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Mothers' knowledge of breastfeeding and infant feeding types affect acute respiratory infections

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Keywords

Acute Respiratory Infections • Exclusive Breastfeeding • Feeding practice • Mothers' knowledge

Summary

Introduction. World Health Organization (WHO) recommends exclusive breastfeeding for new-borns until 6 months of age. However, exclusive breastfeeding in Indonesia only reached 52.3% in 2014 and 65.16% in 2018. It is known that administration of infant formula and non-formula supplements to infants aged less than 6 months increases the risk of Acute Respiratory Infections (ARIs). In addition, the high prevalence of ARIs in infants in Sleman Regency, Indonesia indicates the need of optimal early prevention. Therefore, we conducted this study to confirm that mothers' knowledge of breastfeeding and infant feeding types affect the prevalence of Acute Respiratory Infections (ARIs).

Methods. Data were collected through questionnaires from 50 mothers with infants aged 7-12 months who had experienced ARIs

in the last 3 months (case group) and 50 mothers with healthy infants (control group). Collected data were then analysed using Chi-Square, Logistic Regression, Lambda, and Somers' D tests.

Results. The results showed that types of infant feeding are associated with the prevalence of ARIs. Non-breastfed infants were 14 times riskier to contract ARIs. Mothers' knowledge of exclusive breastfeeding influenced their preferences of feeding practice. However, their attitude towards breastfeeding did not appear to significantly affect their choices of feeding practice.

Conclusions. Exclusive breastfeeding during the first 6 months of an infant's life can lower the prevalence of ARIs for when they are older. Mothers' good knowledge of breastfeeding is associated with its practice.

Introduction

Acute respiratory infections (ARIs) are acute infections in one or more parts of the respiratory tract extending from the nose to the alveoli in the lungs [1]. ARIs are caused by various pathogens such as bacteria or viruses [2]. ARIs produce several symptoms such as fever, cough, sore throat, flu, shortness of breath, wheezing or difficulty of breathing [3].

More than 10 million children under five years of age die every year, and one of the most common causes is ARIs [4]. Less developed countries have 2-6 times higher percentage of deaths caused by ARIs than developed countries [5]. In Indonesia, ARIs have become one of the main causes of infant death and often rank first on the morbidity rate of children under five years of age with a percentage of 20-30% [6].

The prevalence of ARIs is associated with ventilation condition, kitchen location, population density, socio-economic status, nutritional status and immunization status [5, 7]. Age is an independent risk factor for ARIs, and the risk of contracting ARIs is lower when we get older [8]. Exclusive breastfeeding, nutritional status and young age are associated with ARIs prevalence in infants and toddlers [8-10]. Exclusive breastfeeding prevents infants from broader exposure to pathogens [11] while

good nutritional status improves the immune system [12], resulting in lower risk of ARIs prevalence. On the other hand, infants at the age of less than 23 months old are riskier to contract ARIs [13], hence supporting the importance of breastfeeding up to two years of age.

Appropriate and timely feeding practices of breast milk, infant formula, and non-breast supplements in infants and toddlers can support their growth and development [14]. United Nations Children's Fund (UNICEF) and World Health Organization (WHO) recommend exclusive breastfeeding for new-borns until 6 months of age. Breastfeeding practice is encouraged to continue until 2 years of age with the addition of non-breast supplements after the first 6 months [15].

Based on the data acquired from the Health Profile of Indonesia in 2014, exclusive breastfeeding in Indonesia only reached 52.3% in 2014 and 65.16% in 2018 of the 80% target, showing that the targeted number has not been reached yet [10]. Maternal education on feeding practice increases mothers' knowledge on exclusive breastfeeding and its practice [4].

