Original Article

J Prev Med Public Health 2022;55:549-558 • https://doi.org/10.3961/jpmph.22.199

pISSN 1975-8375 eISSN 2233-4521

Journal of Preventive Medicine & Public Health

Prevalence and Predictors of Complementary Feeding Practices Among Children Aged 6-23 Months in Indonesia

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Objectives: Poor complementary feeding practices have consistently contributed to the burden of child undernutrition in Indonesia. This study aimed to estimate the prevalence and predictors of the time of the introduction of solid, semi-solid, and soft foods (ISSSF), minimum dietary diversity (MDD), minimum meal frequency (MMF), and minimum acceptable diet (MAD).

Methods: We analyzed 4804 last-born infants aged 6-23 months from the 2017 Indonesia Demographic and Health Survey, which employed multistage cluster random sampling. The outcomes were calculated based on the 2021 World Health Organization/United Nations Children's Fund guidelines. The predictors of the 4 complementary feeding indicators were assessed using multivariate Poisson regression with robust variance adjusting for potential confounders and study design.

Results: The prevalence of ISSSF, MDD, MMF, and MAD was 86.1%, 54.3%, 71.8%, and 37.6%, respectively, with younger children less likely to meet 3 out of the 4 outcomes. Parental education, the presence of a birth attendant, and maternal media consumption were among the predictors of MDD and MAD. Children from families with higher income were more likely to meet MDD than those from low-income households (adjusted prevalence ratio [aPR], 1.16; 95% confidence interval [CI], 1.05 to 1.28). Living in an urban area was positively associated with MMF (aPR, 1.09; 95% CI, 1.04 to 1.15) and MAD (aPR, 1.12; 95% CI 1.02 to 1.24). In eastern regions, the prevalence of children achieving MDD and MAD was lower than in those living in Java and Bali.

Conclusions: It is crucial that more attention and efforts are made to improve the recommended practices throughout Indonesia, since the prevalence of adequate complementary feeding practices remains low.

Key words: Complementary feeding, Children, Demographic and Health Survey, Indonesia

Received: May 5, 2022 Accepted: September 30, 2022

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INTRODUCTION

Poor infant and young child feeding (IYCF) practices deteriorate the health, development, and nutritional status of children, increasing their risk of mortality. With 115 000 under-5 children dying annually, Indonesia was the country with the seventh highest burden of mortality in under-5 children in 2019 [1]. Complementary feeding is among the most effective interventions, reducing mortality in under-5 children by an esti-

mated 6% [2]. The World Health Organization (WHO) global strategy of IYCF recommends exclusive breastfeeding for the first 6 months of life and continued breastfeeding with timely, adequate, and safe complementary feeding up to 2 years of age or beyond [3]. Complementary feeding includes introducing solid, semi-solid, and soft foods (ISSSF), which when combined with breastfeeding is an important step in reducing the risk of undernutrition [4]. Meeting minimum dietary diversity (MDD) promotes linear growth, prevents micronutrient deficiencies, and enhances cognitive and physical development [5,6]. The minimum meal frequency (MMF) contributes to total energy and micronutrient intake, affecting infants' nutritional status [7]. ISSSF, MMD, MMF, and the minimum acceptable diet (MAD), which is a composite indicator calculated from the MDD and MMF, are 4 key globally recognized IYCF indicators.

In 2021, the WHO and United Nations Children's Fund (UNICEF) published updated guidelines from the 2008 definitions of IYCF indicators to rectify issues of MMD and MMF by including breastmilk as a food group [7]. After information was gathered from 2 major routine surveys—the Demographic and Health Surveys (DHSs) and the Multiple Indicator Cluster Survey—the method of measuring ISSSF was also updated. The new guidelines for calculating ISSSF are based on open recall and list-based recall, whereas the previous methods were based on feeding frequency [7].

