



Antibiotic Resistance: Efficacy of Guidelines Intervention on Mothers' Awareness

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ABSTRACT

Background: The inappropriate and excessive use of antibiotics is a global health issue that significantly affects children. One of the main causes of antibiotic misuse, which might contribute to the phenomenon of antibiotic resistance, is mothers' ignorance of the right way to use antibiotics. **Aim:** This study aimed to evaluate the efficacy of guidelines intervention on mothers' awareness regarding proper antibiotic usage and resistance. **Design:** A quasi-experimental research design. **Setting:** This study was carried out in a pediatric outpatient clinic, affiliated to Ain Shams Pediatric Hospital, Cairo Governorate, Egypt. **Sampling:** convenience sampling composed of 112 mothers who had children aged ≤ 5 years old. **Tools:** Three tools were utilized in this study: 1) Antibiotic knowledge questionnaire for mothers. 2) Mothers' attitudes regarding antibiotic usage and resistance. 3) Mothers' self-reported practices regarding antibiotics. **Results:** revealed that 66.1% of mothers had poor knowledge about antibiotic use and resistance pre-intervention, which improved after the intervention to good knowledge (75%, 63.2%) in post-, and follow-up respectively. The minority (8.9%, 13.4%) of mothers had positive attitudes and satisfactory reported practices about antibiotic use and resistance in pre-intervention while increasing to the majority (87.5%, 83%) in the post and to more than three-quarters (79.2%, 76.4%) at follow-up intervention respectively. **Conclusion:** The guidelines intervention and health education session had a significant impact on improving mothers' knowledge, attitudes, and practices related to antibiotics use and its resistance. **Recommendation:** The study recommends that healthcare providers should educate mothers to reduce the development of antibiotic resistance and preserve the effectiveness of antibiotics for future generations.

Keywords: Antibiotic resistance, Guidelines intervention, Mothers' Awareness.

Introduction

Antibiotic resistance is one of the most serious global threats to public health. It is now considered among the ten global health issues that need to be monitored in 2021 (WHO, 2021). The global consumption of antibiotics

has rapidly increased, especially in low and middle-income countries where self-medication with antibiotics and their use outside hospitals is common (Klein et al., 2018).

Antibiotic resistance poses a significant health risk today, exacerbated by the systematic

misapplication and excessive use of antibiotics, coupled with inadequate infection control. This resistance leads to treatment inefficacies, heightened mortality rates, and indirect healthcare expenses. It is a universal concern, impacting individuals of all ages, irrespective of geographical location. Antibiotic resistance arises when bacteria undergo alterations due to antibiotic exposure **(WHO, 2018)**.

Children often receive antibiotics, and the responsible caregivers hold a crucial role in determining the suitable usage of these medications. Globally, young children tend to be prescribed antibiotics excessively due to their susceptibility to infections. The overuse of antibiotics in children is particularly worrisome in low- and middle-income nations, given the elevated occurrence of infectious diseases, inadequate hygiene and sanitation, and challenges in public health within these regions **(Abd El-Kader & Mohammed, 2021)**.

Antibiotics play a crucial role in treating severe infections like sepsis, yet their usage comes with potential side effects and the risk of fostering antibiotic resistance. During this yearly observance, it is vital to emphasize that enhanced antibiotic prescribing practices and usage are essential for safeguarding patients, ensuring efficient infection treatment, and actively addressing the challenge of antibiotic resistance **(Centers for Disease Control & Prevention “CDC”, 2019)**.

Antibiotic resistance poses significant challenges in the healthcare sector, rendering the use of antibiotics less advisable. One prevalent factor contributing to the emergence of antibiotic resistance is self-medication, a practice on the rise in communities. This phenomenon is driven by factors such as low socio-economic status, ignorance, time restrictions, limited awareness of antibiotic resistance, and the inclination towards self-care. As a result, the practice of self-medication has gradually escalated within communities, further complicating the issue of antibiotic resistance **(Revathi & Pandurangan, 2020)**.

Enhancing parents' understanding of appropriate drug usage, particularly antibiotics, holds the potential to enhance the efficacy of childhood illness treatment. However, if parents become accustomed to using over-the-counter antibiotics, it could lead to the improper administration of antibiotics for children **(Lakshmi et al., 2021)**.

Antibiotic-resistant bacterial strains have been shown to develop in response to ignorance, misunderstandings of the use of antibiotics, and opposing opinions on infectious diseases **(Bukhamsin et al., 2021)**. Likewise, the primary causes of antibiotic resistance are excessive and improper prescriptions depending on the needs of the patient **(Mallah et al., 2020; Chokshi et al., 2019)**. The effect of antibiotic unawareness not only affects the children but also the entire community in a gradual manner thereby leading

to antibiotic resistance (**Revathi & Pandurangan, 2020**).

