has been suggested that peer pressure is crucial in starting to practice such risky activities [13] and the use of the Internet has made this effect exponential: in fact, the videos on YouTube are extremely instigating as they show young participants at choking game that encourage other kids to imitate them to experience the same sensations [19].

The Blue Whale challenge

The Blue Whale Challenge is one of the online challenges that has taken on the most importance in the media, as numerous cases of suicide among children and adolescents have been attributed to it. Despite the challenge has been often cited in the media, there is usually a lack of media literacy about this theme. As a matter of fact, it is often very difficult to discriminate whether the reports about suicide games are only rumors and fake news or if they are to be believed [3-24].

It was born in 2013 in Russia on a social network called Vkontakte and has spread all over the world. The creator of the game is a young Russian, a psychology student Philipp Budeikin, who is convinced that the victims were just nothing.

The name refers to the phenomenon of stranding whales that leads to their death.

It is a step-by-step challenge, lasting 50 days, with one step per day to overcome. It is not a self-managed challenge like other challenges can be. In this one, there is a "curator", a person who lures the young person online and by private chat sends him or her the daily tasks to be performed every day. The 50 tasks are very dangerous ranging from getting razor cuts on different parts of the body, going to the top of roofs or the edge of bridges or railroad tracks, to the last request which is to jump off a building and take their own life [25]. Once what is requested has been carried out, this must be documented with photos or videos and sent to the curator who verifies that it has been properly carried out, but the smartphone is constantly monitored in its every movement as a sort of virus for which the teenager is not able to break free from this game.

On a psychological level, it acts on the self-esteem of the young person involved, the achievement of one goal of the game feeds the desire to reach the next level, creating a sort of addiction [26].

An important role in dissemination is that of social media, in which information and messages regarding this type of games spread very quickly. The big giants of the Internet are involved, including WhatsApp, Instagram, Facebook, Snapchat, Yahoo and Google chat [27]; studies have also been carried out by analyzing posts on Twitter, YouTube, Tumblr, Reddit, blogs and forums, evaluating them as for or against the Blue Whale [28]. From the analysis of literature, it was emerged that the average age ranges from 11 to 17 years with prevalence of female, which involved numerous countries. Cases are reported from Russia [27], Pakistan [26], India [29-30], Spain [31], Italy.

In particular, in Italy, 5 cases of girls between 14 and 17 years old observed at the Regina Margherita hospital in Turin have been reported. The girls had stab wounds linked to the Blue Whale Challenge. All had various family, economic and social problems and some stories of self-harm [25].

Teenagers in this age group experience curiosity, the fascination of risk, rebellion, acceptance into the peer group but it has been seen that many young people involved would be particularly vulnerable subjects with depressive traits or borderline personality traits. Many would create a bond with their healer by feeling the need to please him/her and carrying out all the requests made to the point of taking their own life [32].

Challenges that cause skin damage

17.7% of the challenges that adolescents undertake end up causing skin damage. Among those the most relevant ones are the “Deodorant challenge” and the “Salt and Ice challenge” that cause injury by thermal withdrawal from the skin [33]. In the “Deodorant challenge” heat is withdrawn from the skin spraying an aerosolized liquid near the skin for 10 to 20 seconds [2-33]. The rapid temperature-drop causes frostbite injuries and, in some cases, even severe burns. In the “Salt and Ice challenge” salt is placed onto the skin and ice is held upon the area. The melting of the ice causes first and second degree burn injuries. After the resolution of this injury often the skin becomes scarred or develops long-term change in pigmentation [2-33-34].

Other challenges that are part of this group are the “Eraser challenge” and the “Kylie Jenner lip challenge”. In the “Eraser challenge” an eraser is rubbed in the skin causing erosions [2-35]. Meanwhile in the “Kylie Jenner lip challenge” lips are placed in a small glass or bottle in which a vacuum effect is created by suction. Due the vacuum created lips swell for several hours. In addition, if the vacuum is kept for too long the small capillaries in the lips engorge and may rupture causing bruising and pain. Moreover, the prolong negative pressure may shatter the glass that may in turn injure the skin [2].