Complementary feeding in Indonesia has not seen significant progress, as indicated by the stagnating trends in the percentage of children with MAD (41.0% in 2007 and 42.3% in 2017) and the MDD decreasing by 16.3% within a decade [8,9]. The 2012 and 2017 Indonesian DHS (IDHS) found that an estimated 20% of infants aged 6-8 months did not receive any complementary feeding [9]. Conversely, MMF among children increased from 52.9% to 72.0% [8,9]. Previous studies have identified numerous variables as predictors of complementary feeding practices [10-12]. However, inconsistencies exist in which variables are significantly associated and the associations' directions, even within a country. A review examining the feeding practices of children aged 6-23 months in Indonesia found that IYCF practices were still not optimal, and the indicators measured still varied, making comparisons difficult [13]. This study aimed to estimate the prevalence and predictors of 4 IYCF indicators (ISSSF, MDD, MMF, and MAD) in Indonesia, using the newly updated WHO/UNICEF 2021 guidelines.

METHODS

Data and Variables

This study used data from the 2017 IDHS, a nationally representative survey conducted every 5 years. It employed a two-stage cluster random sampling strategy, where the primary sampling unit was census blocks, which were selected during the first stage considering urban/rural blocks in each province. Within each block chosen, 25 households were randomly selected in the second stage. In each selected household, trained enumerators conducted an initial interview to determine eligible participants, including female aged 15-49 years and married male aged 15-54 years. Data were also collected on children aged 0-5 years and on the household. The study design and methodology have been described in more detail in the IDHS report [9].

The total sample size of infants aged 6-23 months in the 2017 IDHS was 5367. We restricted our analysis to last-born infants aged 6-23 months who were alive and resided with the mother. After applying those criteria and eliminating observations with missing data, 4804 observations were ready for analysis (Supplemental Material 1). In general, the response rate for DHSs is consistently high (>90%) [14], including that of individual female sampled in the 2017 IDHS (98%) [9].

This study covered 4 IYCF outcomes, which were calculated based on the 2021 WHO/UNICEF guidelines: (1) ISSSF, an indicator that measures the timely introduction of complementary feeding among infants aged 6-8 months; (2) MDD, an indicator measuring whether children aged 6-23 months meet the minimum dietary diversity; (3) MMF, an indicator that assesses whether infants aged 6-23 months meet the minimum meal frequency based on age; and (4) MAD, an indicator that reflects the minimum standard of infant feeding, which is calculated from MDD and MMF [7]. In addition to breastmilk, 20 solid, semi-solid and soft foods (SSSF) were listed in the questionnaires, and 1 open question that did not specify the food name was also asked to determine whether children were given the corresponding foods on the previous day, along with the frequency. Following the 2021 guidelines, we categorized the foods into 8 food groups: (1) breast milk; (2) grain, roots, tubers, and plantains; (3) pulses, nuts, and seeds; (4) dairy products; (5) flesh foods; (6) eggs; (7) fruits and vegetables containing a high level of vitamin-A; and (8) other fruits and vegetables.

We coded "yes" for ISSSF if the child was fed at least 1 of the 20 foods. Infants consuming at least 5 out of the 8 food groups

during the previous day were coded "yes" for MDD. The 2008 guidelines only calculated 4 out of 7 food groups for MDD since breastmilk was not counted [15]. The calculation for MMF differed by age groups: (1) 2 feedings of SSSF for breastfed infants aged 6-8 months; (2) 3 feedings of SSSF for breastfed infants aged 9-23 months; and (3) 4 feedings of SSSF or milk feedings for non-breastfed infants aged 6-23 months and at least 1 of the 4 feedings was SSSF. The condition for meeting MMF changed for non-breastfed infants, as in the previous guidelines there was no condition that 1 of the feedings must have been SSSF (i.e., MMF could be achieved by milk feeding only) [7]. We coded MAD as "yes" if the children met MDD and MMF.

To assess the predictors of each outcome, we selected 22 independent variables considered conceptually relevant based on previous studies [16,17], as illustrated in the proposed conceptual framework (Supplemental Material 2). The measurement of the independent variables is detailed in Table 1.

