

An Ideological Multifunctional Baby Naptime Device for Safe and Eco-friendly Modern Living

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Abstract

Studies have shown that many baby devices contain toxic chemicals that are harmful to the environment and can cause infant death. This research aims to propose a multi-functional, eco-friendly product with an auspicious theme following Malaysian parents' ideology. Literature was reviewed; parents' views on newborns and the negative impact of baby devices with toxic ingredients on the babies and the environment were collected and investigated.

The results of the survey found that Malaysian parents have a high degree of safety awareness, design preferences, and requirements on the functions and materials used in baby devices. A multi-functional baby resting device was made with a corrugated board with a rotated "C" shape and an outer contour of a dove. It was designed with changeable accessories, which easily convert the rocking configuration to non-rocking. This baby device promotes the concept of safety, non-toxicity, lightness and ease of reassembly, ease of movement, and improved ventilation through the flutes of the eco-friendly material furnished with a customized dove design that symbolizes longevity, peace, maternity, harmony, and maternal love.

Keywords: *Baby Device; Baby Box; Ideology; Eco-Friendly Materials; Corrugated Board.*

1. Introduction

Bassinets, baby rockers, baby bouncers, and strollers are various baby resting devices commonly seen in Malaysia. Baby devices have evolved with varying levels of complexity and diversity. Multi-functional baby chairs with music and toy accessories are now available with varying prices and qualities. Most of these devices are made of metal pipes or hard polymer plastics that might contain hidden dangers to babies and toxic materials that damage the environment. Unsafe design and structures are also valid concerns when it comes to product-related hazards in commercial baby bouncer seats (Federal Register, 2017). Parents are committed to looking for good baby products that can help them to take care of their babies. Without understanding the quality of a baby product, young parents may choose unsustainable products that cannot be recycled and may harm their baby.

The main objective of this research is to integrate non-toxic substances and biodegradable materials to create a baby device with a favorable shape and structure according to the ideologies of Malaysian parents, thus providing them with an easily disassembled and assembled, durable, multi-functional, eco-friendly product that can comfortably and securely support a baby up to twelve months of age. At the same time, it can also help to improve awareness of environmental issues, reduce landfill problems, and allow the recycling of baby devices that are not in use.

1.1 Demographic Statistics for Newborn Babies, Malaysia

According to Malaysia's demographic report (www.dosm.gov.my), there were only 124,240 live births at the end of 2019 (Mahidin, 2019). However, the birth rate of newborns in Malaysia has been decreasing at a rate of about 1.46% per year for the past 10 years.

The term "ideology" was coined by Count Destutt de Tracy (1754-1836) (Georges Cabanis, 2010). The French philosopher Louis Althusser (1918-1990) once stated that ideology permeates every corner of

life, thus involving every single person. Malays, also known as Bumiputera (which includes aboriginal people such as the Orang Asli, Dayaks, Kadazan, and such), make up the largest percentage of Malaysia's population with 69.3%. Ethnic Chinese citizens make up a total of 22.8%, while Indians make up 6.9% (Mahidin, 2020). Malaysia practices freedom of religious belief. The Islamic faith has the most believers, with 63.7% of the population, followed by Buddhism with 17.7% and Hinduism at 6%. About 12.6% of the population engages in Christianity or other religions (Countrymeters, 2019). Islam is defined as the official religion in Malaysia; all Malays must be Muslims (Religion in Malaysia, 2015). Their lifestyle, behavior, and educational methods are all based on Islam as a lifelong faith since their birth. On the other hand, Malaysian Chinese and Indians are still influenced by their chosen religion when it comes to traditional rituals and/or certain attitudes towards life.

a) Malay ideology regarding newborns

The Qur'an clearly states that all life is sacred. Once a mother conceives, the child has the right to life (Stacey, 2017). Muslims believe that babies are a gift from God and the birth of a baby will bring blessings and livelihood to the family (Tanuri, 2018). Muslim parents believe that they are responsible for their child's moral and religious upbringing. Parents who fulfill their responsibility are said to be free from adverse consequences on the Day of Judgment (Al-Uthaymeen, n. d.).

b) Chinese ideology regarding newborns

In traditional Chinese culture, not having children is considered unfilial. Giving birth to children is a type of filial piety, borne out of one's responsibility in continuing the family bloodline (Custer, 2019). When a Chinese wife is pregnant or "YouXi" (transliterated as "has happiness"), both she and the child will receive care from the whole family. Pregnancies are often surrounded by many superstitions such as disallowing house renovations and saying words that are considered taboo or offensive to gods. Otherwise, bad consequences will befall both mother and child (Yeo, 2013). At present, Chinese people still adhere to and abide by these traditional concepts, gradually contributing to the ideology of Chinese people during the pregnancy period.

c) Indian ideology regarding newborns

Hindus believe that having children and becoming a parent is a lifetime obligation for Indian couples soon after marriage (BBC, 2009). Children are very precious in Hinduism (IOL, 2001). The arrival of newborns is a happy event and cause for a joyful celebration (Soundararajan, 2018). Traditional celebrations and rituals are often carried out before and after the baby is born to bless the newborn baby, thus becoming part of the modern Indian ideology regarding newborns.

