Playing in Upright Position Affect Gross Motor and Language Development of Orphan Infants

การเล่นในท่าแนวตั้งส่งผลต่อพัฒนาการด้านการเคลื่อนไหวกล้ามเนื้อมัดใหญ่และด้านภาษาของทารกในสถานสงเคราะห์

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ABSTRACT

It has been found that institutionalized infants aged 6 to 12 months displayed reduced variability of gross motor development via series assessments (Prommin et al., 2017; 2018). We hypothesized that the institutionalized infants would have less opportunity to play in upright position such as sitting or standing (Siritaratiwat et al., 2011). Increasing an opportunity for being upright would help to stimulate variability of gross motor and other development. Therefore, the current study aimed to explore the intra-variability of gross motor and language development in orphaned infants after receiving a 3-month playing in upright position program. Thirteen healthy infants aged from 6 to 8 months, from a children's home, were recruited. The Alberta Infants Motor Scale (AIMS) and Communication and Symbolic Behavior Scales Development Profile Infant/Toddler Checklist (CSBS DP) were used to assess the intra-variability of gross motor and language development each month for 3 months. Mostly, orphan infants in this current study showed wide mean value of the variability of gross motor (42±16.5 percentiles) and language development (36±15.8 percentiles). Infants from maternal substance abuse and mental illness during pregnancy displayed little variability of gross motor and language percentile, which was lower than the 50th percentile. The study concludes that play in an upright position, including free play activity with variation movement and listen to story book in sitting position improve an intra-variability of gross motor and language development in orphan infants.

บทคัดย่อ

การประเมินพัฒนาการระยะยาวในทารกสถานสงเคราะห์พบว่าเด็กอายุ 6-12 เดือนมีความแปรปรวนภายในบุคคลของพัฒนาการกล้ามเนื้อมัดใหญ่น้อย มีข้อสันนิษฐานว่าอาจเป็นเพราะทารกช่วงอายุนี้มีโอกาสได้เล่นอยู่ในท่านั่งและท่ายืนน้อย การเพิ่มโอกาสให้อยู่ในท่าทางดังกล่าวอาจจะช่วยกระตุ้นความแปรปรวนภายในของพัฒนาการด้านการเคลื่อนไหวและด้านอื่นได้ การศึกษานี้จึงมีวัตถุประสงค์เพื่อศึกษาผลของการเล่นในท่าแนวตั้งเป็นเวลา 3 เดือนต่อความแปรปรวนภายในบุคคลของพัฒนาการด้านการเคลื่อนไหวกล้ามเนื้อมัดใหญ่และด้านภาษาของทารกในสถานสงเคราะห์ อาสาสมัครทารกสุขภาพดีจำนวน 13 คน อายุระหว่าง 6 ถึง 8 เดือนจากสถานสงเคราะห์เด็กกำพร้า เข้าร่วมการวิจัย ผู้วิจัยประเมินพัฒนาการด้านการเคลื่อนไหวโดยใช้แบบประเมิน Alberta Infant Motor Scale (AIMS) และด้านภาษาโดยใช้แบบประเมิน Communication and Symbolic Behavior Scales Development Profile Infant/Toddler Checklist (CSBS DP) ก่อนและหลังการกระตุ้นในแต่ละเดือนเป็นเวลา 3 เดือน ผลการศึกษาพบว่า ทารกในสถานสงเคราะห์ที่อายุ 6-12 เดือน มีค่าเฉลี่ยความแปรปรวนกว้างของพัฒนาการด้านการเคลื่อนไหวของกล้ามเนื้อมัดใหญ่ (42±16.5 เปอร์เซ็นต์ไทล์) และด้านภาษา (36±15.8 เปอร์เซ็นต์ไทล์) ทารกที่มีมารดามีภาวะจิตประสาทและใช้สารเสพติดขณะตั้งครรภ์แสดงความแปรปรวนของพัฒนาการด้านการเคลื่อนไหวของกล้ามเนื้อมัดใหญ่และด้านภาษาแคบและต่ำกว่า 50 เปอร์เซ็นต์ไทล์ การศึกษาครั้งนี้สรุปว่าการเล่นในท่าแนวตั้งโดยใช้ของเล่นสร้างแรงจูงใจให้เด็กมีการทรงตัว เล่นอย่างอิสระโดยมีการเคลื่อนไหวที่หลากหลาย และการอ่านนิทานในท่านั่งปรับปรุงความแปรปรวนภายในบุคคลของพัฒนาการด้านการเคลื่อนไหวกล้ามเนื้อมัดใหญ่และด้านภาษาให้ดีขึ้น

