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Association Between Nutritional Status and Development of Preschool Children at An-Nizam Kindergarten, North Sumatra: A Cross-Sectional Study

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This study aims to analyze the implementation of administrative innovations in the Healthy Indonesia Program with a Family Approach (PIS-PK) and its impact on program effectiveness and family participation. The research method used a qualitative approach with data collection through in-depth interviews, participant observation, and documentation of PIS-PK administration in four community health centers. Data analysis was conducted through data reduction, coding, comparisons between community health centers, and triangulation to ensure the validity of the findings. The results showed that administrative innovations included digitizing family data, standardizing health forms and indicators, digital data-based monitoring, family education and participation, and cross-stakeholder coordination. The implementation of these innovations increased the accuracy and efficiency of data collection, accelerated reporting, facilitated the identification of priority families, and encouraged active family involvement. The main challenges included limited human resources, infrastructure, and community adaptation to the digital system. However, strategies such as routine training, portable hotspots, and cadre mentoring were able to overcome these challenges. This study provides an important contribution to the development of standardized and integrated data-based family health service administration and environmental health management.

Keywords: Anthropometry, Child Development, Nutritional Status, Preschool Children

INTRODUCTION

Children development is a psychological change occurring due to the maturation of physical functions. This change can be observed from environmental factors and the learning process of children at a certain time toward maturity (Arranz-Freijo et al., 2025). The maturity of children depends on every care and education obtained by parents, which are stimuli from every environment and can influence life towards maturity. This stimulation is obtained from the living environment where parents are the main factor responsible for organizing, coordinating, and providing education to children. The development process is influenced by several factors, including nutritional status (Evans, 2021).

Nutritional status is an equal condition between the intake and required nutrients by a person. In children, anthropometry is an effective method to measure nutritional status serving as indicators to determine the quality of human resources in the future (Halder & Kejriwal, 2016). Based on definition, nutritional status is changes in the body caused by food consumption or a measure of nutritional attainment. It is the balance between the amount of nutrients consumed and required by the body for various biological functions, including growth and development of body tissues, cognitive function, health maintenance, and productivity (Fernández-Lázaro & Seco-Calvo, 2023). Good and balanced nutritional status supports children development, which is strongly associated with poor nutrition and low health status (Kahraman et al., 2020). This is particularly valid for preschool children whose development and growth can be affected by malnutrition. Based on categorization, sensory development includes gross and fine motor. Moreover, there is development in language and speech as well as social and independence.

In Indonesia, nutritional status is among the health challenges that are often encountered. The 2022 survey on the Status of Nutrition in Indonesia (SSGI) conducted by the Ministry of Health of Indonesia provided a summary of the nutritional status of children under 5. Based on the survey data, the prevalence of stunting, wasting, underweight, and overweight was 21.6%, 7.7%, 17.1%, and 3.5%, respectively. Meanwhile, the data on the nutritional status of children in North Sumatra according to SSGI in 2022 are 21.1% stunting, 7.8% wasting, 15.8% underweight, and 2.3% overweight. The

Indonesian Nutrition Status Survey in 2022 also presented data on the nutritional status of children under 5 in Medan City, namely stunting at 15.4%, wasting 9.2%, underweight 14.7%, and overweight 1.8%(Sa'adah et al., 2025). In 2019, the World Health Organization (WHO) reported data on the nutritional status of children in Southeast Asia under 5, with 24.7 being stunted and a percentage between 20-30% in the high category. An amount of 8.2 is in the medium category with a percentage of 5-10% of children <5 years old in Southeast Asia declared wasting. For overweight data, 7.5 is in the medium category with a percentage of 5-10%. Currently, there are 38.3 million children worldwide who are overweight, showing an increase of 8 million since 2020.

