

RESEARCH ARTICLE

Inadequate Energy Intake as a Risk Factor to Developmental Delay of Pre-School Aged Children

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Abstract: Background and objectives: The linkage between nutrition, exclusive breast feeding, and poor parenting can lead to developmental disorders in children. This study was aimed at finding out the risk factors of developmental delay in children which includes intakes of energy, protein, exclusive breastfeeding, and maternal parenting.

Research Method: This study was conducted by using a case control design with a total number of 42 children. Children development was measured by using modified Pre-Screening Developmental Questionnaire. The intakes of energy and protein were measured by using a 24-hour recall method. The data were then analyzed through logistic regression test with a p-value of <0.05.

Results: 25.3% of children suffer from developmental delay. The risk factors to the children development are exclusive breastfeeding (Odd Ratio (OR)= 8.92; 95% confidence interval (CI)= 1.33-59.66), energy intake (OR= 35.63;95% CI= 3.20-396.25) and maternal parenting (OR= 14.94; 95% CI= 1.49-149.65).

Conclusion: inadequate energy intake, non-exclusive breastfeeding, and poor maternal parenting are risk factors to the delayed development of pre-school children.

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1. INTRODUCTION

Every child has the right to optimal survival and growth [1-4]. A period of pre-school age is a golden period of motor development in addition to physical, intellectual, emotional, language, and social development that occur very quickly [5]. The motor development, which consists of gross motor and fine motor development, is one of the most important development in individuals [6]. Development and growth happened at the same time. The development of various mental processes is supported by the growth and maturation of brain cells. If the growth and maturation of the brain cells are not optimal yet, the cognitive development is not optimal either [7]. In order for the development of a pre-school aged child to be optimal, a stimulation is needed to provide a stimulus to all aspects of child development [8].

The success of growth and development in childhood determines the quality of future human resources [9]. The linkage between nutrition, health, and parenting affects child's growth and development [10]. In order for a child to grow and develop well, nurturing from people around him/her, especially parents - both father and mother, is highly needed.

The reality, however, in family life in Indonesia generally, the person who serves to function as a nanny is the mother [11]. Two studies conducted in East Java and Manado, Indonesia, found that 50% of all activities involved in parenting belong to the mother's responsibility, and 40% of them belong to father and mother's responsibilities. This still indicates that the role of parenting is mostly done by mother [10].

One of the important factors that also affects the child development is the child's nutritional status. Children who experience growth delay become inactive, apathetic, passive, and incapable of concentrating [12]. A study found that stunting may make children suffer from growth and developmental disorders [13], yet other studies found that children who are cared for, treated, and have good nutritional status have a good development rate [14, 15]. Similarly, intakes of nutrients, especially energy and protein intakes, greatly affect the growth and development of children. Results of a study show that lack of energy and protein has an impact on the development of children under five years of age [16]. Protein is a substance within the brain. If one suffers from severe protein deficiency, it will affect their cognitive and motoric development [17].

Mother's breast milk is the best food for babies. Exclusive breastfeeding provides an opportunity for babies to have

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better motor development. Results of a study show that babies that receive breastfeeding less than three months have a risk of experiencing gross motor disorders three times greater than those who receive exclusive breastfeeding [18]. Babies who receive only 50% of breastfeeding suffer from motor disorders [19].

Another important element in child’s motor development is parenting, especially parenting performed by the mother. Good parenting can help a child to have his/her motor development in accordance with his/her age development [20]. A study found there is a relationship between parenting and child development [21, 22].

This study was aimed at finding out the risk factors of developmental delay in children which includes the adequacy of energy, protein, exclusive breastfeeding, and parenting.

2. RESEARCH METHOD

The study was conducted from June to July 2017 in 3 Early Childhood Education (ECC) Pre-school under the supervision of Tegowanu *Puskesmas* (Community health Center), in Grobogan Regency by using a case-control design. The case group refers to children with delayed development, while the control group refers to children with normal development.

