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Knowledge of Safe Medications in Pregnancy among Medical students at different levels, King Saud University

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Abstract

Background

Medical students, as future healthcare providers, must possess a comprehensive understanding of medication safety during pregnancy to prevent teratogenic risks and ensure maternal health. Knowledge gaps in this area can lead to adverse clinical outcomes and patient anxiety.

Objective

To assess the knowledge, educational exposure, and self-perceived preparedness regarding the safe use of medications during pregnancy among medical students at King Saud University.

Methods

A cross-sectional analytical study was conducted during the 2025/2026 academic year at the College of Medicine, King Saud University. An 18-item digital questionnaire was distributed to 297 medical students across all five academic years and the internship period. Data were analyzed using descriptive statistics, Mann-Whitney U tests, Kruskal-Wallis H tests, and multiple linear regression to identify predictors of knowledge.

Results

The mean knowledge score was less than 40% of the total possible score. While 85.9% of students correctly identified the timing of major congenital malformations, significantly fewer understood FDA Category D (32.0%) or Category C (35.4%) classifications. Multiple linear regression revealed that educational exposure ($p < .001$), GPA range ($p = 0.002$), and academic year ($p = 0.006$) were significant independent predictors of knowledge. Gender did not significantly influence scores ($p = 0.819$).

Conclusion

There is a substantial knowledge gap regarding medication safety in pregnancy among medical students at KSU, particularly concerning drug risk classifications and clinical management. The decline in knowledge among medical students and interns suggests a lack of retention or clinical reinforcement. These findings highlight an urgent need to enhance the undergraduate medical curriculum and provide targeted educational interventions to ensure future physicians are prepared for safe prescribing practices.

Introduction

Prescribing medications during pregnancy presents a significant clinical challenge, as physicians must carefully balance maternal therapeutic benefits against potential risks to the developing fetus (1). Although medication use is often necessary for the management of acute medical conditions during pregnancy, there has been a notable increase in medication consumption among pregnant women, including both prescribed and non-prescribed drugs (2–4). So Medical students play a critical role as future physicians in ensuring the safe use of medications during pregnancy. Adequate knowledge of pregnancy safe medications is essential to prevent potential harm to both the mother and the developing fetus. As medical students progress into clinical practice, they are increasingly involved in patient care, and counseling pregnant women. Insufficient understanding of drug safety during pregnancy may lead to inappropriate counseling, delayed treatment, or the unnecessary avoidance of essential medications. Therefore, early and comprehensive education on medication safety in pregnancy is fundamental to promoting patient safety, improving clinical decision making, and reducing medication related risks in maternal healthcare.

Medical regulatory authorities worldwide have established medication risk classification systems to guide drug use during pregnancy by balancing potential benefits against associated risks, while acknowledging the inherent limitations of these classifications and the necessity for individualized clinical assessment (5). The classification of drugs during pregnancy is crucial for ensuring maternal and fetal safety. This system, established by the Food and Drug Administration (FDA), categorizes drugs based on their potential risks to the fetus, with categories ranging from A (safe) to X (contraindicated). This literature review examines the implications of drug classification during pregnancy, particularly focusing on how these classifications inform treatment decisions and impact obstetric outcomes for women with complex medical conditions, However, existing categorization systems are limited by insufficient data on the long-term effects of drug exposure during pregnancy. Substantial gaps remain in the understanding of teratogenic mechanisms, underscoring the need for improved educational resources and training for healthcare professionals to effectively counsel pregnant patients regarding potential medication-related risks. Furthermore, the identification of emerging teratogens and the assessment of environmental exposures continue to represent significant challenges in maternal–fetal medicine (6).

In general, among medical participants, 51% demonstrated good knowledge of teratogenicity, 30% had a fair level of knowledge, and the remaining 19% exhibited poor knowledge in this area (7). Despite an overall satisfactory level of awareness regarding teratogenicity among medical students specifically, notable gaps in knowledge remain. These deficiencies are particularly evident in the understanding of drug induced teratogenic effects across all stages of pregnancy, awareness of regulatory classification systems such as the US-FDA fetal risk categories, and the ability to identify specific teratogenic drugs and their associated congenital anomalies (8). Another study showed that 71% of students were aware of the teratogenic properties of certain harmful drugs.