Nutritional status of preschool children in Indonesia is still a serious concern, particularly in urban areas such as Medan Denai. However, nutritional problems in early childhood are often caused by several factors, such as low levels of parental knowledge about balanced nutrition, unsupportive parenting, and limited access to nutritious food. Children who are malnourished often show signs of underweight, fatigue, as well as impaired mental and motor development. An-Nizam Kindergarten Medan Denai is one of the educational institutions that has an important role in monitoring the development of preschool-age children. However, data and observations show that not all children in this kindergarten have optimal nutritional status. This is because some experience delays in motor, language, and cognitive development, which may be related to their nutritional intake.

Another problem that arises is the lack of awareness and attention of parents to the importance of fulfilling balanced nutrition for children (Davis et al., 2010). Many parents do not fully understand the long-term impact of malnutrition due to low levels of education, lack of access to information on proper nutrition, and inaccurate views of the nutritional needs (Mahomed et al., 2022). Parents often neglect the quality of food and focus more on quantity or convenience, such as providing fast food that lacks essential nutrients (Jones et al., 2023). Additionally, economic problems in some families affect the fulfillment of children nutrition. Economic limitations make families unable to provide nutritious and balanced meals, causing vulnerability to malnutrition or undernutrition. In this context, children from families with low economic backgrounds in An-Nizam Kindergarten tend to experience more problems in physical and mental development than children from better-off families.

The problem is also increased by the lack of supervision from the school in terms of monitoring children nutritional status and development. Although An-Nizam Kindergarten provides formal education, efforts to ensure adequate nutrition are not integrated into the learning program. To address this problem, the school should be more proactive in organizing programs that include providing information and education on nutrition, both to children and parents, to create a strong synergy in supporting growth and development. Another challenge is the lack of awareness of regularly evaluating children's nutritional status. Preschool children are supposed to pass through regular check-ups to monitor their physical growth, including height and weight, as well as other aspects of development. However, in An-Nizam Kindergarten, this has not been a major concern, as children with poor or malnourished status are often not identified quickly, leading to late interventions.

Based on the description, this study aimed to explore the relationship between nutritional status and the development of preschool children at An-Nizam Kindergarten Medan Denai. The results were expected to be a reference for parents, educators, and related parties in increasing attention to the nutritional intake of preschool children to achieve optimal development and be ready for the next stage of education.

METHOD

Research Design and Location

This study employed an analytical quantitative research design with a cross-sectional approach to analyse the relationship between nutritional status and the development of pre-school children at An-Nizam Nursery School in Medan Denai District, North Sumatra Province. The cross-sectional approach was chosen because it allows for the measurement of nutritional status and child development variables at the same time, thereby enabling the relationship between variables to be analysed efficiently within a single observation period. The study was conducted from January to March 2024 at An-Nizam Kindergarten as the main data collection site.

Population and Sample

The population for this study comprised all pre-school children aged 4–6 years who were enrolled as active pupils at An-Nizam Nursery School during the 2023/2024 academic year. According to the school's administrative records, the total number of children meeting the criteria was 50 respondents. Given the relatively small population size, this study employed a total sampling technique, whereby all members of the population were included in the study sample. Inclusion criteria included children aged 4–6 years who were actively participating in learning activities at An-Nizam Kindergarten, were present at the time of data collection, and had obtained consent from their parents or guardians to take part in the study. Meanwhile, children who were suffering from a serious illness, had a congenital abnormality, or were suffering from a chronic condition that could significantly affect their growth and development were excluded from the study. Respondents with incomplete anthropometric data or developmental assessment results were also excluded from the analysis. Based on this selection process, all respondents met the criteria, resulting in a total sample of 50 children analysed.

Research Variables

The independent variable in this study is the nutritional status of pre-school children, whilst the dependent variables comprise child development,

consisting of gross motor skills, fine motor skills, language skills, and personal and social development.