Statistical Analysis

We presented descriptive statistics as counts and percentages. The analyses employed multivariate Poisson regression with robust variance, and the results were given as adjusted prevalence ratios (aPRs) with the corresponding 95% confidence intervals (CIs) [18]. The initial step in building the model was identifying the crude association between each independent variable and the outcome. In this step, we also checked

Table 1. Definition of the independent variables

Variables	Definition (categories)
Individual level	
Mother's age	Age in years at the time of the survey (15-19, 20-34, 35-49)
Mother's education	The highest level of education attended (no formal education/ primary, secondary school, college/higher)
Mother's occupation	Occupation in the last 6 mo preceding the survey (not working, agriculture, other sectors); Other sectors include industrial, clerical, sales, services, and professional/technical/ managerial work
Father's education	The highest level of education attended (no formal education/ primary, secondary school, college/higher)
Infant's age	Age in months at the time of the survey
Infant's sex	Sex of the infant (male, female)
Birth interval	The difference between birth date of the child and birth date of preceding child in months (no previous birth, <24, ≥24 mo)
Birth order	The order in which a child is born (first child, second child, third or more)
Perceived birth size	The size of the child at born as perceived by the mother (small, average, large)
Place of delivery	The place of birth of the child (health facility, non-health facility)
Birth attendant	The presence of a birth attendant for the child (health professional, non-health professionals)
Antenatal care	No. of antenatal care visits (none, 1-3, ≥4 times), coded as a binary variable for ISSSF analysis (<4, ≥4 times)
Postnatal care	If the mother received postnatal care (yes, no)
Mother reading newspapers or magazines	If the mother read newspapers or magazines at any frequency (yes, no)
Mother listening to radio	If the mother listened to radio at any frequency (yes, no)
Mother watching television	If the mother watched television at any frequency (yes, no)
Mother's participation in decision making	No. of decisions that mothers took by herself or jointly with her partner; The decisions asked about were regarding her health, large household purchases, visiting family or relatives, and husband's earnings. (0, 1-3, 4)
Mother's attitude towards wife-beating	Mothers' agreement with the 4 reasons for domestic violence (neglecting children, burning food, arguing with husband, and refusing to have sex with husband): conforming if she agreed to at least 1 reason and not conforming if she did not justify domestic violence for all reasons (conforming, non-conforming)
Household level	
Household wealth index	A composite measure of a household's cumulative living standard calculated based on selected assets, housing materials, water, and sanitation facilities in the households (poor, middle, rich)
Health insurance	If the family had any health insurance (yes, no)
Community level	
Residence	Respondent's place of residence (urban, rural)
Geographical region	The region where the respondent lived (Java and Bali, Sumatera, Kalimantan and Sulawesi, eastern regions); The eastern regions included all provinces in Nusa Tenggara, Maluku, and Papua islands

ISSSF, introduction of solid, semi-solid, and soft foods.

for multicollinearity among all independent covariates using the variance inflation factor. We then combined the variables to form a full model, as all of the variables were considered conceptually relevant and there was no multicollinearity. Each independent variable was excluded stepwise from the full model based on the *p*-value, starting from the variable with the highest *p*-value. Variables with *p*-value ≤0.05 or for which the elimination affected the aPR by ≥10% were retained in the model (Supplemental Materials 3 and 4).

The IDHS applied 4 main sampling weights: household weights, household weights for male, individual weights for male, and individual weights for female [19]. In this study, we used the individual weights for female, as the observation unit was female with children aged 6-23 months. Data analysis was conducted in Stata version 15.1 (StataCorp., College Station, TX, USA), considering the study design and sample weights.

Ethics Statement

For the IDHS, ethical clearance was sought from the institution responsible for collecting the primary data. For this study, the authors were granted access and received an authorization letter to analyze the IDHS data after registering the study with the DHS.