Although 90% recognized that the early first trimester is the most susceptible period, only 21% were able to identify the importance of providing counseling regarding drug use prior to pregnancy (9). Another study in India shows Only a small proportion of second-year medical students (33.58%) were aware of all five US-FDA (A-X) fetal risk categories, indicating that awareness of drug risk classification is limited at earlier levels of medical training (10). Despite the importance of adequate knowledge for ensuring safe medication use during pregnancy, existing evidence indicates considerable gaps among pharmacy professionals. Although a large proportion of community pharmacists demonstrated awareness of teratogenic drugs, only a small minority possessed comprehensive knowledge of pregnancy drug risk categories. Knowledge related to the safe use of commonly prescribed medicines, over-the-counter products and herbal preparations during pregnancy was particularly limited. In contrast, awareness regarding general aspects of maternal care, such as nutritional requirements and physical activity during pregnancy, was relatively higher. These findings highlight an imbalance in knowledge, where general health recommendations are better understood than medication-specific safety considerations, suggesting deficiencies in pharmacotherapy training related to pregnancy(11)One of the study published at 2014 identified significant differences in pharmacological knowledge between pharmacy and medical students, with pharmacy students demonstrating superior basic pharmacology knowledge, particularly in pharmacokinetics, drug interactions, adverse effects, and ATC classification. As these domains underpin the assessment of medication safety in pregnancy, the findings suggest that pharmacy students may be better prepared to evaluate drug-related risks in pregnant women. Although applied pharmacology knowledge was similar between groups, the authors attributed these differences to disparities in undergraduate curricula, with pharmacy students receiving substantially more pharmacology education than medical students (12). From a financial perspective medication related error, including unsafe prescribing practices, represent one of the leading sources of avoidable harm in healthcare systems globally. According to estimates from the (WHO), the financial burden associated with medication errors reaches approximately USD 42 billion annually worldwide (13). So, UK General Medical Council guidance emphasizes that newly qualified doctors must be able to prescribe medicines “safely, effectively and economically (14). highlighting the key role of medical schools in shaping students’ prescribing competence. In parallel, the delivery of clinical pharmacology and therapeutics has changed markedly over recent decades, with many programmed moving from traditional lecture-based teaching to problem-based learning (PBL), As pharmacology content is increasingly embedded within PBL rather than taught as a discrete subject to minimize information overload (15). ensuring that essential competencies such as safe prescribing for higher-risk groups, including pregnant women are explicitly taught and assessed becomes especially important. Other shifting from traditional teaching includes many types shows high effectiveness in medical students’ curriculum such as E-learning which is the most widely used strategy with 16 studies investigating its effectiveness (20%), CBL (with 10 studies, 12.5%), simulation and role play (with 6 studies, 8%) (16). Besides the considerable gap mentioned that pharmacy students have higher awareness of nutritional requirements and physical activity (11), another gap is strongly related to drug categorization. Many educational and research studies still refer to the former US-FDA pregnancy risk categories (A, B, C, D and X) (10). However, this letter-category system has important limitations because it can oversimplify risk and may be misinterpreted as a graded scale of safety. (17).

Methodology

Study Design

This research is designed as a cross-sectional analytical study to evaluate the levels of knowledge and perceptions among the target population.

Study Setting and Duration

The study will be conducted at the College of Medicine, King Saud University, in Riyadh, Saudi Arabia. The data collection and research activities are scheduled to take place during the 2025/2026 academic year.

Sample Size and Sampling Technique

The sample size was determined using a single proportion equation with a 95% confidence level, an estimated proportion (p) of 80%, and a 0.05 margin of error, resulting in a base requirement of 246 participants. To account for potential non-response, a 20% buffer (50 participants) was added, bringing the final recruitment target to **296 students**.