1.2 Baby Sleeping Devices

In the first six months, babies generally need fourteen to eighteen hours of sleep per day. They require rest or sleep every two hours (Lack, 2018). As they grow older, they will sleep less during the day, and more during the night (Raisingchildren.net.au, 2019). Today, there are two categories of baby sleeping/resting devices. The first aims to provide a nighttime bed for the baby, such as a baby bassinet. The second aims for the baby to rest and play during the day, such as baby bouncers and baby rockers.

a) Baby bouncer/bouncer seat

Baby bouncers are popular products used to support babies in a seated position. The design consists of a metal or hard plastic tube bent in the shape of an inverted "U" to achieve a spring system. When a baby sits in the bouncer, their weight can be used to initiate up and down movements. The seating pads are made of cotton fabric for comfort or mesh fabrics for better ventilation. They are ergonomic and designed to support and protect the baby's spine, neck, and head (Jenkins, 2019).

Compared to ordinary cribs, baby bouncers are relatively simple in configuration and convenient for easy carrying, thus making them a popular choice for baby's play and naptime amongst ordinary families. Some baby bouncers even come with music devices, and toys to entertain and lull the baby to sleep.

b) Baby rocker

Manufacturers sometimes combine the concepts of bouncers and rockers to meet the demands of different markets. Instead of a base that is flat or parallel to the ground, a parallel elongated curved rocking base is attached, allowing the device to swing back and forth, thus providing two functions in one device. It can soothe crying babies by swaying in the upright configuration or rocking back to forth. It also can provide stable support during feeding time. The rocker's base comes with adjustable "stopper" supports to be converted into a flat or upright position by flipping over the foldable supports on the lower base.

c) Baby box

During World War 2 from 1939 to 1944, poor families in Finland did not have a proper place for babies to sleep and could not afford proper and appropriate healthcare for their children. As a result, 6.5% of newborn babies died within the first twelve months of their lives (Kit, 2018).

To reduce the infant mortality rate, the Finnish government provided maternity benefits, including the provision of cash grants or "baby boxes". The boxes contained quality baby care products and could then be converted into a sleeping device for the child. The Finnish government continued to provide baby boxes after the war ended and actively encouraged pregnant women to undergo health checks. Currently, Finland has the world's lowest maternal and child mortality rate since 1949 (JamesBBox, 2017). The concept of Finnish baby boxes has been emulated and implemented in many countries, such as Scotland, the United States of America, Great Britain, Canada, India, and South African governments (Matchar, 2017). About 3,500 babies die from sudden infant death syndrome (SIDS) in the USA each year without a certifiable cause (Norton, 2016). The USA has started to actively promote its baby box campaign to reduce the number of infant deaths.

1.2.1 Present Circumstance on Baby Devices

The probability of infant fatality due to unsafe baby devices is higher than other causes, such as improper care under nannies or childcare providers (Liaw, Moon, Han, & Colvin, 2019). Baby rockers and bouncers are designed to ensure that the baby is in a semi-recumbent position when sitting inside; it is liable to be harmful if not used properly. Studies have shown that baby devices, especially baby bouncers, have caused numerous infant deaths (Batra, Midgett, & Moon, 2015).

a) Exceeding the weight limit

Ordinary economical baby bouncers and rockers can only bear a maximum of 9 - 13 kg (Figure 1). Parents should adhere to the weight limit when using the products (Consumer Reports, 2008). Healthy babies can reach 8 - 10 kg by eight months of age (American Academy of Pediatrics, 2009). As such, ordinary baby bouncers and baby rockers are not suitable for infants older than nine months. According to the ASTM (International/American Society for Testing and Materials) F2167-17, ordinary baby bouncers are only suitable for infants who have not been able to sit up properly, which usually happens around the six-month mark (Federal Register, 2017). Continuous usage may cause one end of the bouncers or rockers to tilt towards the ground, lowering the baby's head; it may cause abnormal blood circulation, thus causing breathing difficulties and pose as a hazard for suffocation.

b) Soft cushions can cause baby positional plagiocephaly

Most sit-in bouncers and baby rockers are made of fabric that will soften after prolonged use. This can cause the baby to sink into the seat with a wrong posture, where the baby's chin is tucked too close to the chest, thus creating breathing problems. To avoid SIDS, many healthcare professionals advised parents to ensure their babies sleep on their backs.

