

# Preventing choking and suffocation in children

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## Abstract

Choking, suffocation, and strangulation cause serious unintentional injuries in children and are leading causes of unintentional death in infants and toddlers. Nearly all choking, suffocation and strangulation deaths and injuries are preventable. The present statement reviews definitions, epidemiology and effective prevention strategies for these injuries. Recommendations that combine approaches for improving safety, including research, surveillance, legislation and standards, product design and education, are made. Paediatric health care providers should be encouraging parents and other caregivers to learn CPR and choking first aid, as well as offering anticipatory, age-appropriate guidance to prevent these injuries, at regular health visits.

**Key Words:** Anticipatory guidance; Choking; Injury prevention; Strangulation; Suffocation

## Introduction

Choking, suffocation and strangulation are important causes of unintentional injuries in children and rank as leading causes of unintentional injury deaths in infants and toddlers [1]. Choking and suffocation are responsible for almost 40% of unintentional injuries in infants under the age of one in Canada [2]. For every choking-related death, there are an estimated 110 children treated in hospital emergency departments [3]. The number of children receiving first aid or outpatient assessment for significant choking incidents in the community is unknown. Morbidity associated with these injuries can be significant, including anoxic brain

injury and esophageal perforation [4]. Virtually all choking and suffocation deaths and injuries can be prevented.

## Definitions [2][5]-[9]

Deaths due to choking, suffocation, strangulation or entrapment are the result of asphyxia, a lack of oxygen supply to the brain. Asphyxia may also occur in enclosed spaces, such as a toy box, old refrigerator or freezer, a grain silo, or the trunk of a car.

**Choking** is the interruption of respiration by an internal obstruction of the airway, usually a food item or small object.

**Aspiration** occurs when this object is inhaled into the respiratory system.

**Suffocation** is obstruction of the airway by an external object that blocks the nose and mouth, such as a plastic bag, bedding, or mattress.

**Strangulation** is external constriction of the neck that interferes with respiration, and may be caused by a curtain cord or clothing drawstring.

**Entrapment** refers to mechanical interference with respiration when the head and neck are caught in a constricting place or position, such as a gap in play equipment, a bunk bed barrier, between balcony rails, or in a car window.

**Traumatic (crush) asphyxia** occurs when there is mechanical fixation of the chest, by fallen furniture, for example, or closing garage door, or by burial in soil, grain or other materials. Entrapment can result in suffocation, strangulation or asphyxia.

Children younger than three years of age are at highest risk of mechanical airway obstruction because their airway development is still incomplete and eating can be difficult at this developmental age and stage. Young children lack the ability to consistently and effectively chew food into manageable pieces. The swallowing mechanism is still underdeveloped, and they lack the experience to prevent or abort a potential choking episode [5]. Studies of mouthing behaviour show that children younger than three years of age put more things in their mouth—and keep them there for longer—than any other age group, with children under one year of age mouthing the widest variety and number of items. At this age, virtually any item a child comes into contact with is mouthed [9].

## Epidemiology

Foreign body ingestion/aspiration is the fourth leading cause of injury hospitalizations and deaths in children younger than four years of age. Incidence peaks at nine to 11 months of age, declining thereafter [10]. The majority of choking and suffocation deaths occur in the first year of life, with the majority of hospitalizations occurring in the first three years and an elevated risk of hospitalization persisting until six years of age [4][11]. Deaths from choking occur in the home environment in up to 95% of cases [2]. The presence of older siblings in the household increases the risk for choking, possibly because toys and other objects with small parts are more likely to be present and caregiving activities, such as feeding, to be undertaken by older siblings [5].

Specific patterns of suffocation and choking vary by severity of injury and by age. Studies of asphyxia incidents in children 0 to 14 years of age in Australia

documented that fatal events were caused by strangulation in 38% of cases, by entrapment of the head and neck in 31%, by foreign body aspiration in 19%, and by facial occlusion in 12% [11]. Children older than one year of age were typically injured by strangulation, while infants were more at risk for the other three injury types. For nonfatal injuries, 95% of hospitalizations and 87% of emergency department visits were due to aspiration. Food and non-food items were equally represented in hospitalizations, whereas foods (61%) and coins were the most common items implicated in emergency department visits [4].