Keywords: Playing in upright position, Gross motor development, Language development
คำสำคัญ: การเล่นในท่าแนวตั้ง พัฒนาการด้านการเคลื่อนไหวกล้ามเนื้อมัดใหญ่ พัฒนาการด้านภาษา

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Introduction

An orphanage is an institution or children's home which aims to care for abandoned children and children whose parents cannot raise them appropriately (Freundlich et al., 2005; Browne, 2009). The environment in which infants live may be clean, but caregivers can only provide basic care for institutionalized infants. Because of a heavy workload, less organized activities that interlace planned caregiver-child interactions than routine caregiving was seen (Groark et al., 2011). Research studies on the development of children in institutions have reported that orphan infants tend to have developmental delays and health problems (Sweeney, 1995; Miller and Hendrie, 2000; Rettig and McCarthy-Rittig, 2006; Cohen et al., 2008; Hearst et al., 2014). Institutionalized infants who lacked suitable stimulation tend to have increased risk of physical and behavioral-emotional problems.

Many studies have reported that the development of institutionalized and adopted young children aged 0-6 years showed developmental scores lower than those of non-institutionalized children. Previous evidence reports that 69% of adopted children from an orphanage showed delayed development during their first year of life (Miller and Hendrie., 2000; Rettig and McCarthy-Rittig, 2006). The study of Worku et al. (2018) showed that young children living in Ethiopian children's villages had delayed gross motor and language development compared with family-reared children. However, most studies reported cross-sectional findings. Limited evidence regarding longitudinal assessments of institutionalized infants' development were still presented.

Series assessments are recommended and used to display specific outcomes of intra-individual variability of development in early childhood (Darrah et al., 1998; Darrah et al., 2003; Darrah et al., 2009). Previous studies have found that gross motor development among healthy infants assessed by the Alberta Infant Motor Scale (AIMS) shows a variability of gross motor development aged from 1 to 13 months (Darrah et al., 1998). The concept of variability of gross motor development assumes that while healthy infants achieved or learned new skills, their percentiles rank were rising (Thelen, 1979; Newell et al., 1993). In contrast, high-risk infants with neurological dysfunction have been linked with reduced variability in early development (Newell and Corcos, 1993; Newell and Slifkin, 1998). According to the motor development theory of dynamic systems, the role of variability in early development behaviors are the result of interacting organization of nervous system, body subsystems, environment and experience of movements (Kamm et al., 1990; Thelen et al., 2005). Researchers have also explained that learning with environmental exploring and experiencing of movements related to synaptic changes of motor cortex (Xu et al. 2009, Wang et al. 2011, Fu et al. 2012), suggesting that it may be a general mechanism for control motor variability as a function of learning (Dhawale et al., 2017). Recently, previous studies. found that institutionalized infants aged 6 to 12 months displayed reduced variability of gross motor development (Prommin et al., 2017; 2018). Additionally, the gross motor percentiles of orphan infants were below the 50th percentiles. The decreased variability may be due to the biological risks of infants or the limited circumstances in the orphanage (Prommin et al., 2017; 2018). Possibly,

institutionalized infants have less opportunity to be held in an upright position, such as supported sitting or standing (Siritaratiwat and Saetan, 2011). Being in upright position either in sitting or standing is an appropriate posture to perform different activities conducive to learning and optimizing of performance of motor exploration which is beneficial for variability even in well-learned skills (Dhawale et al., 2017).

