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The Association between Maternal Dietary Diversity and Minimum Acceptance Diet on Toddlers to Prevent Undernutrition in Developing Countries: A Systematic Review

Hubungan Maternal Dietary Diversity *terhadap* Minimum Acceptance Diet *pada Anak dalam Pencegahan Gizi Buruk di Negara Berkembang:* Systematic Review

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ABSTRACT

Background: The MAD in children has an important role in preventing the risk of undernutrition. MAD in children is often associated with MDD in mothers because the mother's consumption pattern continues to feed the child who is born.
Objectives: This systematic review aims to examine the relationship between MDD in mothers and MAD in children, and its role in undernutrition prevention.
Methods: Articles were selected using the PRISMA method. Articles were obtained from Sciencedirect, Medline, and Embase in the 2017-2022 timeframe without data restrictions. The vocabulary used in the search is "Maternal Dietary Diversity" and "Minimum Acceptable Diet", and undernutrition, and only researched articles in English. Table matriculation was carried out to obtain an overview of the relationship between MDD in mothers and children's MAD in undernutrition prevention.
Discussion: Research from 7 selected studies was conducted in five developing countries with high levels of food insecurity. Samples were obtained of 167 to 10,291 children aged 6-59.9 months. Six studies indicate the level of food insecurity in the area studied. Four of the seven studies showed significant results between MDD in mothers with MAD and undernutrition in children.
Conclusions: Maternal MDD has a significant role in MAD in children and can be one of the factors that influence undernutrition, especially in developing countries which are highly food insecure.

INTRODUCTION

The problem of malnutrition is still one of the biggest nutrition-related problems in Indonesia. Based on data from the Indonesian Toddler Nutrition Status Survey, it is known that 27.67% of Indonesian children experience stunting, 7.44% of children experience wasting, and 16.29% of children experience malnutrition[1]. The problem of malnutrition in children, especially stunting, is caused by several factors, including low children's food intake, catabolism diseases, family food insecurity, unclean living environments, poor sanitation, inadequate health services, and low parental knowledge regarding feeding practices for children[2–4].

Seeing the high level of nutritional problems in children under 5 years of age, WHO and UNICEF created indicators to analyze feeding practices for children and babies that is Infant and Young Child Feeding / IYCF. The indicators created include 9 things, one of which is MAD. MAD includes two main indicators that show whether the diet given to children is sufficient or not, namely MDD and Minimum Meal Frequency (MMF). MDD measures a child's ability to get more than 5 types of food every day, while MFF measures whether the child gets food that meets a number of different criteria for each age group and status (breast milk) exclusive breastfeeding[3–5]. Children who receive a variety of foods and are given foods that meet the minimum frequency are said to meet

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MAD. Until now, it is known globally that only 15.9% of children in the world have succeeded in achieving MAD[6,7]. Meanwhile, in Indonesia itself, it is known that the achievement of MAD for children aged 6-23 months was around 40.3% in 2017 with the smallest proportion aged 6-11 months at 33.8% and increasing as the children's age increases[8–11].

The low rate to achieve MAD in Indonesia is known to be related to a number of factors including family socio-economic factors, level of family welfare, number of children, mother's level of knowledge, exposure to the media, parents' occupation, and others[12–15]. One of the factors that influence MAD in children that needs to be highlighted is maternal nutritional factors. Based on research by Marshall (2022), it is known that the amount and variety of food consumed by mothers before and during pregnancy and breastfeeding has an effect on the health of the mother and children[16]. Maternal Dietary Diversity (MDD) or the diversity of a mother's diet during pregnancy and breastfeeding reflects the food that will be given to the child. Mothers who have lower MDD are known to contribute to poorer child nutrition[17]. Seeing the possibility of malnutrition occurring due to the mother's lack of dietary diversity requires a deeper analysis to see the link between maternal MDD and MAD in children. For this reason, this systematic review aims to determine the relationship between maternal MDD and child MAD as a step to prevent the incidence of malnutrition in children.