## Choking

Foods and latex balloons are involved in a significant proportion of choking cases [2]-[5][11]-[14] (Table 1). Most foods implicated are small, round or cylindrical in shape, conforming to the contours of a child's airway (eg, hot dog rounds, whole grapes, carrot slices, peanuts, seeds and hard candy) (Table 2). Latex balloons are the principal nonfood item causing choking deaths in children, implicated in 29% of nonfood-related choking deaths reported to the United States Consumer Product Safety Commission (CPSC) between 1972 and 1992 [13][15]. Between 1982 and 1995 at least six children two to nine years of age died due to balloon aspiration in Canada [2]. Death due to choking on examination gloves given to children in clinicians' offices has also been reported [16]. Coins are the leading nonfood product implicated in nonfatal foreign body ingestion, but they usually do not cause true choking in children [2]-[4]. They become lodged in the esophagus and may need to be removed endoscopically. A swallowed coin is the most common cause of hospitalization for this type of injury.

**TABLE 1**  
**Choking and suffocation hazards in the home**

Small objects	Cords	Suffocation hazards	Entrapment hazards
Round, smooth objects under 4 cm (1.5 in) in diameter are particularly hazardous, as well as conformable items such as balloons*	Pull-cords longer than 20 cm (8 in), or any dangling or loose cords that is attached to a fixed object	Household items that might cover the nose and mouth and obstruct breathing	Places with a poor air supply, a heavy lid or a self-latching door, or spaces measuring between 9-22.9 cm (3.3-9 in) rungs or rails
buttons bottle caps, plastic soda bottle tops, plastic screw-top caps coins disc batteries latex balloons lego, other small toys marbles, small rubber balls foods (see Table 2) plastic corners snipped from milk bags or freezies	suspended toys or mobiles in the crib or playpen drawstrings on clothing blind and drapery cords ropes, belts, leashes (eg, especially if attached to a beds deck railing or play structure)	<b>In the crib:</b> soft toys, bedding, bumper pads, pets <b>Packaging:</b> plastic bags, plastic film dry cleaning bags latex balloons	toy boxes or chests old refrigerators, freezers, ice boxes, washers/dryers with latch-type closures improperly spaced rungs, rails, or spaces on play equipment

\* Any household item that can be passed through an empty toilet paper roll—which closely approximates the size of the testing cylinder in the small parts standard—is a choking hazard.

**TABLE 2**  
**Preventing choking when feeding infants and toddlers**

Foods to avoid for children under 4 years of age	Foods requiring special preparation
hard candies, cough drops gum, gummy candies and chewable vitamins peanuts sunflower seeds fish with bones snacks on toothpicks or skewers	grapes – slice lengthwise hot dogs, sausages – slice lengthwise raw carrots, apples – chop, grate

Source: Reference [50]

Small parts standards have been developed to identify toys and children’s products that present a choking hazard, although children still choke on objects which pass these tests [17]-[19]. Standards determine the warnings seen on toys and other children’s products (eg, “Not suitable for children under age three”). The US federal Hazardous Substances Act specifies a test of object-size using the Small Parts Test Fixture (SPTF), a cylinder with a diameter of 3.17 cm and a depth between 2.54 cm and 5.71 cm. An empty toilet paper roll closely approximates this size and can be used to assess choking hazards in the home; if an item

is small enough to pass through the cylinder, it is a choking hazard.

