Abstract. Recently, there has been a growing demand for Rattan baby cribs in the international market, primarily due to aesthetic appeal of handwoven rattan. Given that these cribs are intended for infants, safety is a paramount concern alongside aesthetics. Previous research identified a potential risk of limb injury in infants aged 5-12 months due to inconsistent rattan gap decorations exceeding 60 mm in crib width. However, achieving standard gap dimensions in conventional handcrafted production methods has been challenging. This study aims to investigate safety, aesthetics, and manufacturing efficiency in Rattan baby crib production through Focus Group Discussion (FGD) involving research designers, the Research and Development (R&D) Department, the production department, the marketing division, and expert guest designers. Rattan with a diameter of 22 mm and a consistent gap width below 60 mm, is utilized. The crib’s structural elements will apply simple, robust, straight rattan weaving. Visual design recommendation encompasses natural luxury, playfulness, and safety. Various rattan types that balance aesthetics and strength, including thinner-diameter rattan with intricate weaving as non-structural aesthetic elements and side-by-side dual system, enhance beauty while meeting strength and material efficiency requirements. The development of Rattan baby cribs, focusing on child safety and aesthetics, is highly demand due to increasing market demand in the United States, Australia, and Europe and potential opportunities in the local market.

1 Introduction

Products made from natural material have become a choice due to consumer sentiment toward environmental conversation, such as rattan-based baby cribs. The unique characteristic of rattan, including its flexibility, lightness, and aesthetic beauty of handcrafted rattan weaves, offer advantages when apply to children’s products. With global policies restricting wood materials, rattan has emerged as a sustainable alternative material for furniture products sought after by the
global market (Ministry of Industry, 2020). However, safety factors are often overlooked in the production of rattan baby cribs [1], [2]. One crucial aspect is the gap between slats of fence in the crib’s enclosure. Gaps that are too wide may potentially lead to limb entrapment, and a minimum gap spacing of 2 3/8 inches is recommended for infant protection [3-8], as well as to prevent infant entrapment [4]. This falls under hazardous sleeping environments that can result in Sudden Infant Death Syndrome (SIDS) [4], [5], [9].

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On the other hand, handmade rattan baby cribs pose a risk of producing inconsistent decorative gap spacing that may trap infant body parts and potentially cause injury [10]. Beautifully woven patterns, such as intricate weaves (Figure 1-2), have been found to have a higher potential for infants to slip through or get trapped. In this weave type, even though the gap spacing is regulated, there is potential for infants to insert their limbs into gaps between the weaves, ultimately loosening the weaves interconnections and increasing the gap spacing (Figure 2) [7]. Straight weave pattern (Figure 1) allows for relatively consistent gap spacing between slats, even with extra supervision. However, visually, they may need more aesthetic appeal or resemblance to products made from material other than rattan, such as wood or iron. Therefore, a consistent design with straight slats, minimizing intricate weaves and connection, especially in critical areas, and maintaining a consistent gap spacing of less than 60 mm. On the other hand, despite having established standard spacing for crib bars, manually crafted weaves often struggle to consistently maintain the gap between the main slats of the crib’s enclosure. Hence, a production strategy is required to align manual production process with the safety standard that must be met. It is not just about how production can meet the requirements but also how it can achieve efficiency in the production process. Several rounds of manufacturing experiments and evaluation involving various production-related division are necessary to refine the final product. Since product development involves some production division, a product’s evaluation and development process should conduct the FGD in several stages. This research aims to explore the safety, aesthetics, and production efficiency of rattan baby cribs. Considering these three factors, the goal is to develop a strategy for the rattan baby crib’s development. This research involves research designers, R&D teams, production departments, marketing division, and expert guest designers.
Fig. 1. Woven curved pattern (left) and straight pattern (right)[11]. A: Main framework on the outer side without rattan binding; B: Irregular slat spacing exceeding 60 mm (left), regular and less than 60 mm spacing (right); C: Corner junction meeting parallel (left) and perpendicular (right) [11]

Fig 2. Potential for infants to slip and get trapped in the curved rattan weave [7]