Bacterial infection has commonly been treated using antibiotics. Nevertheless, improper handling of antibiotics by patients and health practitioners has contributed to the rise of antibiotic resistance. Some of the consequences of these actions are a lack of effective treatments and an increase in medication costs. Furthermore, treatable diseases today may soon turn fatal. Notwithstanding this, the quest to discover new antibiotics to combat antibiotic resistance is a challenge, as new classes of antibiotics have not been found for over 40 years (**Mohamad et al., 2020**)

The World Health Assembly approved a global action plan in May 2015 to address the issue of antibiotic and other antimicrobial medication resistance. The first objective seeks to enhance understanding and awareness of worldwide antibiotic resistance through efficient communication, instruction, and training (**WHO, 2015**).

Mothers' beliefs and behaviors concerning medication play a crucial role in treating childhood illnesses. Antibiotic misapplication is a notable concern, as it involves prescribing antibiotics for conditions where they are not effective, notably for viral infections that are prevalent among children. Additionally, approximately half of antibiotic usage is inappropriate, contributing significantly to the emergence of antibiotic resistance, an escalating

issue impacting the health of children (**Kutrani et al., 2019**).

The utilization of antibiotics in children is significantly impacted by the knowledge, beliefs, behaviors, attitudes, and practices of parents, particularly mothers who play a pivotal role in administering antibiotics to their children (**Alrafiaah et al., 2017**). Mothers, being the primary decision-makers, determine the specific antibiotics deemed necessary for their children. This decision-making process is influenced by a deficiency in health education and a heightened reliance on local pharmacists, leading mothers to acquire antibiotics from nearby pharmacies even in the absence of appropriate prescriptions from physicians (**Revathi & Pandurangan, 2020**).

Educating mothers on public health is crucial for enhancing their understanding of health-related matters, including antibiotic resistance, viral infections, and the risks associated with improper antibiotic use. Delivering tailored education aligned with contemporary scientific principles is a strategy to attain optimal learning outcomes and elevate satisfaction levels (**Salimi et al., 2021**).

Nurses have an essential role in upholding and advocating for responsible antibiotic usage (**Monsees et al., 2018**). Their responsibilities encompass educating parents and families on the correct utilization of antibiotics, elucidating the associated risks, and dispelling misconceptions about these medications. Additionally, nurses are tasked with ensuring parents comprehend

treatment plans accurately, offering insights into potential adverse drug reactions, highlighting the risks of drug interactions, specifying the anticipated duration of antibiotic administration, and addressing expected challenges in the oral administration of antibiotics to children (Hamdy et al., 2019).

Significance of the study

If present trends persist, an anticipated 10 million individuals will die due to the effects of antimicrobial resistance (AMR) annually by 2050, with 40% of these fatalities expected to transpire in Africa. Currently, globally, more than 700,000 deaths occur annually due to resistant bacterial pathogens, encompassing 214,000 deaths related to neonatal sepsis (Dadari, 2020).

Antibiotic resistance is escalating to alarming levels globally. Novel immune mechanisms are emerging and disseminating, jeopardizing our capacity to combat prevalent infectious diseases. Conditions like pneumonia, tuberculosis, blood poisoning, gonorrhoea, and foodborne illnesses are becoming progressively challenging, if not insurmountable, to manage without antibiotics. In regions lacking standardized treatment protocols, antibiotics face frequent overprescription by medical professionals and veterinarians, coupled with misuse by the general public (WHO, 2020).

Antibiotics are the most prescribed drugs for children worldwide, both in community settings and hospitals. Broad-spectrum antibiotics are

prescribed for viral infections or significantly longer antibiotic courses than necessary, with a 20%–50% rate of unnecessary or inappropriate prescriptions (Pierantoni et al., 2021).

WHO, 2015 survey registered that, antibiotic use differs considerably between countries, in Egypt more than half of respondents reported taking antibiotics within the past month. Numerous studies indicate a deficiency in parents' understanding and awareness regarding the use of antibiotics in children (Alrafiaah et al., 2017; Atif et al., 2018; Bert et al., 2016; Dadari, 2020; Szenborn et al., 2017). Limited interventional research has been undertaken to educate parents on the appropriate use of antibiotics and the issue of resistance in children in Egypt. (Abd El-Kader & Mohammed, 2021; Soleimani et al., 2016). Therefore hopefully, this study will improve mothers' awareness regarding proper antibiotics usage and resistance.

Aim of the study

This study aimed to evaluate the efficacy of guidelines intervention on mothers' awareness regarding proper antibiotics usage and resistance through the following objectives:

- 1) Assessing mothers' knowledge, attitudes, and reported practices about proper antibiotics usage and resistance.
- 2) Designing and implementing guidelines and educational session for mothers about proper antibiotics usage and resistance.

3) Evaluating the impact of guidelines and educational session on enhancing mothers' knowledge, attitudes, and reported practices related to the appropriate use of antibiotics and resistance.