METHODS

This research takes the form of a systematic review by comparing a number of quantitative observational studies conducted in a number of countries. The systematic review analysis method is based on the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) protocol. The inclusion criteria for selecting articles involved in the research included using subjects aged 0-59 months, obtaining data on child growth and family food insecurity, assessing maternal MDD and child MAD. Meanwhile, the research exclusion criteria are using research subjects with comorbidities, inborn metabolic errors, having psychiatric disorders, and not clearly knowing the methods for assessing maternal MDD and child MAD, not in accordance with predetermined population characteristics, carrying out interventions, not making a connection between maternal MDD and children's MAD, and comes from the proceedings or scientific work of dissertations and theses to obtain an academic degree.

Article searches are limited to using only observational articles (not articles that provide intervention treatment), have gone through an in-depth review by journal reviewers, were published in English between 2017 and 2022 (5 years), can be accessed in full, can be accessed for free, and is not a review article. Articles that are incomplete (only display the abstract or have parts cut off) are excluded from the review process. The databases used for the article search process are Sciencedirect, Embase, Medline, and verified on Google Scholar. Articles that have been collected are checked for duplicates and incomplete articles. The selection and review process was carried out by three researchers independently and the articles were assessed based on the Cochrane Risk of Bias Tool criteria following the predetermined inclusion and exclusion criteria. After the screening process was carried out, it was discovered that there were 7 articles that met the inclusion and exclusion criteria and continued in the critical appraisal and data extraction process which included first author, year of publication, country of research, study design, study subjects, food security, MDD in mothers, and, MAD in children, prevalence of malnutrition, and research results.

Table 1. Literature search keywords

Journal Database	Searching Keywords	n
Sciencedirect	maternal dietary diversity and minimum acceptable diet	435
Medline	maternal dietary diversity and minimum acceptable diet	51
Embase Cochrane	maternal dietary diversity and minimum acceptable diet	159
Google Scholar	maternal dietary diversity and minimum acceptable diet	2120

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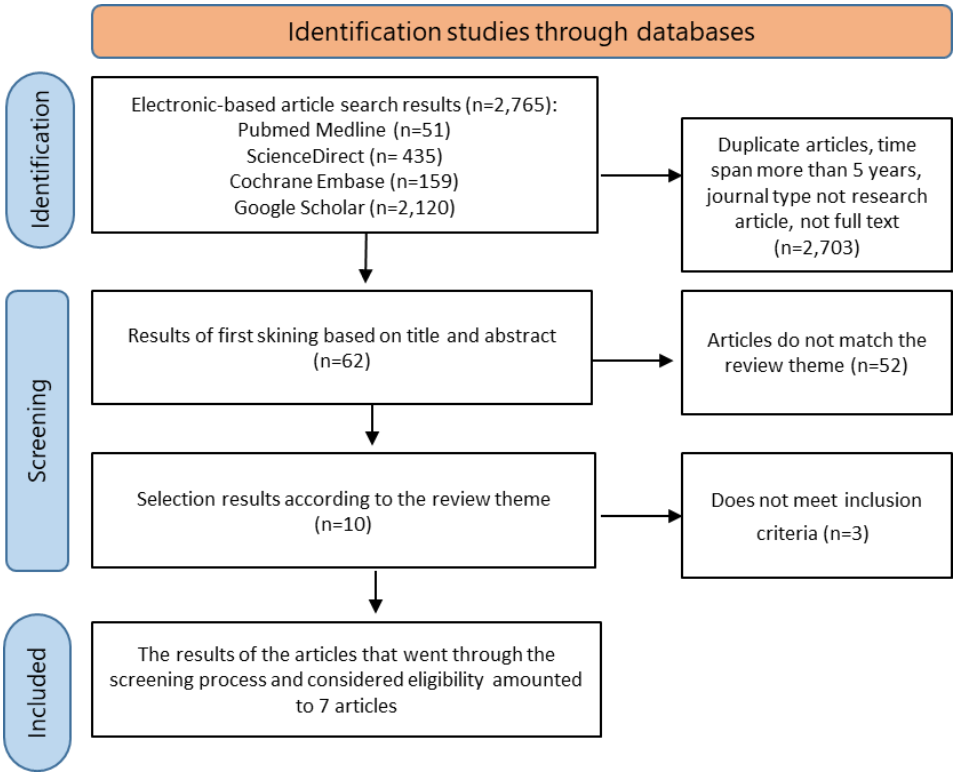