A seat that can conform to a baby's spine, providing safe and comfortable support should be given precedence to help the baby grow up safely (Sehat, & Nirmal 2017). The baby's sleep setting should not be too soft, nor have loose bedclothes or soft pillows as these may cause SIDS (Norton, 2016). Sleeping or resting in baby bouncers or baby rockers for too long can cause positional plagiocephaly, or flattened head syndrome (Jenkins, 2019).

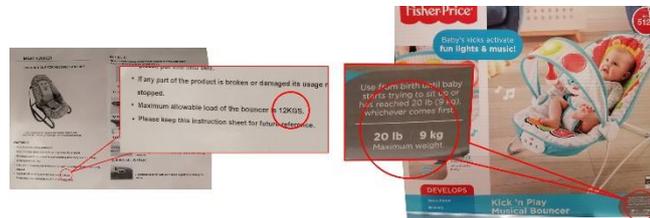


Figure 1 Maximum weight allowable for ordinary bouncer and rocker

1.2.2 Materials Used on Baby device

In addition to the structure of baby devices that may cause harm to babies, the materials used are also an issue as it is one of the causes of infant death.

a) Toxic flame retardants materials

To increase heat resistance and durability, toxic flame retardants are added during the production of baby necessities, devices, and toys (Toxic-Free Future, 2012). This includes baby bouncers (Winnebeck, 2013). Accidental inhalation of toxic flame retardants may damage the liver, brain, and reproductive organs. These materials are also carcinogenic, which increases the risk of cancer.

b) Toxic substances in the plastic and color coating

The colorful coating applied to devices (Figure 2) for aesthetic purposes may carry toxic substances. Phthalates, commonly found in plastics, can disrupt the endocrine system if inhaled or eaten. As children love to mouth and bite items, this poses a risk to the baby (Winnebeck, 2013).



Figure 2 Color coated metal pipes for baby rockers

c) Negative impacts of plastic on the environment

Plastics are economical and easy to fabricate. They are widely used in various products and production lines (Sojobi, Nwobodo, & Aladegboye, 2016). In 2015, 63 million tons of plastic waste were produced. However, only 9% of the plastic waste was recycled, which means that 49.77 million tons of plastic waste still accumulated in landfills that same year (Geyer, Jambeck, & Law, 2017) and it will take at least 500 years to degrade. Moreover, plastics thrown into the ocean kill around 100,000 marine lives annually, whether by accidental ingestion or suffocation (D'Alessandro, 2014).

Currently, most commercial baby products are made of polymer plastics. In the article '10 best baby bouncers in 2020' according to reviews by 10,852 users (MSN, 2020), 30% of the baby bouncers have main brackets made of plastics. In the remaining 70%, the caps of the bracket connectors, the music and swinging controller casing, the seat belt buckle, toys, and entertainment accessories were also made out of plastic (Figure 3). If not processed and recycled properly after use, these products will definitely cause landfill problems for our environment.

d) Alternatives for baby devices - baby box

Finnish baby boxes, made of corrugated board, are used by many countries as resting and sleeping devices for babies. However, no studies have confirmed that baby boxes help prevent infant deaths or are 100% harmless to newborns. Professor Peter Blair from the University of Bristol, UK, mentioned that the baby box can only be used as a temporary substitute and is not a safe sleeping space for infants (Willets, 2017), so parents need to be extra careful when using it.

The Finnish baby boxes are usually around 70 cm (length) x 42.8 cm (width) x 27 cm (height), the size may not be big enough for babies older than three months. The excess cardboard surface prevents good air circulation, creating a stuffy atmosphere for the baby. In fact, there is no proof that it is solid enough to support babies after three months of age (Therrien, 2018).

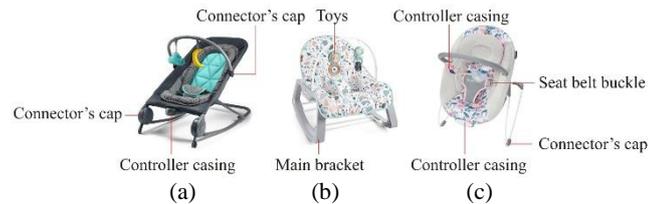


Figure 3 Samples of plastic components on baby bouncers

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(a) https://www.v2mshop.com/?product_id=54099634_62,

(b) <https://www.pinterest.com/pin/daily-sweepstakes--816981188652777748/>,

(c) <https://www.amazon.com/Baby-Trend-EZ-Bouncer-Bluebell/dp/B07C9ZR2VC?th=1>

1.3 Exploring Materials for Baby Usage

As climate change concerns increase, many companies have started to focus on green features and environmental issues to remain competitive in the market (Omar, Osman, Alam, & Sanusi, 2015). Green features can be implemented via green operational methods by producing green products with non-toxic, biodegradable materials in many baby products.

