Short Paper: Damage Mechanism and Risk Control on Kid's Sunglasses

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Abstract. Kid's sunglasses have been the articles for children daily use. Therefore based on the children's physical and mental development characteristics and injury events in recent years, this paper analyzes the harm mechanism of nickel precipitation, transmission, high-temperature resistance and so on of the kid's sunglasses, parses the problems existed in standards and supervision of kid's sunglasses in China, and offers proposals for accelerating revision of national standards, strengthening consumption guide and enterprise supervision in order to improve the quality safety level of kid's sunglasses.

Keywords: Kid's sunglasses · Quality safety · Risk analysis and standards

1 Foreword

People regulate the light flux though the pupil size in the sun, but the eyes are hurt when the light intensity exceeds regulating capacity of the eyes. So the sunglasses are used in summer in some outdoor activities to relieve eye regulating fatigue or prevent injury from strong light stimulation. As for sunshading, the sunglasses, also called sun blinkers, is a vision care appliance to protect the eyes from strong sunlight stimulation. With the improvement of people's living and educational levels, the sunglasses also become the special ornament for beauty or personal style. Sunglasses can be divided into ordinary, polarized or specialized ones, etc. While the kid's sunglasses refer to the ones that are designed and manufactured specially for children's sunshading and ornament.

As a large country for sunglasses production, import and export, there are nearly 1000 sunglasses manufacturers in China currently, they are spread over Guangdong, Fujian, Zhejiang, Jiangsu, Shanghai and so on, their output is 40% of the total output in the world, the annual output value exceeds RMB8,000,000,000, and the annual volume of export is about USD600,000,000–700,000,000. At the same time, China also the consumption power of glasses, the consumer group of sunglasses is about 400,000,000 people.

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2 Review of Injury Events Concerned Product Quality Safety

In recent years, reports about teenagers' pathopoiesis and injury caused by quality problems of kid's sunglasses are repeated. According to incomplete statistics, in 2009–2013, there are more than 40 quality safety events caused by the kid's sunglasses.

Case 1: In September 2011, a consumer feeds back that his 6 years old child has swollen, blisters and suppurating on his temples after wearing the sunglasses. In the hospital, it is confirmed that the reason is nickel in the spectacle frame.

Case 2: In June 2013, a 5 years old child named Yang Yang in Weihai, Shandong wears four kid's sunglasses in the shapes of Xiyangyang, Grandfather Sun, little frog and heart. After two weeks, the kid has photophobia, tears and gum in the left eye, the doctor diagnoses as keratitis. And the reason is Yang Yang often wears the inferior sunglasses.

Case 3: On June 12, 2013, a consumer in Meishan, Nanjing complaints that his 12 years old son's resin lens burst suddenly to hurt the eye, and several stitches are given in the hospital. The experts believe that the resin lens expand quickly when they go from low to high temperature suddenly, but the frame constrains them till they bust.

3 Main Hazards and Injury Mechanism

3.1 Characteristics of Kid's Visual Development

The 0–14 years old children are in the growth and development stage, including their eyes. The vision improves fastest in 3–5 years old, and the vision reaches the adult level at the age of 6; but before it, physiological hyperopia is the physiological character of children's eyes. For this reason, children under 6 shall not wear the sunglasses. In 7–10 years old, the children's eyeballs grows with age, their axis oculi extend gradually too, which reduces the degree of physiological hyperopia step by step. By the age of 7, the children's eyes approach the adult. And the children's eye size almost reaches the size of a adult at the age of 10. The eyeballs of the children in 10–15 years old still grow slowly, with the refractive status change constantly, which increases the risk of adverse effects caused by external factors.

3.2 Injury Mechanism

The main hazard factors to cause the above mentioned kid's sunglasses quality safety harmful events are the nickel release of the frame, the transmission property and the high-temperature resistance.

Nickel Release. As a heavy metal element, nickel may cause skin contact allergy. According to the medical evidences, contacting nickelic articles for long-term may cause skin allergy even carcinogenic. Extra nickel release from the kid's sunglasses frame may threaten health. For nickel ion may penetrate into the skin through the pore and sebaceous gland following sweat to cause allergy and inflammation of the skin, and the clinical manifestation is dermatitis and eczema. The clinical manifestation of the

nickel allergic dermatitis is pruritus, popular dermatitis or popular vesicular dermatitis with lichenification, even skin eruptions.