Figure 1. PRISMA Flow Diagram

DISCUSSION

Based on the search and selection results, 7 articles were selected that underwent critical appraisal. The seven articles come from 5 countries, namely Ethiopia (2 studies), Bangladesh (2 studies), Timor Leste, Ghana and Mongolia. 100% of the research subjects from all studies included children aged 6-23 months and mothers of toddlers aged 15-59 months. The range of study subjects was between 167-10,291 children. The research design is 100% observational research, 6 of which are studies that use national scale data in that country.

Among the five countries included in this review, it is known that Timor Leste has the lowest food insecurity with a percentage of 26.6% according to research by Bonis-Profumo (2020) and the country with the highest food insecurity is Mongolia with a percentage of 63.4% according to research by Janmohamed (2017)[18–20]. Household food security is known to provide adequate access to resources for each family member. Osei's (2010) research shows that food insecurity in the household will have different effects on children's MMF, MDD and MAD[21]. This is supported by research by Humphries (2015) which found that household food security is related to the anthropometry of children under 5 years because it determines the quality and quantity of the children's diet[22]. Therefore it is known that food insecurity has a negative effect on reducing children's MMF, MDD and MAD, causing children's growth to not be optimal.

Table 2. Research food safety data

Study	Food secure (%)	Food insecure (mildly, moderate, severe) (%)
Choudhury et al., 2016	48.1	51.9
Sunny S. Kim et al., 2016	51.9	53.7
Agbadi et al., 2017	63.9	36.1
Hasan et al., 2017	47.0	53.0
Janmohamed et al., 2018	36.6	63.4
Kuche et al., 2018	66.6	33.4
Bonis-Profumo et al., 2020	73.4	26.6

MDD is significantly correlated with the possibility of mothers providing adequate complementary foods for their children. Maternal MDD during childcare reflects the same maternal MDD during pregnancy. If the mother's MDD is known to be poor, then it also reflects the pregnancy outcome and child growth. Children who experience malnutrition are known to be related to the mother's lack of food consumption during pregnancy and this is carried over to the mother breastfeeding and providing complementary food for breast milk (MPASI) for the child.[17]. Based on study in Ghana[23], It is known that MDD is positively correlated with inadequate MAD in children and consistently supports research in Sub-Saharan Africa, South and East Asia, and Latin America[24–26].

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Good maternal MDD is associated with a lower prevalence of child malnutrition. Based on the results of research in Bangladesh, it is known that the worse the diversity of a mother's diet, the more it can support the occurrence of malnutrition in children because this is correlated with the poor quality and quantity of nutrition given to children from pregnant women to toddlers[27]. Maternal factors play a very important role in caring for and feeding children. This is closely related to the mother's level of education and literacy, the mother's exposure to information sources, and social support for the mother's parenting and child feeding patterns. The lower the mother's knowledge and desire to change the diversity of her diet, the greater the incidence of malnutrition in children.

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Table 3. Characteristics of selected studies