Subject Recruitment and Selection:

Target Population

Medical students at various academic levels within the College of Medicine at King Saud University.

Recruitment Procedures

Researchers will coordinate with the Medical Students’ Council to obtain contact information, including email addresses and phone numbers, to facilitate outreach.

Inclusion Criteria

All medical students currently enrolled in the College of Medicine at King Saud University.

Exclusion Criteria

Any questionnaire submissions containing incomplete or missing responses will be excluded from the final analysis.

Data Collection Method

Data will be gathered using a structured questionnaire composed of open-access materials. The survey will be disseminated digitally via Google Forms through platforms such as Email and WhatsApp. All participants must provide informed consent before accessing the survey. Once collected, responses will be compiled into Google Sheets for processing.

Confidentiality and Ethical Considerations

Ethical standards are prioritized through mandatory informed consent for all participants. To ensure anonymity, names will not be linked to survey responses. In the event of paper-based submissions, forms will be kept in sealed envelopes to maintain strict confidentiality and prevent the disclosure of identity to the investigators.

Statistical Analysis

Data analysis will be performed using **PSPP statistical software**. The analytical plan includes

Univariate Analysis

Descriptive statistics, including frequencies, percentages, means, and standard deviations, will be used to summarize study variables.

Bivariate Analysis

The student's t-test and one-way ANOVA (with post hoc testing) will compare mean values across categorical groups. Pearson's Chi-square tests and Odds ratios will be employed to measure associations between categorical variables.

Correlation and Regression

Pearson's correlation and simple linear regression will quantify relationships between quantitative variables.

Significance

Statistical significance is defined by a **p-value of ≤ 0.05** with 95% confidence intervals to ensure precision.

Results

Descriptive Analysis:

Socio-Demographic Characteristics:

The current study aimed to identify the perceptions of the different levels of the medical school years regarding the concept of professionalism. A cross-sectional survey study, using an online format included 18 items (multiple choice questions and Likert-type scale) distributed to 297 students enrolled in the five years of the undergraduate curriculum at the College of Medicine, King Saud University, including the interns. The participants included 215 males (72.4%) and 82 females (27.6%). The largest group of participants were in Year 3 (39.7%) followed by Year 4 (24.2%), Year 1 (13.1%), Year 2 (10.8%), Year 5 (8.1%), and the interns (4.0%). The GPAs of the participants showed that 62% were in the range of 4.50– 5.00, 24.6% in the range of 4.00–4.49, 11.8% in the range of 3.50–3.99, and 1.7% were less than 3.50. Table 1.

Table 1
Socio-Demographic Characteristics of Study Participants (N = 297)

Variable	*Categories*	*N*	*%*
Gender	*Male*	*215*	*72.4%*
	Female	*82*	*27.6%*
Academic Year	*Year 1*	*39*	*13.1%*
	Year 2	*32*	*10.8%*
	Year 3	*118*	*39.7%*
	Year 4	*72*	*24.2%*
	Year 5	*24*	*8.1%*
	Intern	*12*	*4.0%*
GPA Range	*Less than 3.00*	*3*	*1.0%*
	3.00–3.49	*2*	*0.7%*
	3.50–3.99	*35*	*11.8%*
	4.00–4.49	*73*	*24.6%*
	4.50–5.00	*184*	*62.0%*

Knowledge of Safe Medications in Pregnancy:

Table 2 shows the distribution of correct answers for the 14 knowledge items. The question regarding the time of pregnancy when major structural congenital malformations occur was the item most often answered correctly (85.9%). Other items for which a majority of respondents provided correct answers included the question regarding valproic acid as the medication with the highest risk of major malformations among those listed (59.9%), the definition of FDA Category A (no risk in humans) (57.6%), and the medications used to treat musculoskeletal pain in the third trimester (30.6% for NSAIDs; 40.6% for acetaminophen). The lowest percentages of correct answers were for the items regarding which medication to use for bleeding in a pregnant woman (35.0%), the treatment of diabetes (39.1%), FDA Category D (32.0%), and FDA Category C (35.4%). For the FDA Category B question, 28.3% of respondents selected "Missing/Unsure".

