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Structural Model for Preparing Safe and Hygienic Complementary Food in Indonesia

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ABSTRACT

Introduction: Early childhood nutrition is a fundamental determinant of optimal growth and development. The study aimed to evaluate how mothers provide complementary feeding (CF) to infants and young children aged 6-23 months. It explored factors influencing the adoption of safe and hygienic CF practices recommended by the WHO and Infant and Child Feeding Guidelines.

Methods: A non-experimental quantitative approach surveyed 1125 mothers across 28 districts/cities. Reliability was assessed using composite reliability (ρ_c), ensuring reliability threshold (≥0.7) was met. Although most constructs comprised single items, they were deemed reliable.

Results: Findings indicated that being the first child didn't significantly impact maternal understanding of CF (β=0.034, p=0.215) or adherence to safe CF practices (β=-0.001, p=0.307). Maternal employment status also showed no significant influence on CF knowledge (β=0.022, p=0.492) or safe CF practices (β=-0.001, p=0.568). However, maternal education significantly affected CF knowledge (β=-0.060, p=0.001) and safe CF practices (β=0.002, p=0.026).

Conclusion: In essence, higher maternal education levels correlated with better understanding of CF, thereby indirectly promoting safe and hygienic CF preparation.

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INTRODUCTION

Nutritional issues among toddlers in Indonesia remain significant (1). According to the 2022 Indonesian Nutrition Status Survey (SSGI), 7.7% of toddlers suffer from wasting, while 21.6% are stunted. The Indonesian government has prioritized addressing nutrition, particularly stunting, making it a key focus in the National Medium-term Development Plan 2020-2024 (2). In 2021, Presidential Decree No. 72/2021 was enacted to accelerate stunting reduction, aiming for a 14% reduction in stunting and 7% reduction in wasting by 2024 (3). Nutritional status significantly impacts human resource development success (4). The SSGI 2022 revealed a significant increase in stunting from 6-11 months (13.7%) to 12-23 months (22.4%), coinciding with the introduction of complementary feeding (CF), suggesting suboptimal CF practices in this age group (5). Studies in Dhaka, India, highlighted suboptimal CF quantity, composition, and consistency (6). Similarly, research in rural Dhaka revealed unacceptable CF type and frequency (7). Family support plays a crucial role in adhering to recommended CF practices, yet maternal knowledge gaps and influence from family members, particularly mothers-in-law, hinder optimal CF initiation and food choice (8).

The WHO 2023 Global Strategy for Infant and Young Child Feeding recommends seven crucial factors for providing appropriate food to infants and children under two, aiming for optimal growth and development (9), with CF playing a pivotal role (10). CF introduction is pivotal for establishing healthy long-term dietary patterns, preventing later-life non-communicable diseases like diabetes and hypertension (11). This critical period coincides with peak risk for growth faltering, nutrient deficiencies, and higher cognitive function development (6,12). In Indonesia, over 40% of infants are introduced to CF prematurely, leading to increased risks of diarrhea and upper respiratory tract infections (URTI). Suboptimal CF diversity and frequency persist among children aged 6 months to 2 years, with many lacking essential nutrients like vitamin A and iron. Responsive feeding practices are inconsistently applied, disproportionately affecting children from low-income families (13). Various factors contribute to nutritional issues, including inadequate food intake and frequent infections, compounded by parenting patterns, limited knowledge, and socioeconomic barriers to accessing nutritious food and healthcare. The proportion of toddlers consuming a varied diet is only 52.5%, while infections, particularly URTIs, remain prevalent (12,14).

The 2018 Indonesian Health Demographic Survey reported early CF introduction rates, indicating a need for improved maternal knowledge. Additionally, basic data from the Better Investment for Stunting Alleviation Program in North Central Timor revealed low maternal understanding of CF benefits and poor dietary diversity among children. Childhood stunting hampers physical growth, neurodevelopment, cognitive function, and predisposes individuals to chronic diseases in adulthood (15). Addressing stunting requires enhancing nutrition knowledge, education, water, sanitation, healthcare utilization, and poverty eradication. Maternal education, caregiving practices, and healthcare utilization significantly influence child nutrition outcomes (16). Ensuring food hygiene and sanitation during CF preparation and feeding is crucial for child health. However, around 9% of households engage in unhygienic practices, posing risks to child health. Addressing these challenges requires further research and standardized protocols (17). This study aims to identify determinants of safe and hygienic CF in line with WHO recommendations, offering insights to educate mothers and improve child nutrition outcomes.