Hypotheses

H₁: Mothers' knowledge scores show a notable enhancement following the implementation of guidelines intervention and educational session addressing appropriate antibiotic usage and resistance.

H₂: The guidelines intervention and educational session is a positive effective approach for improving mothers' attitudes and practices regarding proper antibiotics usage and resistance.

Operational definition

Mothers' awareness means mothers' knowledge, attitudes, and reported practices.

Subjects and Methods

Research design

This study used a quasi-experimental research design (pre / post test).

Study settings

The study was conducted in a pediatric outpatient clinic affiliated to Ain-shams Children's Hospital, Cairo Governorate, Egypt.

Subjects

The study included 112 mothers with children aged ≤ 5 years who visited the pediatric

outpatient clinic for various concerns and voluntarily agreed to take part in the research.

Sampling

A convenience sampling technique was used for the selection of mothers who participated in the study after obtaining their consent.

Sample size

Depended on data from the literature (**Abd Elkader and Mohammed, 2021**), taking into account the level of significance of 5% and the power of study of 80%. The sample size can be determined using the following formula:

$$n = \frac{2(Z_{\alpha/2} + Z_{\beta})^2 \times p(1-p)}{(d)^2}$$

where, p = pooled proportion obtained from previous study; d = expected difference in proportion of events; $Z_{\alpha/2} = 1.96$ (for 5% level of significance) and $Z_{\beta} = 0.84$ (for 80% power of study). Therefore,

$$n = \frac{2(1.96 + 0.84)^2 \times 0.816(1-0.816)}{(0.145)^2} = 111.9.$$

Accordingly, the sample size required is 112.

Tools of data collection

Tool I: antibiotic Knowledge Questionnaire for Mothers was designed by researchers in straightforward Arabic language following a review of the existing recent literature. The questionnaire comprises the following sections:

Section 1: characteristics about mothers and children, encompassing the mother's age, education level, occupation, number of children

aged ≤ 5 years, child age, residence, family income, the distance between residence and healthcare facilities, and the sources from which mothers acquire knowledge about the prudent use of antibiotics and antibiotic resistance.

Section 2: The assessment of mothers' knowledge of antibiotic use and resistance was conducted through a knowledge questionnaire, targeting four key domains: identification of antibiotics (5 questions), the role of antibiotics (10 questions), side effects (3 questions), and antibiotic resistance (14 questions). Respondents were provided with three response options: "Yes," "No," or "Do not know."

Regarding the scoring system, the knowledge questionnaire consisted of a total of 32 questions, with each correct answer earning 1 point, and incorrect or "do not know" responses receiving 0 points. The resulting scores ranged from 0 to 32, which were then converted into percentages. Categories of knowledge are as follows: poor ($< 50\%$, 0-15 grade), fair ($50 - < 75\%$, 15 – 23 grade), and good ($\geq 75\%$, 24 -32 grade).

Tool II: Mothers' Attitudes Regarding Antibiotic Usage and Resistance. It was adapted from **Atif et al., 2018** and modified by the researchers. It contained 14 statements that assessed mothers' attitudes toward antibiotic use and resistance. A Likert scale was used to analyze the responses of the mothers rated on a 5-point score from 1-5; strongly disagree (1), disagree (2), neither agree nor disagree (3), agree

(4), strongly Agree (5) for the positive attitudes; while strongly Agree (1), agree (2), neither agree nor disagree (3), disagree (4), strongly disagree (5) for the negative attitudes. Examples of these statements: If my child suffers from a common cold, I expect from my doctor to prescribe antibiotics for him; Before I give antibiotics to my child read its expiry date; Only doctors know the meaning of antibiotic resistance, etc.

Scoring system for attitude

The total number of attitudes questions was 14. Its scores ranged from 14 to 70 grades, which were categorized into negative attitude $< 70\%$ (14-48 grade) while positive attitude $\geq 70\%$ (49-70 grade).

Tool III: mothers' Self-reported Practices Regarding Antibiotics: the researcher developed a tool to evaluate mothers' self-reported practices and recent antibiotic usage over the preceding three months. This encompassed actions such as self-medicating children with antibiotics without a physician's prescription, ensuring awareness of antibiotic expiration dates, obtaining antibiotics recommended by local pharmacists for their children, and adhering to the full course of antibiotics if improvements were observed. Each practice was assigned a score of one for proper conduct and zero for improper actions. The cumulative practice score was then classified as unsatisfactory if below 70% and satisfactory if 70% or higher.

2- Operational Design

Preparatory phase:

In the initial stage of operational design, the preparatory phase involved an examination of existing literature about antibiotic use and resistance. This comprehensive review encompassed diverse sources such as books, articles, magazines, and online searches. The primary objective was to address various facets of the research problem and utilize the gathered insights to formulate the tools essential for data collection during the study.