Organ systems of infants under 6 months of age are still immature, including their pulmonary, genitourinary, and gastrointestinal (GI) systems [16]. The epithelial layers, mucus secretions, and the mucosal immunologic system from those organ systems provide protection against

pathogens [17, 18]. In neonates, the mucosal immune system is still immature which makes them vulnerable to infections. At the same time, infants are at high risk of various antigen exposure shortly after birth [19]. The ingestion of breast milk helps regulate the development of the immune system in infants [20]. It also has been known that breast milk contains nutrition, anti-pathogenic and anti-inflammatory factors. These factors will provide passive defense mechanisms against pathogens [21]. In response to that, the WHO and UNICEF, as well as Indonesian Government, recommend mothers to exclusively breastfeed their infants for the first 6 months. Infant formula and non-breast supplements can be given after the infants reach 6 months old [10]. However, not all mothers practice exclusive breastfeeding. Therefore, to emphasize the importance of exclusive breastfeeding in relation to ARIs, we conducted this study to investigate the association between types of infant feeding and the prevalence of ARIs, as well as determining the association between mothers' knowledge and their attitude towards exclusive breastfeeding.

Methods

STUDY DESIGN, SITE AND ETHICAL CLEARANCE

This case-control study was conducted using retrospective techniques to study the association between feeding practice in infants aged 0-6 months and the prevalence of ARIs in infants aged 7-12 months in relation to mothers' knowledge and attitude towards exclusive breastfeeding. Data were collected from Maternal and Child Health Services in the area of 3 Community Health Centres (Mlati I, Godean I, and Gamping I) in Sleman Regency, Special Region of Yogyakarta, Indonesia. Those Community Health Centres were preferred because of the high ARIs prevalence on infants under 1 year of age in the last 4 years (2013-2016). The study was conducted in April-May 2017. It has acquired research permit from Regional Development Planning Department (Badan Perencanaan Pembangunan Daerah) of Sleman Regency (Ref. No.: 070/Bappeda/1632/2017) and has been approved by Medical and Health Research Ethics Committee of the Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada (Reference no. KE/FK/0457/EC/2017).

PARTICIPANTS

The participants of this study were 50 mothers of 7-12 months old infants with ARIs (case group) and other 50 mothers with healthy infants (control group). Calculation of sample size was performed using Odds Ratio sample size formula [22] for case control study, and the results showed that the study required at least 47 ($n = 46.27$) participants. Participants who met the inclusion criteria were selected using consecutive sampling technique. The inclusion criteria for the case group were mothers and their 7-12 months old infants who suffered from ARIs with non-pneumonia cough condition and were not being infected by other infections. For the control group, mothers and their

healthy 7-12 months old infants who had not been infected with ARIs in the last 3 months were chosen. The participants were either recruited at the Community Health Centres through a direct interview or selected by screening through the sign-up forms. For the case group, respiratory rate (number of breaths per minute) of the infants was recorded, and presence of stridor in infants was also observed. After the selection of participants, the mothers completed informed consent forms before the data collection using questionnaires was conducted.

DATA COLLECTIONS AND INSTRUMENT ASSESSMENT

Participants who consented were requested to provide demographic data consisting of mother and infant personal information and asked additional data to ensure that the chosen participants were appropriate for the study through direct interviews. The mothers were asked if their infants were born with normal weight, not having measles, diarrhoea, and asthma condition. Infant's nutritional status was measured by considering the body weight and height of the infants. Completeness of mandatory vaccinations (BCG, Hepatitis B, Polio, and DTP) in infants was also confirmed by the mothers. After the above screening process, data of feeding practice during the first 6 months of the infant's life were collected. Feeding practice was categorized into 6 types: exclusive breastfeeding, breast milk plus infant formula, breast milk plus non-formula supplement, infant formula, infant formula plus non-formula supplement, and mixed feeding (mix of breast milk, infant formula and non-formula supplement). The mothers were also asked to fill in the questionnaire related to their knowledge and attitude towards exclusive breastfeeding.