Challenges in which objects and inflammable liquids are set on fire on the body account for 9.8% of the challenges. In these challenges the most common outcome is severe second degree burns and even third degree burns in case the fire is not extinguished promptly [2-33-36-37].

Finally, in the “Hot water challenge” a pot of extremely hot or boiling water is poured on themselves or a friend (often sleeping) usually causing severe burns that often require hospitalization and may also result in the death of the participant. A variation of this challenge consists in drinking boiling water through a straw [2].

All the challenges previously described are usually recorded by the participant and then posted on social media platforms. The most used platform for this purpose is YouTube. As a matter of fact, searching these challenges in this platform yields numerous results. Adolescents participating these self-injurious challenges can either be more prone to risk-taking behavior and therefore participate in even more dangerous challenges, but may also on the contrary be a sign of an underlying depression, personality disorder and even suicidal ideation [2]. Adolescents taking part in these challenges usually perceive that the

social benefit resulting from participating in the challenge outweighs the potential risk. Among adolescents the ones that most often undertake the challenges are usually males [1-2-33-36]. In further detail it is seen that especially challenges in which fire is involved are dominated by males. In addition, the age group most likely to participate in these challenges is approximately the 10-14 age group as this is the most susceptible to peer pressure and impulsive as well as the least averse to risk taking [2].

Ingestion challenges

Around half of the videos portraying challenges videos can be grouped in the so-called ingestion challenges. These challenges can be divided in two main subgroups. The first subgroup is made of challenges that cause irritation upon ingestion while the second subgroup is made of challenges that cause nausea and disgust [33].

The cinnamon challenge consists in inhaling the greatest amount of cinnamon from a spoon in 60 seconds without drinking water, inducing a coughing reaction and choking sensation. Cinnamon challenge videos are posted on many social networks and the greatest popularity was achieved on YouTube channels. Claiming an immense increase in popularity from 2001 to 2007, as of August 10, 2012, there were 51 100 YouTube clips depicting the Cinnamon Challenge and one video was viewed 19 million times, predominantly by 13- to 24-year-olds [38-39]. Cinnamon inhalation can cause pulmonary inflammation, predisposing airways to epithelial lesions and scarring. Aspirated powder entering the upper airways can cause inflammation and, in more severe cases, aspiration pneumonia; the fibers and other components of cinnamon can also cause allergic and irritant reactions, including acute symptoms and temporary, if not permanent, lung function changes [38]. Schools and pediatricians should be encouraged to discuss with children the Cinnamon Challenge and its possible harmful effects, especially with children having cinnamon hypersensitivity, asthma, pulmonary cystic fibrosis, or chronic lung disease [38-40].

In the chili challenge ingestion of a very hot chili fruit or of a sauce made from it elicits the nociceptors in the mouth resulting in a burning sensation in the mouth and throat. In addition, due to the contact with the irritative substance present in the chili there is a change in the vascular tone that results in hyperemia. This challenge can be particularly

dangerous for younger children and sensitive subjects. As a matter of fact, there have been case reports of this challenge ending up with the death of the participant [33].

A somewhat similar challenge to the one just describes is the Pepper-Spray Challenge. In this variation of the challenge the pepper spray is sprayed in the eyes causing swelling of the mucous membrane and in asthmatic users also shortness of breath [33].

In the Tide Pods challenge the users ingest the laundry detergent contained in the dissolvable plastic causing severe burns to the mouth, esophagus, and respiratory tract. In case of laundry detergent ingestion, it is of critical importance to immediately contact a physician or the poison control center. Moreover, as in the chili challenge, younger children usually have more severe health repercussions [5].

The banana and sprite challenge consists in rapidly eating 2 bananas and then drinking 1.5 liters of lemonade filling up the stomach to maximum capacity. The ingestion of this mixture possibly results in the formation of a gel and foam that stimulates the peristalsis. As a result, the stomach and diaphragm contract, the stomach mouth opens allowing the stomach contents to pass through the esophagus and go to the outside [33].