2 Method

The FGD in this research adopt Krugger methods [13]. It was part of the Research and Development (R&D) process in the development of safety baby crib, which modified the Borg and Gall model [13]. The R&D process was carried out in several stages: 1. Formulation of product criteria (FGD 1); 2) Development of designs; 3) Discussion of proposed designed (FGD 2); 4) Development of prototypes; 5) Evaluation (FGD 3); 6) Development of the final product; and 7) Final evaluation as a reference for further product development (FGD 4); 8) Subsequent product. Based on previous research [7], [11], the spacing between rattan slat had to be below 60 mm to ensure baby safety by preventing entrapment. FGD is necessary to obtain the right design and a good production strategy. The goal was to achieve not only safety but also other equally important factors such as aesthetics, market preferences, construction, and the production process. The stages included: 1) FGD for formulating product criteria before proposing the initial design; 2) FGD 2 to discuss the proposes designs before creating prototypes; 3) FGD 3 to evaluate the prototype manufacture process before producing the final product for the market; and 4) FGD 4 as a final evaluation for reference in further product development.
Each stage of the FGD involved representatives from each team involved in the production and development of the baby crib product, namely a designer, a R&D, one of the production team, and an expert guest designer in multiple stages of the R&D team, marketing team and production team. Expert designer teams participated in FGD 4, the final evaluation, to provide recommendations for further design. The FGD sessions took place in a conducive discussion space and lasted 1-2 hours. Each division conveyed its perspectives verbally and through visual presentations during discussion. The discussion was primarily focused on the themes relevant to each stage. In FGD 1, the primary focus was on developing a design to meet the criteria for a 60 mm spacing between bars. The recommendations from this stage served as a reference for initial design development. In FGD 2, the design and research findings were further explored in discussion, resulting in recommendations for the design that would be realized in the prototype. FGD 3 evaluated the prototypes created by presenting 1:1 mock-up in the discussion space. The evaluation covered the final product, the production process, and possible production techniques. FGD 3 was considered the final FGD before the product was produced and marketed. FGD 4, the Final evaluation, involved external ergonomic experts, the designer team, and representatives from the production team who had also participated in FGD 1-3. This ensured a more objective depth of analysis that would valuable for the subsequent product development.

A list of important points for discussions was prepared before each session, but the discussion flowed flexibly and openly, allowing for possibly overlaps between different points. However, if deeper exploration were required, the discussion would return to the main points being examined. The secretary made the documentation of the outcomes of each discussion served as the reference for subsequent processes. The moderator is the designer, guided the discussion to achieve the desired results. All participants in the discussion had an equal standing and were encouraged to provide their perspectives and input, irrespective of their hierarchical positions within the company.

3 Result and Discussion

FGD 1 formulated product criteria before proposing the initial design. To achieve spacing between rattan slats below 60 mm, the results of FGD, particularly from the production team, established the criteria for the minimum rattan diameter to ensure sturdy construction, which is set at 22 millimeters. On the other hand, the crib’s main frame uses rattan with a diameter of 28-30 mm. Additionally, the primary criteria for rattan weaving were simplicity, strength, and straightness (without curves). With these criteria in mind, alternatives design created then surveyed among the community. Two straight slats were placed together before the next two slats were spaced 60 mm apart to enhance slat strength. Woven rattan with curves was only applied between the main bars to add beauty and robust construction. Figure 3 displays four design variations. The Yilmaz and Bitna types employ single-slat rattan with a 22 mm diameter for their cribs. The differences lies in Yilmaz having additional curved decorative elements for embellishment, while Bitna does not. The other two designs, Infinity and Kalu use double-slat rattan with a diameter smaller than 22 mm. Despite being smaller than 22 mm, using double slats meets the strength requirements equivalent to 22 mm. Moreover, the variation of double slats also adds aesthetic value and ease of production. All these design aim to adhere to the spacing standards between slats while prioritizing aesthetics.
The result of the market interest survey on the four baby cribs design were used as the baseline in FGD 2, which focused on design and the market. Proposals were made based on these results before proceeding to prototype development. Out of the 28 randomly surveyed online consumers, 10 expressed interests in the Kalu and Infinity Baby Cribs, while 8 preferred the Yilmaz Baby Crib (Figure 3). In FGD 2, market analysis based on the survey findings revealed the following: a) Market segmentation targeted young families aged 25-36 years who appreciate natural furniture product and belong to the middle to upper-middle class; b) The target market is receptive to innovation, values environmental concerns, and prioritizes the safety children’s products; and c) Market positioning aimed at consumers interested in minimalist, natural products and those interests in designing children’s room interior. The design concept was selected based on user preferences and needs when using rattan baby cribs. The target market was young families aged 25-36 who appreciate natural furniture product. The mood board derived from this analysis included elements of natural luxury, playfulness, and safety. The results of exploring rattan bar design were integrated with the existing concept to serve as a guide for developing new design.

As the next step involved prototype creation, the production division was also involved in FGD 2. The production process represents a stage of product creation based on the agrees-upon concept, requiring a comprehensive understanding of product design specifications. Therefore, it is essential to understand the production capabilities that align with the concept to ensure the successful realization of product design development. The findings indicated that safety and operational production standards were the primary criteria in the production of baby cribs. The assembly of the main frame for the crib used rattan with a diameter of 28-30 mm, with support frames of 24-26 mm and 18 mm. During this process, specialized jigs or holding tools were necessary for precise assembly, particularly for determining the knockdown locking connections.

Subsequently, the design division provided exploration in FGD regarding the direction of design development based on input from the marketing and production teams. The design division
recommended the design concept of natural luxury, playfulness, and safety. The value of natural luxury reflects the aesthetics of rattan in its raw form, with distinctive characteristics resulting from the combination of construction, rattan weaving, decorative elements, and the incorporation of various rattan materials. The values of playfulness and safety within the natural concept are essential components in creating products for children made from rattan. The organic natural trend, inspired by the metamorphosis of natural forms such as vines and curves, responds to the current environmental conditions in a fast-paced human world, emphasizing the appreciation of products in their natural state (versatility). The results of exploring rattan bar designs were aligned with this concept to guide the development of new design. Adjustments were made to the initial alternative designs based on the outcomes of FGD 2. Following FGD 2, several alternative designs were created, producing prototypes (Figure 4).

