

Policy Standards for Children's Furniture in Environmental Design

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Introduction

The U.S. Consumer Product Safety Commission (U.S. CPSC) is in charge of protecting the public from illogical dangers of injury or death from different types of consumer products (U.S. CPSC, 2009). Over the past 30 years CPSC continuously decreased the rate of injury or death related to consumer products (U.S. CPSC, 2009). According to the U.S. CPSC (n.d.b), the meaning of a 'children's product' is "a consumer product designed or intended primarily for children 12 years of age or younger". There are safety regulations for children's products such as toys, cribs, car seat, and flammability of sleepwear.

For example, to illustrate the scarcity of data relative to built environment, the following examples offer an entry into this paradigm. The Consumer Product Safety Improvement Act (CPSIA) under U.S. CPSC commands that all children's products be tested for lead content. According to the American Society of Testing and Materials (ASTM) F963 and CPSC 16 CFR 1303, manufacturers of children's products should not produce to sell toys that contain more than 600 ppm of lead (ASTM, 2009; CPSC, 2008).

For the child safety seat, the national recommendation is to use booster seats until children are able to use an adult safety belt properly (Texas Department of Public Safety, 2000). According to the Texas Department of Public Safety (2000), this is when a child turns eight years old, where the height is approximately 4 feet 9 inches. Some states have child safety seat laws to enforce children to use booster seats until they turn eight years old (Texas Department of Public Safety, 2000).

Another example of children's products safety regulation is sleepwear flammability regulations. There are two

regulations, CPSC 16 CFR 1615 and 1616 which are categorized by sizes; size 0 to 6X and size 7 to 14 (U.S. CPSC, 1996). These regulations indicate that manufacturers should sell tight-fitting sleepwear with hang tags and neck labels demonstrating that the fabric is not flame-resistant (U.S. CPSC, 1996).

Problem Statement

There are many regulations regarding children safety, but standards for children furniture are scarce, and if any, it focuses on flammability of furniture fabric. However, there is no regulation or any standard measurements for developing children's furniture for age 2 to 5. Children age 2-5 share furniture in public with all different age groups including adults. They live in the same environment as adults or teens. For example, when a two year old child is sitting on the same size chair with 5 year old child, the 2 year old child is dangling on the chair whereas the 5 year old child might flip the chair over because the chair is too small for him or her. Risk around children 2 to 5 years old has been overlooked for a long time.

Understanding anthropometric data is necessary for children product designers to ensure the safety of these products. However, the main resources of children's anthropometric data are over two decades old (Shin & Istook, 2008). The ASTM D5826 is the most reliable source for children 2 to 7 years old body dimensions, and the original data was based on the research studied by the U.S. Department of Agriculture in the 1930s (O'Brien, et al., 1941; Shin & Istook, 2008). The ASTM D5826 is also referred by the charts from the National Center for Health Statistics in 1980 and the Anthropometric Study of U.S. Infants and Children conducted by the University of Michigan in 1977 (Shin & Istook, 2008; Snyder, 1977).

Body dimensions for children in the present are significantly different than those in the past (Shin & Istook, 2008; Smith & Norris, 2004). According to Shin & Istook (2008) & Stone (2007), current children have gained more weight notably over the past decade, and the apparel industry, for instance, are paying attention to dramatic growth on overweight children, thus adding larger sizes to clothing stock. However, according to Shin & Istook (2008), adding larger sizes for heavier children is not a solution for these children since the different stages of children's growth will result in different body proportions.

The research conducted by Evans, Courtney, & Fok indicated that the dimensions of body proportion varied with the age range. For example, the ratio of sitting height to stature for boys varied from 55.9% at age 6 to 52.4% at age 13 (Evans, Courtney, & Fok, 1988). Proportions of other body dimensions also varied. Therefore, using mean sectional proportions is not appropriate to estimate individual body parameters from one body dimension such as stature. Thus, as age is a critical aspect for design, anthropometric data is essential to represent the age population.

Several researches have been conducted about the relation of school furniture and body dimensions of schoolchildren (Evans et al., 1988; Gouvali & Boudolos, 2006; Jeong & Park, 1990; Knight & Noyes, 1999; Panagiotopoulou et al., 2004). However, it is difficult to find research of 2 to 5 years old age group population, or research that addresses issues of policies and standards for children's products.