a) Biodegradable materials

Studies have shown that corrugated cardboard is biodegradable and completely recyclable (Davis, 2017). Fast-growing pine trees are the main material used in the production of corrugated cardboard (How Products Are Made, 2019). Corrugated cardboard has also been introduced to the food and beverage (F&B) industry as a solution to non-degradable fast-food packaging (Liew & Siek, 2019). Re-board is another biodegradable and recyclable material. The inner core of the re-board is made of 100% recycled paper, making it safe for both humans and the environment. Since the two materials mentioned are non-toxic, biodegradable, and recyclable (Davis, 2017; Oriam green, 2019), they are suitable for use in baby products.

b) Vary in the maximum weight

If multiply layers of corrugated cardboard are glued together, it can be very durable and bear a heavyweight (Natter, 2019). Similarly, multiple layers of re-board can become strong enough to support a heavy-duty automobile. Today, these materials have been used to make furniture, as they are eco-friendly and resistant to pressure.

1.3.1 Corrugated Board

Corrugated boards are widely used for carton boxes to deliver foodstuffs and war materials since World War II (Nordstrand, 2003). It is also applied to furniture, such as a chair for children and babies. The world's first mass-produced corrugated cardboard seat was the "Spotty Children Chair" (Figure 4) designed by British designer Peter Murdoch (1792~1873) in 1963. It is non-toxic, waterproof, and chemical-resistant. In 2010, the German architect, Manuel Kretzer, designed and developed "Chick "n" Egg Chair," which was initially designed for kids (Figure 5) (Kretzer, 2011). Lately, the "Rip + Tatter child's chair" (2011) (Figure 6) was designed by New York designer Pete Oyler using a series of corrugated paper chairs for the age of 2 to 5. It is claimed that the product is resistant to baby drool. The material has a history of being applied chairs for almost 60 years and presently these chairs are still selling in the market. A corrugated board has a great application value as it is convenient for printing and is possible to be formed into different shapes and sizes (Packaging Innovation, 2020).



Figure 4 Spotty Children Chair

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Figure 5 Chick “n” Egg Chair

Reprinted from: <https://www.homedit.com/cardboard-furniture/>



Figure 6 Rip+Tatter child’s chair

Reprinted from: <https://afilii.com/en/rip-tatter-chair-for-children-by-pete-oyley/>

a) Anti-bump effect

A corrugated board is made of arched craft papers sandwiched between two flat facings (liners) with flutes in the middle. This structure has an anti-bump effect that can reduce the effect of external forces and effectively absorb impact, helping the contents to resist damages from accidental impact or falls (Heritae Paper, 2017).

b) Flutes in the structure of the corrugated board

Corrugated board panels are made up of wavy cardboard flutes sandwiched between two flat facings (liners), and are categorized according to their flutes. The flutes also act like cotton or sponges, enabling the box to maintain a cool temperature while creating a ventilation effect. Larger flutes confer greater strength and cushioning ability to the cardboard. Different flutes can be combined to meet specific needs. In general, the corrugated board offers good compressive and pile-up strength. The “C Flute” corrugated board is the most popular option, taking up 80% of the market (Cross, 2017).

1.3.2 Re-Board

Re-board has high durability and moisture resistance. It usually has a thickness of 10 - 16 mm and is available in different colors. The flutes of re-board are structured in a vertical format and are more intensive compared to ordinary corrugated cardboard. It is also relatively lighter, thus reducing the carbon footprint required for logistics (Oriam green, 2019). Due to its advantages and eco-friendly properties, it has gradually replaced some traditional materials, such as plywood in industrial productions and exhibition construction, and is also widely used to make children’s furniture.

1.4 Exploration of Dove Imagery in Ideology

In many myths and folklore, birds are said to have extraordinary power and have been described as Godly mounts, spiritual animals beside the Gods, or even the embodiment of Gods. Therefore, birds are often used to symbolize the soul and spirit of human beings; they represent thoughts and have lofty spirits and thoughts (Huffman, 2016). The white dove has been a symbol of peace for hundreds of years. It is often depicted alongside words of love, devotion, and peace in current imagery (Patane, 2018).

Doves mate for life, making them a symbol of longevity and loyalty in Chinese societies. Chinese people respect the dove for its devotion to its offspring and regard it as a symbol of fertility as well (Chinasage, 2018). According to Chinese Fengshui, a dove totem can change the “qi” to increase peacefulness and harmony in one place (King, 2019). In Hindu mythology, Parvati the goddess of love protects marriage and fertility in a family (Choate, 2014). It is said that Parvati had a happy marriage with her husband, Shiva, in a cave called Amarnath, whilst in form of doves called Kapotesvara and Kapotesvari (ENVIS Resource Partner On Avian Ecology, 2015). Dove totems also often appear in Native American, Slavic, Celtic, and Japanese mythology and folklore (Bartlett, 2019). They are rooted in different cultures and clans. Most people believe that doves symbolize longevity, peace, maternity, harmony, and maternal love.