RESULTS

Respondents' Characteristics

The sample of ISSSF consisted of 747 infants aged 6-8 months, while 4804 children aged 6-23 months were analyzed for the other 3 indicators. Over 70% of the mothers were between 20 years and 34 years of age and 23.4% had never been enrolled in formal education or only attended primary school (Table 2). Over 50% of mothers were unemployed, and fewer than 10% were employed in the agricultural sector. The respondents were relatively equally distributed across the 3 categories of the wealth index, as was the case for the respondents' distribution based on their residence.

Prevalence of the Complementary Feeding Indicators

Table 3 shows the distribution of infants achieving complementary feeding practices by their age. While almost 90% of infants aged 6-8 months had received ISSSF, over 30% of infants aged 6 months had still not received complementary foods. The overall percentage of infants meeting MDD was 54.3%.

Table 2. Individual-, household-, and community-level characteristics of infants, Indonesia 2017[1]

Characteristics	Infants (mo)	
	6-8	6-23
Unweighted sample size (n)	747	4804
Individual level		
Mother's age (y)		
15-19	44 (5.8)	173 (3.3)
20-34	546 (73.2)	3441 (71.6)
35-49	157 (20.8)	1190 (25.1)
Mother's education		
No formal education/primary	171 (21.7)	1089 (23.4)
Secondary school	410 (58.4)	2745 (59.3)
College/higher	166 (19.9)	970 (17.3)
Mother's occupation		
Not working	419 (56.6)	2549 (55.7)
Agriculture	52 (4.9)	400 (7.0)
Other sectors[2]	276 (38.5)	1855 (37.3)
Father's education		
No formal education/primary	181 (25.1)	1214 (26.1)
Secondary school	427 (56.5)	2806 (58.9)
College/higher	139 (18.4)	784 (15.0)
Infant's age (mo)		
6-11	-	1591 (33.2)
12-17	-	1715 (35.7)
18-23	-	1498 (31.1)
Infant's sex		
Male	402 (54.9)	2541 (51.9)
Female	345 (45.1)	2263 (48.1)
Birth interval (mo)		
No previous birth	261 (37.1)	1542 (33.4)
<24	47 (4.4)	302 (4.8)
≥24	439 (58.4)	2960 (61.8)
Birth order		
First child	261 (37.1)	1542 (33.4)
Second child	252 (35.6)	1550 (34.5)
Third or more	234 (27.3)	1712 (32.2)
Perceived birth size		
Small	83 (10.1)	613 (11.3)
Average	416 (58.0)	2593 (57.7)
Large	248 (31.9)	1598 (31.0)
Place of delivery		
Health facility	620 (86.6)	3805 (84.1)
Non-health facility	127 (13.3)	999 (15.9)
Birth attendant		
Health professional	696 (93.4)	4435 (93.6)
Non-health professional	51 (6.6)	369 (6.4)

(*Continued to the next page*)

Table 2. Continued from the previous page

Characteristics	Infants (mo)	
	6-8	6-23
No. of visits antenatal care[3]		
None	-	110 (1.9)
1-3	72 (6.4)	369 (6.1)
≥4	675 (93.6)	4325 (92.0)
Postnatal care		
Yes	515 (73.8)	3219 (69.0)
No	232 (26.2)	1585 (31.0)
Mothers reading newspapers or magazines		
Yes	324 (39.1)	2100 (38.3)
No	423 (60.9)	2704 (61.7)
Mothers listening to radio		
Yes	315 (40.4)	1929 (36.6)
No	432 (59.6)	2875 (63.4)
Mothers watching television		
Yes	711 (95.4)	4566 (96.1)
No	36 (4.5)	238 (3.9)
Mothers' participation in decision making[4]		
0	20 (1.7)	117 (2.1)
1-3	233 (34.4)	1559 (34.3)
4	494 (63.8)	3128 (63.6)
Mothers' attitude towards wife-beating[5]		
Conforming	241 (29.4)	1659 (31.3)
Non-conforming	506 (70.6)	3145 (68.7)
Household level		
Household wealth index[6]		
Poor	292 (32.1)	1902 (33.4)
Middle	242 (35.7)	1486 (33.3)
Rich	213 (32.1)	1416 (33.3)
Health insurance		
Yes	486 (62.3)	3106 (61.9)
No	261 (37.7)	1698 (38.1)
Community level		
Residence		
Urban	382 (51.4)	2429 (49.7)
Rural	365 (48.5)	2375 (50.3)
Geographical region		
Java and Bali	255 (59.6)	1552 (57.4)
Sumatera	186 (21.1)	1269 (22.5)
Kalimantan and Sulawesi	174 (12.1)	1147 (12.8)
Eastern regions[7]	132 (7.2)	836 (7.3)