Author, Research Location, Year	Research Subject	Research Design	n Stunting/ Wasting	Food Insecurity Level	MDD in Mother	MAD in Children	MAD and Undernutrition	Research Result
Choudhury et al. Bangladesh 2016[28]	10,291 children <2 years old	Cross-sectional survey through the Food Security Nutritional Surveillance Project (FSNSP)	3168 (30.95%)	- Food secure = 4952 (48.12%) - Mildly food insecure = 513 (4.98%) - Moderately food insecure = 432 (4.2%) - Severely food insecure = 4395 (42.7%)	Overall MDD 54.6%	- Overall MAD = 30.85% - 6–8 months = 153 (11.5%) - 9–23 months = 2165 (35.64%) - 6–23 months without breast milk = 87 (22.31%)	MAD against wasting in children aged 6-11 months p=0.012, children aged 12-23 months p=0.003	Dietary diversity in children aged 6-11 months was significantly related (p=0.012), OR 1.47. Dietary diversity in children aged 12-23 months was significantly related (p=0.003), OR 1.22. There is a significant relationship between children's MAD and malnutrition in both age groups
Sunny S., Kim et al. Ethiopia 2016[29]	900 children aged 6-23.9 months, 1500 children aged 24-59.9 months (2400 children aged < 5 years)	Repeated cross-sectional through Ethiopia's Alive & Thrive (A&T) program	- 2010 = 55.9% - 2014 = 51.5%	Household food insecurity, % of children 0-23.9 months: 2010 = 64.7 2014 = 51.9 HH food insecurity, % of children 24-59.9 months: 2010 = 66.3 2014 = 53.7	Dietary diversity score (range 0–9) of mothers with children 0-23.9 months: 2010 = 2.7 ± 1.5 2014 = 3.1 ± 1.5 Dietary diversity score (range 0–9) Mothers with children 24-59.9 months: 2010 = 2.8 ± 1.4 2014 = 3.1 ± 1.4	MDD aged 6–23.9 months 2010 = 6.3% 2014 = 11.8% MMF aged 6-23.9 months 2010 = 45.6% 2014 = 70.4% MAD age 6-23.9% 2010 = 4.6% 2014 = 9.9%	Children's MAD against malnutrition p<0.05	There is a significant relationship between children's MAD on children's growth and the practice of giving MPASI to children = adjusted T2-T1 p<0.05
Agbadi et al. Ghana 2017[23]	871 children aged 6-23 months	Cross sectional secondary data Ghana 2012 Feed the Future Population Baseline Survey	-	Little to no hunger (food secure) = 63.9% Moderate hunger (food insecure) = 35.6% Severe hunger (food insecure) = 0.6%	Most mothers consume meat and fish (78.6%), but a small proportion consume other types of food (6%-50.4%)	MAD for children aged 6-11 months (reference) p<0.001 MAD children aged 12–17 months p=0.18, OR = 0.55 MAD children aged 18-23 months P<0.001, OR = 0.29	Children's MAD againts malnutrition p<0.05	There is a significant relationship between children's MAD and malnutrition

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Author, Research Location, Year	Research Subject	Research Design	n Stunting/ Wasting	Food Insecurity Level	MDD in Mother	MAD in Children	MAD and Undernutrition	Research Result
Hasan et al. Bangladesh 2017[27]	296 children aged <2 years	Case control Cases at Dhaka Hospital of ICDDR	Case = −2.71 ± 0.51 Control −0.13 ± 0.72 p<0.001	-	Case = 4.23 ± 0.31 (58% of mothers consume <5 food groups) Control = 4.89 ± 0.29 (45% of mothers consume <5 food groups)	MDD Cases = 7% Control = 16% MMF Cases = 56% Control = 68% MAD Cases = 4% Control= 11%	MAD children against malnutrition P=0.04 Adjusted OR = 1.72	MDD <5 food groups P=0.04, OR = 1.72 Children who consume <5 food groups are at 1.72 times the risk of malnutrition compared to children who consume ≥5 food groups
Janmohamed et al. Mongolia 2018[18]	938 children aged 6-23 months	Cross sectional secondary data from the 2017 Mongolia National Nutrition Survey	58 (6.3%)	Food secure = 343 (36.6%) Mild food insecurity = 146 (15.5%) Moderate food insecurity = 257 (27.4%) Severe food insecurity = 192 (20.5%)	MDD-W overall 45%	MMF = 325 (90.5%) MDD = 162 (45.3%) MAD = 148 (41.2%)	Malnourished children = adjusted T2-T1 p<0.05	Regarding the significant relationship between children's MAD and malnutrition
Kuche et al. Ethiopia 2018[30]	4,980 children aged 0–47 months	Cross sectional secondary data from the Sustainable Undernutrition Reduction in Ethiopia (SURE) baseline survey	-	Food insecurity score (HFIAS) (n = 1,667) P=0.04, OR= 0.98	MDD-W overall 1,775	Children aged 6-23 months who: Not consuming complementary foods (only breast milk) = 6% Consuming 1 type of food group = 16% Consuming 2 types of food groups = 31.1% Consuming 3 food groups = 26.9% Consuming ≥4 groups = 19.5%	Children's MAD (between 4-7 food groups) against malnutrition P=0.06, OR= 0.42	Maternal MAD against Malnutrition P=0.79, OR= 0.01 Children's MAD (between 4-7 food groups) on malnutrition P = 0.06, OR = 0.42 Children who consume 4-7 food groups do not have a significant relationship to malnutrition