2. Objectives

There are three objectives in this study:

- 1) To identify the needs of parents’ requirements for a baby device
- 2) To design a baby device for parents that can securely support a baby up to twelve months of age
- 3) To create a recyclable baby device that also helps parents to improve awareness of environmental issues

3. Materials and Methods

Literature reviews and studies show that baby bouncers and baby rockers generally contain toxic flame retardants and toxic color coatings that may cause pollution or harm babies. The researchers herein decided to use questionnaires from previous related studies as a reference for the requirements of the questionnaire design; the questionnaire was only released to respondents after pilot tests were conducted with professional experts. The researchers also planned to use an experimental research method to ascertain the most suitable material for a baby resting device.

3.1 Questionnaire Design

Questionnaire surveys (United States Census, 2019) were used to explore Malaysian working parents’ perceptions regarding the functions, features, and materials used in baby devices. The first section of each group of questions investigated the parents’ safety awareness and knowledge. The second section was aimed at understanding the parents’ requirements for the functions and features. The third section was aimed at gaining an understanding of parents’ requirements on material safety, as well as structure and shape preferences that are auspicious and harmonious for the baby (Table 1).

Table 1 Questionnaire design

Part	Category	Group	Section
1	Classification Question	Personal Information	Basic data
		Baby Bouncer Baby Rocker	Experience in using a Baby device Safety knowledge and cognition Function and feature
2	Likert Scale Question	Baby Box	Safety knowledge and cognition
		Baby Device	Function and feature
			Material used
3	Personal Preference	Design Suggestion	Structure and shape

3.1.1 Research Measuring Instrument

Research has shown that the five-point Likert scale enables a data collection rate to parallel in-person responses to a statement or proposition (Cherry, 2018; Vinney, 2019; Sauro, 2019). A partial correlation analysis method was used to analyze the collected data because this method describes the correlation between two variables under the influence of one or several additional variables (SAS, 2018); making it possible to combine two approximate variables into one.

The online survey and data collection tool – Formplus (www.formpl.us) was used to measure knowledge, user experience, requirements, and opinions. The researchers made each question required using the “make the field required” function to ensure that all questions were answered and each questionnaire complied with the requirements.

3.1.2 Pilot Test and Reliability

Expert sampling methods were conducted by seven professional experts with at least 10 years of working experience in relevant design fields, who were also parents (Table 2). The pilot test had a 100% attendance rate. Three experts E1, E2, and E4 suggested a reduction in the number of questions to minimize the time required to complete the questionnaire; all experts agreed that the content and questions were in line with the research objectives.

Table 2 Experts’ biodata

Sequence	Experts	Education	Working Experience	Profession
E1	Ms. N	PhD	10 years	Industrial Designer
E2	Ms. H	Master	18 years	Fine Art Artist
E3	Mr. N	Degree	15 years	Fine Art Artist & Sculptor
E4	Mr. A	Master	18 years	Architect
E5	Mr. Lu	Master	20 years	Industrial Designer
E6	Mr. I	Master	23 years	Industrial Designer
E7	Mr. L	Master	10 years	Applied Science Architect

3.1.3 Selection of Respondents for Questionnaire

Purposive sampling in the intercept recruiting method was applied to select potential respondents from corporate groups, local societal hubs, etc., where respondents had similar backgrounds and experiences to share (Workbook E: Conducting In-depth Interviews, 2015).

For the primary group of respondents that were conducted through a face-to-face questionnaire survey, the researcher targeted Malaysians living in Klang Valley, a big area with a high-density population encompassing Selangor and the national capital city of Malaysia – Kuala Lumpur.

The researchers also adopted a snowballing technique to obtain more data from respondents at different locations and to complete the questionnaire survey within the specified time because this method can easily collect a large sample size if applied several times (Albuam, 1993).