Validity

The questionnaire underwent content validity assessment by three pediatric nursing experts. This evaluation aimed to determine the relevance of the questionnaire items and their effectiveness in measuring mothers' knowledge, attitudes, and practices concerning appropriate antibiotic use and resistance. All necessary adjustments were made based on the feedback provided by the experts, ensuring the content's appropriateness.

Reliability of the study tools

The tools underwent an assessment of internal reliability, and the Cronbach's alpha values were as follows: 0.874 for mothers' knowledge of antibiotic use and resistance, 0.896 for attitude, and 0.893 for reported practice.

Pilot Study

Before commencing the main data collection, a pilot study was conducted with 10%

of the intended participants to assess the clarity and suitability of the research tools. This pilot study aimed to estimate the time needed for respondents to complete the tools. Following the pilot study's results, essential adjustments and reorganization of the research tools were implemented. It's noteworthy that mothers who took part in the pilot study were excluded from the final study sample.

Ethical considerations

The research received formal approval from the Research Ethical Committee of Mansoura Faculty of Nursing, indicated by Reference Number p. 0497. Informed consent was diligently obtained from the participating mothers, ensuring their understanding and willingness to take part in the study. Participants were explicitly assured that any data collected would be handled confidentially, exclusively for research purposes, and for their benefit. Additionally, participants were informed of their rights to refuse involvement or withdraw from the study at any point. The study prioritized maintaining the anonymity, confidentiality, and privacy of all participants.

Field work

The research spanned 4 months, with fieldwork conducted from mid-July to mid-November. Researchers were present at the study location twice a week, from 9 A.M. to 12 P.M. The researcher introduced herself, explained the study's purpose to the participating mothers, and secured written informed consent

before their enrollment. Baseline assessments of mothers' knowledge, attitudes, and practices related to antibiotic use and resistance were performed using the mentioned tools. Subsequently, an educational intervention session transpired, involving teaching and discussions facilitated by a PowerPoint presentation. The session covered information on antibiotic use and resistance, and mothers were provided with a guideline leaflet on appropriate antibiotic use. Evaluation of the intervention's impact occurred immediately after the session and again at a 3-month follow-up through phone interviews using the same tools. Unfortunately, six mothers dropped out of the study.

Administrative design

The research was conducted following the formal approval granted by the director of Ain Shams Children's Hospital for data collection. The study's objectives and anticipated outcomes of raising mothers' awareness regarding antibiotics efficient use were explicitly communicated.

Statistical Analysis

The statistical analyses were conducted utilizing SPSS for Windows version 20.0 (SPSS, Chicago, IL). Continuous data, found to be normally distributed, were presented in their expressed form. Categorical data were represented using numerical values and percentages. The comparison of variables with categorical data employed the chi-square test,

while the correlation coefficient test was utilized to assess the correlation between two variables. The study's questionnaires underwent a reliability (internal consistency) test. Significance in statistical outcomes was determined at a threshold of $p < 0.05$.

Results of the research

Table (1) indicates that over 60.7% of the mothers fell within the age range of 21 to 40 years. Regarding the educational level of mothers, less than half (46.4%) possessed a diploma. A significant majority (78.6%) of the mothers were homemakers, while less than half (47.4%) of their children were between 4 to 5 years old. Additionally, nearly two-thirds (64.3%) of the mothers had a single child and lived in rural areas. Three-quarters (75.0%) of families in the study had a moderate income. As well, the same table reveals that (58.0%) of mothers in the study lived more than 10 km away from a healthcare facility. Regarding sources of mothers' knowledge about antibiotic use and resistance, more than two-thirds (67.9%) obtain information from friends and family.

Table (2) shows that the percentage of mothers who had good knowledge about topics (identification, role, side effects of antibiotics, and antibiotic resistance) increased from (13.4%, 1.8%, 28.6%, and 11.6%) at pre-intervention to (90.2%, 78.6%, 60.7%, and 71.5%) at post-intervention respectively. The same table indicates that the mothers' knowledge related to the identification, role of antibiotics, and

antibiotic resistance had remained high in follow-up, it was (84.0%, 67.0%, and 79.2%) respectively with a very highly statistically significant difference ($P < 0.001$).

Figure (1) the data reveals that 75% of mothers demonstrated good knowledge post-intervention, and this positive trend continued during the follow-up intervention, with 63.2% exhibiting good knowledge. In contrast, prior to the intervention, only 16.1% of mothers had good knowledge.

Figure (2) shows that the minority (8.9%) of mothers had positive attitudes about antibiotic use and resistance in pre-intervention while increasing to the majority (87.5%) and slightly less than four-fifths (79.2%) in post and follow-up intervention respectively.

Figure (3) clarifies that the majority (83%) and more than three-quarters (76.4%) of mothers had satisfactory reported practices regarding antibiotic use and resistance post and follow-up intervention respectively compared to 13.4% of them pre-intervention.