Ensuring food hygiene and sanitation during CF preparation and feeding is crucial for child health. However, around 9% of households engage in unhygienic practices, posing risks to child health. Addressing these challenges requires further research and standardized protocols. This study aims to identify determinants of safe and hygienic CF in line with WHO recommendations, offering insights to educate mothers and improve child nutrition outcomes. Despite existing research on CF practices, there are specific gaps in the literature regarding the determinants of safe and hygienic CF practices in Indonesia, especially considering the influence of maternal education and employment status. This study builds on previous research by providing a comprehensive analysis of these factors in a large, diverse sample, thereby contributing to the body of knowledge and offering actionable insights for public health interventions.

METHOD

This research is a non-experimental quantitative study involving 1125 respondents who are mothers of children under two years old from 28 different districts/cities. Data collection was carried out through online distribution of questionnaires to mothers as target participants. The survey sample constitutes the total number of respondents. The survey was conducted between January 28th until February 2nd, 2024.

Questionnaire Development and Validation

The first page of the survey questionnaire provides clear and concise information about the survey's objectives, duration, confidentiality, and participants' agreement to participate (18). The data collection instrument used in the research was a closed questionnaire, where respondents selected a single correct answer from multiple options. The questionnaire was designed based on the guidelines for providing complementary feeding (CF) outlined in the Global Strategy for Infant and Young Feeding by the WHO in 2023. It was modified to include the following aspects: 1) Timeliness of CF introduction, 2) Adequacy of CF provision, 3) Safety and hygiene practices related to CF, and 4) Correct administration methods. This included considerations such as the appropriate timing for introducing CF, the method and quantity of CF given, the diversity of food types provided, common sources of animal protein,

responsive feeding practices, safe and hygienic handling and storage of CF, as well as common barriers encountered in providing CF to toddlers (15).

The questionnaire was developed through a multi-stage process. Initially, a draft was created based on existing literature and guidelines. This draft was reviewed by a panel of experts in public health, nutrition, and pediatric care to ensure content validity. Reliability was assessed using composite reliability (ρ_c) to ensure that the reliability threshold (≥0.7) was met. Although most constructs comprised single items, they were deemed reliable.

Data Analysis

The collected data was then used to examine the relationships between variables (19). The relationships between variables were analyzed using a structural equation modelling approach with the partial least squares parameter estimation method (PLS-SEM) (20). PLS-SEM is a widely used model for analyzing relationships between variables and moderating variables (21), consisting of a measurement model and a structural model (22).

Measurement Model

Measurement models are employed to evaluate the reliability and validity of the items and variables utilized in the model (21). Factor loading values are used to assess the reliability of the items, while composite reliability is used to evaluate the reliability of the variables/constructs. Both reliabilities should be at least 0.7 (21). Construct validity is measured through the average variance extracted (AVE), which should be a minimum of 0.5, indicating that the items comprising the construct can reflect at least 50% of its variance. Another metric evaluated in the measurement model is the heterotrait-monotrait ratio (HTMT), with a rule-of-thumb threshold of 0.85 indicating how distinct a construct is compared to others. Once all metrics in the measurement model confirm the validity and reliability of the items and constructs, the relationship between variables can be explored through a structural model (22). Structural model analysis is conducted using bootstrapping with a minimum of 5000 replications (19). The relationship between variables in the model is examined by considering the total effect of one variable on others. Bootstrapping involves resampling the obtained data repeatedly to generate new simulation data, allowing for the calculation of standard errors, confidence intervals, and hypothesis testing for various statistical analyses (23). Structural model analysis is conducted using bootstrapping with a minimum of 5000 replications. The relationship between variables in the model is examined by considering the total effect of one variable on others. Bootstrapping involves resampling the obtained data repeatedly to generate new simulation data, allowing for the calculation of standard errors, confidence intervals, and hypothesis testing for various statistical analyses.

