

Aboveground Swimming Pool Child Access Prevention Through Product Design

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Abstract: Child drownings continue to be problematic in aboveground swimming pools. Attempts to address the hazard posed by child access to aboveground pools through on-product warnings and instruction manuals have not been effective in stemming the incidence of child drowning. Utilizing the safety hierarchy to implement other higher-level risk reduction methods through product design has the potential to greatly reduce this risk. U.S. Consumer Product Safety Commission In-Depth Investigation (CPSC IDI) reports indicate that children have accessed aboveground swimming pools by using the A-frame pool ladder and by using the pool exterior support strap as a foothold. The current research studied children to determine their ability to access a pool using the exterior support strap as well as various aboveground pool ladder designs, each of which contained varying levels of child resistance and active versus passive safety devices.

Keywords: Aboveground Swimming Pool, Child Access Prevention, Product Design

1. Literature Review

On average, from 2020 through 2022, there were an estimated 6,300 pool or spa-related, hospital emergency department treated, nonfatal drownings each year in the United States. Seventy-six percent of these nonfatal drowning injuries involved children younger than five years of age. Pool or spa-related fatal child drownings involving children younger than five years of age increased ten percent in 2020 with 279 fatalities reported. Of the reported pool or spa-related fatal child drownings, 75 percent involved children younger than five years of age. Where location was known, 80 percent of reported fatal child drownings occurred in residential settings such as the victim's home, or that of a family member, friend, or neighbor, with 91 percent of those drownings occurring in those younger than five years of age (U.S. CPSC, 2023).

Previous preliminary research studied five representative aboveground swimming pool ladder designs using two-year-old child subjects to determine their ability to access a pool (Mathias and Brickman, 2015). The test results showed that all four child subjects were able to scale the standard A-frame ladder design to access the pool, whereas none of the child subjects were able to access the pool using four alternative ladder designs incorporating child resistance features. Currently, there are swimming pool standards outside the United States that require pool ladders to have child resistance features (AFNOR P90-306, 2007; EN 16582-1, 2015). In the U.S., while the aboveground portable pool standard for residential use requires that the pool ladder have child resistance for children under the age of five years (ASTM F2666, 2016), the aboveground residential swimming pools standard does not include ladder child resistance requirements (ANSI/ASPS/ICC-4, 2012).

U.S. CPSC In-Depth Investigation (CPSC IDI) reports have documented incidents where children have used an aboveground swimming pool support strap as a step to climb into the pool (U.S. CPSC, 2020). Figure 1 displays images of a two-year-old child gaining access to the aboveground pool by standing on the exterior support strap (U.S. CPSC, 2011). Currently, the ANSI/APSP/ICC-4 aboveground Residential Swimming Pools Standard does not address the pool wall design with respect to the support strap providing a foothold (ANSI/ASPS/ICC-4, 2012). However, the ANSI/APSP/ICC-4 standard committee is considering this risk. Relevant approaches are prevention through design concepts (ANSI/ASSP Z590.3, 2021), or the safety hierarchy, as the U.S. CPSC references mitigating pool drowning incidents by eliminating the hazard through design, guarding to prevent or slow access to the hazard, and using warning signs, in order of effectiveness (U.S. CPSC, 2017).



Figure 1. Two-Year-Old Accessing Aboveground Pool by Using Support Strap as a Foothold (U.S. CPSC)

Table 1. Test Trial 1 Child Subject Anthropometry

Subject No.	Age (mo.)	Weight (lbs.)	Height (in.)	Reach (in.)
1	30	36.0	37.0	44.5
2	24	37.5	36.0	41.0
3	26	25.0	34.0	42.0
4	27	34.3	37.3	45.5
5	28	31.4	38.0	46.0
6	20	22.5	31.0	37.0
7	45	27.9	35.0	45.0
8	26	37.0	37.0	43.5

2. Aboveground Swimming Pool Ladder Testing

Two separate test trials were conducted with child subjects under four years of age to analyze whether the children could access an empty aboveground swimming pool using various pool ladders. The test procedure utilized in these two test trials was the same as the previous aboveground swimming pool ladder safety research study (Mathias and Brickman, 2015).

1.1 Test Trial 1

Eight child subjects ranging from 20 to 45 months of age attempted to gain access to the 52-inch aboveground pool using four separate ladders set up around the pool. One pool ladder had an A-frame design, one pool ladder had removable steps, and two pool ladders had a self-closing and self-latching door design. The pool was not filled with water during this testing. The caregiver of each child subject demonstrated how the ladders functioned. Then the caregiver or researcher encouraged the child to get into the pool using the provided ladders. The child subjects were not timed but were allowed to try each ladder until they chose to stop. The caregiver remained nearby for encouragement and spotting. The test criterion was whether the child subject was able to climb to the top of the ladder and access the pool.