Table 2
Knowledge of Safe Medications in Pregnancy (N = 297)

Variable	N	%
1. Which of the following best describes FDA Pregnancy Risk Category A?		
No risk in humans (Correct*)	171	57.6%
Animal studies show risk; no human data	23	7.7%
Evidence of fetal risk; benefits may outweigh risk	16	5.4%
Contraindicated in pregnancy	12	4.0%
Missing / Unsure	75	25.3%
2. Which of the following best describes FDA Pregnancy Risk Category B?		
No risk in humans	11	3.7%
Animal studies show no risk; no adequate human studies (Correct*)	158	53.2%
Evidence of fetal risk in humans	29	9.8%
Contraindicated in pregnancy	15	5.1%
Missing / Unsure	84	28.3%
3. Which of the following best describes FDA Pregnancy Risk Category C?		
No risk in humans	10	3.4%
Animal studies show no risk; no adequate human studies	46	15.5%
Evidence of fetal risk in humans	117	39.4%
Contraindicated in pregnancy	19	6.4%
Correct answer / Missing / Unsure	105	35.4%
4. Which of the following best describes FDA Pregnancy Risk Category D?		
No risk in humans	22	7.4%
Evidence of fetal risk in humans	44	14.8%
Evidence of human fetal risk; benefits may justify use (Correct*)	46	15.5%
Contraindicated in pregnancy	90	30.3%
Missing / Unsure	95	32.0%
5. Which of the following best describes FDA Pregnancy Risk Category X?		
No risk in humans	8	2.7%
Evidence of human fetal risk; benefits may justify use	17	5.7%
Contraindicated; risk outweighs benefits (Correct*)	137	46.1%
Use with caution	21	7.1%
Missing / Unsure	114	38.4%
6. What is the most sensitive period for structural congenital malformations?		
First trimester/organogenesis (Correct*)	255	85.9%
Second trimester	26	8.8%
Third trimester	5	1.7%
Preconception period	11	3.7%
7. What is the primary effect of drug exposure during the second trimester?		
Growth and functional maturation (Correct*)	169	56.9%
Organ formation	84	28.3%
Chromosomal development	33	11.1%
Placental implantation	11	3.7%
8. What is the primary effect of drug exposure during the third trimester?		

Variable	N	%
1. Which of the following best describes FDA Pregnancy Risk Category A?		
Functional fetal effects (Correct*)	116	39.1%
Growth and functional maturation	104	35.0%
Neural tube defects	66	22.2%
Chromosomal development	11	3.7%
9. Which medication should be avoided for musculoskeletal pain in the third trimester?		
NSAID (Correct*)	91	30.6%
Paracetamol	22	7.4%
Codeine	101	34.0%
Topical lidocaine	14	4.7%
Missing / Unsure	69	23.2%
10. What is the most appropriate antibiotic for UTI at 10 weeks gestation?		
Amoxicillin (Correct*)	142	47.8%
Ciprofloxacin	40	13.5%
Chloramphenicol	11	3.7%
Tetracycline	18	6.1%
Missing / Unsure	86	29.0%
11. Which antihypertensive is contraindicated in pregnancy?		
ACE inhibitors (Correct*)	154	51.9%
Labetalol	16	5.4%
Methyldopa	23	7.7%
Nifedipine	26	8.8%
Missing / Unsure	78	26.3%
12. Which antiepileptic has the highest risk of congenital malformations?		
Valproic acid (Correct*)	178	59.9%
Levetiracetam	14	4.7%
Lamotrigine	13	4.4%
Carbamazepine	16	5.4%
Missing / Unsure	76	25.6%
13. Which antidiabetic agent is most used and considered safe in pregnancy?		
Insulin (Correct*)	139	46.8%
Glyburide	21	7.1%
Glibenclamide	9	3.0%
Tolbutamide	12	4.0%
Missing / Unsure	116	39.1%
14. Which anticoagulant is considered safe during pregnancy?		
Heparin (Correct*)	120	40.4%
Warfarin	20	6.7%
Rivaroxaban	21	7.1%
Dabigatran	32	10.8%
Missing / Unsure	104	35.0%