RESULTS

The source population consisted of mother-child pairs with children aged 6-23 months, willing to participate in the survey from 28 provinces in Indonesia, including Sumatra (n=135), Kalimantan (n=230), Java (n=632), Sulawesi, Maluku, and Papua (n=59), as well as Bali-NTT-NTB (n=59). The majority of mothers had toddlers aged 12-23 months (64.9%), followed by 6-8 months (18.8%), and 9-11 months (16.4%). Most mothers were mothers of second-born children (36.3%). Maternal ages ranged from 17 to over 65 years, with the highest proportion falling between 26-35 years (53%), followed by 36-45 years (23.2%), 17-25 years (12.4%), 46-55 years (6%), 56-65 years (4.7%), and over 65 years (0.3%). The majority of mothers were housewives (76.4%), while 23.6% were employed. The highest levels of maternal education were high school (47.6%), followed by college (34.3%), secondary school (12.4%), elementary school (5.1%), and no schooling (0.6%). Approximately 78% of respondents initiated complementary feeding (CF) when their child reached 6 months or older. Around 50.8% of respondents reported encountering difficulties in providing CF to their toddlers.

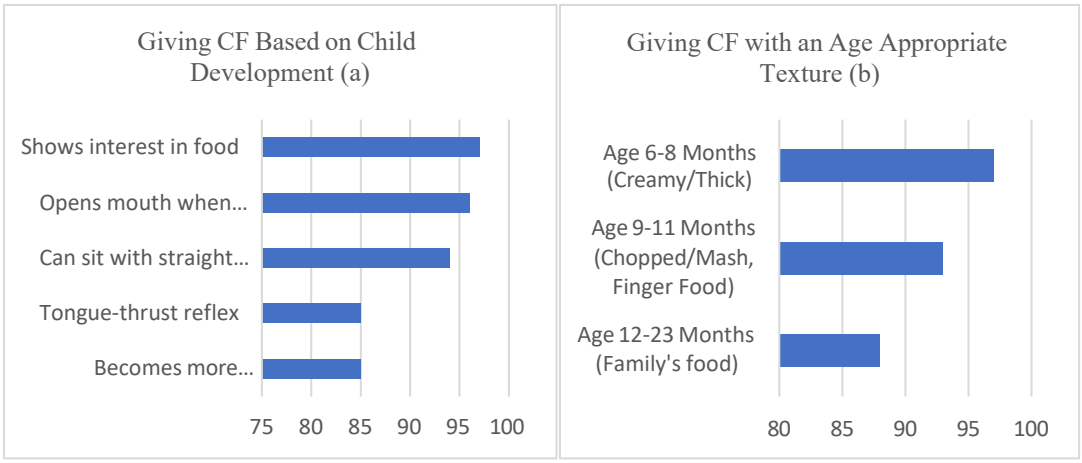


Diagram 1. Giving CF based on the child's development and with a texture according to the child's age