When the children wear the sunglasses in summer, the inner side of the glasses leg and the frame contact the skin for long-time, besides children are active and easy to sweat, so nickel element is absorbable through sweat (Fig. 1). In particular, the children's body apparatus are developing and vulnerable, so safety of wearing the sunglasses with a metal frame in high temperature cannot be ignored.

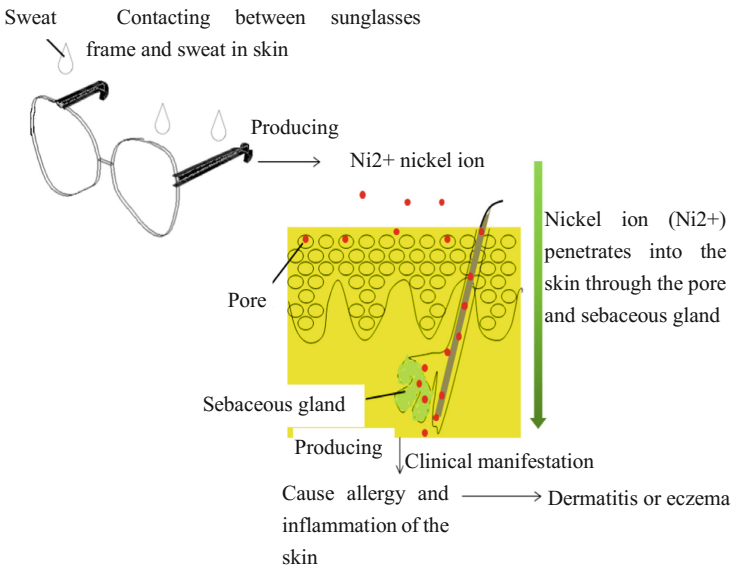

Fig. 1. Nickel precipitation and body absorption for a child wearing the sunglasses

Transmission Property. The transmission property is mainly expressed by the light transmissivity, including the visible light transmissivity and the ultraviolet spectrum transmissivity. Because children's vision is growing and developing, the kid's sunglasses with too low light transmissivity (Color too dark) can cover the children's eyes, restrain normal development of the children's vision and cause amblyopia. While a too

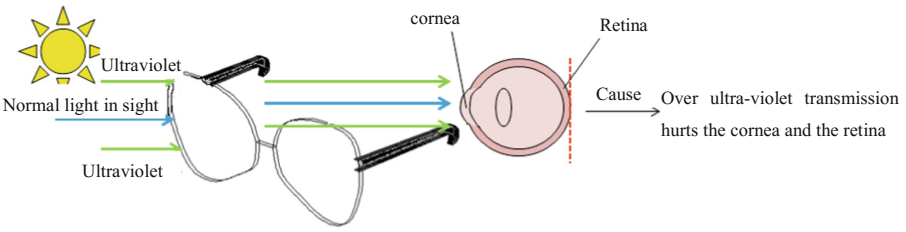

Fig. 2. Schematic diagram of hazard to children caused by the kid's sunglasses transmission properties

large ultraviolet transmission can hurt the eyes, especially the children's eyes are very sensitive to ultraviolet, so over ultraviolet transmissivity is easy to hurt the cornea and the retina (Fig. 2).

High-Temperature Resistance. The lens of the sunglasses are made from resin normally, in high temperature, the sunglasses resin lens expand by heating, during this procedure, their physical stability decreases largely, especially in the environment of excessive heat and cold, cracks or fractures are prone to producing, even burst, which may hurt the user's face and eyes (Fig. 3). Because children are active and playful, they often use the sunglasses as the toy. Many children wear the sunglasses for long time, which is very easily to occur lens fracture caused by a high temperature.