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Author, Research Location, Year	Research Subject	Research Design	n Stunting/ Wasting	Food Insecurity Level	MDD in Mother	MAD in Children	MAD and Undernutrition	Research Result
Bonis-Profumo et al. Timor Leste 2020[19]	167 mothers and children aged 6-59 months	A longitudinal observational study cohort	-	Moderate and severe = 22% Severe = 4.6%	Mother's DSS (mean, SD) = 3.1 (1.3%) MDD = 14.4%	DDS in children (mean SD) = 2.5 (1.3%) MDD = 22.2% MFF = 47.5% MAD = 9.1%	P<0.001 OR= 1.11	MDD (yes) Mother to child's DDS P<0.001, OR= 1.11 Children who do not meet the MAD are at a significant 1.11 times higher risk of malnutrition

MAD: Minimum Acceptance Diets, MDD: Minimum Dietary Diversity, MDD-W: Minimum Dietary Diversity Women, MMF: Minimum Meal Frequency, OR: Odds Ratio, HH: House Hold, DDS: Dietary Diversity Score

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The transition from exclusive breastfeeding to MPASI is a challenge that is often difficult for mothers to overcome. The mother's unpreparedness in providing adequate MPASI to the child will cause the child to be late in getting his first meal and the tendency to provide food that is inadequate in quantity and quality to support the child's growth and development[13,31–33]. The fact that the diversity of a mother's diet is good is related to the diversity of her child's diet, which leads to a theory which shows that mothers who consume a variety of foods are more likely to be able to ensure their children's diet is better[18]. This is supported by the fact that the diversity of the mother's diet determines what food is served to the family considering that in the family sphere food is placed on the table and eaten together. So if the mother's food diversity is not good, it will also reflect on food consumption in the family[30].