## Suffocation and strangulation

Child deaths caused by suffocating in a crib, waterbed, bunk bed or toy box, and by strangling on a drapery or pacifier cord, or on playground equipment, are still being reported in Canada [2]. General patterns in “mechanical suffocation” differ by age. Older children are typically injured by hanging during play [2][11][20]. Infants are more often injured in the sleep environment, by becoming wedged (40%), facial occlusion (24%), overlying (8%), entrapment with suspension (7%), and hanging (5%) [21]. Hollow hemispherical or egg-shaped containers that can cover a child’s nose and mouth, creating a seal, are particularly hazardous for young children at play or in their crib (eg, toys, lids, containers) [22].

The importance of a safe sleep environment is now well established in the literature, especially of having a crib that meets current safety standards, that has a firm, tight-fitting mattress and no soft bedding [11][21][23] [24]. Altmann documented that 40% of unintentional asphyxial deaths in children under 15 years of age are related to the child’s own bed or bed accessories, to

an inappropriate sleep location (eg, a sofa, adult bed), or to having furniture, cords, or other hazardous objects in the sleep environment <sup>[11]</sup>. Canada has had strict crib safety regulations in force since 1986, but 12 deaths and seven hospitalizations due to mechanical suffocation in beds, cribs and cradles were reported in Canada in 1990-1992. About two-thirds of these deaths were associated with cribs, either because they did not meet current standards or had damaged mattress supports or crib sides. Other fatal bed injuries implicate bunk beds and toddler beds with guardrails <sup>[2]</sup>. Nakamura has documented a variety of potentially fatal hazards associated with adult beds, including wedging between the mattress and wall, entrapment between the mattress and bed frame or adjacent furniture, strangulation between bed railings and suffocation on waterbeds <sup>[25]</sup>. Parents of young children or of a child with special needs may use a toddler beds with rails, or modify a bed to prevent a fall; such devices and modifications can be hazardous, and have been implicated in injury deaths <sup>[26]</sup>.

In older children, strangulation is the most common cause of fatal asphyxial injury. Window blind cords and drawstrings on clothing are prominent causes for this type of injury, with regulatory implications discussed below. Older children have been strangled while playing with ropes and cords, such as by tying a skipping rope to a play structure or tree branch <sup>[11]</sup>. Another less common but potentially fatal cause of asphyxia is entrapment: in hide-a-beds <sup>[27]</sup>, electrically-operated garage doors, and in car windows or trunks <sup>[7][28][29]</sup>.

Between 1991 and 2000, 160 fatal window blind cord strangulations were reported to the US CPSC, including 140 incidents associated with the outer pull-cords and 20 with the inner cords that run through blind slats. Outer pull-cord incidents involved children eight months to six years of age, with babies accessing cords from their crib and toddlers and older children injured by playing with loose cords. Inner cord incidents occurred in children nine to 17 months of age who were in a crib or playpen within reach of blind cords. Through largely voluntary efforts by the window covering industry, window blinds sold since 1995 do not have outer cords that form a loop, and blinds sold since November 2000 have been redesigned so that the inner cord cannot be pulled into a loop <sup>[30]-[32]</sup>. Current corded window covering product regulations place further restrictions on the formation of cord loops and require warning labels. However, they still do not address certain hazards posed by Roman shades and roll-up blinds. While design modifications have

eliminated certain types of blind cord hazards, there is still a significant risk of strangulation. Parents and caregivers need to eliminate loose or dangling cords by cutting them short and by anchoring any remaining.

Drawstrings on children's clothing can get caught on playground equipment, a bus door, farm machinery, or crib structure, causing strangulation <sup>[33]</sup>. Between 1985 and 1999 the CPSC received reports of 22 fatal and 48 nonfatal incidents involving drawstrings <sup>[34]</sup>. Two-thirds of these incidents involved the hood/neck drawstrings of upper outerwear in children between two and eight years of age, typically by getting caught on playground slides. The remaining incidents involved waist-area drawstrings and children between seven and 14 years of age who were caught and dragged or run over when their drawstrings became caught on the school bus door or handrail. In 1996 the CPSC published industry guidelines for drawstrings and closures on children's outerwear which were then incorporated in a voluntary American Society for Testing and Materials (ASTM) standard (1997). Drawstrings are not regulated in Canada, and voluntary compliance with the ASTM standard is inconsistent.