3.2 Repeated Measurements on Different Thicknesses of Boards

The repeated measurements method from the experimental research design where all subjects will receive the same method of tests (Ross, & Morrison, 2004) was applied to “manipulate and control” and to observe the causal processes and effectiveness of the experimental results for this study. “C Flute” corrugated board and re-board brown were used as the main experimental subjects for this research study (Table 3) or “liners” that were made of brown color craft papers.

a) Sustainable weight and durability of corrugated board vs re-board

Two prototypes were placed separately on a scale (Figure 7) to compare the total carrying weight. In this experiment, the re-board proved to be approximately 60 g heavier than the corrugated board.

b) Weight-bearing capacity and durability

A 12 kg and 16 kg dumbbell were placed on the two prototypes and then rocked continuously for one minute to test the weight-bearing capacity and durability of the two materials. The observation result shows that the corrugated board had a significantly slighter slant compared to the re-board, please refer to the red arrows pointed in figure 8.

c) Ventilation capability

A hairdryer was used to test the ventilation of the two prototypes. A piece of paper was stuck on the top side of the prototype and the hairdryer was aimed at the flutes of the two prototypes at the same power. After three attempts, it was determined that the corrugated cardboard with wavy flutes had better ventilation compared to the re-board with vertical flutes as the slender paper strip floated higher (Figure 9). Re-board is heavier and more durable compared to corrugated board, but its ventilation effect is not as good. Hence, the researchers decided to use corrugated cardboard as the main material for this research study.

Table 3 Experiments on materials

No.	Materials	mm	Experiments
1	“C Flute” Corrugated board	5	<ul style="list-style-type: none"> Strength and supporting capabilities Ventilation capability
2	Re-board Brown	10	<ul style="list-style-type: none"> Total weight for carrying

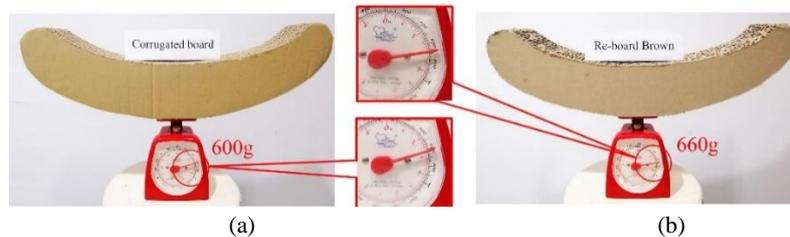


Figure 7 A test for comparison of total sustainable weight: (a) is corrugated board weighted 600g, (b) is Re-board brown weighted 660g

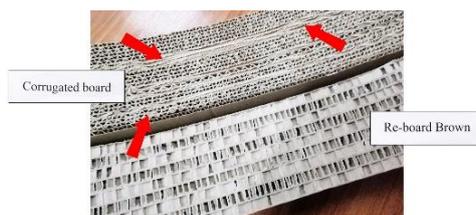


Figure 8 Weight-bearing capacity and durability of materials.

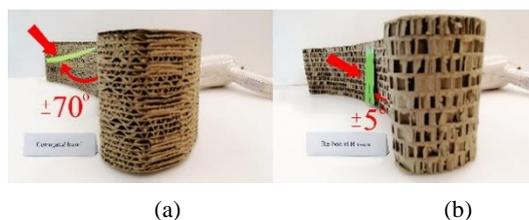


Figure 9 A hairdryer was used to test for comparison of ventilation capability, (a) corrugated with wavy flutes managed to lift the paper to approximate 70 degrees, (b) re-board with vertical flutes only managed to lift to approximate to 5 degrees.

4. Results

The researchers collected a total of 252 sets of valid questionnaires in the 14 days after the pilot was tested. Data were recorded in the online production system with statistical and detailed analysis. It was classified into six sections: basic data, safety knowledge and cognition, function and feature, the material used, and personal preferences on design.

Out of the 252 sets of data, 214 were parents with one (42.9%) to two children (42.1%). Only 38 (15%) of them had three or more children (Table 4). It showed that the average number of children for Malaysians is 1 - 2. According to the respondents, 103 (40.7%) of them had two baby resting devices at home. There were 91 respondents (36.1%) who reported having only one baby resting device at home, while only 58 (23.3%) had three or more such devices at home (Table 5). Regarding safety knowledge, more than 70% of the respondents agreed it was safe to put the baby in bouncers and/or rockers, and it was fine for the infant to be placed inside for 60 mins or more. There were 248 (98.4%) respondents who understood that the device ceased to be suitable and/or safe when the baby's head was lower than the horizontal line of the feet.

Table 4 Number of children at home

Children	Total respondents	
One	108	(42.9%)
Two	106	(42.1%)
Three and above	38	(15.0%)
Total	252	(100%)

Table 5 Number of baby devices used

Device used	Total respondents	
One	91	(36.1%)
Two	103	(40.7%)
Three and above	58	(23.2%)
Total	252	(100%)

For functions and features, only 163 (64%) respondents agreed that the inverted U-shape cotton fabric backrest provided good protection for the baby's back. Other features such as stoppers, easy assembly and disassembly, and removable and washable accessories seemed to be a must, as indicated by more than 90% of the respondents. When it came to entertainment, 71% of the respondents agreed that entertainment was one of the main considerations on a device.

