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Design of Motor Development Stimulation Mattress for Low-Birth-Weight Babies

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ABSTRACT
A mattress is one of the tools used to stimulate a baby's motor development. However, the mattresses currently on the market cannot stimulate a baby's movement, which emphasises the ability to control the head or neck stability and maintain a stable body. Based on these problems, a mattress aid was developed to improve the movement ability of babies with low birth weight (LBW) and facilitate the components of LBW development in the first six months. Objective: produce tool stimulation motion (prototype), namely a stimulation mat for stimulating the growth of baby motor skills LBW. The method used in making a stimulation mattress prototype is divided into five stages: preparation, design, expert validation, tool creation and testing. The prototype produced is a stimulation mattress with a wavy design to make it easier for babies to breathe when lying on their stomachs or prevent suffocation (because the nostrils are closed). The front of the mattress is slightly high to facilitate the baby lifting his head when lying on his stomach. The test results on LBW showed that the baby could easily roll over because the mattress position was down and bumpy. Conclusion: The undulating position of the mattress stimulates the baby's ability to control the head and, at the same time, can facilitate the baby's ability to roll over.
Keywords: LBW, Mattress, Motor development, Stimulation.

ABSTRAK
Matras merupakan salah satu yang alat yang digunakan untuk menstimulasi perkembangan motoric bayi, namun matras yang ada di pasaran saat ini belum dapat memfasilitasi stimulasi pergerakan bayi yang menekankan pada kemampuan kontrol kepala atau stabilitas leher dan kemampuan kontrol badan yang stabil. Berdasarkan permasalahan tersebut, dilakukan pengembangan alat bantu matras yang dapat meningkatkan kemampuan gerak bayi berat badan lahir rendah (BBLR) dan memfasilitasi komponen-komponen perkembangan BBLR pada 6 bulan pertama. Tujuan: menghasilkan alat stimulasi gerak (*prototype*) yaitu matras stimulasi untuk menstimulasi perkembangan motorik bayi BBLR. Metode yang digunakan dalam membuat prototype matras stimulasi terbagi menjadi 5 tahap: yaitu tahap persiapan,

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perancangan, validasi pakar, pembuatan dan pengujian alat. Prototype yang dihasilkan adalah matras stimulasi dengan disain bergelombang untuk memudahkan bayi bernapas saat tengkurap atau mencegah *suffocation* (karena lubang hidung tertutup). Bagian depan matras agak tinggi untuk memfasilitasi bayi mengangkat kepala saat tengkurap. Hasil pengujian pada BBLR memperlihatkan bayi dapat dengan mudah berguling karena posisi matras yang menurun dan bergelombang. Kesimpulan: Posisi matras yang bergelombang menstimulasi kemampuan bayi dalam mengontrol kepala dan pada saat yang bersamaan dapat memfasilitasi kemampuan bayi untuk berguling.
Kata Kunci: BBLR, Matras, Perkembangan motorik, Stimulasi.

INTRODUCTION

Low birth weight (LBW) predicts prenatal mortality and morbidity and indicates nutritional adequacy during intrauterine. Babies with LBW are characterized by a birth weight of less than 2500 grams. According to the 2018 Indonesian Basic Health Research (Riskesdas) results, the prevalence of LBW in Indonesia is 6.2%, a slight decrease compared to the previous Riskesdas results (Indonesian Ministry of Health, 2019). Babies with LBW have complex problems. Health problems that occur can have an impact on the growth and development of the baby. In the first five years of life, LBW babies have a greater risk of experiencing developmental disorders, one of which is gross motor or movement disorders (Baysoy et al., 2021). Findings from several studies identified a significant relationship (p-value = 0.000) between birth weight and toddlers' motor development (Khayati and Sundari, 2019).

Motor development is essential in the growth and development of children's movement abilities. Gross motor skills are a part of children's lives and are related to their body movements and positions. According to research conducted by Maryuni (2016), it was reported that children born with LBW had a 5.20 times higher risk of experiencing abnormal development compared to children born with normal weight. Other studies report that a history of low birth weight (LBW) babies is associated with lower levels of physical activity in the future. Physical activity can be seen in preschool children's motor skills and cognitive development (Aoyama et al., 2023; Zeng et al., 2017). According to Upadhyay et al., 2021, in their research in Haryana, northern India, it was found that children born with a history of LBW had lower abilities compared to children born with normal weight. Children who experience motor development problems at an early age tend to have low levels of sports participation as teenagers, which can be predicted as early physical activity (Aoyama et al., 2023).

