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ORIGINAL RESEARCH

Development and Validation of Questionnaire to Measure Parents' Knowledge, Attitude, and Practice on Self-Medication of Children with Antibiotics in Bandung, Indonesia

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Purpose: This study aimed to develop and validate a questionnaire to measure the knowledge, attitude, and practice of parents regarding antibiotic use in Indonesian children using structural equation modeling (SEM) analysis.

Methods: The instrument development process was conducted from January 5 to 19, 2023, using the following steps: 1) literature review and item development, 2) internal review and refinement, 3) structural model analysis, and 4) measurement models' reliability and validity. A convenience sample was used to recruit parents as participants from Arcamanik District, Bandung, Indonesia. A total of 83 respondents completed the on-site interview questionnaire. Furthermore, statistical analyses were performed using SPSS Version 21.0 and Analysis of Moment Structures (AMOS) Version 26.0.

Results: The content validity for the scales was over 50%, and the reliabilities for the 38 items of the questionnaire were above 0.6, respectively. The suitability of the model was assessed, and the findings showed parameters for indicators: chi-square = 0.0004, CFI = 0.977, RMSEA = 0.044, CMIN/DF = 1.162, AGFI = 0.651, TLI = 0.973, and NFI = 0.860. The GFI parameter did not fit with the output value of 0.718, while the convergent and divergent validity of scores provided evidence in the expected direction.

Conclusion: This psychometric development study provides preliminary evidence that the 38-item scales were reliable and valid for assessing knowledge, attitude, and practice toward parents in the self-medication of antibiotics in children.

Keywords: drug resistance, children, parents, validity, reliability, structural equation modeling

Introduction

The emergence of resistance among the most important bacterial pathogens is recognized as a major public health threat affecting humans on a global scale and should be considered a high priority by all healthcare workers and institutions. The irrational use of antibiotics, such as the wrong antibiotic or dose leads to a significant increase in the infection rate of multidrug-resistant bacteria.[1] This infection pertains to infectious diseases instigated by bacteria possessing a specific resistance to antimicrobial drugs. After the onset of drug-resistant bacterial infection, it substantially prolongs the patient's duration of hospitalization and exerts an influence on the case fatality rate and overall medical expenditures.[2,3]

The incidence of antibiotic resistance (AMR) is also a public health threat relating to children. According to WHO data, infections caused by multidrug-resistant (MDR) bacteria result in 700,000 deaths across all ages, of which around 200,000 are newborns.[4] In Europe, MDR infections in pediatric patients may represent up to 30% of the total cases.[5] In Southeast Asia, including Indonesia, 83% of children are affected by E. coli resistant to first-line antibiotics.[6] This is

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because AMR is more difficult to treat and is related to a more severe and prolonged illness leading to longer hospitalization times, with a 20% increase in length of stay and a poorer outcome, raising mortality by up to 40% in MDR hospital-acquired infections.[7–10]

Lack of knowledge among parents regarding the judicious use of antibiotics in managing common childhood illnesses is one of the reasons for increased AMR.[11] According to Karuniawati et al, 63% of 575 parents assumed that antibiotics could be used to treat viral infections and reduce fever.[12] In addition, some stated that antibiotics could be stopped when the disease was cured and reused in the future.[12] In another previous study, there were significant gaps in parents' understanding of antibiotics. There is a belief held by some parents that antibiotics should be administered whenever a child encounters a fever, and shorter courses of antibiotics are more beneficial for their well-being.[13,14] Therefore, the development of psychometric properties to assess the knowledge, attitude, and practice (KAP) of parents regarding this issue is urgently needed.

This study aimed to develop and validate a questionnaire to measure the knowledge, attitude, and practice of parents regarding antibiotic use in children using structural equation modeling (SEM) analysis. This is the first analysis to investigate the psychometric properties of the Indonesian-parent KAP in the use of antibiotics in children. The questionnaire is used as a standard that can provide specifications, guidelines, and characteristics that can be used consistently. A validated standard is important to ensure accurate data, provide clear data, and ensure the legitimacy of research findings. The results provided data for stakeholders to better strategize interventional plans and implement necessary measures to reduce the impact of antibiotic misuse on children.