The characteristics of the eight child subjects in test trial 1 are displayed in Table 1. Results of the first test trial of the current research indicate that all eight child subjects were able to climb to the top of the A-frame pool ladder and access the pool with representative child subjects shown in Figure 2. All eight child subjects were unable to climb to the top of the three alternative pool ladder designs with child resistance design features. Figures 3 and 4 exhibit representative child subjects unable to climb the removable steps ladder design and the self-closing and self-latching door ladder design, respectively.

1.1 Test Trial 2

Eight child subjects ranging from 23 to 35 months of age attempted to gain access to the 48-inch aboveground pool using five separate ladders set up around the pool. One pool ladder had an A-frame design, two pool ladders had foldable steps, and two pool ladders had the same self-closing and self-latching door design as used in test trial 1. The test protocol for test trial 2 was the same as employed in test trial 1.

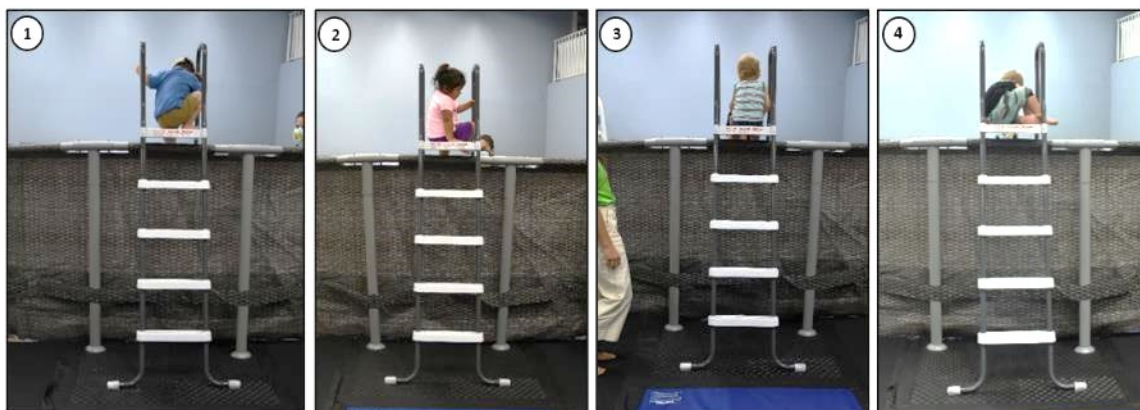


Figure 2. Child Subjects Able to Climb A-Frame Ladder to Access Pool (Test Trial 1)



Figure 3. Child Subjects Unable to Climb Pool Ladder with Removable Steps (Test Trial 1)

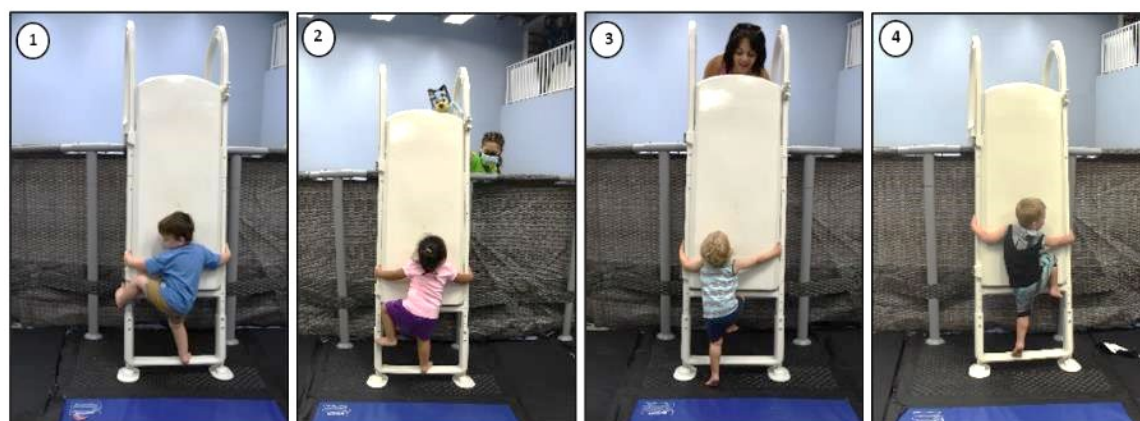


Figure 4. Child Subjects Unable to Climb Pool Ladder with Self-Closing and Self-Latching Door (Test Trial 1)

Table 2. Test Trial 2 Child Subject Anthropometry

Subject No.	Age (mo.)	Weight (lbs.)	Height (in.)	Reach (in.)
1	25	29.0	37.0	42.0
2	35	29.3	37.0	44.0
3	34	30.9	38.0	43.0
4	25	22.2	33.0	37.0
5	34	35.3	37.0	42.0
6	23	28.0	35.0	37.0
7	29	32.4	38.0	44.5
8	31	33.3	38.0	43.0