The population of this study was pre-school aged children from 3 Early Childhood Education (ECC) under the supervision of Tegowanu *Puskesmas* (Community health Center) with a total number of 83 children. The sampling was done by using modified Pre-screening Developmental Questionnaire. Based on the results of the questionnaire, it was obtained that there were 21 children with delayed development - the case group. The second group was the control group with a total of 21 children with normal development. The development of the children was measured by using the modified Pre-screening Developmental Questionnaire [23, 24] which was previously validated. The questionnaire consisted of 9-10 questions about the developmental abilities that a child has achieved consisting of gross motor skill, fine motor skill, social skill and independence as well as speaking skill and language skill. Energy and protein intakes by children obtained from foods and beverages were measured by using the 24-hour recall method for 3 consecutive days, and the results in percentage compared to recommended dietary allowances of energy and protein individual. Exclusive breastfeeding is give only breastmilk without providing other foods and beverages to infants from birth to six months of age, except drugs and vitamins. The history of exclusive breastfeeding was obtained from interviews and supported by the data taken from the children’s *Kartu Menuju Sehat* (KMS - which literally means *Go Healthy Card*). Maternal

parenting is a pattern of parent interaction with children covering physical needs (eating, drinking, clothes, etc.) and psychological needs (affection or feeling) and norms in society so that children can live in harmony with the environment. The data for parenting were obtained through questionnaire-based interviews. The research was approved by the Bioethics Commission of the Faculty of Medicine of UNISSULA with the number of 183/V/2017/*Komisi Bioetik*. A bivariate analysis was used to look at the relationship between each independent variable and the developmental status with a simple logistic regression test. A multivariate analysis was used to find out the risk factors to the delayed development in pre-school aged children with a multiple logistic regression test with a significance level of 5%. The collected data were then analyzed by using Microsoft Excel and SPSS version 17.0 for Windows.

3. RESULTS

Based on the screening results of 83 children from 3 Early Childhood Education Pre-schools under the supervision of Tegowanu *Puskesmas*, 21 (25.3%) of them are children with developmental delay, while 62 (74.7%) of them are children with proper developmental stages. A total of 21 children who suffer from developmental delay were taken as the case group, while 21 were taken randomly from 62 children with proper development stages as the control group.

The distribution of samples according to nutrition intake, exclusive breastfeeding, and parenting is shown in Table 1. It can be seen in Table 1 that the intakes of energy and protein in the control group are higher than in the case group. Children in the control group receive more exclusive breastfeeding than those in the case group. Children in the control group receive better maternal parenting than those in the case group. In Table 1, it is seen that things that are closely related to the developmental status of the children are energy intake, exclusive breastfeeding, and maternal parenting.

The determinant factor of children developmental delay can be seen in Table 2. Based on Table 2, the children’s opportunity of suffering from development delay is as follows:

Children who do not receive exclusive breastfeeding suffer from inadequate energy intake. Children with poor maternal parenting have the chance to suffer from developmental delay of 98,32%.

4. DISCUSSION

In this study, it is found that inadequate energy intake in children has an effect on the delay of their development. Several previous studies reveal that macro nutrients, including energy and protein deficiencies, have a significant effect

$$P(X= developmental delay) = \frac{1}{1 + e^{-(-4,39 + 2.19*Asi Ekslusif+3.57*Kec. Energi+2.704*Pola Asuh)}}$$

$$P(X= developmental delay) = \frac{1}{1 + e^{-(-4,074)}} = \frac{1}{1 + 0,017} = \frac{1}{1,017} = 0,9832$$

Table 1. Sample distribution according to independent variables and development status.

| Variables | Case | | Control | | p value | OR | 95% CI OR |
|----------------|------|------|---------|------|---------|-------|--------------|
| | n | % | n | % | | | |
| Energy Intake | | | | | 0.001* | 10.24 | 2.47 - 42.37 |
| Poor | 16 | 76.2 | 5 | 23.8 | | | |
| Good | 5 | 23.8 | 16 | 76.2 | | | |
| Protein Intake | | | | | 0.999* | 1.99 | 0 |
| Poor | 4 | 19.0 | 0 | 0 | | | |
| Good | 17 | 81.0 | 21 | 100 | | | |
| Breastfeeding | | | | | 0.007* | 6.4 | 1.65 - 24.77 |
| Nonexclusive | 14 | 66.7 | 5 | 23.8 | | | |
| Exclusive | 7 | 33.3 | 16 | 76.2 | | | |
| Parenting | | | | | 0.016* | 5.00 | 1.35 - 18.55 |
| Poor | 14 | 66.7 | 6 | 28.6 | | | |
| Good | 7 | 33.3 | 15 | 71.4 | | | |

* = significant (p<0,05)

Table 2. Determinant factors to developmental delay in children.

