

The association between nutritional status and motor development in children under five years old

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ABSTRACT

Background Severe malnutrition in children is closely related to delayed physical growth and mental development. Very few reports mention the effects of mild to moderate malnutrition on motor development.

Objective The objective of this study was to determine the relationship between nutritional status and motor development in early childhood.

Methods In this cross-sectional study, we examined body weight of children under 5 years of age, the ability to sit or walk without support, and parachute sign in those under 2 years of age who came to community child health surveillance posts in Tuminting Subdistrict, Manado, Indonesia.

Results Among 359 under-five children, 296 were well-nourished and 63 had mild to moderate malnutrition. The ability to sit without support in malnourished children was significantly delayed compared to that in well-nourished ones ($P=0.03$). The ability to walk without support and parachute sign were not significantly different between the two groups.

Conclusion The ability to sit without support in children with mild to moderate malnutrition is delayed compared to that in well-nourished ones [Paediatr Indones 2005;45:107-110].

Keywords: malnutrition, motor development, sitting, walking, parachute sign

Severe malnutrition has detrimental effects on mental, behavioral and cognitive development of children, in addition to the influences of social and cultural deprivation.¹⁻³ However, the effects of mild to moderate malnutrition on children's development are less clear. The effects of malnutrition on mental and behavioral development during infancy are markedly influenced by the social and economic backgrounds of families with malnourished children. It is difficult to differentiate the effects of mild to moderate malnutrition from those of environmental factors in any single study. Very few reports have mentioned the effects of mild to moderate malnutrition on motor development of infants.⁴⁻⁸ Only a few reports have mentioned the neurological responses of malnourished children during infancy and early childhood. An appropriate indicator of neurological response is the parachute reaction, which is seen in neurologically normal infants aged 6 to 12 months.⁹

In 2000, 149.6 million children (26.7% of the world's population of children) were at least moderately malnourished. Over half of all child deaths in developing countries have been attributed to the detrimental effects of malnutrition, and poor nutritional status is closely related to mortality in children admitted to health facilities.^{1,2}

Presented at the Poster Session of the 2nd Annual Scientific Meeting of the Indonesian Society of Pediatricians; 2004 Jul 12-14; Batam, Indonesia.

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The objective of this study was to clarify the association between nutritional state and motor development in early childhood.

Methods

This cross-sectional study was conducted in January 2004. Children younger than 5 years of age were examined at *Posyandu* (community child health surveillance posts) in Tuminting Subdistrict, Manado, Indonesia. Children who attended *Posyandu* were examined for body weight, motor development with respect to the ability to sit or walk without support, and parachute sign. Village health volunteers measured the children's body weight with a standard beam balance. According to weight-for-age (WHO/NCHS, 1983) the children were categorized as having good nutritional status (80% and over), mild to moderate malnutrition (60-80%), or severe malnutrition (less than 60%). The child's age was recorded on a growth chart. Children under 2 years of age were examined for motor development and parachute reaction by trained village health volunteers under supervision of one of the authors. In this study, sitting without support was defined as a child's ability to sit without support for more than 30 seconds, and walking without support as the ability to walk without any support for a couple of steps. A positive parachute reaction implied that when a child in prone position is lowered suddenly toward a flat surface, the arms extend forward and the palms of the hands open.

The chi-square test was used to determine the association between variables. A P value of <0.05 was considered statistically significant.

Ethical approval for this study was given by the Medical Research Ethics Committee, Medical School, Sam Ratulangi University, Manado.

Results

Among 359 under-five children who attended *Posyandu*, 296 (82.45%) were well-nourished and 63 (17.55%) had mild to moderate malnutrition. None of them had severe malnutrition. Two-hundred-and-ninety-five children (82.17%) were younger than 2 years of age. The characteristics of the subjects are shown in **Table 1**.

One-hundred-and-sixty-three infants aged 6 to 12 months were examined for sitting ability. At 8 months of age, 95.49% of 133 well-nourished infants could sit without support, while only 86.67% of 30 malnourished ones could sit (**Figure 1**). Sitting without support was significantly delayed in malnourished 8-month-old infants ($p=0.03$). For walking ability, 92 children aged 9-20 months were examined. Attainment of walking without support was not significantly different between malnourished children ($n=17$) and well-nourished ones ($n=75$) (**Figure 2**). As for parachute reaction, 47 infants aged 6-12 months were examined. There was no statistically significant difference between well-nourished ($n=41$) and malnourished infants ($n=6$) (**Figure 3**).

TABLE 1. SUBJECT CHARACTERISTICS

Age (months)	Sex		Nutritional Status		Total
	Male	Female	Normal	Mild to moderate malnutrition	
0-5	43	35	76	2	78
6-11	72	91	133	30	163
12-17	17	14	24	7	31
18-23	13	10	16	7	23
24-29	15	10	16	9	25
30-35	14	8	16	6	22
36-41	2	3	5	0	5
42-47	3	2	4	1	5
48-53	3	2	4	1	5
54-60	2	0	2	0	2
Total	184	175	296	63	359