Assessment of Nutritional Status

Nutritional status assessment was carried out through anthropometric measurements conducted in person by researchers and trained enumerators in accordance with standard measurement procedures. Children's weight was measured using digital scales calibrated to an accuracy of 0.1 kg, whilst height was measured using a microtoise or portable stadiometer with an accuracy of 0.1 cm. During the measurement process, children wore light clothing and were barefoot to minimise measurement bias. Data on children's ages were obtained from school records and birth certificates to determine their exact age in months. Anthropometric data were then analysed using WHO growth standards via the WHO Anthro application. Nutritional status was assessed based on weight-for-age (WFA), height-for-age (HFA), and weight-for-height (WFH) indices. Nutritional status categories were determined based on z-scores: underweight if the z-score was < −2 SD, normal weight if within the range of −2 SD to +2 SD, and overweight if the z-score was > +2 SD.

Child Development Assessment

Child development is assessed using the Developmental Pre-Screening Questionnaire (KPSP), a standardised tool used for the early detection of developmental issues in children in Indonesia. This tool assesses four areas of development: gross motor skills, fine motor skills, language, and personal and social skills. The questionnaire was completed by parents or guardians with the assistance of a researcher to ensure that each question was properly understood. The results of the developmental assessment were categorised as 'typical', 'concerning' or 'abnormal' in accordance with the KPSP interpretation guidelines.

Data Collection Procedure

Prior to conducting the research, the researcher first obtained permission from the school and explained the purpose, benefits and procedures of the research to the parents or guardians. Parents who were willing to participate were asked to sign an informed consent form as a sign of their agreement to take part in the research. Data collection was carried out in person at the school according to a pre-determined schedule. Anthropometric measurements were taken in the morning to ensure consistent measurement conditions. Subsequently, child development assessments using the KPSP instrument were carried out in a comfortable, separate room to ensure the respondents' privacy and to improve concentration during the questionnaire completion process. Once all data had been collected, the researchers cross-checked the forms and measurement results to ensure the completeness and consistency of the data.

Data Analysis

The data collected was then edited, coded, entered and cleaned before being analysed. Univariate analysis was used to describe the characteristics of the respondents, their nutritional status and child development in the form of frequency distributions and percentages. Bivariate analysis was conducted to determine the relationship between nutritional status and each domain of child development. The chi-square test was used where the test criteria were met, whilst Fisher's Exact Test was used for tables with an expected count of less than five. The level of statistical significance was set at $p < 0.05$. This study did not perform multivariate analysis due to the relatively limited sample size; therefore, the analysis focused on exploratory relationships between variables.

Research Ethics

This study was conducted in accordance with the ethical principles governing research involving human subjects. All respondents participated in the study voluntarily after their parents or guardians had given their written consent. The confidentiality of the respondents' identities was maintained throughout the research process, and the results were reported without disclosing the personal identities of the study participants. Ethical approval was obtained from the Ethics Committee of the Medan Public Health Polytechnic under the Ministry of Health, with registration number 01.25 469/KEPK/Poltekkes Kemenkes Medan 2024

RESULTS AND DISCUSSION

Characteristics of Respondents

A total of 50 preschool children and their mothers participated in this study. The socio-demographic characteristics of respondents, children's nutritional status, and developmental profiles are presented in Table 1.

Table 1.

Characteristics of Respondents, Nutritional Status, and Developmental Outcomes of Preschool Children at An-Nizam Kindergarten, North Sumatra, Indonesia (n = 50)