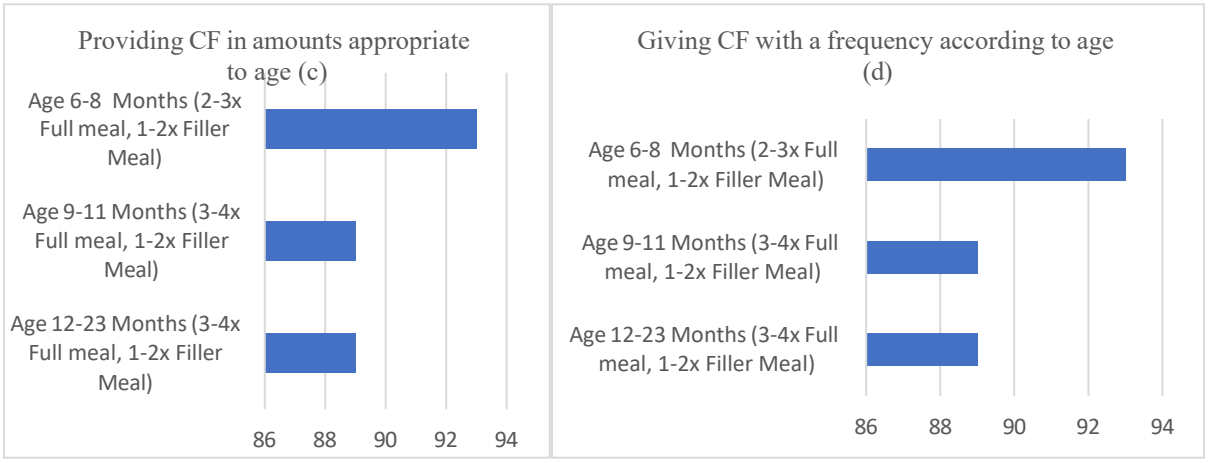


Diagram 2. Giving CF in quantity and frequency according to the child's age

According to the WHO 2023 Infant and Young Child Feeding (IYCF) guidelines, complementary feeding (CF) should adhere to several key principles: 1) Timely introduction of CF when breast milk alone no longer meets the baby's nutritional needs, ensuring adequacy and completeness of nutrients, 2) Ensuring CF is safe and hygienic, and 3) Employing the correct administration method, such as responsive feeding. As per the WHO 2023 recommendations, children aged 6-23 months should be fed responsively. Responsive feeding entails practices that actively encourage children to eat independently, taking into account their physiological and developmental requirements. This approach fosters self-regulation in eating and supports cognitive, emotional, and social development.

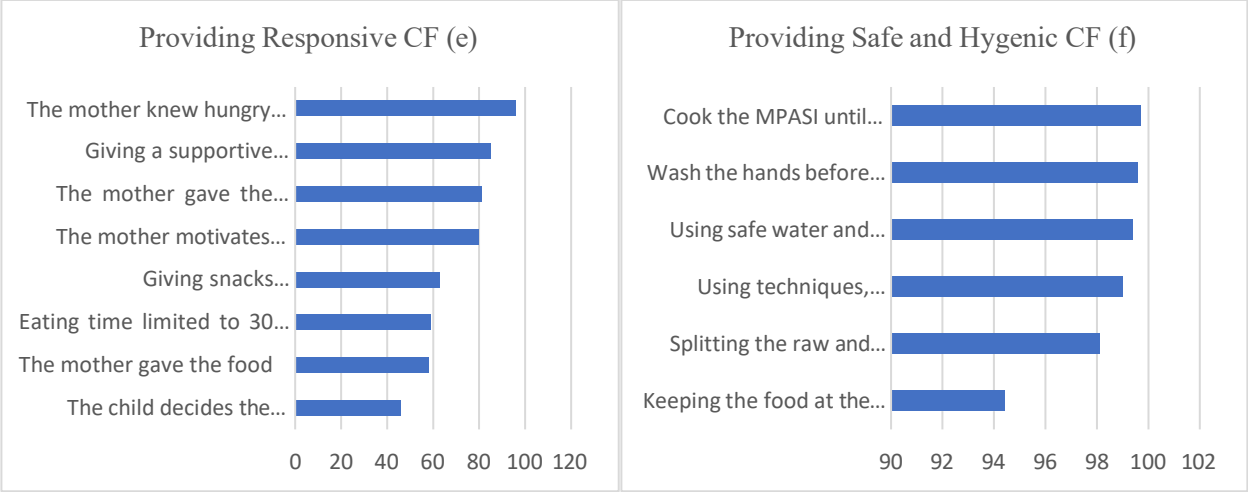


Diagram 3. Responsive provision of CF and safe and hygienic provision of CF

The findings reveal that 96% of mothers actively encourage their children to eat, recognize hunger and fullness signals (96%), create a supportive eating environment (85%), stick to meal schedules (81%), and encourage children to self-feed (80%). Additionally, 63% of respondents provide snacks regularly and in a planned manner, while 59% limit their children's eating time to a maximum of 30 minutes. However, 58% of respondents insist on feeding their children, and 46% allow their children to determine the amount of food consumed. Regarding safe and hygienic complementary feeding (CF) practices, 99.7% of respondents cook CF until fully cooked, wash their hands before handling food (99.6%), use safe water and raw materials (99.4%), employ hygienic methods, materials, and tools (99.0%), separate raw and cooked food (98.1%), and maintain food at the correct temperature (94.4%).

Measurement Model

The measurement model investigated the reliability and validity of the items and constructs used (19,22). This reliability value can be measured using composite reliability (ρ_c) with a threshold of 0.7. Almost all constructs consist of a single item; therefore, they are considered reliable. The only construct that consisted of multiple items was the safe complementary feeding construct, which showed a reliability value that met the threshold. In other words, the complementary feeding construct is reliable (21). To measure validity, one metric that can be used is the heterotrait monotrait ratio (HTMT). HTMT measures discriminant validity, which is the extent to which each construct in the model shows differences in the constructs it represents. Table 1 shows that each construct had good discriminant validity (less than 0.85) (20).

