Early developmental milestones and age of independent walking in orphans compared with typical home-raised infants

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ARTICLE INFO

ABSTRACT

Aim: Early gross motor development is a major indicator of global milestones in the first year of life, affecting the walking ability of a child. There has been limited research reporting on early motor development and the age of independent walking of orphaned infants compared to typical home-raised infants. The purpose of this study was to compare the mean scores of early gross motor movement at 4, 6 and 8 months of age and at the age of walking attainment of typically raised infants and orphaned infants. In addition, we looked to compare the walking age between these same infants.
Materials and methods: This cross-sectional study recruited 59 typical home-raised infants and 62 orphans. Their gross motor development was assessed using the Alberta Infant Motor Scale (AIMS). The age of walking attainment was also prospectively monitored and ascertained. The Student's independent *t*-test was used to analyse the differences of the AIMS scores at 4, 6 and 8 months of age and at the age of independent walking between the two groups.
Results: The orphans showed significantly lower AIMS scores at 4, 6 and 8 months of age and the age of independent walking (*P*-value < 0.05). The orphan group had a 5-month older mean age of walking attainment (15.0 ± 4.2 months) compared with typical home-raised infants (9.9 ± 1.4 months).
Conclusion: Orphans have delays in early gross motor development and walk independently at an older age, compared with home-raised infants.

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1. Introduction

Development of gross motor ability in a typically developing child advances visibly during the first year of life. The gross motor accomplishments during this time are the abilities to sit, crawl, pull to stand and finally walk independently. The mean age of walking in healthy infants has been reported at approximately 12 months with an acceptable range of 8–18 months [1]. Research suggests that early gross motor milestones are critical gross motor development predictors of the age of walking [2]. Early movement patterns, such as rolling, crawling and sitting, are related to the independent walking age. The children who can perform these key milestones at an appropriate age walk earlier than those who cannot [2]. Storvold and colleagues also found that children who crawled on their hands and knees, started to walk without

support at 13.1 months, which was earlier than infants performing bottom shuffling, who walked at 14 months [3].

Having the opportunity to experience movement early is perceived to be necessary for a child's gross motor development. Previous studies have reported that infants who were placed in the prone position while awake had earlier attainment of prone-specific motor milestones [4], such as supported sitting, sitting alone, crawling and pulling to stand, than infants who were placed supine [5,6]. Furthermore, having the experience of an upright position at an early age can advance head control [7,8]. Lee and Galloway proposed that infant positioning, caregiver handling and caregiver–infant interactions were likely contributing factors of early gross motor milestones [7].

Being hindered by limited resources, such as an inappropriate child-to-caregiver ratio, orphaned infants have less opportunity to be carried, fewer caregiver–infant interactions and less free play outside. These children have different early life experiences and movement opportunities from those being raised by their family. Roeber and colleagues suggested that early life environmental deprivation could affect gross motor development in infants [9]. A child who was abandoned and raised with long periods of institutionalisation showed delayed balance

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and bilateral coordination compared with infants being raised with their birth family [9]. Moreover, infants involved with an urban child welfare system also showed lower mean scores for gross motor development than population norms [10]. In line with Hanson and co-workers [10], Siritaratiwat and Saetan reported that orphaned infants showed delays in sitting and standing development [11]. Compared with non-institutionalised infants, adopted infants from orphanages show delayed gross motor development and do not fully and easily remediate following a change to an enriched environment later in life [9]. Thus, orphaned infants show delayed walking ability, and their age of walking attainment may relate to early motor milestones while living in orphanages. Evidence regarding the early gross motor development of infants in orphanages is still limited, and there has been no report on the mean walking age of these infants. Therefore, the aim of this study was to determine the early motor development milestones using the Alberta Infant Motor Scale (AIMS) [12] and to compare the age of walking attainment between orphaned and home-raised infants.

2. Methods

2.1. Participants

Healthy, full-term, typical home-raised infants from the local community near Khon Kaen University, Khon Kaen Province were recruited. Healthy, full-term, orphaned infants were recruited from an orphanage in Khon Kaen Province. The number of participants was calculated from the pilot study using the means of the AIMS scores, at 4, 6 and 8 months of age and at the age of walking attainment, of 10 orphaned infants not included in the main study and the AIMS norm-referenced values [12] with the computer program G*power version 3.1.9.2 [13]. The power of the test was set at 0.80, and the significance level was lower than 0.05, resulting in 14 infants at age 4 months, 10 infants at age 6 months, 25 infants at age 8 months and 10 infants for walking age for each group of participants. The inclusion criteria for the typical home-raised infants were healthy, full-term infants born between 37 and 40 weeks [2,14], birth weight ≥ 2500 g [15] and no risk for and no diagnosis of delayed motor development. The orphaned participants were recruited if they had the same inclusion criteria as the typical home-raised group and had been placed in the children's home for a consecutive period of at least 3 months before participating in the study [16].