All of the questionnaires used in this study have been tested for instrument validity and reliability. ARIs screening questionnaire, adapted from Integrated Management of Childhood Illness-World Health Organization (IMCI-WHO), was used to select the participants. Feeding practice questionnaire was used to determine the type of feeding practice that the infants had been given during the first 6 months of life. The questionnaire of mothers' knowledge and attitudes towards exclusive breastfeeding was adapted from the Modules of Early Initiation of Breastfeeding Activities and 6 Months Exclusive Breastfeeding from the Ministry of Health of the Republic of Indonesia in 2008. The questionnaire of mothers' knowledge on exclusive breastfeeding consisted of 16 questions in the form of multiple choices (a, b, c and d) covering 5 major themes: definitions, benefits, procedures, when to breastfeed and how to manage problems related to breastfeeding. The questionnaire of mothers' attitude towards exclusive breastfeeding consisted of 12 attitude statements in the form of a Likert scale: Strongly Agree (SS), Agree (S), Disagree (TS) and Strongly Disagree (STS). The questionnaires of mothers' knowledge and attitude towards exclusive breastfeeding were then graded and classified into 3 groups: good (> 70%), enough (51-69%), and poor (< 50%). Data collection was conducted for approximately 45 minutes for each participant.

DATA ANALYSIS

The acquired data went through 5 steps of data analysis, which were editing, coding, data entry, processing, and cleaning. Coded data were then inputted to a data analysis software and processed. Data analysis was performed using univariate, bivariate, and multivariable analysis. Chi-Square Test (univariate analysis) was used to determine the distribution of participants' characteristics between case and control groups (mother's education level, mother's employment status, sex of the infants, mother's age, and number of children) and association between feeding practice and the prevalence of ARIs. Bivariate analysis, with Lambda tests, was used to observe the association between feeding practice during the first 6 months of infant life and the prevalence of ARIs when they were 7-12 months old. The same analysis was also used to see the association between mothers' knowledge and attitude towards exclusive breastfeeding and the type of feeding practice they were given to their infants during the first 6 months. The multivariable analysis using logistic regression was performed to determine the extent of the association of types of feeding practice, ARIs prevalence, and other variables involved in this study. The last step of the analysis was the cleaning process which served to double check if there were any errors with the inputted data.

Results

Demographic data of the participants are shown in Table I. It shows that there were no significant differences between the participants in both control and case groups in 5 aspects, which were mother's education background ($P = 0.29$), mother's employment status ($P = 0.30$),

sex of the infants ($P = 0.69$), mother's age ($P = 0.27$), number of children ($P = 0.18$), mothers' knowledge in breastfeeding ($P = 0.30$), and mothers' attitude towards breastfeeding ($P = 0.80$). The association between feeding practice and ARIs prevalence in infants is shown in Table II. The results showed that the association was statistically significant with $P = 0.001$. Based on the performed Lambda test, the I value was 0.50 (moderately positive), indicating that infants with mixed feeding were more likely to contract ARIs than breastfed infants. Table III shows the results of multivariable analysis on types of feeding practice in infants compared to exclusive breastfeeding to see which type of feeding practice highly affects ARIs prevalence (model 1). Mixed feeding had the highest risk of causing ARIs with an odds ratio 14 times higher than exclusive breastfeeding. Infant formula and infant formula plus non-formula supplement types of feeding also had 14 times higher risk to cause ARIs compared to exclusive breastfeeding. Mothers' knowledge (model 2), mothers' attitude (model 3) or both combined (model 4) did not affect the prevalence of ARIs. The analysis of all variables altogether (model 5) also did not significantly affect ARIs prevalence.

Table IV shows the association between feeding practice in infants and mother's knowledge and attitude towards exclusive breastfeeding. The percentage of exclusive breastfeeding in both groups is the highest with 36% in case group and 86% in control group. Mothers' knowledge was significantly associated with types of infant feeding ($P = 0.016$) with moderately positive correlation ($G = 0.38$). However, insignificant association between types of feeding practice in 0-6 months old infants and mothers' attitude towards exclusive breastfeeding was observed with $P = 0.17$.