Previous evidence had modified the structure of the orphanage in order to adjust the child to caregiver ratio, educated caregivers and increased child and caregiver interaction (Muhamedrahimov et al., 2004; Groark et al., 2005; Sparling et al., 2005; Johnson et al., 2010; Koch et al., 2017). Previous studies investigated the effect of a 3-phase intervention program of structured play. In 2002, Taneja et al. developed 'structured 90-minute active play' for children's motor, language, and cognitive development from age 6 months to 2.5 years, and placed it into the daily routine of an orphanage. Later in 2004, this program was applied to another orphanage by Taneja and colleagues. Finally, it had been validated in healthy institutionalized children, and the results had been followed up over 1 year (Taneja et al., 2005). Results showed that this project could significantly increase young children's development scores after 3 months of intervention (Taneja et al., 2002; 2004; 2005). In addition, a previous study investigating the effects of a massage and passive movement program suggested that active play in an upright position should be promoted in orphaned infants to improve infants' gross motor development for those aged more than 5 months (Siritaratiwat and Saetan, 2011). Currently, limited research data regarding the effect of an intervention program on the intra-individual variability of gross motor and language development in orphan infants were presented. This study then modified ' a 45-minute developmental stimulation activity' that is was simple, easy and suitable for healthy infants in the context of the orphanage was investigated in this study. Therefore, the hypothesis was healthy orphan infants who had the opportunity to being in upright position and free play activity with variation of movement such as exploring objects while sitting or standing, listening to storybook and having the opportunity to be exposed to the outside environment could display different intra-variability in their development. These stimulations leading to raising the degree of variability of early development were assumed.

Objective of the study

The aim of this study was to investigate the effects of playing in upright position on the intra-individual variability of gross motor and language development in institutionalized infants aged 6-12 months.

Methodology

Design

This quasi-experimental study took place in a Children' s home in Khon Kaen Province. The guardian of the institution was asked to sign an informed consent and allowed orphaned infants and caregivers to participate in the study. The research protocol was approved by the Khon Kaen University Ethics Committee for Human Research (HE 622234).

Participants

Healthy full-term institutionalized infants with a gestation age of 37-42 weeks were recruited following inclusive criteria: 1) aged between 6 and 8 months 2) birth weight ≥ 2,500 grams 3) Apgar score at 5 minutes between 8-10 marks and 4) no opportunity to receive breastmilk feeding.

Procedures

Data collection occurred at the orphanage. The characteristic data of institutionalized infants were recorded from their history files, including sex, birth weight, birth height, head circumference, Apgar score at 5 minutes, gestational age, age at admission in days and causes of child's admission to the institutional setting. All infants aged between 6 and 8 months were screened according to inclusion criteria.

Gross motor development of each infant was evaluated by a physical therapist using the AIMS Thai version (Aimsamrarn et al., 2019). The early communication behavioral development of each infant was observed by a familiar caregiver using the Thai adaptation of the CSBS DP prior to starting of the stimulation program. The gross motor movement and language were re-assessed monthly for 3 months. The assessors who performed the AIMS and the CSBS DP were blinded from the score summation.

Measurement tools

Alberta Infant Motor Scale (AIMS)

The AIMS is a valid and reliable screening tool used to observe gross motor movement in infants aged 0-18 months or until walking independently (Piper and Darrah, 1994). The AIMS consist of 58 items grouped into four main positions, including 21 prone items, 9 supine items, 12 sitting items and 16 standing items. This observational assessment requires minimal baby touching, and takes 20 minutes to administer. A toy may be used to motivate movement. If the baby is not ready for the assessment or has other factors interfering with the test, the assessor can perform the test again within 5 days after the first assessment (Piper and Darrah, 1994). Scoring the gross motor development gives a point for each observed position. The score for each main position is summed from the observed items within the window of movement and the previous items credited. Finally, the summed score is plotted on the graph of the percentiles from the Thai samples (Tupsila et al., 2020). The examiner in the current study is a physical therapist with 4 year' experience in pediatric physical therapy. The intra-rater reliability of the tester in this study using video recordings of 12 healthy infants aged 6 to 12 months with 1-month interval was indicated to be at 0.99 (95%CI = 0.98-0.99) by the $ICC_{(3,1)}$.