Methods

Questionnaire Design

Literature Review and Item Generation

The initial step in developing the study instrument was to identify the most representative variables in four domains as presented in Table 1. These were identified and selected based on a literature review of articles published in international journals from India,[15] the United Arab Emirates,[16] and Saudi Arabia[11] as well as according to the government guidelines regarding the Handbook of Antibiotic use in Indonesia.[17] Based on these variables, a draft of the instrument for the parents' assessment of self-medication of children with antibiotics consisting of 48 items grouped in five blocks. The first 9-item set was intended for social and demographic identification and the rest of them was a Likert scale. Scores were

Table 1 The Critical Ratios of the Trajectories Between the Items of the 4 Latent Variables

Items	Estimate	S.E.	C.R***
Knowledge			
K1. Antibiotics should be administered according to the doctor's recommendations, even though the symptoms of the disease are starting to improve	0.956	0.084	11.366
K2. Antibiotics need to be taken when a child is sick, regardless of the disease	0.944	0.088	10.763
K3. Antibiotics are mandatory when treatment with other drugs has no effect	0.810	0.098	8.293
K4. Antibiotics are used to treat diseases caused by viral infections	0.993	0.085	11.664
K5. Cough requires antibiotics	0.962	0.085	11.322
K6. Fever should be treated using antibiotics	0.643	0.086	7.472
K7. Misuse of antibiotics can take a long time to heal	0.732	0.090	8.169
K8. Diarrhea is a disease that requires antibiotics	0.790	0.090	8.785
K9. Inappropriate use of antibiotics can cause antibiotic-resistant bacteria	1.011	0.083	12.174
K10. Inappropriate use of antibiotics can lead to increased medical costs	1.020	0.084	12.091
K11. Antibiotics can kill the "good bacteria" in the body	0.922	0.096	9.606
K12. Penicillin or Amoxicillin are examples of antibiotics	0.843	0.091	9.286
K13. Paracetamol is an example of an antibiotic	0.846	0.086	9.820
K14. Antibiotic resistance is a phenomenon when an antibiotic loses its ability to kill bacteria	1.000	-	-

(*Continued*)

Table 1 (Continued).

Items	Estimate	S.E.	C.R***
Practice			
P1. I can treat my children with antibiotics without consulting a doctor or pharmacist	1.000	-	-
P2. I decided to give antibiotics for self-medication if my child's illness did not improve after a few days	0.909	0.101	9.028
P3. I decided to give antibiotics for self-medication as soon as my child's symptoms (such as cough and fever) appeared	0.879	0.101	8.690
P4. I give antibiotics for self-medication to my child after getting feedback from family members or friends	0.975	0.101	9.635
P5. I decide the dosage or amount of antibiotics for my child's self-medication after reading the leaflet or information on the medicine packaging	0.934	0.097	9.676
P6. I give my child antibiotics for self-medication based on my previous experience	0.889	0.087	10.243
P7. I give antibiotics for self-medication to my child after reading information on the internet	1.013	0.078	13.009
P8. I will stop giving antibiotics to my child after the symptoms are gone	0.904	0.076	11.861
P9. I will stop giving antibiotics to my child after 3–5 days, regardless of the results or improvement	0.931	0.071	13.163
P10.I get antibiotics for self-medication from pharmacy	1.018	0.079	12.833
P11.I get antibiotics for self-medication for my child from the antibiotics I previously used	0.925	0.076	12.144
P12.I get antibiotics for self-medication for my child from friends, family, or neighbors	1.002	0.080	12.571
Attitude			
A1. I administer antibiotics as a stand-alone treatment because my child has previously experienced the same symptoms	0.784	0.064	12.257
A2. As a parent, I feel that giving antibiotics is very effective in curing any disease in my child	0.830	0.063	13.134
A3. I give antibiotics as a stand-alone treatment because I believe my child's illness is minor	0.893	0.053	16.987
A4. I give antibiotics to my child as independent treatment because I felt that I needed to wait a long time to go to the clinic	0.894	0.057	15.632
A5. I give antibiotics to my child as independent treatment because of the high cost of consulting a doctor	0.868	0.071	12.185
A6. I give antibiotics as self-medication to my child because I know as a medical professional (I am a pharmacist, doctor, or another health worker)	0.904	0.076	11.956
A7. I have to immediately give my child antibiotics as self-medication as soon as the other children around him have fevers or cold	1.012	0.063	16.178
A8. I prefer antibiotics, which are more expensive for self-medication (treatment without a doctor's prescription), for my child	1.000	-	-
Facilitator			
F1. I need to get adequate information from health workers (doctors, pharmacists, and other health workers) regarding the appropriate and wise use of antibiotics for my child	1.000	-	-
F2. I need to take part in educational activities (eg, workshops, webinars, lectures) regarding the correct and wise use of antibiotics for my child	1.043	0.100	10.407
F3. I need to have correct and practical guidelines regarding the appropriate and wise use of antibiotics for my child	1.007	0.100	10.092
F4. I need to get better and optimal access to the clinic regarding my child's illness that requires the use of antibiotics	0.975	0.096	10.120