The ability to sway and rock in multiple degrees and directions (93.7%), and adequate space to accommodate the baby (88.5%) were not the main concerns of most respondents (Table 6). Regarding the material used to make baby devices, more than 90% of the respondents agreed that characteristics such as biodegradable materials, good ventilation, hypoallergenic, shock absorbance, and durability are all necessary features to ensure the baby's comfort and safety. In the personal preference and design suggestion section, 80 (31.8%) respondents picked the shape of a cute bird because it carried an auspicious and harmonious meaning. Although 32.9% of the respondents selected 'others' as an option, they did not specify the preferred symbol, icon, or animal. Hence, the researchers decided to take the 2nd highest-ranking element as the key element (Table 7).

Table 6 Function and Features of the baby device

Questions	Agree / Very much agree		Disagree / Strongly disagree	
The inverted U-shaped cotton fabric backrest provides good protection to the baby's back.	163	(64.7%)	83	(32.9%)
The stopper's function is the main reason for selecting a baby rocker	238	(94.4%)	-	
Easy folding or disassembling functions is the main consideration	245	(97.2%)	-	

Questions	Agree / Very much agree	Disagree / Strongly disagree
It is important that the accessories used in the device can be removed and washed easily.	251 (99.6%)	-
The entertainment functions are the main consideration.	179 (71.0%)	-
Baby rocker can be swayed and rocked in any degree and direction.	-	236 (93.7%)
It is more important to consider the space in which the baby’s daytime resting device can accommodate the baby than the weight it can withstand.	-	223 (88.5%)

Table 7 Personal preference and design suggestion

Devices with auspicious and harmonious meaning	Total respondents
Adorable bird	80 (31.8%)
Adorable little mammal	(20.8%)
Daytime scenery	(14.5%)
Others	(32.9%)
Total	252 (100%)

5. Discussion

The researchers intend to create an eco-friendly non-toxic baby resting device that caters to Malaysian parents’ ideologies and requirements regarding the functions and materials based on data collected from 252 respondents. The collected data was used as a reference for production and design work, to uphold the four key elements requested by respondents: the assembly process, stopper, good ventilation, and ideology.

a) Device assembly

The newly designed baby resting device will consist of a few half-joined portions that can be easily assembled and disassembled. Parents can assemble them into a complete and intact baby resting device in a few simple steps with simple tools that will be provided.

b) Stopper

A rectangular brick made out of the same material can be slotted-in at the base of the device to stop the device from rocking, effectively converting it into its stable configuration and giving it dual functions.

c) Ventilation issue

After repeated measurements on two materials, a corrugated board will be used as the main material to achieve the best ventilation effect. This has the benefit of reducing the chances of allergic reactions due to the hypoallergenic nature of the corrugated board.

d) Ideology

The researcher intends to use the dove as the symbolic and model reference for this study to convey auspicious meanings such as blessings and harmony.

5.1 Design Progress of the Device’s Dove Structure

The structure and shape were created with a rotated “C” shape seating cushion. Based on the photograph of a dove, the bottom part of the drawing was modified into a curve, creating a final outer contour that looks like a dove (Figure 10, step 1).

a) Prototype making

The researchers synthesized all results and outcomes to make a prototype of the baby resting device that mimicked the shape of a dove using the corrugated board. The researcher tested various origami techniques and found

a big disadvantage where all the flutes of the board were covered, thus reducing ventilation and preventing air circulation (Figure 10, step 2). To combat this problem, the corrugated boards were arranged in an upright manner where all the flutes were in a vertical position to increase good ventilation for babies to lay (Figure 10, step 3).

b) Size of the device

To accommodate a baby of up to 10 months old, the new baby resting device for this research study was made to be larger than ordinary devices with measurements of 100 cm length, 50 cm width, and 46 cm height (Figure 10, step 4).

c) Stopper

A brick shape stopper was created with the same material to slot into the hole under the device to convert to its stable configuration (Figure 10, step 5). The device can then be raised at one end to ensure the baby's head is higher than the feet when lying inside the device (Figure 10, step 6).

d) Easy assembly and disassembly function

The entire device comes in three half-joined portions to facilitate easy self-assembly and disassembly. The middle frame including the structure of the dove's head and the tail is the main support for the baby's body weight. The left and right sides are the auxiliary frames that provide a larger resting space for the baby to lie flat and flip without any obstruction when combined with the middle frame. The outermost prevention frames are fences to prevent the baby from accidentally turning over or falling out of the device when sleeping (Figure 10, step 7). Two wooden bars are applied as the main bonding tool to maintain balance and hold its weight. In three simple steps, parents can connect all portions by slotting in the wooden bars that have screws to lock them together from the other side (Figure 10, step 8). A removable small sleeping mattress filled with cotton is used to provide a comfortable base with good ventilation and to facilitate easy cleaning (Figure 10, step 9).

