

Development of An Ergonomically Designed Infant Walker

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Abstract

Baby walkers have a huge patronage since its introduction in the early 15th century in Europe among parents aiding their children in developing their baby's locomotor skills, a common misconception that had been overlook, due to poor consideration of the early designs injury reduction had been overlooked resulting to injuries possible, toe walking due to mismatch on the early designs versus the infant's body measurements. Despite the plea of medical professionals in banning the product in the market due to reported cases of emergency room injuries caused by walkers (Molina, 2018) from which majority is from head and neck injuries along with reports that use of the baby device delays the developmental growth of the infant according to a cohort study and two cross sectional studies reporting developmental delays which has a long run to go since the evidence against the product is not enough considering the large number of baby walker users worldwide. Despite such plea market for walkers had been increasing according to the market analysis conducted by the authors potential market for the product is at 8,856 this 2018 and is projected to go up to 9,753 in 2022. A potential market size indicates a high social desirability for the device, thus the researcher sought to provide a correction to the design in order to minimize if not to eliminate possible risk of injuries. In order to develop a proposed design for the product, the researchers used anthropometry to determine the appropriate dimensions of the product. Identified which body dimensions will be needed as reference for the proposed product dimensions. After determining the appropriate body dimensions, the values for the dimension of the product parts with respect to the 5th and 95th. Materials to be used should be mainly made up of polyethylene and aluminum alloy.

Keywords

Special Population, Infant, Design, Ergonomics, Anthropometry, Product Evaluation

1. Introduction

Infant walkers have been a main stay in most households for childcare over the centuries. It is commonly made of a metal and plastic frame on wheels in which a baby is suspended in a sling-seat. Children usually use them between the ages of 4 and 12 months (Patricia Burrows, 2002). Most parents perceive that the use of baby walkers provides benefit for their growing child such as infant safety, encouraging mobility, promoting walking and providing exercise. Parents also believe that the incorporation of infant walkers in a child's growth accelerates the development of independent walking skills (Miriam E Bar-on, 1998). But in contrast with public beliefs, number of researchers, medical practitioners and organizations tend to stop the use of baby walkers for it imposes threat to safety and developmental delays among infants. In a study done in the United States, infant walker – related injuries can be severe and can include skull fracture, brain injury, burns, poisoning and drowning. Also, 8 pediatric fatalities associated with infant walkers were recorded from 2004 to 2008. Despite these claims and recommendation from the American Academy of Pediatrics to ban the manufacture and sale of infant walkers, purchase and usage of these devices remain high among families (Ariel Sims, 2018). Reports and studies estimate that in the United States between 70% and 92% of parents with one – year old children use infant walkers (Patricia Burrows, 2002) (Ariel Sims, 2018).

As strong opposition to the use of infant walkers arise over time, countries such as Canada completely banned the sale of these devices since 1989 and the American Academy of Pediatrics has not recommended the use of baby walkers as well. Contribution to child development and safety are two vital factors that can be considered in assessing current designs of walkers. Pediatricians emphasize that the use of infant walkers shows no substantial value in the development of a child's motor skills. First, they provide precocious locomotion in infants, which may interfere with the natural process that an infant needs to develop. Second, they prevent visual experience of moving limbs because of their design which are believed to have a critical role in development of motor systems (Shervin

Badihian, 2017). Aside from health and development issues, the safety of infants using the device is also a critical concern infant walkers are facing. Falling from stairs or elevated areas, falling out from the infant walker,

and proximity mechanisms are the most common causes of injuries associated with infant walkers. Also, the increased mobility through infant walkers exposes them to other hazardous situations. In the United States, majority of children sustained an injury on the head or neck (90.6%) and upper extremities (4.5%) (Ariel Sims, 2018).