The next stage involved FGD 3, which aimed to reevaluate the product, refereeing to the initially agreed-upon designs. Led by the designer the discussion encompassed various aspects, including material quality, construction strength, product craftsmanship, and production costs. The assessment of the initial prototype (Figure 4) relayed the application of curves at the top and bottom of the crib. This application did not affect the central rattan weaving but improved the slats overall sturdiness. This enhancement contributed to a higher level of safety. Using rattan with a diameter smaller than 22 mm added aesthetic appeal without compromising strength due to the double arrangement.

![Fig. 4. The initial prototype design featured a floral petal motif that had been simplified to create a luxurious impression.](image)

Other production considerations included the assembly locking system to ensure safety, the quality of material, the precision of rattan bar connections, rattan weaving, and verifying the spacing between the bars. From the initial prototype, it was deemed necessary to explore its decoration further to showcase the beauty of the rattan curves while still adhering to safety principles established in the initial study. In this space, the design team translated the recommendation from FGD 2 into a new design (Figure 5). To maintain the characteristic appearances of rattan baby cribs, rectangular sections measuring 12 cm in height were applied to section A’s upper boundary and section B’s lower boundary, with rattan decorative explorations. This addition also reinforced the main structure of the baby crib. The rattan décor applied to section A and B featured 9-10 mm diameters, like that used in the distinctive and attractive rattan bassinet. The design of the bars in section C complied with safety standards and the established criteria. The addition of partitioned areas and the inclusion of section D contributed to both
strength and aesthetic aspects. Creating a baby crib product that met the criteria recommended by the American Academy of Pediatrics (AAP) for a safe sleep environment, reducing the risk of all sleep-related deaths. This includes placing the baby on their back. Using a stable and flat sleep environment, the final prototype design (Figure 5) introduced a mattress leveling feature (on the left side of the image). The stipulated height for the mattress leveling, extending to the outermost side, is 330 mm, designed for infants aged 0-5 months. For children aged 5-24 months, a mattress leveling height extending to the outermost side of 600 mm is employed [17]. The knockdown locking system was also crucial in the FGD discussion for rattan baby crib products, focusing on sleep environment safety. Different rattan materials were applied according to their function while considering aesthetics. The correct positioning of locking components was ensured without interference from decorative elements, rattan bars, or rattan weaving, allowing for effective and robust product assembly. Assembly instruction manuals played a vital role, serving as a reference for consumers when assembling the product in their child’s room.

FGD 4 was conducted after the product had been successfully marketed in several countries. This FGD aimed to evaluate the safety, aesthetics, and production system design. From a market perspective, the product received positive feedback and demonstrated strong sales performance. Using rattan with a diameter smaller than 22 mm but paired in parallel, as seen in the initial design (Figure 4), offered the potential for production efficiency and added aesthetic appeal. It was evident that designs of this nature also gained popularity in the market – the spacing between the bars needed to be widened for efficiency. In the product, the bar spacing was set at 60 mm, measured from the outermost sides. Precise weaving patterns were necessary for artisans at a 1:1 scale, allowing them to replicate the manual weaving precisely by adhering to the pattern. This ensured that artisans could use the precise pattern for quality control purposes. Alternative
designs for additional elements, apart from the main crib structure, could be developed based on market demand, preserving the characteristic aesthetic of curvilinear rattan weaving while prioritizing safety in rattan baby crib production. Aspects related to final production that posed risks to children, such as rattan weaving remnants, needed careful attention to prevent any falling during the final stage, ensuring child safety. Adequate supervision was carried out needed to be maintained to uphold quality standards. The production of the baby crib involved various components produced by separate cottage industry artisans, distinct from the leading company. Therefore, specific standard operating procedures for each production line in rattan furniture manufacturing were necessary to maintain consistency and quality. Since this product was knockdown, including detailed assembly manuals and instructions with every item was essential. These documents served to provide information and educate buyers about creating a safe sleep environment for infants.

4 Conclusion

The focus group discussion was conducted to ensure that safety standards align with aesthetics, including market preferences and production efficiency. Consistent spacing between slats below 60 mm is recommended as the standard, with a simple, sturdy, straight rattan weave (avoiding curvature). Visual design recommendations encompass natural luxury, playfulness, and safety. To enhance production efficiency, it is imperative to select and process high quality rattan materials, ensure production workflow certainty and supervision, and implement an integrated and secure locking system. Various types of rattan that support aesthetics and strength should be considered, including thin-diameter rattan with intricate weaving for aesthetic elements, separate from the main structure. Rattan, with a diameter of less than 22 mm and a side-by-side dual system, can enhance aesthetics while meeting strength and material efficiency requirements. The development of rattan-based baby cribs, prioritizing child safety and aesthetics, is highly warranted given the increasing demand for such products in the United States, Australia, and Europe and potential opportunities in the local market.

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