| Variables | B | p Value | OR | 95% CI OR |
|-------------------------|-------|---------|-------|---------------|
| Exclusive breastfeeding | 2.19 | 0.024* | 8.92 | 1.33 -59.66 |
| Adequacy of energy | 3.57 | 0.004* | 35.63 | 3.20 - 396.25 |
| Parenting | 2.704 | 0.021* | 14.94 | 1.49 - 149.65 |
| Constant | -4.39 | 0.012* | | |

* = significant (p<0,05)

on the development of brain dysfunctions [25-29]. The availability of energy also affects the children’s physical activity, in which it is correlated with motor development [30]. In line with the findings of other studies, it is found that there is a relationship between energy intake and the development and interaction of children with the environment [31, 32]. Malnutrition in pre-school aged children affects low cognitive abilities and low IQ scores characterized by low achievement and learning abilities at schools. Children with poor nutrition lose their IQ scores of 5-11 points. Children with poor intakes of energy and protein have slow motor skills due to late muscle maturity process that the mechanical ability of their muscle decreases [33]. A research conducted in Panagalangan, West Java, to children with poor nutrition aged 12-18 months shows that high energy supplementation and micro-nutrients have higher motor development score compared to that of in the control group [34]. Children with inadequate intakes of energy and protein lose their curiosity about the environment and thus they fail to achieve their motor development compared to normal children in general [35]. Energy intake is also a direct factor affecting child development [36]. Energy can affect the chemical substance in the brain,

often called as neurotransmitter, that serves to function to deliver a node from one nerve to another to produce motor movements. Performing a movement requires sufficient energy in accordance with the nutritional adequacy rate by age. Motor activity requires considerable energy availability [37]. The growth period in infants requires energy to prevent the decline in motor development. If the condition of malnutrition is ignored continuously, this will result in neurotransmitter disorders, attention concentration disorders, and decreased sensory integration that the motor development is disrupted [38-41].

In this study, it is found that nonexclusive breastfeeding leads to delay on child development. Breastfeeding, as the main source of nutrition for infants, plays an important role since it contains components that suit the digestion and needs of the infants. Giving infants exclusive breastfeeding until 6 months of age is believed to be able to increase the score of the infants’ motor development. In addition to being related to the fulfillment of nutritional needs for infants, breastfeeding is also associated with the mother and child bond which is important for mental and motor development of the baby [42, 43]. Good baby development is determined by the suc-

cessful growth and development of the baby's brain. Mother's breast milk is the best food for baby's brain development [44]. A research conducted in Honduras reveals that babies that receive mother's breast milk without any additional food and drink for the first 6 months of life have better motor functions - they can crawl faster and can walk at the age of 12 months - compared to babies that receive exclusive breast milk until the age of four months [45]. Other studies have also proved that there is a correlation between exclusive breast-feeding and child development [46, 47]. Babies exclusively breastfed and having good nutritional status have normal gross motor development [48]. Other studies have also shown that a longer period of exclusive breastfeeding contributes to the improvement of language and cognitive development of the babies [49]. Exclusive breastfeeding for 3 months has an IQ mean of 2.1 points higher and for 4-6 months has an IQ mean of 2.6 points higher than other children. Increased intelligence in infants will have an impact on the improvement of their gross motor, fine motor, language, and social independence development [50]. The mother - infant interaction through exclusive breastfeeding provides an opportunity for the infants to grow into more stable humans with better social development [51]. Mother's breast milk contains various nutrients including taurine, lactose, and long-chain fatty acids such as DHA, AA, omega 3, and omega 6 which can promote brain growth and development that exclusive breastfeeding can affect the overall baby development including their gross motor and fine motor development [52-56].

Poor maternal parenting found in this study contributes to the delay in child development. Many previous studies have reported the importance of maternal role in child development. In the process of child development, the maternal parenting plays a very important role. A mother's experience of parenting is highly needed [57]. A child who gets directed and regular stimulation will develop faster compared to those who are less stimulated [58]. This is supported by the findings of previous studies that state that the higher the score of parenting is, the higher the score of motor development of the child is [59, 60]. The interaction between children and adults and their fellow children can stimulate their development [20]. Pre-schooling does not last long, children should get serious attention in their early lives. Given the importance of childhood development, early stimulation and detection should be undertaken [61].

CONCLUSION

The determinant factors of delayed development in pre-school aged children include inadequate energy intake, non-exclusive breastfeeding, and poor maternal parenting.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are the basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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