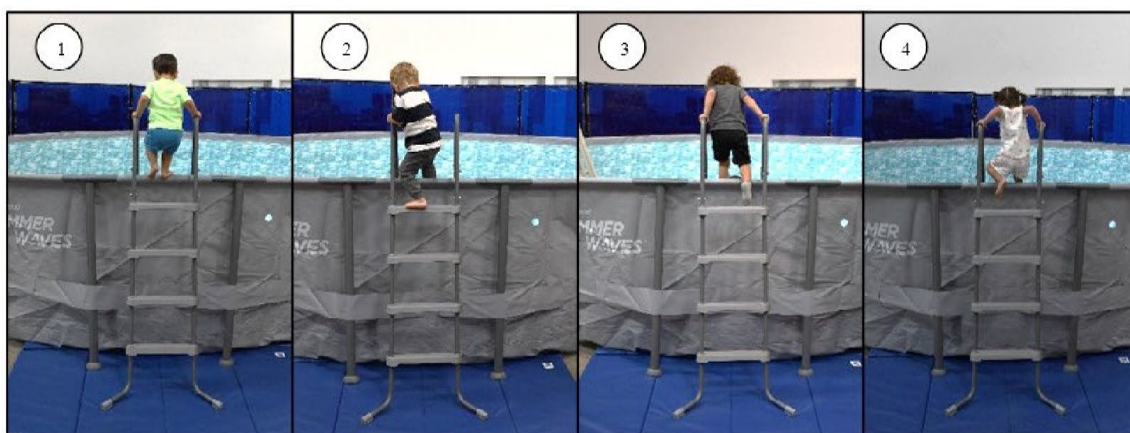


Figure 5. Child Subjects Able to Climb A-Frame Ladder to Access Pool (Test Trial 2)

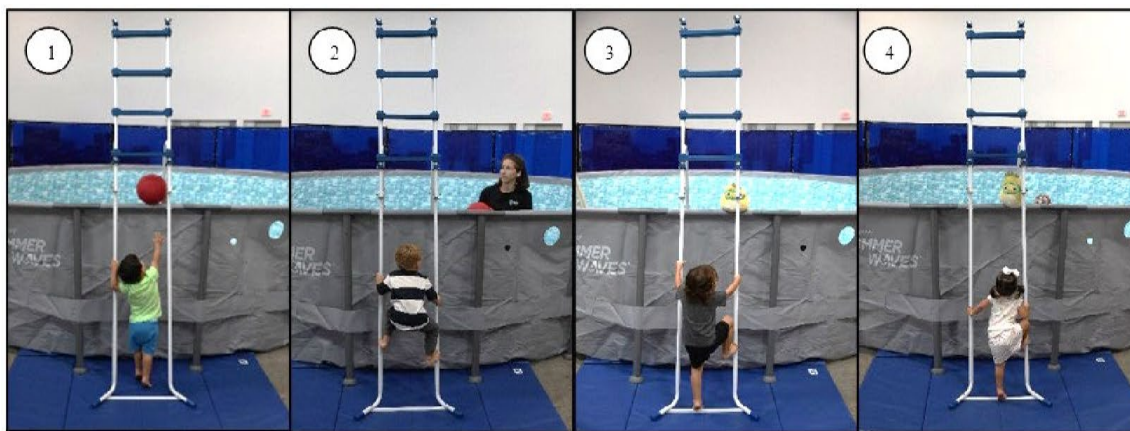


Figure 6. Child Subjects Unable to Climb Pool Ladder with Foldable Steps (Test Trial 2)

The anthropometric characteristics of the eight child subjects in test trial 2 are shown in Table 2. Results of the second test trial indicate that all eight child subjects were able to climb to the top of the A-frame pool ladder and access the pool with representative child subjects displayed in Figure 5. All eight child subjects were unable to climb to the top of the four alternative pool ladder designs with child resistance features. Figures 6 and 7 demonstrate representative child subjects being unable to climb to the top of the two pool ladders with foldable steps and a self-closing and self-latching door, respectively.