Values are presented as number (%).
[1]All estimations were adjusted for the study design and sample weights.
[2]Other sectors included industrial, clerical, sales, services, and professional/technical/managerial work.
[3]Fitted as a categorical variable with 2 categories (<4 and ≥4 visits) for introducing solid, semi-solid, and soft foods analysis.
[4]Number of decisions that mothers took by herself or jointly with partners.
[5]Conforming if mothers agreed to at least 1 reason for wife-beating.
[6]Calculated based on selected assets, housing materials, water, and sanitation facilities in the households.
[7]All provinces in Nusa Tenggara, Maluku, and Papua.

Table 3. Percentage of infants who received solid, semi-solid or soft foods, MDD, MMF, and MAD, by age group, Indonesia 2017[1]

Indicators, infant's age (mo)	Sample size	n (%)	95% CI	
			LL	UL
ISSSF				
6	254	172 (67.9)	60.6	74.5
7	232	215 (94.3)	89.8	96.9
8	261	249 (96.3)	92.9	98.1
6-8	747	636 (86.1)	82.8	88.9
MDD				
6-11	1591	501 (34.2)	31.4	37.2
12-17	1715	1042 (62.9)	59.8	66.0
18-23	1498	959 (65.8)	62.6	68.8
6-23	4804	2502 (54.3)	52.5	56.1
MMF				
6-11	1591	1163 (71.8)	69.0	74.4
12-17	1715	1249 (71.7)	69.0	74.3
18-23	1498	1086 (72.0)	68.8	74.9
6-23	4804	3497 (71.8)	70.1	73.4
MAD				
6-11	1591	370 (25.2)	22.6	28.1
12-17	1715	725 (43.2)	40.2	46.3
18-23	1498	652 (44.3)	41.1	47.5
6-23	4804	1747 (37.6)	35.8	39.4

ISSSF, introduction of solid, semi-solid, and soft foods; MAD, minimum acceptable diet; MDD, minimum dietary diversity; MMF, minimum meal frequency; CI, confidence interval; LL, lower limit; UL, upper limit.
[1]All estimations were adjusted for the study design and sample weights.

Only 1 in 3 infants in the youngest age group met MDD, and this proportion increased 2-fold in the older groups. Around 70% of infants across all age groups met MMF, while only 37.6% met MAD. We also presented the prevalence of each outcome according to respondents' characteristics in Supplemental Material 3.

Predictors of Complementary Feeding Indicators

The final models of the multivariate analysis are available in Table 4. Infant age was among the predictors of ISSSF, MDD, and MAD, while mothers' age was only associated with MDD. The likelihood of infants achieving MAD increased with mothers' education level. However, for MDD, the positive effect of this maternal characteristic was only significant among those attending college/university compared to no formal or primary education (aPR, 1.17; 95% CI, 1.02 to 1.33). Similarly, infants whose fathers attended higher education were more likely to

Table 4. Final model for the predictors of complementary feeding indicators in Indonesia, 2017[1]