Figure (4) illustrates that there is an increase in the percentage of children who received antibiotics for respiratory illness (60.7%), (64.3%), and (52.8%) in pre, post, and follow-up intervention respectively. While there is a decrease in the percentage of children who received antibiotics for other reasons remaining from pre-intervention to follow-up.

Figure (5) showed that more than one-third (34.8%) of mothers reported using antibiotics

with a doctor's prescription in the last 3 months in pre- and post-intervention and increased to three-quarters (75.5%) in the follow-up. While, more than half (51.8%) of mothers used antibiotics one time for their children without a doctor's prescription in the last 3 months in Pre-, and Post-Intervention while, decreased to 17.9% at Follow-up

Table (3) shows a positive statistically significant correlation between mothers' total knowledge score and their attitude and practices regarding antibiotics use and resistance as revealed by ($r = 0.158$ at $p = 0.013$), ($r = 0.312$ at $p = 0.007$) post-intervention respectively. Also, there was a very strong positive statistically significant correlation between mothers' total knowledge score and their attitudes and practices as revealed by ($r = 0.373$ at $p = 0.001$), ($r = 0.351$ at $p = 0.001$) follow-up intervention respectively.

Table (4) represents a statistically significant positive correlation between mothers' attitudes and practices regarding antibiotics use and resistance as revealed by ($r = 0.193$ at $p = 0.002$), ($r = 0.345$ at $p = 0.001$) post and follow-up intervention respectively.

Table 1 Distribution of the Study Mothers Relation to their Socio-demographic Characteristics (no. = 112).

Variables	n	%
Mothers' age (years)		
< 20	12	10.7
21 – 40	68	60.7
41 – 60	32	28.6
Mothers' educational level		
Illiterate	16	14.3
Read and write	24	21.4
Diploma	52	46.4
Bachelor	20	17.9
Mothers' occupation		
Employed	24	21.4
Housewife	88	78.6
Age of child (years)		
< 1	36	32.1
2 – 3	23	20.5
4 – 5	53	47.4
Number of children		
One	72	64.3
Two – Three	29	25.9
More than three	11	9.8
Residency		
Urban	40	35.7
Rural	72	64.3
Family income		
Low	28	25.0
Moderate	84	75.0
Distance between house and healthcare facilities (KM)		
1 – 5	13	11.6
6 – 10	34	30.4
> 10	65	58.0
Sources of mothers' knowledge about antibiotics use and resistance		
Physicians/ nurses	19	17.0
Friends/Family	76	67.9
TV/Radio	9	8.0
Newspaper/Internet	8	7.1

Table 2 Distribution of Mothers' Knowledge Regarding Antibiotic Use and Resistance Pre, Post- and at Follow-up Intervention.

Items	Pre – Intervention (n=112)			Post – Intervention (n=112)			Follow-Up (n=106)			Chi – Square	
	Poor	average	Good	Poor	average	Good	Poor	average	Good	X ²	P
	N %	n %	n %	n%	n %	n %	n %	n %	n %		
Identification of antibiotic	60 53.6	37 33.0	15 13.4	4 3.6	7 6.2	101 90.2	3 2.8	14 13.2	89 84.0	182.135	<0.001**
Role of antibiotic	97 86.6	13 11.6	2 1.8	5 4.4	19 17.0	88 78.6	23 21.7	12 11.3	71 67.0	190.498	<0.001**
Side effects of antibiotics	51 45.5	29 25.9	32 28.6	12 10.7	32 28.6	68 60.7	21 19.9	61 57.5	24 22.6	71.290	<0.001**
Antibiotic resistance	89 79.5	10 8.9	13 11.6	7 6.2	25 22.3	80 71.5	2 1.9	20 18.9	84 79.2	204.687	<0.001**

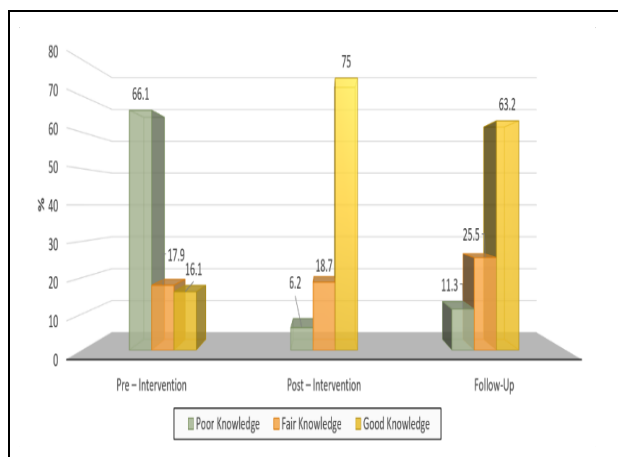


Figure 1 Mothers' Total Knowledge about Antibiotic Uses and Resistance Pre-Post and at Follow-up Intervention.