Communication Symbolic Behavior Scales-Developmental Profile Infant-Toddler Checklist (CSBS-DP).

The CSBS-DP is a descriptive ordinal scale developed to identify early communication, language and symbolic behavior function of infants and toddlers aged 6-24 months (Wetherby and Prizant, 1993). The CSBS-DP is used for both parent reporting and face-to-face assessment of the child. The CSBS-DP can be performed by the caregivers who are familiar with infants in daily living. The CSBS-DP comprises 24 items classified into 3 composites for 57 marks including social, speech and symbolic. The scoring of

each item ranged from 0 point for a checked Not Yet item, 1 point for a Sometimes item and 2 points for an Often item. Items describing a series of numbers are scored as 0 points for a None item and 1-4 points for items containing numbered choices. The obtained total scores are compared to the standard norm-referenced percentiles (Wetherby and Prizant, 2002).

Intervention

Each infant was given the stimulation program for 45 minutes, 3 days per week for 12 weeks by a physical therapist who have at least 4 year' experience in pediatric physical therapy. This 45-minute stimulation program consists of 30-minute upright play activities and a 15-minute free and various movement activity. The criteria for upright play in sitting were that the infant was able to sit with support and was able to hold its head at midline (Karasik et al., 2015), and stand with support by extending their knee joints and having weight-bearing on both feet (Piper and Darrah, 1994). The activities without support were provided when infant was able to independently sit (Kimura-ohba et al., 2011) and pull to a stand (MGRS, 2006). Figure 1 shows the procedures of the intervention.

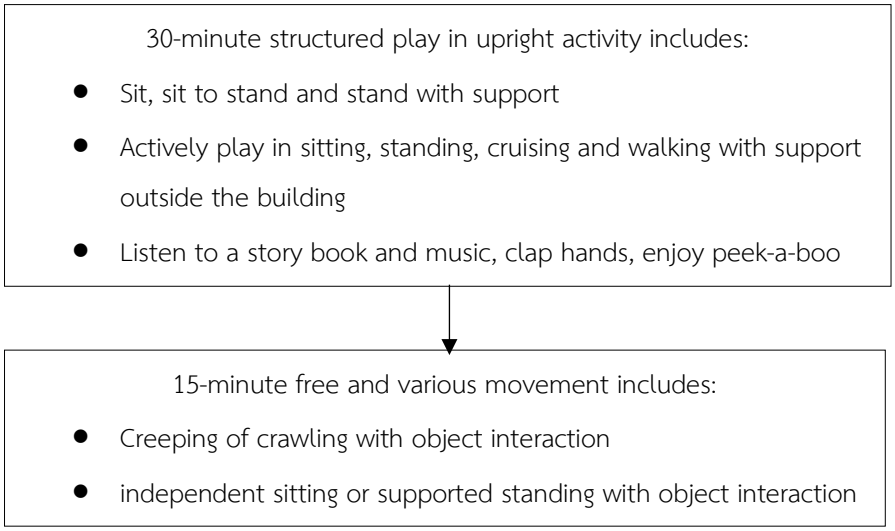

Figure 1 Flowchart of infants' play activity

On the remaining days of the week, all infants received routine care from experienced caregivers at the orphanage. The routine care consisted of a 5-to-10-minute massage and infants had an opportunity to play independently outside their cots for 90 minutes/time, 1-2 times/day.