Variables	ISSSF (n=747)	MDD (n=4804)	MMF (n=4804)	MAD (n=4804)
IIndividual level				
Mother's age (y)				
15-19	-	1.22 (1.02, 1.46)*	-	-
20-34	-	1.00 (reference)	-	-
35-49	-	0.95 (0.88, 1.01)	-	-
Mother's education				
No formal education/primary	-	1.00 (reference)	-	1.00 (reference)
Secondary school	-	1.06 (0.96, 1.17)	-	1.18 (1.02, 1.40)*
College/higher	-	1.17 (1.02, 1.33)*	-	1.33 (1.11, 2.60)**
Mother's occupation				
Not working	-	1.00 (reference)	1.00 (reference)	-
Agriculture	-	0.81 (0.69, 0.96)*	1.02 (0.94, 1.12)	-
Other sectors[2]	-	1.03 (0.96, 1.10)	1.06 (1.01, 1.11)*	-
Father's education				
No formal education/primary	-	1.00 (reference)	-	1.00 (reference)
Secondary school	-	1.06 (0.97, 1.17)	-	1.08 (0.94, 1.23)
College/higher	-	1.17 (1.03, 1.32)**	-	1.30 (1.09, 1.54)**
Infant's age (mo)[3]	1.18 (1.13, 1.24)***	1.06 (1.05, 1.06)***	-	1.58 (1.43, 1.73)***
Birth order				1.31 (1.24, 1.40)***
First child	-	-	1.00 (reference)	
Second child	-	-	0.95 (0.91, 1.00)	
Third or more	-	-	0.92 (0.87, 0.97)**	
Place of delivery				
Health facility	-	-	1.08 (1.01, 1.16)*	-
Non-health facility	-	-	1.00 (reference)	-
Birth attendant				
Health professional	-	1.34 (1.13, 1.65)***	-	1.75 (1.30, 2.34)***
Non-health professional	-	1.00 (reference)	-	1.00 (reference)
Postnatal care				
Yes	-	-	1.09 (1.04, 1.15)***	-
No	-	-	1.00 (reference)	-
Mother reading newspaper or magazine				
Yes	-	1.13 (1.06, 1.20)***	1.06 (1.01, 1.10)*	1.18 (1.08, 1.30)***
No	-	1.00 (reference)	1.00 (reference)	1.00 (reference)
Household level				
Household wealth index[4]				
Poor	-	1.00 (reference)	-	-
Middle	-	1.07 (0.98, 1.17)	-	-
Rich	-	1.16 (1.05, 1.28)**	-	-
Community level				
Residence				
Urban	-	-	1.09 (1.04, 1.15)***	1.12 (1.02, 1.24)*
Rural	-	-	1.00 (reference)	1.00 (reference)
Geographical region				
Java and Bali	-	1.00 (reference)	-	1.00 (reference)
Sumatera	-	1.02 (0.95, 1.09)	-	1.00 (0.90, 1.11)
Kalimantan and Sulawesi	-	0.92 (0.84, 1.01)	-	0.90 (0.80, 1.01)
Eastern regions[5]	-	0.80 (0.71, 0.90)***	-	0.76 (0.64, 0.89)***

Values are presented as adjusted prevalence rate ratio (95% confidence interval).
ISSSF, introduction of solid, semi-solid, and soft foods; MAD, minimum acceptable diet; MDD, minimum dietary diversity; MMF, minimum meal frequency.
[1]All estimations were adjusted for the study design, sample weights and all variables with values in the corresponding column.
[2]Other sectors included industrial, clerical, sales, services, and professional/technical/managerial work.
[3]Fitted as continuous variable in the ISSSF analysis (values: 6, 7, and 8 months); an ordered categorical variable (values: 6-11, 12-17, and 18-23 months) fitted as a continuous term in the analysis of MAD, MMF, and MAD.
[4]Calculated based on selected assets, housing materials, water, and sanitation facilities in the households.
[5]All provinces in Nusa Tenggara, Maluku, and Papua.
*$p<0.05$; **$p<0.01$; ***$p<0.001$.

achieve MDD and MAD than those without formal or primary education. Mothers' occupation was also associated with MDD, particularly for those working in the agricultural sector, which decreased the likelihood of MDD by 19% compared to those that were not employed (aPR, 0.81; 95% CI, 0.69 to 0.96). Meanwhile, infants with mothers working in other sectors were more likely to achieve MMF than infants with non-working mothers.