The study focuses on improving the present design of infant walkers by incorporating statistical and anthropometric approach in the product development phase. Unlike Canada, the Philippines does not impose any bans on the manufacture and sale of infant walkers. In addition, market desirability of infant walkers remains high despite pressing issues. This provides a window of opportunity to further study and develop an infant walker which comply to existing safety standards and promote proper physical development among children. Through sets of surveys and interviews, an ergonomic audit was done to evaluate the present design of infant walkers existing in the Philippine market. As results, the audit presented three prime concerns on the walker's present design. First, the dimension of existing walkers does not fit the children's sizes. More than half of the respondents claim that their child tends to tip – toe walk when using the walker. Second, infant walkers tend to be unstable causing incidents of tip – overs wherein the child falls out from the device. Lastly, some materials used in an infant walker, such as the plastic frame and seat cloth, causes allergic reactions to some children. The study aims to emphasize that there is a need to recreate the current design of infant walkers based on evident facts and market desirability. Moreover, the study intends to incorporate interventions through ergonomic principles that will resolve underlying issues on infant walker's safety and purpose.

2. Conceptual Model

To be able to assess the current design, identify possible risk factors, accident-prone segments and recommend alternative designs in enhancing the current infant walker, the researcher conducted interview and survey as well measuring the anthropometric segments of the special population followed by Product Usability Evaluation of the existing design. Afterwards the design correction phase of the study includes ergonomics intervention and requirement engineering for the components of the design. (Isip & Caparas,, 2019).

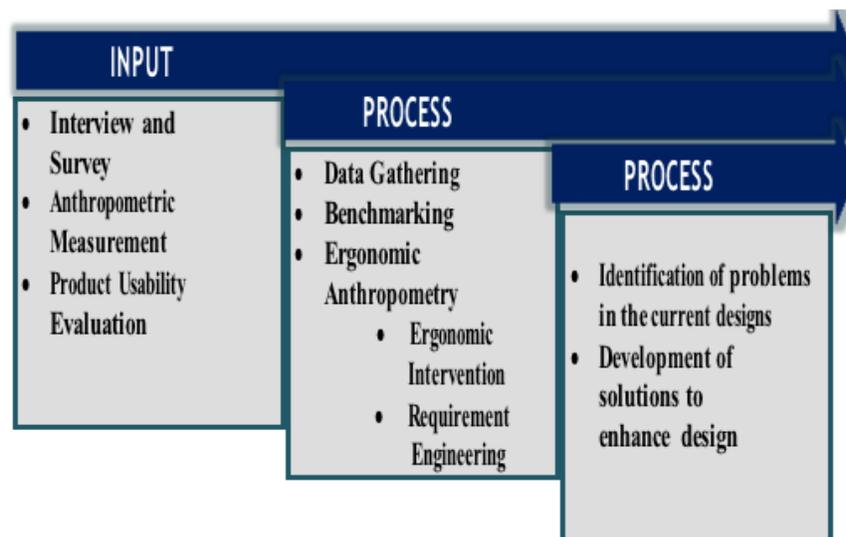


Figure 1. Conceptual Model of Ergonomic Intervention

3. Methodology

Design Evaluation Procedure. The study follows a cross sectional Product Usability Evaluation; the pre-task survey gathered the demographic profile of the infant and the initial evaluation of their parents' and or guardian experience with infant walker, while the existing design is evaluated using a project

dashboard which includes the scope of: Need and purpose of the design, Protective features, Design standard, Maintainability, Optimization of designs, together with a schema-congruity evaluation. The project dashboard form used a 5-point Likert Scale with a Cronbach Alpha of 0.83 with 5 being “State of Art” and 1 being “Needs Significant Attention”.

Sampling. Multiplying the growth rate to the population there would be an estimate number of 864,553 new born baby within the window of 2017 from which 77% are expected to use infant walker (Bar-on, Boyle, & Endriss, 1998), yielding a total study population of 665,705. Using Slovin’s formula (Tejada & Punzalan, 2012) to calculate the sample size, it was approximated that 400 infants together with their care taker/ parent would be required to obtain ± 0.05 or 5% margin of error. However only 273 were able to accomplished the instrument, giving a study error of $\pm .06$ or 6%.

Data Analysis. The study used descriptive statistics for the demographics and anthropometric measurements from the pre-task survey while one sample z test ratifies the quantitative and qualitative assessment from the project dashboard.

4. Result and Discussion

4.1 Demographics

The total sample of infants composes of 48.5% male and 51.5% female (Figure 2.), from which 5% are less than 6 months old, 28.5% are between 6 months to 12 months/1 year, while majority of infant (66.5%) are over a year old. Youngest age of infant walker user observed is 5 months old vs 24 months or 2 years old is the oldest. With an average weight of 7.77 kilogram. Dissection of samples from the guardian are: 65% percent are females vs male which is 35%, from which 39% are the parents of the infant while the remaining 61% are caretaker (Figure 3).