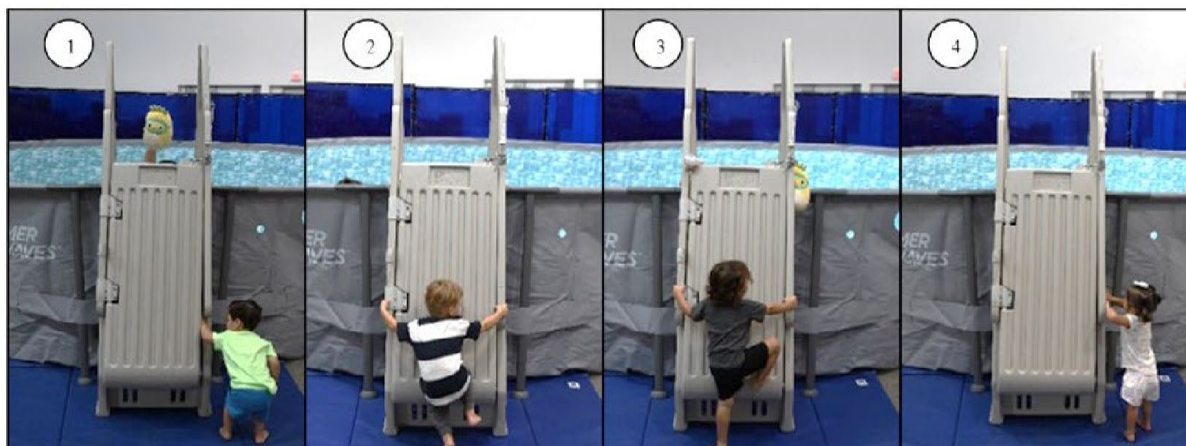


Figure 7. Child Subjects Unable to Climb Pool Ladder with Self-Closing and Self-Latching Door (Test Trial 2)

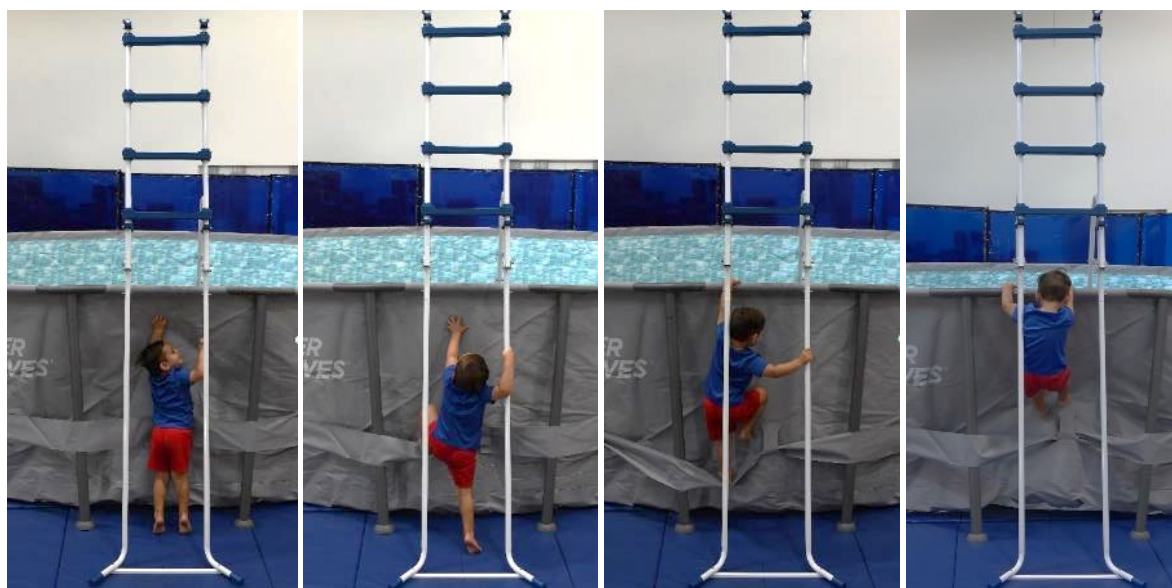


Figure 8. Child Using Pool Exterior Support Strap as a Foothold to Access Pool

3. Aboveground Swimming Pool Exterior Support Strap

During the aboveground swimming pool ladder testing current research study, it was observed that the pool exterior support strap was used by a child subject as a foothold to attempt to gain access to the pool. Figure 8 shows a child subject placing a foot on the pool exterior support strap and his hands on the top of the pool wall in a similar method as in Figure 1. The pool was not filled with water during this testing, but the potential access via the exterior support strap is a concern. Figure 9 exhibits commercially available alternative aboveground pool designs that provide the utility of the exterior support strap without providing a foothold for a child to gain access to the pool (left image) or have eliminated the exterior support strap (right image).



Figure 9. Alternative Aboveground Pool Exterior Designs That Do Not Provide a Foothold

4. Conclusions

This present study describes different aboveground swimming pool ladder and pool exterior design risk reduction methodologies that are commercially available but not required by any U.S. standards; it demonstrates the potential benefit of incorporating child resistance strategies for these products. Risk reduction methodologies incorporating higher levels of the safety hierarchy and child resistance principles can greatly reduce the potential risk to children associated with consumer products which are intended for use by children only under supervision. The primary goal of this paper is to make aboveground swimming pool designers, manufacturers, distributors, sellers, safety standard agencies, and users more aware of the aboveground swimming pool child access risks and to identify alternative product designs which reduce the risk associated with currently available models.

5. References

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