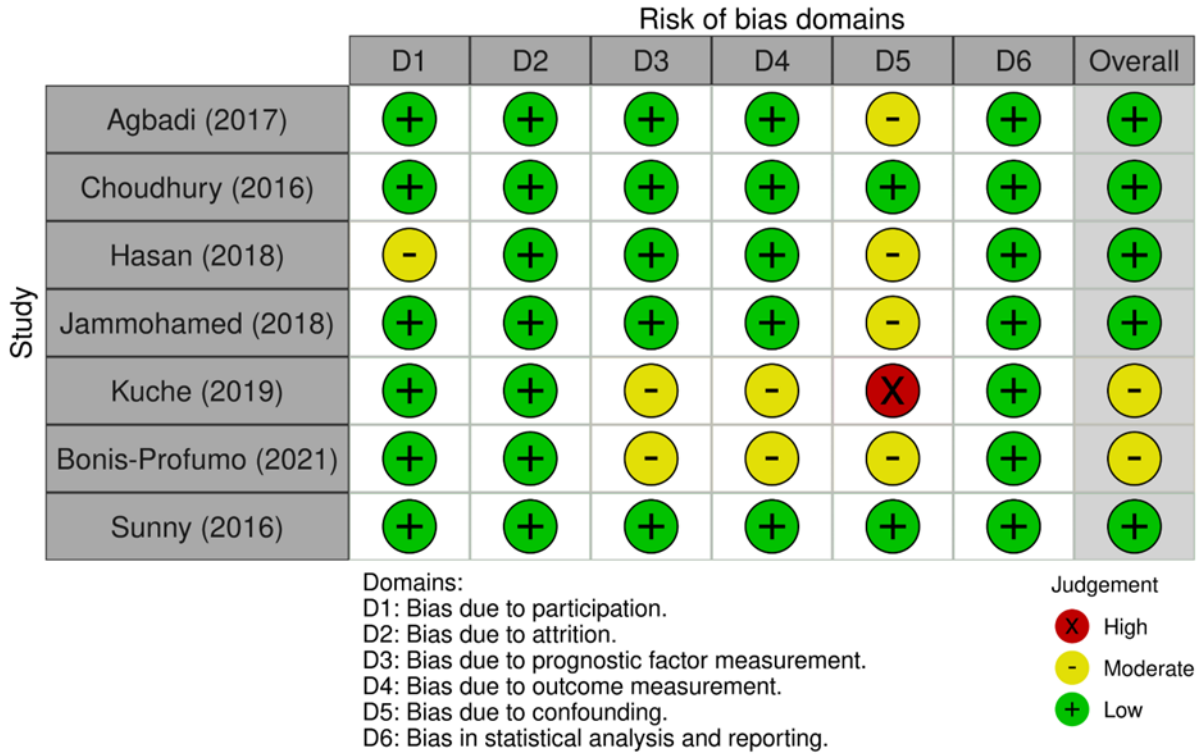

Figure 2. Graph of risk of bias in studies included in the review

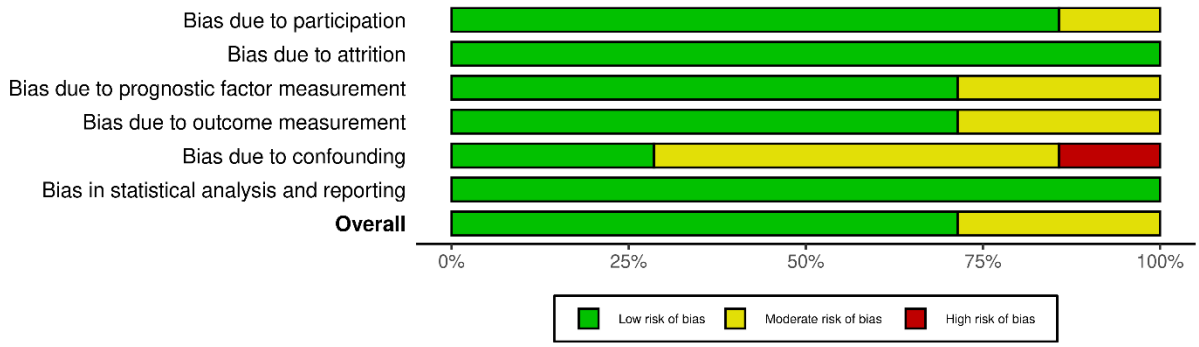

Figure 3. Table of risk of bias of studies included in the review

The research involved was only observational research, most of which was cross sectional. This means that an in-depth analysis of the relationship between MDD and MAD factors cannot be applied because it does not analyze other confounding factors such as economic/occupational level, education level, access to media, health services, and social factors. Some studies have small sample sizes so they are not representative of a country's population in general.

CONCLUSIONS

A number of studies related to nutrition and food security have shown a significant relationship between family food security and the outcomes of children's feeding practices. This is closely related to food diversity

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in the family, including the mother's food diversity. If the mother does not have adequate access to food, this will affect the diversity of the mother's food intake and will also affect the availability of food for the child. This of course will affect the child's food adequacy. If children do not have enough food, this will directly impact slowed growth and increase the incidence of malnutrition. As an effort to prevent malnutrition, it can be emphasized on every family to increase household food security so that it can increase the diversity of maternal food consumption and adequate food for children from pregnant mothers to children aged 5 years. For this reason, direct support from the government is needed by creating policies to increase family food security and providing special interventions, especially for families who have food insecurity in the household.

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