Motor development indicates a child's health in the early stages of life, and

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development determines children's psychological and social development. The motor development of LBW babies needs serious attention to ensure general development so that the child's future improves. Research conducted in Surabaya on 81 children aged < 2 years with a history of LBW reported that 61.7% of children experienced acceptable motor delays and 85.2% experienced gross motor delays. Development was dominated by delays measured using four domains (personal-social (59.3%), fine motor skills (61.7%), language (66.7%), and gross motor skills (85.2%). (Abidanovanty, Suryawan and Hendarto, 2023) . The development of the main movements is very important. The most important thing for a baby is from one month to six months. The birth of an LBW baby impacts the baby's gross motor development. Research conducted in Brazil in 2020 on 98 babies with a history of LBW showed that 45% of the children were suspected of having abnormal motor behaviour, especially in babies aged 9 and 12 months (de Godoy et al., 2021).

An essential developmental component in the first six months of age is increasing visual and functional hand and arm movement abilities, and internal arm and leg coordination help stabilize body control abilities (de Godoy et al., 2021). The components of this development will be beneficial in movement functional rollover from baby LBW as ability-specific. Lack of ability of LBW babies to maintain head control and stability neck, especially when the baby starts learning to lie on his stomach, can cause the baby's airway to close because the baby is unable to lift his head. This can cause it to happen suffocation in baby LBW (Upadhyay et al., 2021). Currently, it is a tool to stimulate the development of babies' movement abilities LBW for six months old. Firstly, few available, primarily developmental stimulation tools, emphasise head or neck stability and stable body control. The development stimulation tools currently available are more specifically for babies with normal birth weight.

Based on the problems above, technological innovation is needed for assistive devices that can improve LBW babies' movement ability and facilitate baby LBW's development at six months. Objective general: Produce tool stimulation motion that is a modified mattress for stimulating the development motion of baby LBW

METHOD

This research has received a health research ethics certificate with number No. KEPK-PKJ3/ 061 /V II I/2023. The steps in carrying out the work are as described in the

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research methodology. A research methodology is a step or sequence researchers use to conduct research.

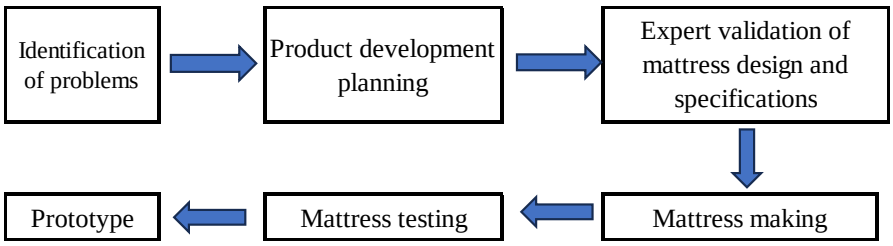

Figure 1. Research Flow Chart

Stage 1. Problem Identification

Gross motor development is the most important thing for a baby from one month to age six months because These developments are several important components of movement development and support further development; the components in question are head control or neck stability (Wahyuni et al., 2022). One of the impacts of LBW birth is the risk of physical developmental disorders or motion. The inability of LBW babies to maintain head control and neck stability, especially when they learn to lie on their stomachs, can obstruct breathing due to the inability to lift their heads. The failure to control the head in LBW babies also affects the swallowing process during breastfeeding and risks aspiration (Dumuids-Vernet et al., 2022). Studies have shown the positive effects of stimulating neck and trunk stabilization exercises in static and dynamic balance. There is a lot of balance between sitting and standing postures supported by stable control postures, and matter is obtained from the newborn until six months first (Hilaire et al., 2021). One way to stimulate the movement of LBW babies is by using tool help. Wrong One tool that helps babies usually use to practice movement is a mat. Currently, mattresses on the market cannot help LBW babies practice movement and head control, so an innovative mattress aid is needed to facilitate baby movement.

Stage 2. Product Development Planning

Stage planning is done to design a mattress that can stimulate the baby's movement and be adapted to the development of LBW babies, such as head control and stabilization abilities, poor neck, and possibly unstable arm and leg coordination. Currently, the mattresses on the market are flat, making it difficult for babies to roll over, and when lying on their stomachs, LBW babies' noses can be blocked. In this

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research, mattress modifications were carried out by designing a wavy mattress to make it easier for babies to breathe when lying on their stomachs or prevent suffocation.

Stage 3. Expert Validation Stage

A stage validation expert/resource person was done to get input related to the design from modified mattresses and materials used. Based on input from experts, several changes/revisions were made to designs or materials according to expert input.

Stage 4. Tool Making Stage

The tool-making stage is carried out based on input from experts regarding the use of materials and tool design.