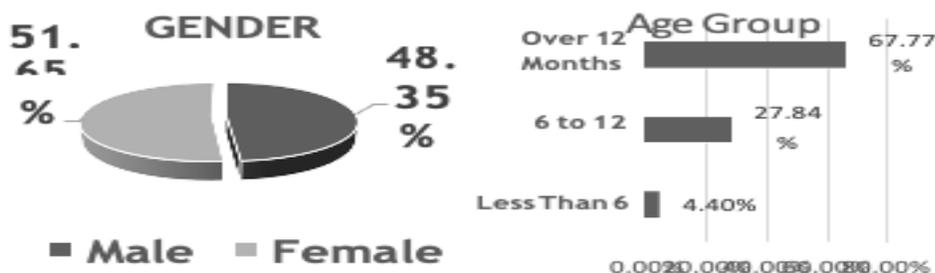


Figure 2 Demographics of Infant

4.2 Anthropometric Measurements

Anthropometric measurements of concerned body segments are collected to evaluate the existing design in terms of dimensions. Average dimensions are as follows: Height 77.88cm, Popliteal Height 16.61cm, Hip Breadth 15.93, Buttock Popliteal Height is 19.55cm, Buttock Knee Length 18.75cm, Chest Breadth 16.14cm, and Chest Depth 14.11cm (Table 1).

Table 1. Anthropometric Dimension of Infant User

Body Dimensions (in CM)								
	Weight	Height	Popliteal Height	Hip Breadth	Buttock Popliteal Height	Buttock Knee Length	Chest Breadth	Chest Depth
MAX	9.8	88	19.5	19	25	22	20	18
MIN	6.5	70	13	11.8	15	13	11.6	11
MEAN	7.77	77.88	16.61	15.93	19.55	18.75	16.14	14.11
STD DEV	0.76	5.05	1.49	1.74	2.68	2.08	1.88	1.53

4.3 Product Dashboard Evaluation

Results from the product evaluation is as follows: Item mean for Need and purpose of the design is at 4.84 (State of

Art) which means the design in terms of serving its purpose in the perspective of the guardians is above satisfaction, Design standard has an item mean of 4.21 (Above Expectation) meaning, the guardians see the design of the product is similar to what should be a baby walker look and function. While, Protective features (2.14) and Maintainability (1.45) has an item mean interpretation of Needs Attention, it shows absence or minimal function in terms of protective functions and maintainability of the designs are present.

Table 2 Product Evaluation Result

Item	Item Mean	Interpretation
Need and purpose of the design	4.84	State of Art
Protective features	2.14	Needs Attention
Design standard	4.21	Above Expectation
Maintainability	1.45	Needs Attention

5. Conclusion

5.1 Recommendations

Protection: Dimensions for the designs of the baby walker should be within the 95th and 5th percentile of the infant. The walkers' leg should be adjustable with respect with the popliteal height, maximum height should be 19.5cm and minimum should be at least 13cm, leg braces should be spread out to provide higher stability to avoid tip overs. Lower base should be a plastic brace covered with foam since it is the portion most likely to collide to other objects. Addition of foam or air pump bracing could lessen the impact due to collision. Wheels should be caster wheels with locking mechanism so standing by, if the care taker would need to go somewhere for a short period of time. The seat should be made up of memory foam to flow airflow as well as to accommodate varying breath of the infant's buttocks





Figure 4. Design Consideration

In addition, a sensor and signal lights should be included to be located on the lower base of the walker mounted in the wheels. Mechanism should light when one of the wheels is not in contact with the floor (if hanging). Maintainability: To improve maintainability parts of the infant walker should be detachable and interchangeable. The study identified the primary concerns on the existing design of infant walker, according to the articles the existing design is prone for accidents as well as triggers tip toe walking that can lead to delay walking or possible injury or trauma in the leg area that might affect the development of locomotor skills of the infant. With this anthropometric measurement of the infant who uses infant walkers are harvest to provide design that can cater the dimensions of the baby as well as to address tip toe walking, additional functions such as sensors and locking are also recommend to be used as per the result of the product evaluation.

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