The NekNomination challenge consists in filming while drinking an excessive amount of alcohol and then nominate a friend to participate in the challenge and beat them. The participant usually associated to this challenge increasingly dangerous mixtures and behaviors such as driving and swimming while intoxicated by the alcohol. Despite numerous deaths have been reported following the participation in this challenge, it is extremely difficult to precisely compute the exact fatality rate resulting from this game as most of the videos have unknown medical sequelae. Alcohol abuse in adolescents is one of the leading causes of accidents and injuries that require hospitalization. Participants in this challenge are most likely young males that participate driven by peer pressure and willingness to be accepted by the group [41]. This last challenge is the most dangerous among the drinking games and therefore has been the only one selectable for this review.

Profiling the participants

From the analysis of the literature, it emerges that online challenges represent a serious problem involving children and adolescents and that puts their health at risk. As we have reported, they are very dangerous as they can cause different types of injuries, temporary

or permanent, for example at the skin, lung or neurological level, but they can also lead to death.

The young people who participate in these challenges can have very different characteristics and three different typologies are recognized in particular. The first are casual participants, i.e. those who are driven by curiosity or peer pressure. Secondly, we find frequent participants who repeat the game many times because they want to get stronger and stronger sensations and often do it alone. Finally, there are those with vulnerable personalities, who are generally motivated to push their limits and are more frequently involved in fatal events [19]. Given the presence of such varied subjects, it is of fundamental importance to discriminate the type of participant. In fact, as emerges from the analysis of different articles, it is necessary to understand whether participation in games that lead to self-harm is the manifestation of an underlying psychological distress or whether the motivation is only curiosity and peer pressure. The latter in particular, by participating in the online challenges underestimate the danger of the same [2-3-13-18-35].

The reasons that lead young people and adolescents to participate in these risky behaviors can be broadly grouped into four types [19]:

- 1) The taking of risk, which allows them to overcome anxiety or fear of the unknown;
- 2) The pursuit of an intense sensation;
- 3) The loss of consciousness, a moment in which they manage to escape from the outside world and their worries and anxieties;
- 4) The awakening/survival, i.e. the feeling of being omnipotent for having passed a potentially deadly test.

In most cases, children and adolescents do not participate in these games with the intention of dying and are not aware of being dangerous for their health, but they do it for thrill seeking as they are eager to experience new sensations. One study found that 40% of young people are unaware of the risks associated with these activities [12]; therefore, they generally believe that these behaviors are safe and represent an alternative and less dangerous way to have fun than the use of alcohol or drugs [9-12]. However, in some challenges, such as the Blue Whale, the ultimate goal is suicide. The repetition of acts of self-harm, however, day after day, reduces and normalizes the player's fear of this type of behavior and so the subject is induced to practice his own suicide as an inevitable and accepted event [25].

Self-injurious behaviors and suicides are a growing problem among young people: according to the WHO, suicide is the second leading cause of death in adolescents worldwide and this figure has worsened in recent years in consequence of exposure to harmful content on the web and the emergence of online extreme challenges [26]. Studies have shown that among adolescents there is an association between the prevalence of the Internet use and suicide rates and an association between the use of electronic devices and social media and depressive symptoms and suicide-related outcomes [28].

The Internet has therefore played a decidedly important role in amplifying this phenomenon since, by allowing free access to violent images and content related to suicide, it has ensured that these risk behaviors are normalized in the eyes of young people [6]. For example, self-suffocation practices have become very frequent among young people as YouTube makes available an ever-increasing number of videos in which young people compete in these games [22-23].

It is typical of adolescents to implement behaviors aimed at achieving strong sensations and participation in dangerous games increases their perception of being powerful and courageous; moreover, sharing these experiences with friends and on social networks helps to strengthen their sense of omnipotence and the feeling of being appreciated, gaining notoriety even among strangers [19].