Objective

The purpose of this study is to address the needs of children's furniture design policies and standards of children's body dimensions that should be applicable for children's furniture in environmental behavior. The objectives of the paper are to (1) investigate policies and standards of children's furniture in environmental design, and (2) investigate if current sizes of children's furniture can be appropriated for children age 2 – 5 years old.

Method

Policies of children's product and standards of children's body dimensions were investigated by searching through the U.S. Consumer Product Safety Commission (U.S. CPSC), National Highway Traffic Safety Administration (NHTSA), and ASTM American Society of Testing and Materials (ASTM). The dimensions of children 2-5 years old were collected in Lubbock, Texas, United States in 2006 with IRB approval. A total of 40 subjects participated in the survey of children's dimensions; 47.5% were girls and 52.5% were boys. In the survey, 22.5% of the children were 2 years old, 27.5% were 3 years old, 12.5% were 4 years old, and 37.5% were 5 years old. The majority were Caucasian (65%), with the remainder being Asian (22.5%) and Hispanics (12.5%). A total of 34 body dimensions per

child were measured with a traditional measurement tape. The measurement method was based on ASTM D 5826-00 (Standard Tables of body Measurements for Children, sizes 2 to 6x/7). The dimensions of hip girth, thigh girth, knee height, and hip height among others were taken for this research.

The following calculation of detail dimensions is based on the collected children's anthropometric data: Hip breadth for the width of chair is estimated as hip girth divided by 2. Since thigh girth is relatively circular, in order to calculate thigh clearance the equation of circumference for a circle was used where diameter is equivalent to the thigh clearance. Since the standing position was measured, it was necessary to replace knee height to popliteal height for chair's seated height. Finally, buttock popliteal length is hip height minus knee height.

Children's body dimensions were compared to children's furniture dimensions. In this study, two types of children's furniture were investigated: 1) Children's furniture that is currently available for purchase (commercial children's furniture), and 2) children's furniture that is in use in public (public children's furniture). The dimensions of commercial furniture were collected from manufacturers' websites. The dimensions of public furniture were taken from children's furniture in public places including clinics, play grounds, libraries and book stores.

The comparisons between children's body dimensions and children's furniture dimensions were performed with T-Test and analyzed through a statistical analysis.

Findings

Children's Product Policy and Standards in Environmental Design

Toys for Children: According to the U.S. Consumer Product Safety Commission (U.S. CPSC), there are specific policies for children's toy products. U.S. CPSC regulation 16 C.F.R. Part 1303 is Ban of Lead-Containing Paint and Certain Consumer Products Bearing Lead-Containing Paint. The purpose of the regulation is to "prevent children from being poisoned when they eat paint chips or dust from paint chips containing lead, or lick their fingers after they play with or touch certain products that are coated with paint that contains lead" (U.S. CPSC, n.d.a).

U.S. CPSC regulation 16 C.F.R. Part 1700 is Requirements under the Poison Prevention Packaging

Act. The purpose of “the PPPA is to protect children under five from poisonings and deaths that occur when the open containers of hazardous products, and eat or drink the contents” (U.S. CPSC, n.d.a). U.S. CPSC regulation 16 C.F.R. Part 1510 is Requirements for Rattles. The regulation “prevents infants from choking or suffocating on rattles. The rule requires that a rattle stay in one piece after certain tests and a rattle be designed and constructed so that it cannot enter an infant’s mouth and block his or her throat” (U.S. CPSC, n.d.a).

U.S. CPSC regulation 16 C.F.R. Part 1505 is called Electrically Operated Toys or Other Electrically Operated Articles Intended for Use by Children. It addresses the concern that “electric motors associated with home-use inflatables are within easy access to young children, and may present an electrocution hazard to children” (U.S. CPSC, n.d.a).

Cribs: According to the U.S. CPSC, there are policies for children’s crib products. U.S. CPSC regulation 16 C.F.R. Part 1509 contains Requirements for Non-Full-Size Baby Cribs. It seeks to “prevent deaths and injuries from falls, entrapment, and contact with parts inside or outside a crib” (U.S. CPSC, n.d.a). A non-full-size baby (NFSB) crib is “a crib that is intended for use in or around the home, for travel, or for other purposes. A non-full-size crib has an interior length that is either greater than 55 inches or smaller than 49¾ inches, an interior width that is either greater than 30%inches or less than 25% inches, or any combination of these lengths and widths” (U.S. CPSC, n.d.a).