Data analysis

Data analyses were performed using SPSS version 17.0 (licensed by Khon Kaen University, Khon Kaen, Thailand). The demographic data was reported with mean (SD). The intra-variability of the AIMS percentiles and the CSBS DP percentiles were described using descriptive statistics and box plots. The

mean (SD) of range of the AIMS and the CSBS DP percentile and 95% confidence intervals (CI) were reported for the variability of the AIMS and CSBS DP.

Results

Thirteen healthy full-term institutionalized infants (7 boys and 6 girls) were recruited. Nine of them were enrolled at 6 months of age, 2 infants at 7 months, and the remaining 2 infants at 8 months. One infant was born from an adolescent pregnancy, 4 infants from maternal mental illness, 3 infants from parental substance abuse and 5 infants from inappropriate care from family. Table 1 shows the characteristics data of all infants.

The mean (SD) of gross motor development percentile range for all infants was 42 (16.5), 95%CI = 32-52. Eleven of 13 infants displayed increasing percentiles of gross motor development. Five of 13 infants displayed wide intra-variability of gross motor percentiles of value more than the 50th percentile. Six of 13 infants showed narrow variability; however, the gross motor development was more than the 50th percentile. Figure 2 shows the box plot of gross motor percentiles variability of 13 institutionalized infants.

The mean (SD) of language percentile range of all infants was 36 (15.8), 95%CI = 26-45. Seven of 13 infants displayed rising percentiles of language development. Five of 13 infants had large variability of language percentiles (26-54%), and 8 infants had the highest value more than the 50th percentile. However, only 2 of 13 infants had narrow variability of language percentiles and results were less than 50th percentiles. Figure 3 displays the box plot of language percentiles of 13 infants. Five of these infants show the maximal percentiles lower than the 50th percentiles.

Table 1 Characteristics of participants (n=13)

Characteristics of infants	Mean (SD)	Min-Max
Birth weight (grams)	2677.7 (132)	2500-2880
Birth height (cm.)	48.9 (3.5)	42-54
Birth head circumference (cm.)	31.5 (1.5)	28-34
Gestational age (weeks)	38 (1)	37-40
Apgar score	9 (0.7)	8-10
Age at admission in the orphanage (days)	66 (39)	10-120

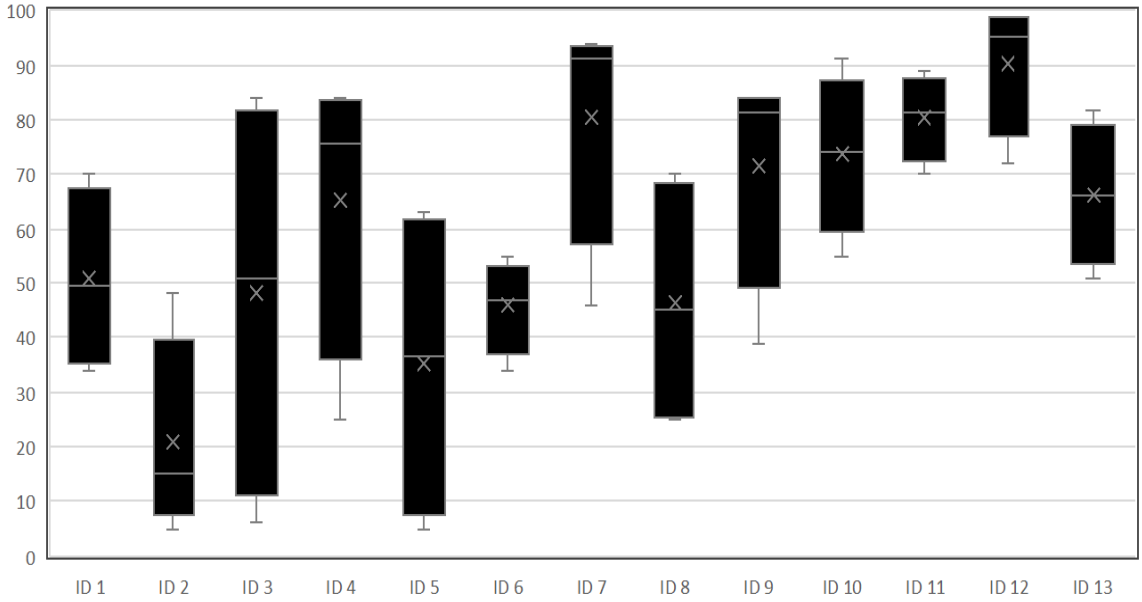

Figure 2 The box plot of intra-variability of gross motor development percentiles