## Prevention strategies

Virtually all deaths and serious injuries from choking, suffocation and strangulation are preventable. Due to the higher burden among younger children, the target age for many prevention efforts is the first four years of life <sup>[2]</sup>. Prevention strategies addressing suffocation and choking hazards should include regulatory standards for baby and child product design/manufacture, appropriate labelling practices and public education.

## Industry regulation

The regulation of baby and baby/child products and equipment usually focuses on design and labelling practices. Specific suffocation and choking hazards that are regulated in some jurisdictions include drapery cords, cribs, refrigerators and freezers, drawstrings, and even plastic bags. The Canadian Hazardous Products Act contains a number of requirements that protect children from certain choking and suffocation hazards <sup>[35][36]</sup>. For packaging of children's toys and products, bags that have an opening of 35.6 cm (14 in) or larger must carry a specific suffocation hazard warning and cannot be made of flexible film (eg, a dry cleaning-type bag). Any toy box or play structure large enough for a child to enter that can be closed by a lid

or door must have openings on two or more adjacent sides. Cribs, cradles, playpens and baby gates have performance and labelling criteria to prevent mechanical suffocation hazards.

Any toy that is likely to be used by a child younger than three years of age must pass a small parts test. Small hard eyes and noses on dolls and plush toys must withstand a pull of 9 kg (20 lbs) for five min. Rattles and pacifiers have specific requirements to prevent choking and suffocation. Consumer warnings are recommended for balloons and for crib toys that are strung across a crib or playpen; notably, these warnings are voluntary. While bunk beds, children's clothing with drawstrings and window blind cords are not fully regulated, Health Canada has undertaken efforts to educate manufacturers and consumers regarding these hazards.

In a study from the mid-eighties, Kraus evaluated the effectiveness of three regulatory strategies in reducing suffocation deaths: the Refrigerator Safety Act (1958), US federal crib regulations, and California state legislation requiring plastic bag warnings [23]. A sharp decline in suffocation deaths was documented in the early 1960s, followed by a plateau and gradual decline to the early 1980s. These declines, however, could not be exclusively attributed to legislation, because reduced exposure and increased parental supervision are also possible explanations. In Canada, incidents of asphyxiation in abandoned refrigerators, suffocation by plastic bags and entrapment of a child's head between crib slats have also declined significantly since federal regulations were introduced. Likewise, Health Canada's efforts to educate manufacturers and consumers about the dangers of drawstrings have paralleled a decrease in drawstring-related fatalities [2]. However, children's clothing with drawstrings is still available on the market despite advocacy for product regulation to prohibit their sale [37][38]. In Ireland, where drawstrings were banned on children's outerwear in 1976, few garments adhere to the safety standard [33].

One study examining the wording commonly used for labelling age-appropriate toys has documented that consumers are more likely to avoid purchasing a toy with small parts when the label warns of a specific hazard (choking) rather than specifying an appropriate age group (eg, "For children three years and older") [39].

## Education

Parental education by physicians has been shown to improve certain safety practices, such as motor vehicle

restraint use, installing smoke alarms, and lowering hot water temperature in home faucets [40][41]. General "childproofing" or "home safety" education, including measures to prevent choking and suffocation, does not seem to be as consistently effective at improving safety practices or reducing injury rates, although individual studies have documented significant changes [40][42]-[45]. Safety education is thought to be most effective when it is combined with strategies to change behaviour [46]. Targeted, simple, action-oriented messaging is to be encouraged, along with periodic reinforcement.

Home visitation programs have been evaluated for their effectiveness in preventing injuries. A review of 11 randomized controlled trials showed a significant preventive effect on the occurrence of childhood injury [47]. A randomized controlled trial of a home visit combined with providing an injury prevention kit showed that this strategy was effective in reducing hazards in the home, including choking and suffocation hazards [48]. A Canadian multicentre randomized controlled trial of a single home visit with providing safety information, coupons, and home safety counselling resulted in significantly fewer injury visits, but did not result in long-term adoption of home safety measures [49].