Table 1. HTMT Values Between Constructs

Track	ρ_c	HTMT			
		1	2	3	4
1. First Child	-				
2. Safe CF	0.704	0.151			
3. Mother's Occupation	-	0.068	0.078		
4. Mother's education	-	0.084	0.248	0.47	
5. Constraints on Mother's Knowledge	-	0.027	0.645	0.046	0.136

After the constructs and items are declared valid and reliable, the relationships between variables can be investigated through a structural model.

Structural Model

The structural model is a model that functions to test the significance of the relationship between variables in the model using the bootstrap method (19). The results of the bootstrap test of 5000 *resamplings* are shown in table 2 below.

Table 2. Total effects of variables in the model

Track	β	t	p
First Child -> Mother's Knowledge Constraints	0.034	1.241	0.215
First Child -> Safe and Hygienic CF	-0.001	1.022	0.307
Paint_Job -> Mother's Knowledge Barriers	0.022	0.687	0.492
Job_Category -> Safe and Hygienic CF	-0.001	0.572	0.568
Education_Category -> Mother's Knowledge Barriers	-0.060	4.288	0.001
Education_Category -> Safe and Hygienic CF	0.002	2.223	0.026
Mother's_Knowledge -> Mother's Knowledge Constraints	-0.030	2.842	0.004

The bootstrap results show that the child's status as the first child does not significantly influence the mother's knowledge of CF ($\beta = 0.034$, $p = 0.215$) and the mother's practice of safe and hygienic CF (β =-0.001, $p = 0.307$). The mother's working status also shows an insignificant influence on the mother's knowledge of CF ($\beta = 0.022$, $p = 0.492$) and the mother's practice of safe and hygienic CF (β = -0.001, $p = 0.568$). A different thing is shown by the mother's education which significantly influences the mother's knowledge of CF (β =-0.060, p =0.001) and the mother's practice of safe and hygienic CF ($\beta = 0.002$, $p = 0.026$). In other words, the higher the mother's education, the less knowledge barriers regarding CF will be, which will indirectly encourage them to be able to prepare CF safely and hygienically. The bootstrapping results showing the direct influence can be seen in Figure 1 below.