Educational Exposure and Perception:

Table 3 shows educational exposure and self-perceived preparedness regarding safe use of medications in pregnancy (Likert scale, five items). Overall, more than half of the participants (52.9–55.6%) perceived that they had been exposed to teaching safe medications in pregnancy during the basic sciences course and also agreed that the basic sciences examinations included questions on safe medications in pregnancy. In contrast, less than 38% of the participants reported that they had been exposed to information on safe use of medications in pregnancy through self-study. Self-perceived preparedness regarding safe use of medications in pregnancy was poor. Although 29.3% of the participants agreed that they had sufficient current knowledge pertaining to their level of training, more than two thirds (69.0%) of the participants agreed that they needed education on safe use of medications in pregnancy. The internal consistency of the five-item scale was assessed with Cronbach's alpha, yielding an α of 0.652 (N = 296 valid cases). For the purposes of the present exploratory research, this was sufficient.

Table 3
Educational Exposure and Perception (Likert Scale) (N = 297)

Perception Item	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)	Agree + Strongly Agree %
Taught about safe medications in pregnancy during basic science courses	20 (6.7)	31 (10.4)	88 (29.6)	71 (23.9)	86 (29.0)	52.9%
Learned through self-study (textbooks, lectures, online)	38 (12.8)	67 (22.6)	81 (27.3)	64 (21.5)	47 (15.8)	37.4%
Exams included questions on medication safety in pregnancy	18 (6.1)	37 (12.5)	77 (25.9)	74 (24.9)	91 (30.6)	55.6%
Current knowledge is adequate for my level of study	34 (11.4)	68 (22.9)	108 (36.4)	50 (16.8)	37 (12.5)	29.3%
I need additional training about medication safety in pregnancy	10 (3.4)	24 (8.1)	58 (19.5)	66 (22.2)	139 (46.8)	69.0%

Overall, Knowledge Score:

Table 4 shows the means and standard deviations of the score on the composite knowledge scale. This scale consisted of 14 items for which binary scores were assigned (1 for correct answers and 0 for incorrect answers). The highest possible score on this scale was therefore 14. The mean score for the women in this study on the composite knowledge scale was 5.86 (SD = 2.85). The highest score obtained by the women in this study was 12. Thus, although the women in this study had obtained a good maximum score for the knowledge scale (the score corresponding to 85.71% correct answers), on average the women in this study had achieved a level of knowledge of less than 40% with respect to the safe use of medication during pregnancy. This clearly indicates a serious gap in knowledge in this important area of maternal and child health.

Table 4
Descriptive Statistics of the Knowledge Score (N = 297)

Domain	Min	Max	Mean	SD
Knowledge score (0–14)	0	12	5.86	2.85
Knowledge percentage score (0–100%)	0.00%	85.71%	41.82%	20.38%

Inferential Analysis:

Association between Gender and Knowledge Score:

Table 5 presents the mean score and SD for the male and female students, together with their 95% CIs. Although the mean score for the knowledge of safe medications in pregnancy of the 17 male students was 5.83 (SD = 2.84, 95% CI 4.41, 7.25), that for the 38 female students was 5.91 (SD = 2.90, 95% CI 5.05, 6.77). Since the knowledge scores in all subgroups were not normally distributed, a non-parametric test, the MannWhitney U test, was performed. The results of the test indicated that there was no significant difference in the knowledge of safe medications in pregnancy between the two groups of students (U = 8684, Z = − 0.229, p = 0.819). Therefore, there was no relationship between gender and knowledge of safe medications in pregnancy. There was little difference between the two genders in terms of numerical score, and the differences were meaningless.