Variable	Category	n	%
Maternal Age (years)	26–35	30	60.0
	36–45	15	30.0

Variable	Category	n	%
	46–55	5	10.0
Maternal Education	No Formal Education	4	8.0
	Elementary School	6	12.0
	Junior High School	9	18.0
	Senior High School	18	36.0
	Higher Education	13	26.0
Maternal Occupation	Unemployed	13	26.0
	Trader	8	16.0
	Civil Servant	6	12.0
	Farmer/Laborer	18	36.0
	Self-employed	5	10.0
Child Age (years)	4	7	14.0
	5	15	30.0
	6	28	56.0
Child Sex	Male	20	40.0
	Female	30	60.0
Nutritional Status	Undernourished	5	10.0
	Normal	42	84.0
	Overnourished	3	6.0
Gross Motor Development	Delayed	15	30.0
	Suspected Delay	28	56.0
	Appropriate	7	14.0
Fine Motor Development	Delayed	12	24.0
	Suspected Delay	30	60.0
	Appropriate	8	16.0
Personal-Social Development	Delayed	7	14.0
	Suspected Delay	25	50.0
	Appropriate	18	36.0
Language Development	Delayed	2	4.0
	Suspected Delay	18	36.0
	Appropriate	30	60.0

Table 1 shows the characteristics of the respondents, nutritional status, and development of pre-school children at An-Nizam Nursery School. The majority of mothers were in the 26–35 age group (60.0%), indicating that most mothers were of working age. In terms of educational attainment, the majority of mothers had completed upper secondary education (36.0%), followed by those with tertiary education (26.0%). Regarding employment, the majority of mothers worked as farmers or labourers (36.0%).

The characteristics of the children show that the majority were aged 6 years (56.0%) and were female (60.0%). The results of the nutritional status assessment show that the majority of children had a normal nutritional status (84.0%), whilst the proportion of children with under-nutrition and over-nutrition was relatively small, at 10.0% and 6.0% respectively.

The results of the developmental screening indicated that the 'suspected delay' category was the most prevalent in gross motor skills (56.0%), fine motor skills (60.0%) and personal-social development (50.0%). Meanwhile, language development showed better results, with the majority of children (60.0%) falling into the age-appropriate development category. Overall, these findings suggest that although the majority of children have a normal nutritional status, a significant proportion still exhibit suspected developmental delays, particularly in gross motor skills, fine motor skills, and personal-social development.

Association Between Nutritional Status and Developmental Domains

Table 2.

Relationship between Variables and Nutritional Status

Variables		Nutritional Status						Total		Statistical Test
		No Deviation		Doubtful		Compliant				
		n	%	n	%	n	%	n	%	
Gross Motor	Undernourished	3	30	6	60	1	10	10	100	p=0.003
	Good Nutrition	2	8	7	28	16	64	25	100	
	More Nutrition	1	6.66	1	6.66	13	86.66	15	100	
Fine Motor	Undernourished	4	40	5	50	1	10	10	100	
	Good Nutrition	1	4	8	32	16	64	25	100	p=0.001
	More Nutrition	0	0	3	20	12	80	15	100	
Social Personal	Undernourished	5	50	3	30	2	20	10	100	
	Good Nutrition	2	8	10	40	13	52	25	100	p=0.001
	More Nutrition	1	0.66	1	0.66	13	86.66	15	100	
Language	Undernourished	3	30	4	40	3	30	10	100	
	Good Nutrition	0	0	10	40	15	60	25	100	p=0.012
	More Nutrition	1	6.66	2	13.33	12	80	15	100	

Table 2 shows that the results of statistical tests using the Chi-Square test obtained a p-value of 0.003, indicating that Ha is accepted. Therefore, nutritional status has a significant relationship with gross motor skills. The results of statistical tests using the Chi-Square test obtained a p-value of 0.001, indicating that Ha is accepted. This shows that nutritional status has a significant relationship with fine motor skills. The results of statistical tests using the Chi-Square test obtained a p-value of 0.001, showing that Ha is accepted. This shows that nutritional status has a significant relationship with personal social skills. The results of statistical tests using the Chi-Square test obtained a p-value of 0.012, indicating that Ha is accepted. The value shows that nutritional status has a significant relationship with language skills.