Note: ***=p<0.001.
Abbreviations: K, knowledge items; P, perception items; A, attitude items; F, facilitator items; S.E., standard errors; CR, critical ratio.

encrypted from 1 to 5 ("strongly disagree", "disagree", "doubtful", "agree", and "strongly agree") to prevent intermediate values from being positive or negative on each item.

Internal Review and Refinement

Upon identification of the conceptual concerns, a panel comprising seasoned experts from one clinical and four academic backgrounds engaged in a collaborative brainstorming session. The objective of this session was to formulate components derived from the item pool that align with the purpose of this study. Furthermore, the items were reviewed and the wording accurately captured the intended concept for gathering relevant information. The measures of readability, length

of items, reversed items, and the format of measurement were also considered in the refinement process. The knowledge, attitude, practice, and facilitator assessments contained 14, 8, 12, and 4 items, respectively.

Structural Model Analysis

The statistical analyses were performed using the SPSS Version 26.0 software package for Windows (SPSS, Inc., Chicago, IL, USA), and AMOS version 26.0 was employed for confirmatory factor analysis (CFA) through SEM. A CFA and SEM were conducted using AMOS 26.0, to determine the constructing validity of the instrument. SEM was widely used in empirical study to investigate relationships among variables, while maximum likelihood estimation (MLE) robust extraction method was utilized to estimate parameters of an assumed probability distribution, given some observed data. To evaluate the global fitting quality, seven indices were used to assess model fit: 1) chi-square (Chisq) with the acceptance level of $p>0.05$, 2) ratio of chi-square and degrees of freedom (CMIN/DF): when the value of the equation was equal or smaller than two, lower than five, and greater than five, the fit was perfect, and unacceptable, 3) goodness of fit index (GFI) with recommended values greater than 0.9 were considered to represent good fits, 4) root mean square error of approximation (RMSEA) recommended values under 0.08 indicated perfect fits,[18] 5) Tucker-Lewis Index (TLI) and Comparative fit Index (CFI) recommended values equal or greater than 0.95 represented good fits.[19] Meanwhile, Normal fit index (NFI) had an acceptance level equal to or greater than 0.80.[20]

Reliability and Validity of Measurement Models

The reliability and validity of reflective measurement models were analysed, and the process entailed evaluation of indicator reliability, internal consistency reliability, discriminant validity, and convergent validity. Composite reliability (CR) was assessed to measure internal consistency and indicator reliability of the reflective constructs.[21,22] The CR appraised the degree to which a set of individual variables in a particular construct offered their estimation of the construct. The recommended value of CR achieved by the construct was 0.6,[23–25] and AVE was used to assess the convergent validity. The result determined the level at which a group of variables represented the same construct. Hair et al recommended a value of 0.5, where both construct and individual variables had high validity.[24]

Population Samples

The study population consisted of parents from Arcamanik District, Bandung, Indonesia. The inclusion criteria were as follows: parents with children aged 0–11 years old, ability to use and understand the Google Form platform, can read well and are willing to fill out informed consent for approval. Convenience sampling was applied to obtain a diverse pool of participants, and 3 minimum sample sizes for 4 latent variables were sufficient for SEM analysis, producing good output for estimating item location.[26]