U.S. CPSC regulation 16 C.F.R. Part 1508 contains Requirements for Full Size Baby Cribs. These regulations seek to “prevent deaths and injuries from falls, entrapment, and contact with parts inside or outside a crib” (U.S. CPSC, n.d.a). According to the regulation, “a full-size baby crib is a bed designed to provide sleeping accommodations for an infant, that is intended for use in or around the home, and that is not covered under the rule for non-full-size cribs, 16 C.F.R. Part 1509. The interior of a full-size crib is 52 inches long by 28 inches wide” (U.S. CPSC, n.d.a).

Car Seat: According to the National Highway Traffic Safety Administration, there are policies for children’s car seat. The regulations are categorized by age groups. The regulation for infants, from birth to at least 1 year old and at least 20 pounds, states that “for the best possible protection

keep infants in the back seat, in rear-facing child safety seats, as long as possible up to the height or weight limit of the particular seat. At a minimum, keep infants rear-facing until a minimum of age 1 and at least 20 pounds” (NHTSA, n.d.a).

The regulation for toddlers, age 1 & 20 lbs to Age 4 & 40 lbs, states that “when children outgrow their rear-facing seats (at a minimum age 1 and at least 20 pounds), they should ride in forward-facing child safety seats, in the back seat, until they reach the upper weight or height limit of the particular seat (usually around age 4 and 40 pounds)” (NHTSA, n.d.b). The regulation for children, from about age 4 to at least age 8, states that “once children outgrow their forward-facing seats (usually around age 4 and 40 pounds), they should ride in booster seats, in the back seat, until the vehicle seat belts fit properly. Seat belts fit properly when the lap belt lays across the upper thighs and the shoulder belt fits across the chest (usually at age 8 or when they are 4’9” tall)” (NHTSA, n.d.c).

Finally, the regulation for tweens, age 8 and older, states that “when children outgrow their booster seats, (usually at age 8 or when they are 4’9” tall), they can use the adult seat belt in the back seat, if it fits properly (lap belt lays across the upper thighs and the shoulder belt fits across the chest)” (NHTSA, n.d.d).

Children’s sleepwear: According to the U.S. CPSC, there are policies for children’s sleepwear. For instance, U.S. CPSC has Children’s Sleepwear Regulations, 16 C.F.R. Part 1615 & 1616. To protect children from burns, the regulation states that “children’s sleepwear must be flame resistant and self extinguish if a flame from a candle, match, lighter or a similar item causes it to catch fire” (U.S. CPSC, n.d.a). Moreover, the rules also cover “all children’s sleepwear above size 9 months and up to size 14 and require that the fabric and garments must pass certain flammability tests; or be “tight fitting” as defined by specified dimensions” (U.S. CPSC, n.d.a).

Children’s furniture: There are various regulations for children’s product concerning their safety. Even though the intent is to cover a wide variety of products, no regulations have been reported for children’s furniture.

Comparison between Children’s Furniture Dimensions and Children’s Body Dimensions

Table 1
T-Test Results of Commercial Furniture Dimensions and Public Furniture Dimensions

Furniture		T-test Results			
		Mean	Variance	<i>t</i>	<i>P</i>
Chairs	Commercial	11.63	2.84	3.18	0.008*
	Public	12.55	3.30		
Tables	Commercial	25.80	17.41	4.30	0.211
	Public	33.85	137.60		

*. *T*-test is significant at the 0.05 level (2-tailed).

Table 1 shows the results from T-Test of comparison between commercial furniture and public furniture. When children's furniture dimensions were compared, there was a significant difference in chair dimensions between commercial furniture and public furniture ($p < 0.05$). However, there was no significant difference in the table dimensions between commercial furniture and public furniture.