The distribution of respondents by age at An-Nizam Kindergarten Medan Denai, North Sumatra Province, in 2024 showed that 30 (60%) mothers were 26 to 35 years old. This age range had the largest frequency, showing that most mothers were in the productive age period, and was generally considered an optimal period in supporting children development. Meanwhile, the age range with the smallest frequency was in the 46 to 55 years, comprising 5 respondents (10%). This data shows that only a small proportion of mothers were in the age group, suggesting the end of the productive period or approaching old age. This result provided an overview of the demographic distribution of respondents based on the age of the mother, which could have implications for parenting patterns, experiences, and methods in supporting the development of preschool-age children at An-Nizam Kindergarten.

Based on the education level, 18 respondents (36%) had a high school education. This group was the dominant, showing that secondary education was the most common level among mothers. The minimum number of respondents comprising 4 mothers (8%) came from the group that had not attended school. This data showed the variation in mothers' education levels, which affected their parenting patterns, understanding of children's education, and participation in supporting learning at school. The results served as a significant reference for considering a

more inclusive educational method for mothers with various educational backgrounds. Based on the occupation, 18 respondents (36%) were farmers or laborers. This occupation dominated and showed the background of the majority of children's families who depended on the agricultural sector or daily wage work. The smallest number of respondents comprising 5 mothers (10%) came from the self-employed group. The results showed the diversity of occupations undertaken by mothers, which affected their daily dynamics and level of inclusion in supporting children's education. This information is important for understanding the socio-economic conditions of families as one of the supporting factors in the development of preschool-age children.

The distribution of respondents based on the age of the children in 2024 showed that 6 years old is the group with the largest frequency, comprising 28 children or 56%. The results show that the majority of children at An-Nizam Kindergarten are at the age of preparation for primary education, which is an important period in children's cognitive, social, and emotional development. This age is also the main focus of early childhood education to build the foundations of learning skills and positive attitudes toward formal education. The result provides a demographic picture of children at An-Nizam Kindergarten that can be used as a reference in designing learning programs that suit the developmental needs of children in this dominant age group. Regarding gender, 30 (60%) children are females, while 20 (40%) are males. This suggests that there is a greater proportion of females than males in the kindergarten. The information can be considered in the management of learning programs and activities designed to meet the needs as well as the potential of children from both sex groups in a balanced manner. Meanwhile, 42 (84%) children had good nutritional status, showing an optimal condition to support their growth and development. The number of children with over-nutrition status was 3 (6%). This data provided a positive picture of health and nutritional adequacy, although overnutrition or other categories should be considered to ensure equal opportunities to achieve optimal development. The results can serve as a basis for considering preventive and curative nutrition intervention programs.

This study shows that nutritional status is associated with various domains of development in pre-school children, including gross motor skills, fine motor skills, language skills, and personal and social skills (Heslin & McNulty, 2023). These findings reinforce the evidence that adequate nutrition in early childhood is a crucial foundation for children's biological growth, neurological maturation, and readiness to learn. The pre-school years are a highly sensitive developmental period, as this phase involves rapid neural network growth, myelination, and intensive cognitive development (Alwaely et al., 2021). Both nutritional deficiencies and excesses during this period can impact a child's development in the short and long term. Recent scientific evidence indicates that dietary quality in early childhood is closely linked to children's cognitive, language, and social development (Di Prete et al., 2025).

Children with good nutritional status in this study tended to demonstrate more optimal developmental outcomes compared to those with undernutrition or overnutrition. This can be explained by biological mechanisms: adequate energy, protein, essential fatty acids, iron, zinc, folate, and iodine are essential for neurotransmitter synthesis, nerve cell growth, and brain metabolic function. Micronutrient deficiencies in early childhood have been linked to attention disorders, delayed motor development, and impaired learning function. Conversely, overnutrition and obesity in children are also associated with systemic inflammation, reduced physical activity, and metabolic disorders that can affect overall developmental function. Therefore, a balanced nutritional status is the ideal condition to support children's growth and development (Roberts et al., 2022).