Data Collections

Data were collected with a questionnaire for two weeks, from January 5 to 19, 2023, through an on-site interview. The instrument was distributed to the parents in four sub-districts of Arcamanik, namely Sukamiskin, Cisaranten Endah, Cisaranten Bina Harapan, and Cisaranten Kulon through Posyandu (Indonesian community activity which integrated essential health services for mothers and children). Furthermore, respondents' information from the Google Form and paper-based questionnaire was extracted, coded, and entered into SPSS version 26.0, then exported into Analysis of Moment Structures (AMOS) version 26.0 for confirmatory analysis through SEM.

Ethical Approval

The ethical approval was granted by the Health Research Ethics Committee of Universitas Harapan Bangsa No. B. LPPM-UHB/1807/05/2023. The respondents provided written informed consent for participation in the survey. This research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

Results

Factor Analysis: Construct Validity

Construct validity was estimated using confirmatory factor analysis (CFA). The path diagrams used for the model were composed of circles or ellipses that represented unobserved variables. The single-headed and double-headed arrows represented the impact and correlation of one variable on another. Table 1 shows the critical ratios of the trajectories between the items of the 4 latent variables.

After the measurement model was assessed to examine reliability and validity, the suitability was also analyzed. The good fit indices implied that the result achieved an acceptable model fit according to normal practice.[20] In this study, all the fit indices indicated a good fit, with chi-square = 0.0004, CFI = 0.977, RMSEA = 0.044, CMIN/DF = 1.162, AGFI = 0.651, TLI = 0.973, and NFI = 0.860. However, the GFI parameter did not fit with the output value of 0.718 (the cut-off value is GFI > 0.95) (Table 2). At least four indices should be presented between the model and the incremental fit groups.[27] Overall, the result of the proposed model showed acceptable fits and the items were the best fit to the data, within a desirable range, as shown in Figure 1.

Measurement Models' Reliability and Validity

The reliability and validity of the reflective measurement model were also conducted, and the process entailed evaluation of indicator reliability, internal consistency, discriminant validity, and convergent validity. In this study, composite reliability (CR) was utilized to measure internal consistency and indicator reliability of the reflective constructs, which were found as follows: knowledge = 0.950, practice = 0.96, attitude = 0.961; and facilitator = 0.793, with a recommended CR value of 0.6 and above. The attainment of reliability was accomplished for the variables, characterized as heterogeneous but possessing similarities within each construct. Furthermore, 36 observed variable indicators in variables passed the item reliability test with loading factors > 0.50 (Table 3) with a cut-off value of 0.4.[24]

Convergent and discriminant validities were used to examine the instruments. The assessment assured the variables were associated with the latent construct measured with the average variance extracted (AVE).[28,29] It was reported that all the dimensions in variables had an AVE value of 0.671, 0.733, 0.793, and 0.693 for knowledge, practice, attitude, and facilitator, as shown in Table 3. To attain validity, the value of the AVE must be greater than or equal to 0.5.[30] Therefore, it can be concluded that all the variables met the requirements of the validity and reliability tests.

Discussion

The global impact of antibiotic resistance, specifically in children, pervades all corners of the world, and when immediate and appropriate measures are not taken on a global scale, severe consequences in terms of fatalities and financial losses are anticipated. The knowledge, attitudes, and practices of parents constitute a crucial determinant among various factors contributing to the improper usage of antibiotics. Extensive study has consistently demonstrated that a significant proportion maintains the belief that antibiotics are efficacious in treating common colds in children and expediting

Table 2 Index Category and Levels of Acceptance

Category of Fit	Index Name	Acceptance Level	Output	Description
Absolute fit	Chi-square (Chisq)	p > 0.05	0.004	Marginal Fit
	RMSEA	RMSEA ≤ 0.08	0.044	Fit
	GFI	GFI ≥ 0.9	0.718	Not Fit
Incremental fit	CMIN/DF	CMIN/DF ≤ 2	1.162	Fit
	AGFI	AGFI ≥ 0.80	0.651	Fit
	TLI	TLI ≥ 0.95	0.973	Fit
	CFI	CFI ≥ 0.95	0.977	Fit
	NFI	NFI ≥ 0.90	0.860	Marginal Fit