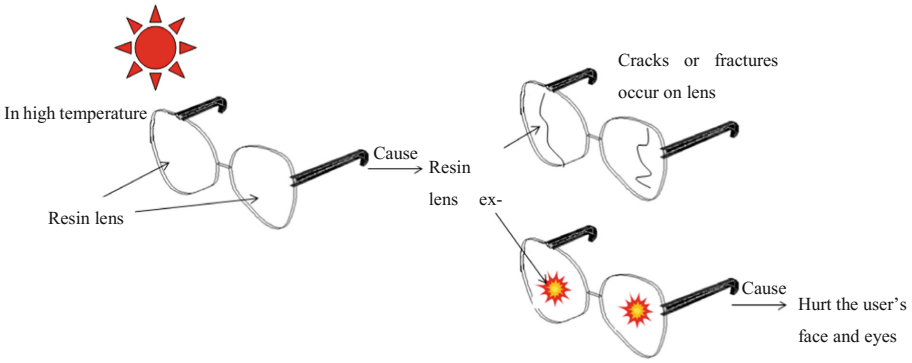

Fig. 3. Hazard caused by kid's sunglasses in high temperature

4 Standards Both in China and Abroad

4.1 Nickel Release

Ophthalmic optics – Spectacle frames – Requirements and test methods (ISO12870-2012) specifies that the limit of nickel release of the spectacle frames is 0.5 μg/cm2/W. And Ophthalmic optics – Spectacle frames – Method for the simulation of wear and detection of nickel release from coated metal and combination spectacle frames (ISO/TS 24348-2007) specifies that the nickel release from metal or alloy of frames directly contacting the user shall not be more than 0.5 μg/cm2/W. Eye and face protection – Sunglasses and related eyewear – Part 1: Sunglasses for general use (ISO12312-1, will be released soon) requires that design and manufacture of the sunglasses shall not endanger the users' health and safety, and the risk of users' skin injury caused by lens or frame material release shall be minimized. In addition, Korea Agency for Technology and Standards issues the amendment for safety and quality marks of industrial products, which adjusts the nickel release of the metal sunglasses and spectacle frames to less than 0.5 μg/cm2/W.

But standards concerned glasses in China currently do not consider the limit of the nickel release and the test method.

4.2 Transmission Property

Both ANSI Z80.3:1996 of USA and EN 1836:1997 of EU specify the transmission property of the sunglasses, and require the transmissivity of UVA shall not be more than 5%, and the transmissivity of UVB shall not be more than 1%.

China industrial standard Sunglasses (QB2457-1999) divides the sunglasses into 3 classes, the light colored sunglasses, the sun blinkers and special purpose sunglasses. Where the UVB transmissivity of the light colored sunglasses shall not be more than 30%, and the UVA transmissivity shall not be more than the transmissivity of visible light; the UVB transmissivity of the sun blinkers shall not be more than 5%, and the UVA transmissivity shall not be more than the transmissivity of visible light; while the UVB transmissivity of the special purpose sunglasses shall not be more than 1%, and the UVA transmissivity shall not be more than half of the transmissivity of visible light. As for the national compulsory standard, Spectacle lenses and related eye wear – Part 3: Transmittance specifications and test methods (GB10810.3-2006), the sunglasses are divided into 4 classes according to the transmittance, Class 1, 2, 3 and 4. Where the UVA transmissivity of Class 1, 2 and 3 shall not be more than 5%, the UVB transmissivity shall not be more than 1%; while the UVA transmissivity of Class 4 shall not be more than half of visible light transmittance, and the UVB transmissivity shall not be more than 1%. The kid's sunglasses in this paper refer in particular to the sun blinkers with the transmittances of Class 2 or 3.

4.3 High-Temperature Resistance

Currently, there is no relative requirements concerned the high-temperature resistance of the kid's sunglasses.

5 Suggestion and Solution

Accelerate Preparation and Revision of National Standards. Strengthen basic scientific research for relative standards concerned children products, and issue the standard about safety requirements for the kid's sunglasses in good time according to children's physical development characteristics. For example: Try to introduce the limit of nickel release requirement into the standard about the spectacle frames, especially the kid's sunglasses, Adornment—Provision for limit of baneful elements (GB28480-2012) can be referred or it can be quoted for nickel migration, thereby nickel release for the kid's sunglasses frames will be stricter than the adult products. At the same time, bring high-temperature resistance into the standard for the kid's sunglasses, specify the standard parameters or the detailed test methods strictly, in order to reduce the risk to children caused by products with bad high-temperature resistance.

Strength Consumption Guide. Strengthen propaganda of sunglasses usage, remind the consumers especially children's parents to prevent relative risk, select the sunglasses made by legitimate manufacturers, and take care of the children during using the product in order to avoid physical and mental damage to children.

Strengthen Supervision to Manufacturers. The relevant authorities shall strengthen supervision to manufacturers of the kid's sunglasses, ban all unlicensed illegal enterprises, enhance spot check for product quality, punish unqualified enterprises severely, increase cost of illegal business, and enforce the enterprises to improve product quality.

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