There was some evidence that third-born infants had a lower likelihood of receiving MMF than first children (aPR, 0.92; 95% CI, 0.87 to 0.97). Having a birth attendant who was a health professional almost doubled the likelihood of MAD (aPR, 1.75; 95% CI, 1.30 to 2.34), and the effect size was smaller for MDD (aPR, 1.34; 95% CI, 1.13 to 1.65). Other maternal health-related behaviors, such as delivering in health facilities and receiving postnatal care, were associated with a higher likelihood of achieving MMF. Consuming printed media was also a predictor of those 3 outcomes, with an effect size ranging from 6% to 18%.

MDD was 16% more likely to be achieved by infants in wealthy families than in low-income families (aPR, 1.16; 95% CI, 1.05 to 1.28). Children living in urban areas had a higher likelihood of meeting MMF and MAD. The analysis of the geographical region as a predictor for MAD showed that infants from eastern regions had a lower likelihood of receiving MAD than those from Java and Bali (aPR, 0.76; 95% CI, 0.64 to 0.89). Nearly identical results were found for MDD.

DISCUSSION

The study, to the best of our knowledge, is the first to analyze the predictors of 4 key IYCF indicators in Indonesia using the updated WHO guidelines. The multivariate analysis revealed that the predictors of complementary feeding included paternal, infant, household, and community-level covariates.

In Indonesia, younger mothers had a higher likelihood of their infants meeting MDD, which agrees with the finding of a study conducted in Pakistan [20]. Younger mothers may have a higher exposure to IYCF through social media or other modern platforms. At the same time, they may be less committed to cultural beliefs discouraging recommended IYCF. Consequently, their knowledge and practice of MDD surpass those of older mothers [21]. Maternal education positively affected MDD and MAD, consistent with previous studies in India [22] and Myanmar [10]. A point of contrast is that no effect on MAD was found among mothers with secondary education in India, however, it had a positive effect in this study. A higher level of education may be indicative of higher socioeconomic status for mothers, and therefore can facilitate building knowledge related to optimal feeding practices, as indicated in our results. Our results found that the paternal education level was among the predictors of MDD and MAD, which is in line with a previous study from Pakistan [20]. Further, fathers with higher education levels had greater knowledge of IYCF and were more supportive and involved in feeding their infants [23]. Fathers are the primary decision-makers and providers of resources in the household in many settings; therefore, their roles in infant feeding such as supporting mothers' decisions on IYCF are vital [24,25].

Mothers' employment in the agricultural sector negatively affected reaching MDD due to seasonal work, low income, long hours and the physical demands of the job, which reduced the time to take care of their infants without providing significant financial benefits [26]. A previous IDHS analysis found that infants whose mothers were professionally employed with a high-income had a greater chance of meeting MDD than those with unemployed mothers [10]. Regarding MMF, evidence was found that female working in non-agricultural industries had higher frequencies of achieving this outcome. A study from Indonesia found that female felt that their work limited the time they have to feed their infants [27]. However, mothers may enlist other family members to feed their infants so that their work does not disturb the feeding frequency [28]. In some settings, family members, such as grandmothers, aunts, elder co-wives, and other senior female in the family, may have a higher authority than mothers. Therefore, mothers' decisions on IYCF are situated within the extended family structure, where the influence can vary, as mothers can have different circumstances: some reside with their husbands, and others may live with or near their in-laws or parents [29].

The infant's age was among the strongest predictors of ISSSF, MDD, and MAD, which concurs with recent analyses conducted in developing countries [30]. Socio-cultural norms have been recognized as an essential factor affecting the age at which infants should be given complementary feeding [31]. Mothers of older infants are more likely to have been exposed to more information related to IYCF, enabling them to adopt the recommendations. This study also found that infants who were born third or more were at a higher risk of not meeting MMF. In this context, having more than 2 children may increase the mother's workload, resulting in insufficient time to prepare

and feed their children at consistent times, despite achieving MDD and MAD.