## Recommendations

### Research and surveillance

Data regarding the circumstances of fatal and near-miss choking and suffocation incidents are essential for identifying new hazards as well as for monitoring the effectiveness of existing or future regulatory and educational strategies. Detailed data, including narrative descriptions of events and products involved, are available only through specialized surveillance programs such as the Canadian Hospitals Injury Reporting and Prevention Program and the proposed National Coroners' Database. These systems are necessary for future research and surveillance related to product safety.

### Legislation and standards

For some existing legislation and standards, data are lacking regarding compliance and effectiveness. For example, while a Canadian standard for play spaces and equipment exists that addresses many potential entrapment risks, the degree of uptake and application by communities and its effectiveness in preventing serious injuries are not known. Standards for play



equipment for preschool-aged children are lacking, and should be developed.

- Nationally, the CPS recommends revising the Hazardous Products Act to include known hazards which are not currently regulated but are associated with fatal and near-fatal incidents, such as bunk beds, toddler bed guardrails, children's clothing with drawstrings, and window covering cords.
- At the provincial level, the CPS recommends that day care regulators integrate safety guidelines, including measures that prevent choking, suffocation and strangulation.
- At the municipal level, the CPS recommends that communities and school boards mandate the use of the (now voluntary) Canadian Standards Association guidelines for play spaces and playground equipment.

### **Product design/manufacture**

Considering that improved product design, labelling and packaging could significantly impact children's

exposure to choking and suffocation hazards, the CPS recommends that manufacturers and designers of baby and children's products and children's facilities use guidance documents such as the ISO Guide 50, which summarizes injury risks, including entrapment, suffocation and choking, in their design and production processes <sup>[6]</sup>. The use of plastic wrap, plastic bags and other choking hazards in the packaging of products for young children should be reduced or eliminated wherever possible. Labelling of children's toys and products should clearly identify a specific risk, rather than simply making an age recommendation.

### **Education**

During health visits, paediatric health care professionals should be educating parents and other caregivers (child care providers, babysitters, grandparents) about choking/suffocation prevention as appropriate for their child's age/developmental stage (see [Table 3](#)). Community public health programs should distribute choking prevention information to child care providers. Babysitting courses should include instruction on preventing choking and treatment protocols (see below).