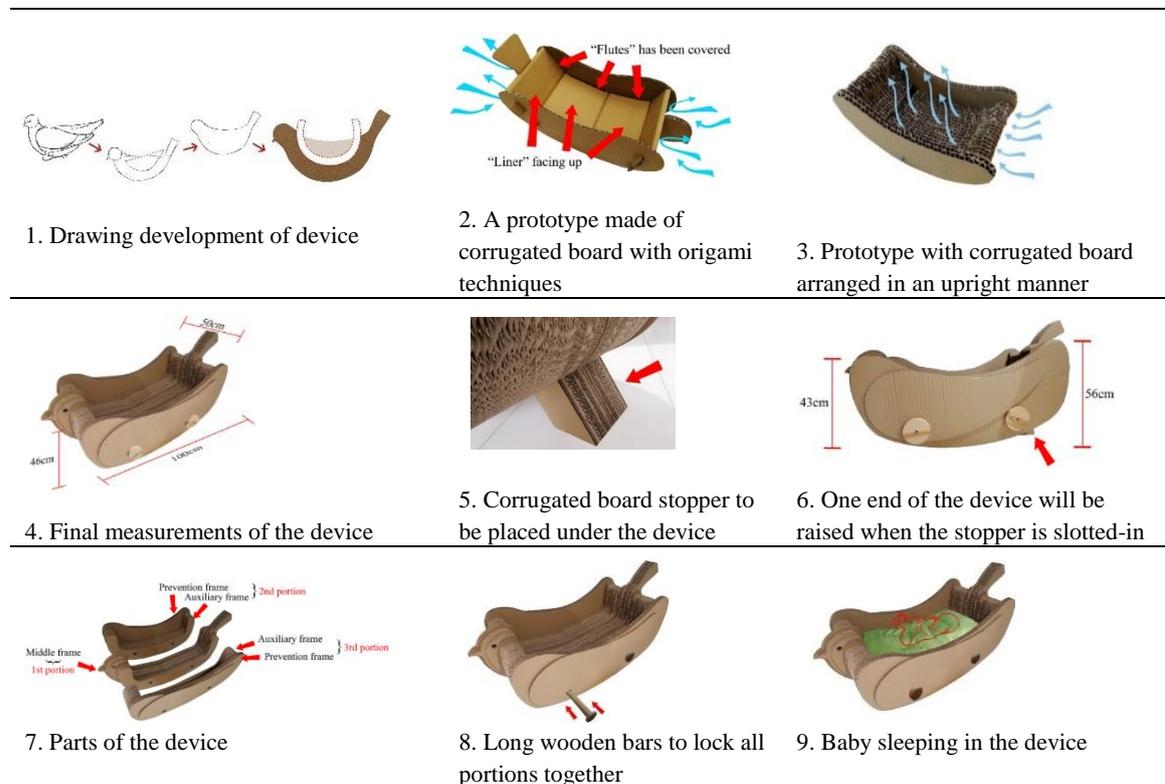


Figure 10 Steps 1 to 9 are arranged from left to right in three rows accordingly

6. Conclusion

Based on the survey, Malaysian parents have started paying more attention to materials used in baby devices and prefer baby devices that do not cause any harm or danger to their infant's health. Besides, due to the ideology on newborn babies, most parents are still prejudiced against using rectangular baby boxes.

After experimenting with the two suggested materials, a corrugated board was used to create the baby resting device through this research study due to its superior ventilation ability and because it is manufactured from recyclable materials that are harmless to babies and the environment. The prototype is also made in the shape of a dove according to the preferred design choice, to relieve concerns and resistance to baby devices made of boxy shapes.

After combining all data and results from the questionnaire surveys and experiments, guidelines and references for the design of the new baby resting device were detailed. As a result, an eco-friendly and multi-functional baby resting device was made with the corrugated board which consisted of the following advantages:

- a) A biodegradable non-toxic material that is recyclable, to help to reduce landfill problems when the device is no longer in use.
- b) Better ventilation capability through the flutes of corrugated boards.
- c) Divided into three half-joined portions for easy re-assembly into a complete and intact baby device with three simple steps.
- d) With an accessory-stopper to change the device from rocking configuration to non-rocking configuration.
- e) A small removable sleeping mattress to enhance the comfortability and ease of cleaning.

The prototype is made on a relatively large scale to ensure it is solid, stable, and can carry heavy weights; however, it may cause inconvenience for parents to carry it around. If the design is slated for mass production, researchers may consider reducing the size to enhance convenience.

The creation of this research study can be extended to provide hotels a possible additional facility for guests with newborn babies, to reduce the hassle of carrying a cumbersome baby device when traveling, while improving the quality and hygiene of the guests in the hotel.

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