In our study, the likelihood of meeting MDD and MAD was greater for those who delivered with a professional birth assistant due to the requirement that these attendants provide information on childcare and feeding practices, which concurs with the results of a study in India [32]. Antenatal visits were associated with MAD, while postnatal care promoted ISSSF and MFF. These variables both reflect mothers' contact with healthcare providers or health facilities and can therefore act as a proxy for better access to health, education, and a higher awareness of child nutrition, health and IYCF practices. Postnatal care enables mothers of newborns to be in contact with health staff and receive information about recommended infant feeding practices, which motivates mothers to provide complementary feeding as recommended [33]. Access to media such as newspapers or magazines could improve mothers' knowledge of IYCF [11,34]. This positive effect on maternal behavior was in line with our study and a previous study from Pakistan [20].

Low-income families were less likely to achieve MDD, corresponding to a previous study in Pakistan [20]. Low-income households often face challenges in providing sufficient nutritious foods for their children, with earlier studies demonstrating that this variable had been a constant barrier to improving MDD [35]. Inadequate complementary feeding practices, as indicated by low rates of MMF and MAD, were more prevalent in rural areas. This finding is in accordance with studies in India for both indicators [32] and Cambodia and Myanmar for MDD [10]. Infants in the eastern regions were less likely to meet MDD and MAD than those in Java and Bali. Some aspects of these geographical areas that could not be captured in this analysis, such as socio-cultural groups [36], cultural practices, and beliefs related to nutrition [37], may have contributed to this result. A review also concluded that there were social norms that disrupted complementary feeding practices, such as the right time to introduce SSSF [31,38]. That conclusion could also partly explain why the younger infants had a lower percentage of achieving ISSSF, MAD, and MDD. Geographical regions, particularly in Indonesia, also vary in terms of cultures, natural resources, access to healthcare, and food, which could not be captured in this analysis but may influence feeding practices.

Exploring the predictors of 4 complementary feeding practices using the new guidelines and nationally representative data in Indonesia provides meaningful information for tracking the progress of the IYCF programs in the country, which continues to struggle with a staggering rate of undernutrition in under-5 children. In addition, all analyses were adjusted for the complex study design and covariates to reduce potential bias. However, when interpreting the results of this study, we should notice that the cross-sectional study design does not enable causal inferences. The data on infant feeding were measured at 1 point by recalling the 24 hours prior to the survey, which gives different information than observations and measurements of feeding patterns.

This study provides meaningful insights into the prevalence and determinants of complementary feeding using the most recent guideline. However, as this is the first study to analyze these relationships in Indonesia, which has high rates of undernutrition, we suggest that future research use more detailed methods, such as primary studies with quantitative and qualitative methods, to formulate interventions for improving MDD, MFF, ISSSF, and MAD. Such methods would allow researchers to collect other essential variables not included in the DHS, while the qualitative approach provides abundant information that cannot be captured by quantitative information. Mothers who have younger infants and live in eastern regions of Indonesia and rural areas should be prioritized in IYCF programs. These programs may include encouraging mothers to seek antenatal and postnatal care. The government should consider interventions to improve the quality of the care provided by health facilities in both urban and rural areas. Improving access to health facilities could increase parents' access to complementary feeding education, which was positively associated with IYCF practices in our study.

SUPPLEMENTAL MATERIALS

Supplemental materials are available at https://doi.org/10.3961/jpmph.22.199.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

FUNDING

None.

ACKNOWLEDGEMENTS

We would like to thank the DHS program for the authorization to use the datasets.

AUTHOR CONTRIBUTIONS

Conceptualization: Nurokhmah S. Data curation: Nurokhmah S. Formal analysis: Nurokhmah S, Hendarto A. Funding acquisition: None. Methodology: Nurokhmah S, Hendarto A. Visualization: Nurokhmah S. Writing – original draft: Nurokhmah S, Middleton L. Writing – review & editing: Nurokhmah S, Middleton L, Hendarto A.

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