**TABLE 3****Basic preventive choking and suffocation strategies**

Age	Anticipatory guidance
<b>Newborn to two months</b>	<ul style="list-style-type: none"> <li>• A crib that meets current government standards is the safest place for infants to sleep. Cribs made before 1986, or that do not have a permanent label with the manufacturer’s name, the model number or name, date of manufacture, instructions for assembly, and a warning statement about mattress size and proper crib use, are not safe to use.</li> <li>• Check the crib regularly for loose parts and hardware, and especially after it has been moved.</li> <li>• Avoid soft bedding, bumper pads or stuffed toys. The crib mattress should be firm and tight-fitting.</li> <li>• Place infants to sleep on their back.</li> <li>• Do not sleep with an infant on an adult bed, sofa, reclining chair or air mattress, and do not use these as sleeping surfaces for infants.</li> <li>• Avoid toys with strings or pull-cord longer 20 cm (8 in), stringed bibs, and baby necklaces.</li> <li>• Avoid any toy that is breakable, that can fit through an empty toilet roll, has small or detachable parts.</li> <li>• Use one-piece pacifiers and replace them at least every two months rather than waiting for signs of damage. Never tie a pacifier around a baby’s neck. Use clips with short ribbons attached to them instead.</li> <li>• Fasten harness straps properly when an infant is in a car seat, carrier, bouncy chair or swing, and always use the crotch strap. A car seat or carrier is not a safe place for a baby to sleep.</li> </ul>
<b>At 4 to 6 months</b>	<p><b>Continue taking all the preventive measures outlined above, PLUS:</b></p> <ul style="list-style-type: none"> <li>• Be on constant lookout for choking hazards in the home. Vacuum or sweep floors often, and be especially attentive when there are visitors and older children present.</li> <li>• Remove suspended crib toys and mobiles as soon as a baby is four months old or can push up with hands and knees.</li> <li>• Make sure the crib is placed away from window blinds or cords.</li> <li>• Cut, tie up or tie down window blind and curtain cords so they are always inaccessible.</li> </ul>
<b>At 6 to 12 months</b>	<p><b>Continue taking all the preventive measures outlined above, PLUS:</b></p> <ul style="list-style-type: none"> <li>• Stay within arm’s reach at mealtimes.</li> <li>• Discourage older siblings from feeding their baby brother or sister.</li> <li>• Consider switching to a teething ring if the baby starts to chew on a pacifier.</li> <li>• Check floors, under furniture and between couch or chair cushions frequently for choking hazards, especially after a party or gathering.</li> <li>• Store older children’s toys in a separate place, so that a younger child cannot get at them.</li> <li>• Check for and adhere to all toy label age and safety recommendations.</li> <li>• Avoid clothing with drawstrings at the neck or waist. For winter wear, use a neck warmer instead of a scarf and mitten clips instead of strings.</li> <li>• Keep pet food off the floor between feedings.</li> <li>• Tie plastic bags in a knot before storing them out of reach and out of sight.</li> </ul>
<b>Preschool (1 to 4 years)</b>	<p><b>Continue taking all the preventive measures outlined above, PLUS:</b></p>

- Avoid magnetic toys.
- Make sure toys batteries are properly installed and not accessible to the child.
- Do not use latex balloons. Choose mylar or foil balloons instead.
- Use only large beads for stringing (more than 4cm [1.5 in] across). Anything smaller is a choking hazard.
- Make sure that your child's toy box is safe: that it has air holes and a lightweight lid with good supporting hinges.
- Only use a bunk bed if it meets current standards (ASTM and 16 CFR), which were developed to prevent fatal entrapment injuries to children resulting from improper guardrail spacing and other design flaws. Children can also become wedged between the wall and mattress or frame; a guardrail on the wall side of the bed can help to prevent this, for both bunks. Never allow a child under 6 years old to use the top bunk, as they are at higher risk for entrapment due to their body size. Ensure the mattress is the correct size and fits snugly, with no more than a 3 cm gap on any side. Children should never tie ropes or cords to bunk beds or other furniture or fixtures.
- Remove a child's bicycle helmet before allowing them on playground equipment.
- Do not allow children to tie skipping ropes, pet leashes or other ropes and cords to trees, decks, or play equipment.
- Encourage table manners: staying seated while eating, being calm and not speaking with food in the mouth, chewing well before swallowing, and no running around while eating.

## First aid/CPR

Parents and caregivers should be encouraged to take CPR and choking first aid (infant/child CPR) courses, offered by local Heart and Stroke Foundation offices (1-888-HSF-INFO), St. John Ambulance or the Red Cross. The infant/child course is geared to child care workers, teachers, babysitters, lifeguards and parents. Paediatric health care providers, particularly prehospital care providers and those serving remote communities, should maintain their advanced paediatric resuscitation knowledge and skills. Basic Rescuer training should be supplemented by Pediatric Advanced Life Support training, with periodic updates and review, as recommended by the American Heart Association <sup>[21][22]</sup>.

## Additional resources

For more information about injury risks, prevention and life-saving skills, visit the following websites:

- Safe Kids Canada: [www.safekidscanada.ca](http://www.safekidscanada.ca)
- Health Canada: [www.hc-sc.gc.ca](http://www.hc-sc.gc.ca)
- Heart and Stroke Foundation of Canada: [www.heartandstroke.ca](http://www.heartandstroke.ca)
- American Heart Association: [www.heart.org](http://www.heart.org)

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