In fact, it has been seen that among the critical factors that increase the probability of participation in these challenges there is the role of the public: if a great deal of attention to the challenge is perceived by the public, the greater the commitment of the participants in the challenge itself to obtain more views to their videos. Another critical factor is the involvement of peers: the more they are involved, the more the subject believes that it is the right behavior to perform [42]. In particular, we have seen how adolescents with a higher level of stress attribute a central role to internal motivation linked to peer pressure [6]. According to the Cognitive Social Theory, the social context, including observation and interaction with others, is decisive in defining the behavior of a subject. This is especially true in the adolescent stage, during which brain development is hugely influenced by the behavior of others, especially one's peers. Social learning is therefore also decisive with regard to self-harm and suicide-related behaviors, especially among the most vulnerable young people [28].

Self-harm in adolescents is described as the strongest predictor of suicide and results from a combination of several variables such as depression, anxiety, lack of belonging, low self-

esteem, perfectionism, social isolation, relationship problems, poor parent-child attachment and poor emotional regulation skills. From the review of the literature, in fact, it emerged that young people who take part in online challenges are mostly subjects with problematic personalities related to family, social or economic problems, who use these games to communicate their distress or temporarily reduce unpleasant sensations [6]. Some challenges can therefore be manifestations of depression, anxiety, stressful events or borderline personality disorders [34]. For example, it was highlighted that the adolescents involved in the Blue Whale Challenge are vulnerable subjects, with depressive traits [27]. Hence the need to pay attention to the mental health of young people, identifying a possible underlying psychological distress, the presence of risky behaviors, especially in combination with exposure to harmful online content, and considering, if necessary, referral to a mental health service.

Prevention

There are a series of signs that can highly suggest the participation of adolescents in online extreme challenges, so it is important to know how to recognize and implement prevention strategies at multiple levels, both in the family and in school as well as at the public health level. It is necessary to understand what are the risk factors that lead to participating in this type of game. Adolescence is an age in which young people are particularly vulnerable and led to know the risk without having the maturity to recognize and manage dangerous behaviors [30].

Several studies have highlighted how adults, both parents, school, and health workers are not sufficiently informed about the phenomenon of online extreme challenges. Instead, it is essential that the aforementioned figures know how to recognize physical, psychological and behavioral signs (e.g., signs on the neck, ocular hyperemia, frequent headaches, disorientation after being alone, isolation and unusual need for privacy, aggressive attitude, difficulty to concentrate, amnesia) and the various possible clinical manifestations (e.g., epileptic seizures, syncopal episodes) typical of those who take part in these activities in order to identify them and intervene early [9-11-43].

For example, the 2008 CDC study of children who died after participating in the choking game showed that 92.9% of parents were unaware of this game until then, testifying to the secret nature of these behaviors [8]. In another study it was found that 3/4 of the parents

interviewed were aware of it, but only 20% had talked about it with their children [44]. McClave et al. have shown that only 68.1% of the doctors are familiar with the choking game challenge, but this does not translate into counseling on the risks of this activity to patients [45].

This results in a delay in the recognition of alarm signs and therefore clinicians and health authorities are alerted when suicidal or self-injurious behaviors have already been committed; it is therefore essential that they are identified as soon as possible in order to implement preventive measures to reduce damage to health or possible deaths [28].

It is also important to develop a conscious and “healthy” use of the Internet in young people; ensure age-appropriate internet access and adequately supervise access to the Internet [25-30].

Prevention would be important if it started from schools. As a matter of fact, schools are an important place of learning and must promote non-risk behaviors. Therefore, it is important to start from the discussion with the kids to educate them on the dangers of such games. An effective strategy could be to use peer education [7].