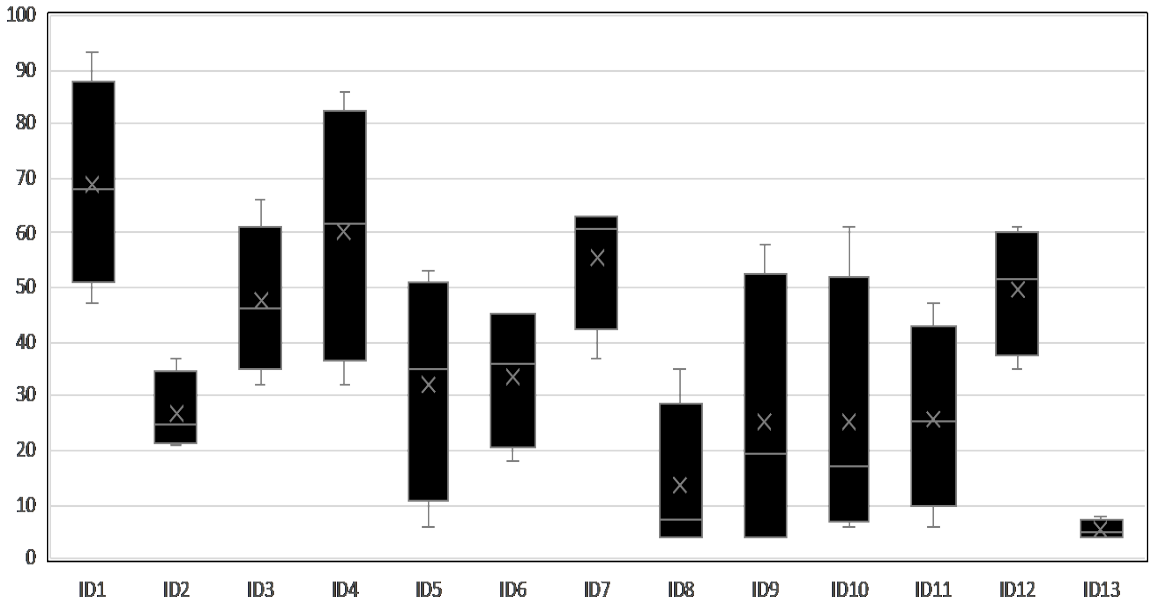

Figure 3 The box plot of intra-variability of language development percentiles

Discussion and conclusions

The present quasi-experimental study demonstrated the effect of play in an upright position on intra-individual variability of gross motor and language development in institutionalized infants aged 6-12 months. According to the protocol, each child received thoroughly intervention with 36 playing sessions. Most