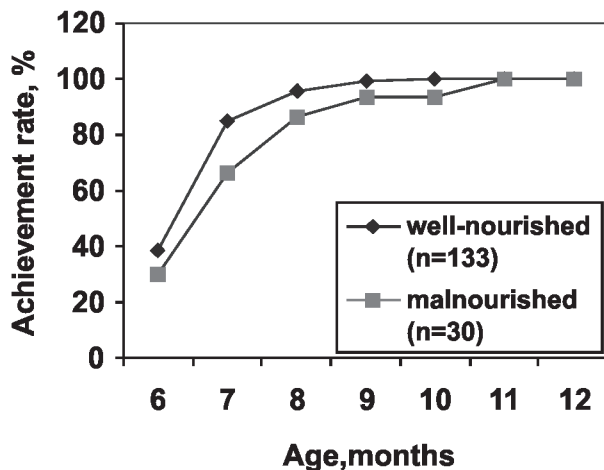


FIGURE 1. SITTING WITHOUT SUPPORT ACHIEVEMENT RATE ACCORDING TO AGE (N=163)

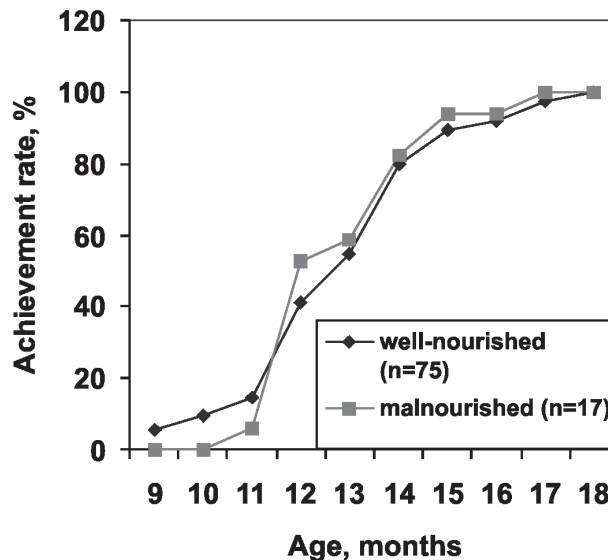


FIGURE 2. WALKING WITHOUT SUPPORT ACHIEVEMENT RATE ACCORDING TO AGE (N=92)

Discussion

In our study, the ability to sit without support was delayed significantly in children with mild to moderate malnutrition compared to well-nourished children ($P=0.03$). No significant difference in walking without support and parachute reaction was found between well-nourished and malnourished children. Our findings were different from those of a previous larger study by Nakamura *et al.*⁴ They reported that motor development with regard to sitting and walking ability was significantly delayed in children with mild to moderate malnutrition compared to well-nourished children, although no difference was found with regard to parachute reaction.

It is well-known that severe malnutrition causes infants to be unable to maintain a sitting or standing position because of severe muscle weakness.² There have been very few reports on the achievement rate of motor development milestones in infants and young children with mild to moderate malnutrition.⁴⁻⁸ Groos⁷ in Papua New Guinea and Sigman *et al.*⁸ in Kenya demonstrated that mild to moderate malnutrition is strongly linked with delayed achievement of important motor skills.

Parachute reaction is considered a postural brainstem reflex, which is usually seen in infants aged 6 to 9 months. When a child older than 12 months

does not show a positive parachute reaction, cerebral palsy or other neurological disorders should be suspected. Examining for the parachute reaction is a very simple technique and can be used to distinguish neurological disorders from inability to walk due to malnutrition. In children with inability to walk due to malnutrition, a positive parachute reaction is seen, while in those with a neurological disorder such as cerebral palsy no parachute reaction is present.^{4,9}

In our study, there was no significant difference in parachute reaction between well-nourished and malnourished children, and most children older than 9 months showed a positive parachute reaction. These findings were similar to those of Nakamura *et al.*, and suggest that neurological development of the brainstem seems to be intact in children with mild to moderate malnutrition.⁴

A limitation of this study was that we used weight-for-age to categorize nutritional status. For screening malnourished children in the community, weight-for-height is the best method, but weight-for-age is the simplest one.¹⁻³ We were unable to measure height due to lack of appropriate equipment and the field workers' inability to measure height accurately.

The recognition of malnutrition by health workers in first-level facilities in developing countries is important to reduce further disability and even mor-

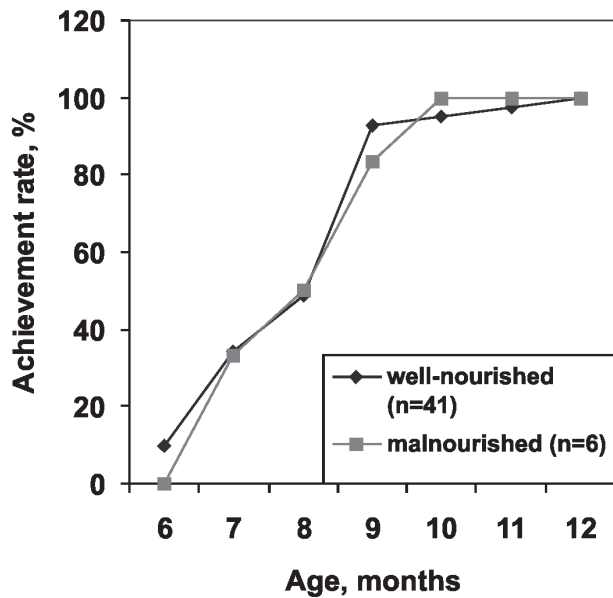


FIGURE 3. PARACHUTE REACTION ACHIEVEMENT RATE ACCORDING TO AGE (N=47)

tality. Finding more reliable ways to help health workers to identify malnourished children with improved training materials and better ongoing supervision should be given high priority.^{3,4}

In conclusion, the ability to sit without support in children with mild to moderate malnutrition is delayed compared to that in well-nourished ones. We suggest that, because of its simplicity, sitting, walking, and parachute sign are examined regularly at the community level as a screening tool for developmental delay in children.

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