Stage 5. Tool Testing Stage

The testing stage for modified mattresses to stimulate the movement of LBW babies was carried out on several LBW babies aged 3 to 6 months (corrected age, who came to the clinic. The selected LBW criteria were LBW babies with stable conditions, no respiratory problems, no problems fulfilling nutritional needs (can breastfeed or drink milk), no congenital abnormalities, and parental approval. Mattresses can be used until the baby is 12 months old. Testing tools were done by comparing stimulation movement babies on the mattress familiar on the market with mattress LBW modification, aiming to determine the modified mattress's effectiveness. Baby movement measurements were carried out using the Hammersmith Infant Neurological Examination (HINE).

RESULTS AND DISCUSSION

The research was carried out in five stages: preparation, design, expert validation, tool making, and tool testing. After going through the preparation process, the next step is the planning stage for tool design and expert validation.

Tool Design Stage and Expert Validation for Tool Design

Modified mattresses are made wavy to make it easier for babies to breathe when lying on their stomachs or to prevent suffocation. The front of the mattress is slightly high to facilitate the baby lifting his head when lying on his stomach, as seen in Figure 1 below.

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Figure 2. Modified Mattress Design

The modified mattress functions as a simulation tool that can stimulate the ability of LBW babies to control their heads and facilitate the baby's ability to roll over. The mattress design is wavy and sloped. The undulating position of the mattress stimulates the baby's ability to control the head, and the down position facilitates the baby's ability to roll over.

A baby needs neck stability skills in the early stages of development. However, his neck and head muscles are not yet strong enough to hold his head. At two months old, the baby started to learn to lift the head when positioned on the stomach. Around 3 – 4 months, the muscles begin to strengthen; this stage also contributes to developing neck and head stability. At age two, up to 4 months is the right time to provide stimulation to improve the strength of the baby's neck and head. Cognitive, social, and motor skills can include strengthening muscles, neck, and shoulder, as well as increased posture, coordination, and visual ability (Linsell et al., 2017). The inability of LBW babies to control their head and neck properly, especially when learning to lie on their stomach, can cause airway obstruction because the baby cannot lift their head correctly. This can cause LBW babies to have difficulty breathing (Molad et al., 2023).

Tool Making Stage:

Rebonded foam (rigid) is covered with super yellow foam (soft) to maintain the baby's comfort and safety when rolling over. This material is also economical and easy to obtain (figure 2).

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Figure 2. Stages of making a stimulator mattress from rebonded foam

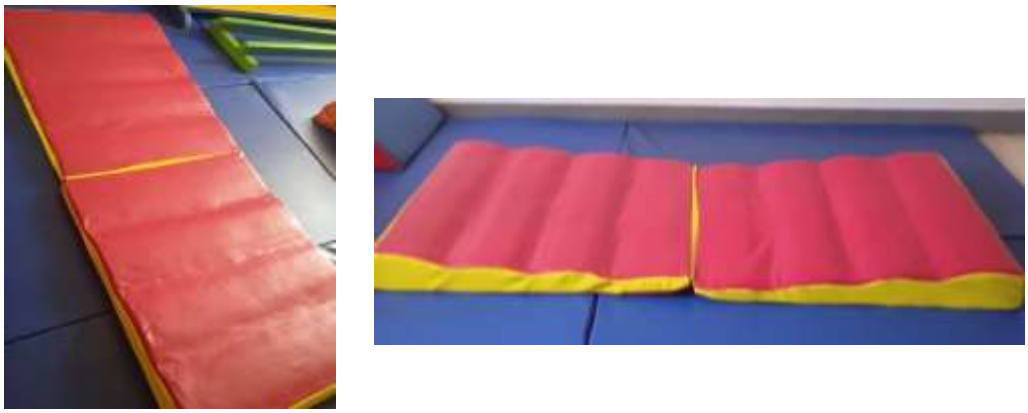

Figure 3. Prototype Tool: Modified mat made wavy

Tool Testing Stage

Testing was carried out on two babies with a history of LBW aged six months. The test results showed the baby could easily roll over because the mattress was downward and wavy. The undulating position of the mattress stimulates the baby's ability to control the head and facilitates the baby's ability to roll over. Meanwhile, when using a regular mattress, babies have difficulty rolling over.

Figure 4. Testing of the LBW Stimulator Mattress on babies

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CONCLUSION

Modified mattresses to stimulate the motor development of LBW babies stimulate the baby's ability to control the head and can facilitate the baby's ability to roll over. The wavy mattress prevents the baby's nose from being covered when lying on his stomach. The wavy bed also helps the baby change position or turn over more easily. The downward position of the mattress is designed to make it easier for the baby to roll over.

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