Tab. I. Characteristics of mothers and infants (n case = 50, n control = 50).

Characteristics	Groups		χ^2	
	Case n (%)	Control n (%)		
Mother's education	Elementary school	0 (0,0)	3 (6)	0.29
	Junior high school	8 (16)	10 (20)	
	Senior high school	31 (62)	29 (58)	
	College	11 (22)	8 (16)	
Mother's employment status	Housewife	33 (66)	37 (75.5)	0.30
	Work	17 (34)	12 (24.5)	
Sex of the infants	Male	25 (50)	23 (46)	0.69
	Female	25(50)	27 (54)	
Mother's age	< 25 years	16 (32)	9 (18)	0.27
	25-35 years	30 (60)	36 (72)	
	> 35 years	4 (8)	5 (10)	
Number of children	≤ 2	47 (94)	43 (86)	0.18
	> 2	3 (6)	7 (14)	
Knowledge	Good	24 (48)	28 (56)	0.30
	Enough	24 (48)	22 (44)	
	Bad	2 (4)	0 (0)	
Attitude	Good	41 (82)	40 (80)	0.80
	Enough	9 (18)	0 (0)	

N: number of samples; χ^2 : chi-square compared test; if Sig. < 0.05: characteristic distribution between two groups is different (heterogenous); %: percentage.

Tab. II. The association between feeding practice and ARIs prevalence in infants (n case = 50, n control = 50).

Feeding practice	Groups				P	λ
	Case		Control			
	N	(%)	N	%		
Exclusive breastfeeding	18	36.0%	43	86.0%	0.001	0.500
Breast milk plus non-formula supplement	7	14.0%	2	4.0%		
Breast milk plus infant formula	9	18.0%	4	8.0%		
Infant formula	5	10.0%	0	0.0%		
Infant formula plus non-formula supplement	5	10.0%	0	0.0%		
Mixed feeding	6	12.0%	1	2.0%		

N: number of samples; p - χ^2 : the data were statistically significant if $p < 0.05$; λ : strength of Lambda test, the closer to 1, the correlation becomes stronger; %: percentage.

Tab. III. Multivariable analysis on the prevalence of ARIs (n case = 50, n control = 50).

	Model 1 ARIs	Model 2 ARIs	Model 3 ARIs	Model 4 ARIs	Model 5 ARIs
Exclusive breastfeeding	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]
Breast milk plus non-formula supplement	8.36* [1.58, 44.19]	8.37* [1.58, 44.31]	9.25* [1.69, 50.67]	9.46** [1.73, 51.76]	10.07* [1.67, 60.67]
Breast milk plus infant formula	5.37* [1.46, 19.72]	5.36* [1.42, 20.14]	5.93** [1.56, 22.50]	5.66* [1.47, 21.80]	7.46* [1.55, 35.89]
Infant formula	13.89** [1.56, 123.45]	13.89** [1.56, 123.45]	13.89** [1.56, 123.45]	13.89** [1.56, 123.45]	13.89** [1.56, 123.45]
Infant formula plus non-formula supplement	13.89** [1.56, 123.45]	13.89** [1.56, 123.45]	13.89** [1.56, 123.45]	13.89** [1.56, 123.45]	13.89** [1.56, 123.45]
Mixed feeding	14.33* [1.61, 127.73]	14.23* [1.50, 135.12]	19.05* [1.93, 187.73]	17.59* [1.72, 179.37]	20.50* [1.77, 236.80]
Mothers' knowledge		1.01 [0.41, 2.51]		1.24 [0.47, 3.32]	1.15 [0.38, 3.52]
Mothers' attitude			0.46 [0.12, 1.72]	0.42 [0.10, 1.69]	0.44 [0.10, 2.01]
Mothers' education					1.44 [0.63, 3.29]
Mothers' employment status					1.58 [0.52, 4.75]
Sex of the infants					0.92 [0.32, 2.66]
Mothers' age					0.94 [0.35, 2.53]
Number of children					0.54 [0.08, 3.63]
N	100	100	100	100	100
Pseudo R-squared (R^2)	0.148	0.148	0.159	0.161	0.202
AIC	113.3	115.3	113.9	115.7	119.7

N: number of samples; data presented as OR: Odds Ratio; CI (in brackets): Confidence Interval, max and min of OR; AIC: Akaike information Criterion; *: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$.