Abbreviations: RMSEA, Root Mean Square Error of Approximation; GFI, Goodness of Fit; CMIN/DF, minimum discrepancy divided by degree of freedom; AGFI, Adjusted Goodness of Fit; TLI, Tucker Lewis index; CFI, Comparative Fit Index; NFI, Normed Fit Index.

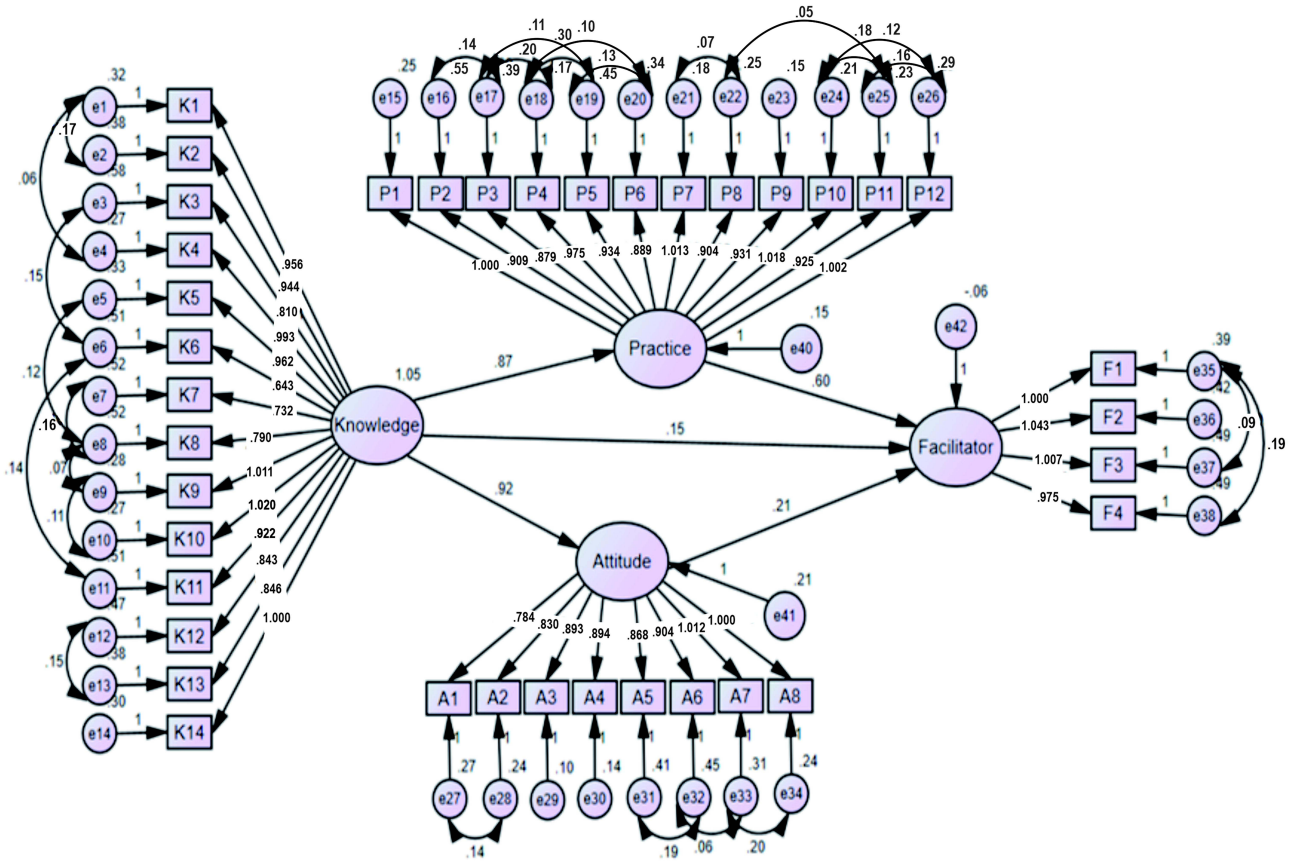

Figure 1 Representation of the model selected by CFA analysis.

their recovery from associated symptoms.[31–33] Therefore, lowering the level of antibiotic resistance depends on parents' knowledge, attitudes, and practice toward the self-medication of children with antibiotics. The availability of a validated tool that can fit their populations should serve as a study instrument and enable program adaptation, as well as comparison across different settings.