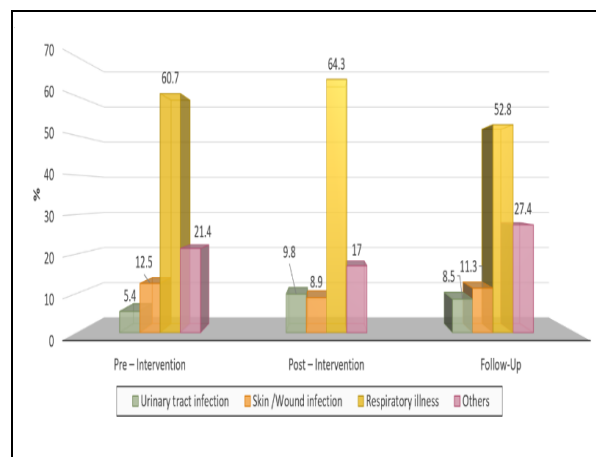


Figure 4 Distribution of Reasons for Giving Antibiotics to the Child Pre-, Post- and at Follow-up Intervention.

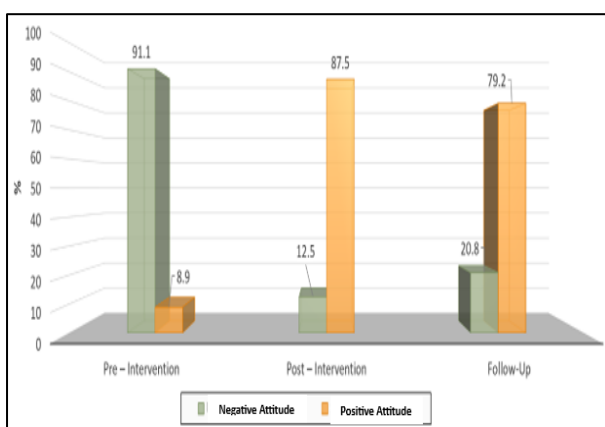


Figure 2 Mothers' Attitudes Regarding Antibiotic Use and Resistance Pre-Post and at Follow-up Intervention.

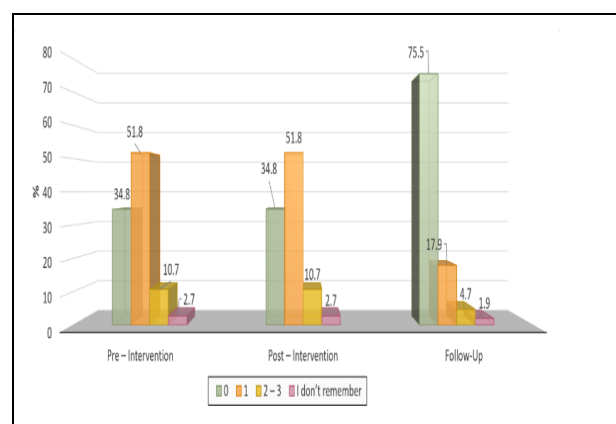


Figure 5 Distribution of antibiotics used for children without a doctor's prescription in the last 3 months Pre-, Post- and at Follow-up Intervention.



Figure 3 Mothers' Reported Practices Regarding Antibiotic Use and Resistance Pre-, Post- and at Follow-up Intervention.

Table 3 Correlation between Mothers' Knowledge, Attitude, and Practices about Antibiotic Uses and Resistance Post- and Follow-up Intervention.

	Knowledge Score			
	Post – Intervention (n=112)		Follow-up (n=106)	
	r	p	r	p
Attitude Score	0.158	0.013*	0.373	<0.001*
Practice Score	0.312	0.007*	0.351	<0.001*

Table 4 Correlation between Mothers' Attitudes and Practices about Antibiotic Uses and Resistance Post- and Follow-up Intervention.

	Attitude Score			
	Post – Intervention (n=112)		Follow-Up (n=106)	
	r	p	r	p
Practice Score	0.193	0.002*	0.345	<0.001**

Discussion

Antibiotic misuse and overuse pose a worldwide health challenge, with a notable impact on children, as highlighted by **Alrafiah et al., (2017)**. Numerous investigations indicate that approximately 50% of antibiotics are inaccurately prescribed for children concerning factors such as rationale, selection, and duration of usage, as observed in the study by **Aslam et al., (2018)**. In many nations, a substantial portion of prescribed antibiotics are directed toward infants and preschoolers. The pivotal role of parents in deciding on healthcare utilization and seeking treatment for their children is evident **Salimi et al., (2021)**.

Children are the category of patients who receive the largest number of antibiotic therapies, Strengthening the awareness regarding antibiotic resistance in parents is a challenge for public health **Zaniboni et al., (2021)**. Therefore, the purpose of this study is to evaluate the efficacy of guidelines intervention on mothers' awareness regarding proper antibiotics usage and resistance.