Tab. IV. The association between feeding practice in infants and mother's knowledge and attitude towards exclusive breastfeeding (n = 100).

		Types of feeding practice						P	G
		A1	A2	A3	A4	A5	A6		
		N	N	N	N	N	N		
Knowledge	Good	36	6	5	2	2	1	0.016	0.38
	Enough	25	3	7	3	3	5		
	Bad	0	0	1	0	0	1		
Attitude	Good	52	7	10	3	5	4	0.17	0.19
	Enough	9	2	3	2	0	3		
	Bad	0	0	0	0	0	0		

A1: exclusive breastfeeding; A2: breast milk plus non-formula supplement; A3: breast milk plus infant formula; A4: exclusive infant formula; A5: infant formula plus non-formula supplement; A6: mixed feeding; n: number of samples; p: statistically significant if $p < 0.05$; %: percentage.

Discussion

This study provides a more general conclusion on the relationship between exclusive breastfeeding and ARI prevalence in infants. Firstly, we identified 5 characteristics of participants to ensure that control and case groups had similar profile. The results showed that the participants of both groups were not different in the areas of mother's education, mother's employment status, sex of the infants, mother's age and number of children. The results also revealed that mothers' knowledge in breastfeeding and their attitude towards breastfeeding did not affect the prevalence of ARIs. However, mothers' knowledge in breastfeeding did affect their preference of feeding practice, especially exclusive breastfeeding.

ARIs often rank first as the cause of infant death in Indonesia. Exclusive breastfeeding for the first 6 months of life as recommended by WHO has been known to lower the risk of respiratory infections, especially in female infants [23-28]. The percentage of infections in infants with exclusive breastfeeding was lower than non-exclusive breastfeeding in the first year of life until they reached the age of 4 years [29]. According to another study, exclusive breastfeeding also contributes to the protection from common infections during infancy by reducing the frequency and severity of episodes. Partial breastfeeding appears to have no such protective effect [30]. The results of this study were in line with those studies. The Lambda test showed that mixed feeding correlates with the prevalence of ARIs, suggesting that exclusive breastfeeding is less likely to increase the chance of ARIs.

Breast milk, other than being an important source of nutrients, contains various bioactive factors that protect against infection and inflammation in infancy, and also contribute to organ development and the maturation of immune system [31-34]. The major bioactive factors found in human breast milk are cells, immunoglobulins, cytokines, chemokines, cytokine inhibitors, growth factors, hormones, anti-microbial, metabolic hormones, oligosaccharides and mucins [32]. The cell components consist of stem cells and macrophages, and the latter gives protection against infection and assists T-cell activation [35-37]. Immunoglobulins such as IgA/sIgA, IgG and IgM also contribute to the inhibition of pathogen binding, serve as anti-microbial and anti-inflammatory agent, and respond to allergens [38-40]. Lactoferrin and lactadherin act as anti-microbial components in breast milk [41-43]. Those bioactive components protect infants from infection, hence the lower prevalence of ARIs in infants who are exclusively breastfed during the first 6 months of life.