This is the first study that investigates the psychometric characteristics of the Indonesian-parent KAP concerning antibiotic usage in children. Therefore, the psychometric characteristics of a KAP questionnaire were developed and validated to close this gap. The content validity was also confirmed by the scale and content indices. The confirmatory factor analysis (CFA) and test-retest reliability demonstrated the questionnaire's construct validity and reliability. The high response rate and low percentage of unanswered questions were important indicators that the public embraced the questionnaire specifically the parent population.

Knowledge and attitudes were stable and unlikely to change quickly.[34] According to the results, the construct validity evaluation showed an acceptable fit for the proposed model, with chi-square = 0.0004, CFI = 0.977, RMSEA = 0.044, CMIN/DF = 1.162, AGFI = 0.651, TLI = 0.973, and NFI = 0.860. The items had a favorable range and provided the best fit to the data. Additionally, 36 observed indicator values in variables passed the item reliability test with loading factors > 0.50 and a cutoff value of 0.4. The results showed that the 36-item questionnaire used to gauge Indonesian-parent KAP on the use of antibiotics on children was reliable. The AVE values for all the dimensions of variables were 0.671, 0.733, 0.793, and 0.693 for knowledge, practice, attitude, and facilitator, respectively. According to these findings, the AVE value was greater than 0.5, meaning all the variables conformed with the validity test requirements.

Based on previous results, the questionnaire was regarded as a valid and trustworthy instrument. It facilitated the assessment of a parent's knowledge, attitudes, and practice of self-medication with antibiotics for children. Even though the 36-item questionnaire was only utilized for this study, it was designed with the possibility of being used in other

Table 3 Satisfaction Constructs' Reliability and Validity

Measurement Model	Factor Loadings	Reliability	
		CR	AVE
Knowledge (X)		0.950	0.671
K1. Antibiotics should be administered according to the doctor's recommendations, even though the symptoms of the disease are starting to improve	0.870		
K2. Antibiotics need to be taken when a child is sick, regardless of the disease	0.848		
K3. Antibiotics are mandatory when treatment with other drugs has no effect	0.732		
K4. Antibiotics are used to treat diseases caused by viral infections	0.881		
K5. Cough requires antibiotics	0.869		
K6. Fever requires antibiotics	0.684		
K7. Misuse of antibiotics can take a long time to heal	0.725		
K8. Diarrhea should be treated with antibiotics	0.759		
K9. Inappropriate use of antibiotics can cause antibiotic-resistant bacteria	0.898		
K10. Inappropriate use of antibiotics can lead to increased medical costs	0.895		
K11. Antibiotics can kill the "good bacteria" in the body	0.799		
K12. Penicillin or Amoxicillin are examples of antibiotics	0.783		
K13. Paracetamol is an example of an antibiotic	0.808		
K14. Antibiotic resistance is a phenomenon when an antibiotic loses its ability to kill bacteria	0.878		
Practice (Z_1)		0.960	0.733
P1. I can treat my children with antibiotics without consulting a doctor or pharmacist	0.882		
P2. I decided to give antibiotics for self-medication if my child's illness did not improve after a few days	0.768		
P3.I decided to give antibiotics for self-medication as soon as my child's symptoms (such as cough and fever) appeared	0.751		
P4. I give antibiotics for self-medication to my child after getting feedback from family members or friends	0.796		
P5. I decide the dosage or amount of antibiotics for my child's self-medication after reading the leaflet or information on the medicine packaging	0.798		
P6. I give my child antibiotics for self-medication based on my previous experience	0.823		
P7. I give antibiotics for self-medication to my child after reading information on the internet	0.918		
P8.I will stop giving antibiotics to my child after the symptoms are gone	0.883		
P9. I will stop giving antibiotics to my child after 3–5 days, regardless of the results or improvement	0.922		
P10. I get antibiotics for self-medication from pharmacy	0.913		
P11. I get antibiotics for self-medication for my child from the antibiotics I previously used	0.892		
P12. I get antibiotics for self-medication for my child from friends, family, or neighbors	0.905		
Attitude (Z_2)		0.961	0.793
A1. I administer antibiotics as a stand-alone treatment because my child has previously experienced the same symptoms	0.847		
A2. As a parent, I feel that giving antibiotics is very effective in curing any disease in my child	0.869		
A3. I give antibiotics as a stand-alone treatment because I believe my child's illness is minor	0.938		
A4. I give antibiotics to my child as independent treatment because I felt that I needed to wait a long time to go to the clinic	0.917		
A5. I give antibiotics to my child as independent treatment because of the high cost of consulting a doctor	0.845		
A6. I give antibiotics as self-medication to my child because I know as a medical professional (I am a pharmacist, doctor, or other health worker)	0.839		
A7. I have to immediately give my child antibiotics as self-medication as soon as the other children around him have fevers or cold	0.926		
A8.I prefer antibiotics, which are more expensive for self-medication (treatment without a doctor's prescription), for my child	0.937		