The current study's findings indicate that over 60% of the mothers belonged to the 21-40 age group. This aligns closely with the results of a study conducted by **Sychareun et al., (2022)**,

titled "Perceptions and reported practices of pregnant women and mothers of children under two years of age regarding antibiotic use and resistance in Vientiane province: a qualitative study." The mentioned study reported participants' ages ranging from 17 to 40 years.

Concerning the mothers' education and occupation, less than half had a diploma, more than three-quarters were housewives, and more than three-fifths of them had one child and resided in rural areas. The results align with **Dawood et al., (2022)** study on the impact of an educational intervention on mothers with breastfeeding infants regarding antibiotic use and resistance, their findings indicated that approximately 33% of mothers possessed a diploma, a majority were not employed, almost 50% had one child, and the majority resided in rural areas. Similarly, **Dadari, (2020)** study in Nigeria, exploring antibiotic use, knowledge, and practices among breastfeeding mothers in Kaduna state, revealed that around two-thirds of the participants reported having more than one child.

As regards family income, the current study illustrated that three-quarters of families had a moderate income. This is consistent with the national average and also, with the study carried out by **Alturaigi et al., (2021)**, in King Saud Medical City, Riyadh, Saudi Arabia about "Knowledge and attitude towards antibiotics use among mothers attending pediatric clinics " who mentioned that most of the participants have an intermediate income. Also, the current study

reported that nearly three-quarters of them lived more than 10 km far from a healthcare facility. These results contradict those of **Lakshmi et al. (2021)**, who evaluated mothers visiting a pediatric outpatient department regarding their knowledge, attitudes, and practices regarding the use of antibiotics in children under the age of five who had a respiratory tract infection. They discovered that less than one-third of mothers reside more than 10 kilometers away from a medical facility.

Regarding mothers' sources of knowledge, the majority of mothers, over two-thirds, acquire information about antibiotic use and resistance from friends and family. This may be due to that the majority of the participant mothers lived in rural areas, were not employed and their residences were far from health facilities, so they gained knowledge from their friends or family. In contrast, **Abd El-Kader and Mohammed, (2021)** study, focused on the impact of an educational intervention on mothers' understanding, behaviors, and attitudes regarding proper antibiotic use, revealed that a significant portion, more than half of the participants, received information from healthcare providers. Additionally, about one-third reported obtaining information from pharmacists, personal experiences, as well as friends and relatives.

The current study found that the guidelines intervention and educational session were successful in raising mothers' post-intervention knowledge of antibiotics regarding the

identification, role, side effects, and antibiotic resistance. and also remained high at the follow-up. This is an important finding, as it could help to reduce the inappropriate use of antibiotics and the development of antibiotic resistance. Similar to the findings of **Abd El-Kader and Mohammed, (2021)**, the initial knowledge levels of participants and regarding antibiotic use indications, proper usage, causes of antibiotic resistance, and prevention were deficient. However, after an educational intervention, there was a notable improvement observed during follow-up, with statistically significant differences at $P \leq 0.001$.

Overall, the results of the current study suggest that the intervention was effective in improving mothers' total knowledge of antibiotic use and resistance after the intervention. Mothers often play a vital role in the care of their families. They were responsible for managing the treatment of family members, such as administering antibiotics. Likewise, the study of **Kutrani et al., (2019)** conducted in Libya, this result aligns with their assessment of mothers' antibiotics information. The study compared the internet and healthcare professionals as sources of informatics and revealed that a significant majority of mothers had insufficient knowledge about the usage of antibiotics for treating their children.

Similarly, **Odili & Ahwinahwi, (2021)** reported that a majority of mothers achieved positive knowledge outcomes after an educational intervention. Additionally, the

findings align with **Rabbani et al., (2020)** study in the United Arab Emirates, which demonstrated a substantial improvement in antibiotic and resistance awareness among residents in Ras Al Khaimah following a community-based educational intervention.

The observed outcome could be attributed to employing straightforward language in the educational sessions, the mothers' readiness to learn about antibiotic use and resistance, especially those with children under five years old, and the clarity and consistency of educational materials. Moreover, the success of the educational intervention may stem from its tailored development, addressing the specific needs of mothers and resulting in an enhancement of their knowledge.

Concerning mothers' attitudes regarding antibiotic use and resistance, the present study revealed that there was a significant increase in the mothers' attitudes after the intervention. Specifically, the mothers' positive attitudes increased from nearly one-tenth in pre-intervention to nearly nine-tenths and slightly less than four-fifths in post and follow-up intervention respectively. This suggests that the intervention was effective in improving mothers' attitudes toward this important topic. This aligns with the findings of **Abd El-Kader & Mohammed (2021)**, indicating that mothers initially had inadequate attitude scores regarding proper antibiotic use. However, following the educational sessions, both immediately and during the follow-up, there was a notable

improvement, with statistically significant differences, leading to satisfactory attitude scores concerning appropriate antibiotic use after the implementation of the educational intervention. From the researcher's point of view, controlling antibiotic resistance requires changing the attitude of mothers who give antibiotics to their children. This can be done through education and other strategies that promote appropriate antibiotic use. They need to be educated about the importance of using them only when necessary and for the full course of treatment. They should also be aware of the risks of antibiotic resistance and how to prevent it.