Some studies suggests that there is very strong evidence that education is effective in changing student attitudes about the risks of injury when playing the choking game. As a matter of fact, it has been demonstrated that an interactive, standardized and skill-based education is crucial not only to enhance student awareness but also to diminish the interest in participation. Another important factor to consider is that students often report that schools themselves are the place where they first heard of the challenge and where the challenge itself is played. In addition, it is necessary to underline that education does not increase the likelihood of participation in the choking game [46]. There is no evidence to suggest that talking about risky behavior leads the adolescent to take part in it; furthermore, the availability and widespread use of the Internet by adolescents means that information on the choking game is already readily available to them, as videos demonstrating how to participate in the game can be easily found on the web. And a lot of teenagers are likely to be aware of the choking game but underestimate the real dangers of this potentially deadly game [45].

The education of young people through the family is essential to eliminate the misconception that this is a harmless activity. The Internet may be a possible way of communicating this message to teens, although research has shown that the most respected

source of preventative messages is parents for younger children and victims or the victim's family for teens and young adults [22].

In addition, the importance of language in the prevention and control of other injuries has been

recognized. Straightforward language that reinforces the message that intentional choking and other risky behaviors might lead to death is warranted [47].

The role of parents is therefore crucial in knowing how to recognize risk factors in their children and prevent them by talking to them and observing them in their daily lives. Some authors have proposed guidelines for both parents and governments [27]. Many parents are known to speak little to their children about the risks of online challenges.

A starting point in prevention could be the production of videos of good quality and accurate compared to those currently circulating, which can be accessed via social media; as well as eliminate harmful videos and those that either glamorize or normalize such behaviors [48].

Traditional public health surveillance does not use real-time data, but is 1-2 years delayed and this limits a quick preventive response. The analysis of social media data, on the other hand, would allow a much faster and almost real-time identification of emerging online trends and risk factors for mental health, thus highlighting the usefulness of such analyzes to implement public health interventions, in response to an emerging online risk. In the same way, communities have the potential to encourage correct attitudes and convey positive and protective messages. Therefore, social media can be a tool for monitoring public health and can be useful prevention strategies to be implemented through the media, such as behavioral therapy programs or online peer support [28].

Moreover, preventive interventions could focus on the emotional support of the adolescent, also making use of new methods and tools, such as video games, mobile applications in order to help them manage their affective states [6].

Furthermore, legislation is urgently needed to manage the circulation and access to internet content that exhibits behaviors that are potentially harmful to young people. For example, in France social media content that encourages young people to engage in such behaviors is blocked and removed [19].

It would be important for institutions to report violent videos or videos that incite violence on the portals. Broad range intervention is necessary when a larger group of young people attends a challenge and was harmed [33].

Pediatricians play an important role in educating parents and patients about the risks of social media trends. Pediatricians should also facilitate conversations and provide resources about topics such as body image, self-esteem, cyberbullying, peer pressure to ensure and promote healthy internet use [5].

Conclusions

Extreme challenges are a phenomenon that has found widespread diffusion on the Internet, especially on social media, thanks to the speed of sharing information, the vastness of the public that can be reached and the "social advantage" that comes from participating in the challenge. Since access to the web is very early, adult supervision is increasingly necessary in the use of these means. In fact, if on the one hand young people use the Internet easily, on the other they do not have the ability to recognize the dangers they may face. The role of parents and teachers in guiding the use of platforms and explaining the content to which young people have access is therefore fundamental. Various education and intervention programs are available, but none of these have yet been formally evaluated [14]. For example, in UK the government disclosed a document called the White Paper on online harm in which they exposed their plan to keep users safe online. At the same time in India big social media companies were asked to remove all links about the Blue Whale Challenge. Furthermore, in Russia has been introduced a law that impute criminal responsibility for those who create online pro-suicide groups on social media and for those who instigate minors to commit suicide [3]. Finally, in 2016 the American Academy of Pediatrics published a set of guidelines "Children and Adolescents and Digital Media" to minimize unhealthy habits and behaviors and to help parents to recognize and address the problem promptly and appropriately. In order to achieve this objective, the authors suggest the development of a Family Media Use Plan to find an appropriate balance between screen time and other activities, set boundaries and prompt age-appropriate critical thinking and create coherent rules about social media use [48].