(*Continued*)

Table 3 (Continued).

Measurement Model	Factor Loadings	Reliability	
		CR	AVE
Facilitator (Y)		0.784	0.693
F1. I need to get adequate information from health workers (doctors, pharmacists, and other health workers) regarding the appropriate and wise use of antibiotics for my child	0.867		
F2. I need to take part in educational activities (eg, workshops, webinars, lectures) regarding the correct and wise use of antibiotics for my child	0.830		
F3. I need to have correct and practical guidelines regarding the appropriate and wise use of antibiotics for my child	0.816		
F4. I need to get better and optimal access to the clinic regarding my child's illness that requires the use of antibiotics	0.817		

settings. The questionnaire also assisted in gathering information from both antibiotic and non-users, which was important for epidemiological studies on Knowledge, Attitudes, and Practices in antibiotic usage investigation.

The findings were also related to previous study conducted by Mallah et al, who validated the knowledge, attitude, and practice questionnaires for individual use of antibiotics in Spain.[35] The results led to the general adult population overwhelmingly approving of the questionnaire's final version. This current study specifically validated the knowledge, attitudes, and practices questionnaires for parents of children who utilized antibiotics. The distinction should be noted since previous results focused on validating similar questionnaires solely for adults.

This study has several limitations, first, the findings could not accurately represent the entire population of Indonesian parents with children utilizing antibiotics due to small sample size. Therefore, further investigation of the questionnaire in various settings and with bigger sample sizes is required. Since the study involved the use of self-administered questionnaires, there is a potential for recall bias concerning antibiotic usage. Subjectivity and varying interpretations of the questions also affected the accuracy of parents' reported knowledge, attitudes, and practices. To address these limitations, future studies should consider incorporating specific questions that restrict the duration of antibiotic use, aiming to minimize memory-related biases when assessing the actual antibiotic usage in children.

Conclusion

This study developed and validated a questionnaire for parents on the self-medication of children with antibiotics. The scales showed appropriate reliability and validity, including internal consistency, discriminant validity, and convergent validity. This scale was used to assess the knowledge, practice, attitude, and facilitators of parents in the use of antibiotics. The content validity of the questionnaire was also confirmed by the scale and content indices. The confirmatory factor analysis (CFA) and test-retest reliability demonstrated the questionnaire's construct validity and reliability. The high response rate and low percentage of unanswered questions were important indicators that the public embraced the questionnaire. Even though the questionnaire is indeed a valid and reliable tool, a more extensive sample size of parents who have strictly adhered to a limited duration of antibiotic use should be gathered to mitigate any potential biases.

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Disclosure

The authors report no conflicts of interest in this work.

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