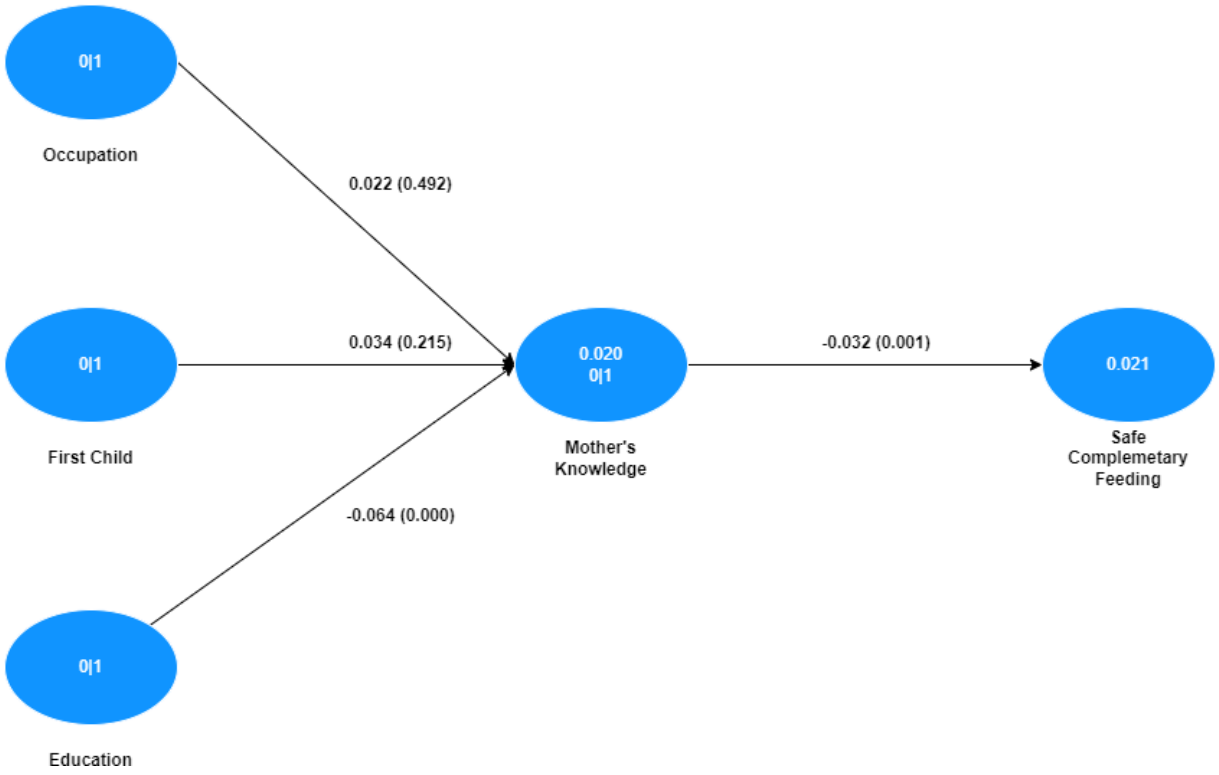


Figure 1. Path Coefficients Between Variables in the Model

DISCUSSION

This study revealed that half of the mothers (50.8%) reported encountering difficulties in providing complementary feeding (CF) to their toddlers (16). Adhering to appropriate basic feeding rules (BFR) according to age is crucial as it promotes optimal growth and development while preventing growth faltering in children. Research has shown that 33% of mothers cease attempting to feed their children when faced with refusal (24). Adequate CF is essential as breast milk alone becomes insufficient to meet the energy and nutritional requirements of children aged 6-23 months. Knowledge is closely linked to education, with higher education expected to yield broader knowledge. However, learning experiences also contribute to knowledge acquisition, skill development, and decision-making abilities (25). Mothers' knowledge concerning food preparation, storage, and serving processes is crucial to ensuring children receive healthy and safe food. Important aspects of food safety include sourcing food from safe sources, implementing adequate cooking methods, maintaining appropriate temperature control, preventing equipment and utensil contamination, and practicing personal hygiene (26).

Lack of knowledge and information during the Infant and Young Child Feeding (IYCF) period is one of the factors contributing to the failure to meet children's nutritional needs, consequently affecting their nutritional status. The prerequisites for providing complementary feeding (CF) include timeliness, adequacy, safety, hygiene, and responsiveness (27). Mothers' knowledge regarding the preparation of complementary foods alongside breastfeeding can be influenced by various factors, including their level of education (28). Higher levels of education typically grant greater access to sources of information, such as medical literature, educational programs, and consultations with well-trained healthcare professionals. Therefore, mothers with higher levels of education often have enhanced opportunities to acquire comprehensive knowledge about various aspects of childcare, including the preparation of CF (17).

The analysis results indicate that the knowledge barrier significantly impacts mothers' practice of providing safe and hygienic complementary food, aligning with findings from previous studies by Mamo et al. (2022) and Matthysen and Daniels (2014) (17). Research conducted by Berhanu Mamo et al. (2022) suggests that adequate knowledge enables mothers to provide appropriate complementary foods to their children. Essentially, mothers with limited knowledge about complementary foods are more likely to encounter difficulties in preparing safe and hygienic options for their children (6). This correlation between knowledge barriers and maternal education level is also supported by the findings of Mamo et al. (2022). Higher levels of maternal education afford greater access to information, as highlighted by Kainuwa et al. (2022) and (Kainuwa et al., 2013) (29). Moreover, mothers with higher educational backgrounds are better equipped to comprehend and assimilate information effectively during the information dissemination process, as emphasized by Edward et al. (2011) (30).

Furthermore, the analysis reveals that the child's status as the firstborn does not influence the knowledge barrier concerning complementary feeding, contrasting with the findings of a study by Nurokhmah et al. (2022). This disparity may be attributed to the knowledge barrier being primarily a psychological hindrance that impedes easy access to information. Additionally, Nurokhmah et al. (2022) observed a significant discrepancy in knowledge between firstborn and third-born children (28). The non-significant findings related to first child status suggest that factors other than birth order might be more influential in shaping maternal knowledge and practices regarding CF. This could include maternal education, access to healthcare information, and support systems. The third determinant in this structural model is the mother's employment status, which does not exhibit any influence on the barriers to mothers' knowledge of complementary feeding. This finding aligns with a study by Zahiruddin et al. (2016), which demonstrated that all mothers possessed equally good knowledge of breastfeeding and complementary feeding (31). However, working mothers encounter challenges in implementing complementary feeding practices, as they must juggle work commitments and household chores while caring for their children (32). Additionally, preparing baby food in advance and storing it in sealed containers in the refrigerator or freezer poses another challenge for working mothers (31). The non-significant influence of maternal employment on CF practices highlights the need for more supportive policies and workplace accommodations to help working mothers manage CF more effectively. This includes flexible working hours, parental leave, and access to childcare facilities.