It is necessary to adapt prevention interventions to different contexts and further research is needed to develop appropriate teaching materials.

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TABLES

Table I.— *Summary of the 48 articles included in the review.*

Authors	Year	Study design	Main outcomes
Harrower et al.	1999	Journal article	The Choking Game
Senanayake et al.	2006	Case report	The Choking Game
Urkin et al.	2006	Editorial	Choking Game in adolescents
Le et al.	2007	Original article	Self strangulation games among children
Toblin et al.	2008	Review	Strangulation deaths from the Chocking Game
Ullrich et al.	2008	Case report	The Choking Game
CDC	2008	Web site	The Choking Game
Egge et al.	2010	Case report	The Choking Game
Linkletter et al.	2010	Original article	The Choking Game: participants' characteristics
McClave et al.	2010	Original article	The Choking Game
Brausch et al.	2011	Original articles	Risk of suicidal ideation in adolescents
Ramowski et al.	2012	Original articles	Health risk in the Choking Game
Ramowski et al.	2012	Original article	Risk behaviors associated with participation in the Chocking Game
Bernacki et al. ⁴⁴	2012	Original article	Choking game preventions strategies for parents
Deklotz et al.	2013	Case report	Skin damages caused by the Eraser Challenge

Authors	Year	Study design	Main outcomes
Avery et al.	2013	Case report	Fire challenge report and analysis of YouTube video
Grant-Alfieri et al.	2013	Original article	Cinnamon Challenge
Isaacs et al.	2013	Journal article	Self- harm in adolescents
Re et al.	2015	Case report and Litterature review	The Choking Game
Albuhairan et al	2015	Case report	The Choking Game
Busse et al.	2015	Review	The Choking Game
Bosmia et al.	2015	Letter to the editor	Lung injuries caused by the Cinnamon Challenge
Ibrahim et al.	2016	Original article	The Choking Game
Defenderfer et al.	2016	Original article	The Choking Game on YouTube
To et al.	2016	Case report	Fire challenge: a case of Hispanic young girl in USA
Butler et al.	2016	Original article	The Choking Game
Chassiakos et al. 48	2016	Technical report	Digital media and children and adolescents
Guilheri et al.	2017	Review	The Choking Game: characteristics of asphyxial games
Soumitra et al	2018	Letter to the editor	Blue Whale Challenge
Khan et al.	2018	Letter to the editor	Blue Whale Challenge

Authors	Year	Study design	Main outcomes
Balhara et al.	2018	Case report	Case of consultation and risk factors of the Blue Whale Challenge
Barbieri et al.	2018	Case report	NekNomination challenges increased numbers of hospitalizations due to alcohol intoxication
Bada et al.	2019	Review	Online suicide games
Villani et al.	2019	Original article	Online self-harm challenges
Mukhra et al.	2019	Letter to the editor	Effects of the Blue Whale challenge on teenagers
Ouellette et al.	2019	Original article	The Choking Game on YouTube
Lupariello et al.	2019	Review	Blue Whale Challenge and self-harm
Sumner et al.	2019	Original article	Public health awareness of suicide game and social media post
Narayan et al.	2019	Case report	Blue Whale Challenge: the case of young boy in India
Deslandes et a.	2020	Original article	Self-harm challenges on YouTube
Bhattacharya et al.	2020	Case Report	Blue Whale Challenge origin and participants characteristics
Prechtl et al.	2020	Original articles	Internet challenges
Bréhin et al.	2021	Case report	Skin damages caused by the Ice and Salt Challenge
Ruiz-Villaverde et al.	2021	Case report	Skin ulcer caused by the Blue Whale Challenge

Authors	Year	Study design	Main outcomes
Young et al.	2021	Review	Social media challenges and their effects on the skin
Kriegel et al.	2021	Review	Internet challenges
Chater et al.	2021	Review	Intentional asphyxiation and addictive properties
Khasawneh et al.	2021	Original article	Characteristics of the participants in Cinnamon Challenge and Ice Bucket Challenge