The current study highlighted a significant improvement in mothers' reported practices about antibiotic use and resistance. Post-intervention, the majority and over three-quarters of mothers demonstrated satisfactory practices, compared to just over a tenth pre-intervention. This positive change is attributed to the implementation of guidelines, interventions, and educational sessions. These efforts effectively enhanced mothers' practices, promoting proper antibiotic use and reducing instances of inappropriate usage. Consistent with the research by **Kandeel et al., (2019)** study in Egypt, affirming enhanced practices and reduced unnecessary antibiotic usage after educational sessions. Moreover, existing literature highlights a prevalent lack of parental knowledge on antibiotic use, emphasizing the

need for additional information to promote optimal practices (**Lakshmi et al., 2021**).

There are a few possible explanations for the observed improvement in practice level. One possibility is that the intervention provided the mothers with new information and skills that they could use to improve their parenting practices. Another possibility is that the intervention created a supportive environment in which the mothers felt comfortable discussing their parenting challenges and seeking help. It is also possible that the intervention simply reminded the mothers of the importance of good parenting practices based on this the study findings supported the hypothesis, as mothers who participated in the educational session showed significant improvement in their knowledge, practices, and attitudes toward antibiotic use for their children.

Children below the age of 5 are susceptible to infections, due to their underdeveloped immune system and anatomical disparities **Hockenberry et al., (2019)**. Managing illnesses in children poses unique challenges, underscoring the need for careful administration of medications, including antibiotics **Lakshmi et al., (2021)**. In regions with limited access to healthcare, where antibiotics are available over the counter without a prescription, parents must possess comprehensive knowledge on the safe and effective use of these medications.

In relation to mothers' use of antibiotics for their children in the last 3 months without a doctor's prescription, the study result revealed

that the number of mothers who reported using antibiotics for their child with a doctor's prescription increased from slightly more than one-third in pre-intervention to three-quarters in follow-up. Overall, the results of this study indicate that the intervention was effective in reducing the number of mothers who used antibiotics for their children without a doctor's instruction. This is likely due to the intervention which may have raised mothers' awareness of the risks of antibiotic overuse and encouraged them to seek medical advice before using antibiotics.

In alignment with **Al-Ayed, (2019)** study, which delved into parents' understanding, attitudes, and behaviors concerning antibiotic usage for children across different Saudi Arabian cities, it was revealed that approximately (31.4%) of parents consistently acquired antibiotic prescriptions from their healthcare providers. Contrarily, over two-thirds of parents obtained antibiotics without prescriptions, primarily relying on local pharmacies as their main source.

Regarding the correlation between mothers' total knowledge, attitudes, and reported practices about antibiotic use and resistance, the present study result revealed that there was a positive statistically significant correlation between mothers' knowledge, attitudes, and practices post- and follow-up intervention. This finding goes in line with **Lakshmi et al., (2021)**. who observed that there was a

significant positive correlation between knowledge, attitude, and practice.

Concerning the correlation between mothers' total attitudes and reported practices about antibiotic uses and resistance post- and follow-up intervention, the present study result revealed that the mothers' attitudes were conducive to making positive changes in the practice. This can be done by providing mothers with information about the risks of antibiotic overuse and the importance of using antibiotics only when necessary. Interventions should also emphasize the importance of seeking medical advice before using antibiotics and following the prescribed antibiotic regimen. This study finding agreed with **Lakshmi et al., (2021)**, who found that the attitude of the parents was favorable for improving their practices regarding antibiotic use in children under 5 years old.

Conclusion

The guidelines intervention and health education session were found to have a significant impact on improving mothers' knowledge, attitudes, and practices related to the use of antibiotics and resistance. Also, the results of the study found that the majority of mothers given antibiotics for their children without a doctor's prescription from local pharmacies, even those who obtained a prescription from their doctor often did not complete the full course of antibiotics for their children if they felt their child was improving. So antibiotic resistance is a serious hazard to

children's health, but we can take steps to prevent and control it.

Recommendations

Based on the study findings, it can be recommended that:

- Health education guidelines should be established to improve mothers' knowledge, attitudes, and practices regarding the safe use of antibiotics and prevent antibiotic resistance.
- Additional research is needed to identify the most effective intervention for the prevention of antibiotic resistance.
- Exploring the factors that shape the association between mothers' attitude and their practices concerning antibiotics.
- Healthcare professionals should educate mothers to reduce the development of antibiotic resistance and preserve the effectiveness of antibiotics for future generations.

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