The relationship between nutritional status and gross motor development in this study aligns with various international studies showing that children with good nutrition have better muscle strength, body coordination, balance, and physical activity capacity. Gross motor development, such as running, jumping, climbing stairs, and maintaining body posture, requires optimal integration between the musculoskeletal system and the central nervous system (Melvin Chung et al., 2021). When children experience chronic energy deficiency or protein deficiency, muscle mass and physical endurance may decline, resulting in suboptimal gross motor skills. Furthermore, children with poor nutritional status tend to be more passive and less engaged in active play, even though physical activity is vital for motor development. A recent meta-analysis also indicates that physical activity interventions in schools can significantly improve children's motor skills (Moon et al., 2024).

Findings regarding fine motor skills are also important as these abilities are closely linked to children's academic readiness. Activities such as drawing, holding a pencil, stacking blocks, fastening clothes, and manipulating small objects require hand-eye coordination, concentration, and good neuromuscular control (Ebrahim et al., 2011). Deficiencies in iron and certain micronutrients have been linked to impairments in visuomotor function and attention in children. Therefore, the results of this study support the view that nutritional status affects not only physical growth but also the functional skills that underpin readiness for primary school. Children with good fine motor skills generally find it easier to engage in early academic activities such as writing and independent tasks (Mohamed et al., 2025).

The relationship between nutritional status and language development in this study also has important implications. Language development is the result of a complex interaction between neurological maturation, environmental stimulation, the quality of care, and the child's health status. Good nutrition contributes to the development of brain areas involved in working memory, attention, auditory processing, and vocabulary

development. Children with good nutritional status tend to be more active in their interactions, more responsive to instructions, and better prepared to engage in verbal learning processes at school. Conversely, children with nutritional problems are at risk of speech delays or poor comprehension of instructions. A recent systematic review indicates that the quality of the diet in early childhood is positively associated with language development and cognitive function (Di Prete et al., 2025).

Social-emotional development was also significantly associated with nutritional status in this study. Social-emotional skills encompass children's ability to interact with peers, regulate emotions, cooperate with others, demonstrate independence, and adapt to different social environments (Sabri et al., 2022). Children with adequate nutritional status generally possess sufficient physical energy and cognitive resources to engage actively in social interactions and participate in group-based learning activities. These abilities are essential for developing self-confidence, communication skills, and positive relationships with Conversely, children with poor nutritional status may experience fatigue, reduced physical activity, lower concentration, and diminished motivation to participate in social activities. Chronic undernutrition has been associated with delayed emotional regulation and reduced social engagement due to its adverse effects on brain development and psychological well-being. Children who experience nutritional deficiencies may be more likely to exhibit withdrawal behaviors, limited peer interaction, and difficulties adapting to structured educational environments. Similarly, excessive nutritional status or childhood obesity may also negatively influence social-emotional development through reduced self-esteem, social stigma, and lower participation in physical and recreational activities.

CONCLUSIONS

This study shows that nutritional status is associated with various domains of development in pre-school children, including gross motor skills, fine motor skills, language skills, and personal and social skills. Children with normal nutritional status tend to demonstrate more optimal developmental outcomes compared to those who are underweight or overweight. These findings underscore that the provision of a balanced diet during the pre-school years plays a crucial role in supporting children's physical growth, neurological development, readiness for learning, and social adaptability. Consequently, nutritional status must be a key component in comprehensive early childhood development initiatives. From a practical perspective, integrated efforts involving families, schools, and healthcare professionals are required to support children's growth and development optimally. Regular growth monitoring, early developmental screening, nutrition education for parents, and the provision of a healthy eating environment in early childhood education settings need to be strengthened. Preschools can serve as a strategic entry point for implementing integrated programmes combining improved nutrition and developmental stimulation for children. Further research is recommended to involve a larger and more diverse sample size, utilise a longitudinal design, and apply multivariate analysis to gain a deeper understanding of the causal relationship between nutritional status and child development. Future studies should also consider other factors such as parenting styles, socio-economic conditions, dietary quality, physical activity, and stimulation at home to obtain more comprehensive evidence as a basis for formulating effective policies and interventions.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest

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