Table 2-a and table 2-b illustrate hip breadth, thigh clearance, popliteal height, and buttock popliteal length for children 2 – 5 years old. The minimum size of all dimensions shown

on table 2-a and table 2-b is in the age of 2 years. However, the maximum size of hip breadth is in the category of the 4 years old group; the maximum size of thigh clearance is from the 4 years old age group; the maximum size of buttock popliteal length is in the 3 years old age group. Thus, this study clearly shows that children have different proportion of their body dimensions relative to their age. It indicates that understanding current children's anthropometric data is necessary for designers in environmental design.

Table 2-a
Results of Body Dimensions for Children 2-5 Years Old

Age	Hip Breadth (in)				Thigh Clearance (in)			
	Min	Max	Mean	SD	Min	Max	Mean	SD
2	9.84	11.54	10.71	0.55	2.76	3.63	3.30	0.30
3	10.30	12.99	11.50	0.85	3.15	4.76	3.84	0.55
4	11.22	14.57	13.15	1.65	3.38	5.14	4.31	0.75
5	11.02	13.78	12.38	0.75	3.45	4.89	3.97	0.49
Total	9.84	14.57	11.86	1.18	2.76	5.14	3.83	0.59

Table 2-b
Results of Body Dimensions for Children 2-5 years old

Age	Popliteal Height (in)				Buttock Popliteal Length (in)			
	Min	Max	Mean	SD	Min	Max	Mean	SD
2	7.48	10.59	9.05	0.98	1.57	9.69	6.43	2.45
3	7.87	11.42	9.70	1.20	6.30	13.19	8.34	1.85
4	8.66	11.02	9.96	0.94	8.27	9.84	8.78	0.62
5	9.84	13.19	10.94	0.91	7.48	12.40	9.55	1.60
Total	7.48	13.19	10.05	1.24	1.57	13.19	8.42	2.12

Table 3 shows the T-test results of comparison between commercial furniture dimensions and children's body dimensions. There was a significant difference between dimensions of commercial furniture and children body dimension ($p < 0.05$). Therefore, the results indicate that the size of commercial furniture is inappropriate for children.

Table 4 shows the T-test results of comparison between public furniture dimensions and children's body dimensions. Similar to the results above, there was a significant difference between public furniture dimensions and children's body dimensions ($p < 0.05$). When the mean values were compared, the fit of public furniture dimensions were far from current children's body dimensions.

Conclusions & Discussion

As a result, this study revealed a significant difference between children's furniture dimensions and current children's body dimensions. Current furniture dimensions are inappropriately developed to current children. In addition, children's anthropometric data in this study portrayed that children had different proportions by their growth. Thus, understanding children's anthropometry will be necessary for children's furniture designers and interior designers in environmental design in order to appropriately plan and suggest furniture dimensions for the age group.

Table 3
T-Test Results of Commercial Furniture Dimensions and Children Body Dimensions

T-test Results				
	Mean	Variance	<i>t</i>	<i>P</i>
Furniture Dimensions	11.63	2.84	3.18	0.015*
Body Dimensions	8.09	8.65		

*. T-test is significant at the 0.05 level (2-tailed).

Table 4
T-Test Results of Public Furniture Dimensions and Children Body Dimensions

T-test Results				
	Mean	Variance	<i>t</i>	<i>P</i>
Furniture Dimensions	12.55	3.30	3.18	0.007*
Body Dimensions	8.09	8.65		

*. *T*-test is significant at the 0.05 level (2-tailed).

In this study, policy and standards for children's product were found in U.S. Consumer Product Safety Commission (U.S. CPSC) and American Society of Testing and Materials (ASTM) for children's safety. However, there is no regulation concerning children furniture in environmental design. Therefore, developing policy of children's products and standards of children's body dimensions are strongly suggested to policy makers and researchers in environmental design.

Limitations of the Study & Further Research

The contents of this study have proven to be valuable, but limitations do exist as these samples cannot be used to generalize to the entire American children population. The American culture is composed of many races making it even harder to generalize the research outcomes. Thus, generalization might be one limitation associated with this research. Considering a larger sample population may provide a better representation of current children's anthropometric data. Also, further research can be done to incorporate children in multiple locations, both urban and rural.

Additionally, the outcome of this study can be used for future research activities that investigate a comparative study of children's body dimensions and current furniture in other countries. Possible variances in children's anthropometric data across different nationalities may provide deeper insight to children's furniture designers and policy makers.

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