2.2. Study site and population

This study was conducted at the participants' homes and the orphanage. Typical home-raised babies came from their home-raised families and had their parents as the main caregivers. The participants' houses were shop houses or single-family homes with one or two storeys. The housing areas were suitable for childrearing. Most of the infants lived with their parents or relatives. Infants aged newborn to 12 months at the orphanage were raised on the second floor of a two-storey building. At the home, there were two to three caregivers per 20–25 infants. The infants were carried or touched during bathing and feeding. Most infants aged <1 year received touch massage for 5 min a day on weekdays. They had an opportunity to be out of the crib or play on the mat once or twice a day for 30–60 min per day. When infants were aged from 12 months to 2 years, they were moved to a new room where they met different and inconsistent caregivers who took care of them, and had a new environment, such as an area for free play, toys and cribs.

2.3. Measurement instrument

2.3.1. Alberta Infant Motor Scale (AIMS)
The AIMS is an observational assessment tool that examines gross motor movement in infants aged 0–18 months [12]. The AIMS consists of four main postures with 58 motor items, including 21 prone items,

9 supine items, 12 sitting items and 16 standing items. Infants are touched minimally during the assessment, and a toy may be used to motivate movement. If the baby does not cooperate or is not ready for the test, feels discomfort, has a fever or cries, the assessor can perform the assessment later, within 5 days of the first assessment [17].

Scoring the gross motor development is performed by giving a point for each main position as follows. Each observed item credited in a window is scored as 1 point, and "not observed" items are given 0 points. Every item that is lined below a window counts as the previous items credited. All observed items credited in the window and previous items credited for each main position are summarised. Total scores for all four postures, including prone, supine, sitting and standing are summarised as a gross motor developmental score. Finally, the gross motor developmental score is plotted on the percentile graph of normative reference. Delayed gross motor development is noted when the score is below the 10th percentile at 4 months and below the 5th percentile at other ages in months [18]. The assessor of this study performed the test on 10 orphaned infants who were not included in the main study, and these 10 infants were observed for their real time gross motor movement twice, using the AIMS, within a 7 day interval by the same assessor. Results showed good intra-rater reliability with Intra class Correlation Coefficient (ICC) = 0.998 (95% CI 0.993–1.00).

2.4. Procedure

Acquisition of participating home-raised infants was organised by public health volunteers. The researchers then made appointments to collect the data and assess gross motor development in all subjects who were willing to participate in a non-randomised method. The parents and caregivers of typical home-raised infants were asked to fill out the demographic data of the infants, including birth weight, height, head circumference, Apgar score at 5 min, gestational age and method of childbirth. Data of orphaned infants were recorded from their medical chart by a researcher.

The gross motor movements were directly observed, and scored using the AIMS, when the baby was aged 4, 6 and 8 months and at the age of walking attainment at their home. The age of walking attainment was defined as when the child started to walk five steps without support [3,19]. The date of the age of walking attainment was observed and monitored by their parents or caregivers when the infant could walk two or three steps; then the researcher was reminded and prepared to assess the child's gross motor development. The date of each child having the ability to walk independently for five steps was finally recorded. Each infant's gross motor development was assessed once. The assessment was performed in a familiar place where parents or caregivers were close to the participant. Each infant wore only a diaper so that the infant's joints and movements were clearly observable during the assessment of motor development. Infants were assessed 30 min after a meal, while they were awake, alert and not crying. Testing time was approximately 20–30 min for each infant.

2.5. Data analysis

Characteristics of participants were described using mean ± SD and reported by frequency and percentile. A Student's independent t-test was used to analyse the differences of the mean score of the AIMS at 4, 6 and 8 months and at the age of independent walking between orphaned infants and home-raised infants. A Student's independent t-test was also used to analyse the difference in the mean age of independent walking between the two groups of participants.

2.6. Ethics

The current study was designed as a cross-sectional study and was approved by the Khon Kaen University Research Ethics Committee. Parents of typical home-raised infants and guardians of the infants from the