The findings of this study carry several practical implications. Firstly, when educating mothers on the importance of safe and hygienic complementary foods, it is crucial to tailor the approach according to their level of education. This underscores the necessity for employing varied strategies that cater to the educational backgrounds of individual mothers, ensuring that information is comprehensible to them (33). Secondly, mothers' knowledge regarding the preparation of complementary foods alongside breastfeeding may be influenced by diverse factors, including their level of education. However, the correlation between education level and knowledge is not always straightforward. While there exists a relationship between these factors, other variables such as access to information, cultural norms (34), environmental factors, and personal experiences also significantly contribute (35). The outcomes of this research are anticipated to contribute to the field of public health by advocating for effective approaches to preparing complementary foods for mothers, employing diverse and inclusive strategies (33). This may entail implementing educational programs tailored to varying levels of education, as well as initiatives aimed at modifying behaviors related to providing complementary foods to children, taking into account determinants that can influence the safe and hygienic provision of such foods (31).

While introducing novel insights into the determinants that both encourage and discourage mothers from preparing safe and hygienic complementary foods, this study is subject to certain limitations. Firstly, there is a potential for sampling bias, as it only reached individuals who were sufficiently interested in the topic to dedicate their time to complete an online questionnaire, had access to the internet, and/or chose to respond to the survey (36). The voluntary nature of participation may have led to respondents self-selecting for the sample, thus introducing bias. However, it is widely acknowledged from various experiences that utilizing an online questionnaire, as opposed to traditional face-to-face surveys, offers greater effectiveness. Secondly, the study's data is cross-sectional, which may introduce bias in analyzing causal relationships (37). Future research should aim to collect longitudinal data to enable more accurate analysis of causal relationships

CONCLUSION

This study found that half of the mothers (50.8%) reported facing difficulties in providing complementary feeding (CF) to their toddlers. The firstborn status of the child did not significantly impact the mother's understanding of CF (β=0.034, p=0.215) or the mother's practice of safe and hygienic CF (β=-0.001, p=0.307). Similarly, the mother's employment status showed no significant influence on her understanding of CF (β=0.022, p=0.492) or her practice of safe and hygienic CF (β=-0.001, p=0.568). However, maternal education exhibited a notable influence on both the mother's understanding of CF (β=-0.060, p=0.001) and her practice of safe and hygienic CF (β=0.002, p=0.026). In essence, higher maternal education levels were associated with fewer knowledge barriers regarding CF, indirectly encouraging mothers to prepare CF safely and hygienically. Furthermore, the mother's employment status did not impact the knowledge barriers affecting the mother's understanding of CF, as both working and non-working mothers demonstrated similar levels of knowledge about CF.

This study has several limitations. Firstly, the potential for sampling bias exists as it only reached individuals who were sufficiently interested in the topic to dedicate their time to complete an online questionnaire, had access to the internet, and/or chose to respond to the survey. Secondly, the study's cross-sectional data may introduce bias in analyzing causal relationships. Future research should aim to collect longitudinal data to enable more accurate analysis of causal relationships and consider employing mixed methods to gain deeper insights into the determinants of safe and hygienic CF practices. Additionally, further studies could explore the role of cultural, socioeconomic, and environmental factors in influencing CF practices to develop more targeted and effective interventions.

The introduction of complementary feeding (CF) presents a crucial opportunity to instill healthy eating habits, tailored to the mother's educational level, while considering various influencing factors affecting the safe and hygienic provision of CF. Based on the research findings, it is recommended to offer education and support to mothers and their families, including husbands, emphasizing the significance of safe and hygienic CF practices. Customized approaches are essential, aligning with the mother's educational background, ensuring information is presented at a level comprehensible to them. Continual encouragement should be provided to mothers, regardless

of their employment status, coupled with measures to prevent and address infectious diseases. This approach aims to instil confidence and readiness in mothers to effectively provide CF to their infants.

AUTHOR'S CONTRIBUTION STATEMENT

All authors have read and agreed to the published version of the manuscript

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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