institutionalized infants in the current study showed wide variability and displayed increasing percentile scores of gross motor and language development. This is in line with the findings obtained by Taneja et al. (2002; 2004; 2005) conducted a program of structured play for 90 minutes/session, 72 play sessions can significantly increase young children's scores of developments. However, these previous evidences were cross sectional studies while this current study is a longitudinal study that healthy institutionalized infants were motivated by 45 minutes-structured play for 36 sessions. Receiving structured play in the upright position could increase proficiency of learning. All institutionalized infants in this study showed a range of gross motor percentile at 42 percentiles and that of language percentile at 36 percentiles. The result of this study was in line with previous studies of typically developing infants who had an absolute the change of percentile scores at least 40 percentiles during the longitudinal assessments (Darrah et al., 2003; 2009). The non-linear nature of the percentile's development suggests that motor learning emerges with an inconsistency, supporting a dynamic systems theory. The role of large variability in motor is attributed to biological factors, body subsystem, movement experiences and motor learning (Kamm et al., 1990; Thelen et al., 2005; Dhawale et al., 2017). Based on this theory, nerve, environmental factors and tasks are effective in foundation the developmental changes. As a result, not only heredity, but also environment play active roles in the growth process (Berk, 2006). Moreover, the nervous system can use the afferent information to produce behavior upon experience and selection of the motor behavior or motor learning in which the best situation for a large variability in motor movement (Hadders-Algra, 2010; 2018).

Previous studies applied different lengths of times and frequency of play. For example, healthy institutionalized infants gained a program of structured play for 90 minutes per session, 72 play sessions which promoted their development (Taneja et al., 2002; 2004; 2005). Moreover, previous studies have interventions for the modified structure of the orphanage and education for caregivers which benefited to physical growth and social-emotion development (Johnson et al., 2010; Koch et al., 2017; Sparling et al., 2005; Berument et al., 2011). However, these previous studies measured their outcome cross sectionally while this present study was a longitudinal study that healthy institutionalized infants were motivated by structured play for 36 sessions. Moreover, this study reflected the progression of the performance, such as the increased variability of gross motor and language development in each infant.

It was assumed that the 45-minute play in an upright position 3 times per week could not be adequately beneficial to the institutionalized infants aged 6-12 months with biological factors such as the children with parental substance abuse, maternal mental illness and behavioral-emotional problems while residing in the orphanage. This assumption could be supported by previous research that women with serious mental illness and substance abuse during pregnancy were likely to have associated behavioral changes in their neuroendocrine system. Pregnant mothers with higher levels of the maternal corticotrophin-released hormone more than in the no pregnant state. It could be a direct relationship between maternal and fetal cortisol levels (Gold & Marcus, 2008) and this might affect an infant's motor behavior while living in an orphanage environment. A review based on independent prospective studies

showed that if a mother is stressed while pregnant, her child is substantially more likely to have emotional or cognitive problems, including an increased risk of motor behavior, attentional deficit and language delay and, interestingly, the associations were independent of maternal postnatal depression and anxiety (Satyanarayana et al., 2018) Therefore, these infants living in the orphanage should have opportunity to receive socio-emotional interactions between caregivers and children in the context of smaller groups and this situation can improve child-caregiver relationships and children's development (The St. Peters- burg USA Orphanage Research Team 2008). Young children need to be cuddled, talked and sung by their caregivers. Failure to provide such warm caregiver-child interactions may result in language and motor behavior problems later in life.

This study had some limitations. Firstly, only one group of small sample size was recruited. Thus, further study should be conducted in both the control and the experimental groups, with a larger number of participants in order to achieve the power of the test at 80%. Secondly, biological factors, including those with maternal substance abuse and mental illness during pregnancy, behavioral-emotional and health problems while residing in the orphanage should be investigated. In addition, 45-minute structured play of with frequency more that 3 times a week could give the better effects for these orphaned infants.

In conclusion, upright play would be beneficial to healthy full-term institutionalized infants. This study suggested that an intervention program for institutionalized infants with biological factors, including maternal mental illness and substance abuse during pregnancy, should be considered in order to modify the environment of orphanages, along with education about the appropriate nurturing issues for institutionalized infants to caregivers. Care givers should be suggested about how to enrich environment, giving an opportunity for infant to be outside the building and giving developmental stimulations in the upright position such as play in sitting or cruising rather only being in prone position.

Acknowledgements

We were extremely grateful for the financial support from the Graduate School of Khon Kaen University and Faculty of Associated Medical Sciences, Khon Kaen University. We would also like to express my most sincere thanks to the director, staff, and caregivers of the Children's home for their willingness to participate in this study.

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