Infants aged 0-6 months are strongly encouraged to get exclusive breastfeeding unless they have specific conditions that require otherwise [4]. Infants who do not get exclusive breastfeeding usually get the other types of infant feeding such as exclusive infant formula, early non-formula supplements, or combination of both [44]. The results of this study showed that infants who were

fed with infant formula, infant formula plus non-formula supplement, and mixed feeding during the first 6 months of life had 14 times higher risk to contract ARIs than those who were exclusively breastfed. This likely occurred due to the lack of dynamic composition of breast milk [31, 33]. Standardized composition of infant formula still cannot mimic the composition or performance of breast milk. Addition of new ingredients to infant formula is often performed to enhance its composition but the risks still persist [45]. Infants fed with formula also have a higher prevalence of respiratory illnesses especially in the first year of life than infants with exclusive breastfeeding [46]. Non-formula supplements such as liquid and solid food also have different compositions of nutrients and bioactive molecules than breast milk. The administration of non-formula supplement decreases breast milk consumption and increases the risk of choking and allergic reaction [47-51]. Besides, early introduction of formula and non-formula supplement increases the risk of pathogen exposure in infants. Infectious agents may contaminate the bottles, teats, formula milk, unclean water used to prepare formula, liquid food and solid food [4, 25] while in breastfeeding, exposure to external pathogens can be minimized. That is why complementary foods are recommended to be given when the infants reach around 6 months of age [52].

The other risk factors for ARIs such as Low Birth Weight (LBW), incomplete immunization, nutritional intake and age were controlled in this study. However, Clean and Healthy Behaviour (CHB) and environment were factors that have not been controlled and reviewed more deeply in this study. It has been known that Sleman Regency has a fairly high percentage of smoking (26.2%) which may affect the incidence of ARIs in infants. Furthermore, some people still use inadequate water resources such as using unprotected well water (53.1%) and rainwater storage for household use (0.5%) which can increase the risk of infections and infant diseases [6].

Based on the results of Gamma test, mothers' knowledge was associated with their attitude towards exclusive breastfeeding which is in line with studies by Rachmaniah [53] and Yuliarti [54]. Factors influencing exclusive breastfeeding knowledge in this case are education, experience, socioeconomic and culture [55]. In this study, only 52% of participants had good knowledge of exclusive breastfeeding which is lower than similar studies conducted in Dabat Health Centre Northwest Ethiopia (69.8%), Abha City Saudi Arabia (55.3%), Guba Lafto Woreda Ethiopia (65.1%), Calabar Nigeria (80%) and Bedele Town Ethiopia (87.3%) [56-60]. The lower percentage of mothers' knowledge might be due to the limited distribution or access to information about exclusive breastfeeding. Furthermore, as it has been mentioned before, education affects mothers' knowledge about exclusive breastfeeding. Most of the participants of this study were high school graduates or less, and only 20% of the participants went to college. The knowledge about exclusive breastfeeding will influence mothers' attitude towards its practice [61, 62]. However, even

though the percentage of mothers' knowledge was low, 81% of participants had good attitudes towards exclusive breastfeeding.

Knowledge and attitude are predisposing factors for mothers in practicing exclusive breastfeeding [63]. However, in this study, Gamma test results indicated that mothers' knowledge was significantly associated with the type of feeding practice while their attitude towards exclusive breastfeeding did not affect their preferences of feeding practice. For instance, working mothers are less likely to give exclusive breastfeeding due to their busy schedules [64]. Some working mothers also prefer to express and freeze their breast milk for future infant feeding. Heat treatment and freeze-thaw processes can degrade many milk proteins and reduce the bioactivity of its components [32].

Conclusions

In conclusion, exclusive breastfeeding during the first 6 months of an infant's life can lower the prevalence of ARIs when they are older. This study revealed that mothers' knowledge of exclusive breastfeeding affected mothers' preferences of feeding types. Further exploration on why mothers with good knowledge and attitude towards exclusive breastfeeding did not implement their knowledge needs to be conducted to formulate better strategies in emphasizing the importance of exclusive breastfeeding during infant's early life.

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Conflict of interest statement

The authors declare no conflict of interest.

Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection, data analysis, and manuscript writing were performed by all authors. All authors read and approved the final manuscript.

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