Table 5
Association between Gender and Knowledge Score

Gender	n	Mean Score ± SD	Test	p-value
Male	215	5.83 ± 2.84	Mann-Whitney U = 8,664 Z = − 0.229	0.819
Female	82	5.91 ± 2.90		

Association between Academic Year and Knowledge Score:

Students were also asked to complete a multiple-choice questionnaire about safe use of medications in pregnancy and/or lactation (Table 6). Means for the questionnaire were highest for the Year 4 students, indicating a good knowledge about safe use of medications in pregnancy. The mean for the Interns was only 3.75, indicating a very poor knowledge about safe use of medications in pregnancy and/or lactation. Although the groups differed significantly in their means for this assessment, Levene's test indicated that the groups did not differ significantly in terms of variance for this assessment ($F (5, 138) = 1.96$; $p = 0.448$). Hence an analysis of variance test was used assuming equal variances between groups. A Kruskal-Wallis tests also revealed a significant difference between the groups ($H (5) = 41.562$; $p < 0.001$). As with the freetext questionnaire, being in Year 4 of the course was associated with a good knowledge of safe use of medications in pregnancy and/or lactation; in contrast, the scores of those completing internship were low.

Table 6
Association between Academic Year and Knowledge Score

Academic Year	n	Mean Score	SD	Std. Error
Year 1	39	4.38	2.84	0.46
Year 2	32	5.31	3.09	0.55
Year 3	118	5.64	2.66	0.25
Year 4	72	7.36	2.40	0.28
Year 5	24	6.58	2.43	0.50
Intern	12	3.75	3.08	0.89
Total	297	5.86	2.85	0.17

Association between GPA Range and Knowledge Score:

Knowledge of medication safety in pregnancy for all categories of GPA increased as the GPA classification increased (see Table 7). The students with the highest mean GPA (4.50–5.00) had the highest mean knowledge score of 6.20 (SD = 2.71). Those in the 4.00–4.49 GPA category had the next highest mean score of 5.60 (SD = 3.17). The students in the 3.50–3.99 GPA category had the lowest mean score of 4.60 (SD = 2.60). The Kruskal-Wallis H test for the differences between the groups was significant: $H (4) = 12.432$; $p = 0.014$. As with the self-efficacy scores, knowledge of medication safety in pregnancy tended to increase as GPA increased. The group with the highest mean GPA category of 3.00–3.49 (n = 2) had a mean score of 8.00; however, this clearly is an unreliable estimate due to the small sample size.

Table 7
Association between GPA Range and Knowledge Score

GPA Range	n	Mean Score	SD	Test Statistic	/ p-value
Less than 3.00	3	4.00	2.65	Kruskal-Wallis H(4) = 12.432	p = 0.014
3.00–3.49	2	8.00	1.41		
3.50–3.99	35	4.60	2.60		
4.00–4.49	73	5.60	3.17		
4.50–5.00	184	6.20	2.71		
Total	297	5.86	2.85		

Correlation between Educational Exposure Score and Knowledge Score:

Table 8. Spearman's rank correlation between total educational exposure score (Likert total) and overall knowledge score. A moderate positive correlation existed between total educational exposure score (Likert total) and overall knowledge score. Participants with greater total exposure to education on safe medications in pregnancy perceived more positive training (Likert total) and gained higher knowledge score ($\rho = 0.420$; $p < 0.001$). The correlation was moderate in size, therefore, while a relationship existed, it is likely that several factors influenced learning in this context.

Table 8
Correlation between Educational Exposure Score and Knowledge Score

Variable	Correlation Test	ρ	p-value
Educational Exposure Score (Likert Total)	Spearman	0.420	< 0.001

Multiple Linear Regression Analysis Predicting Knowledge Score:

Table 9 displays the results from a model that entered all potential predictors into the equation simultaneously to determine the independent predictors of the total knowledge score. The model was highly significant, $F (4, 292) = 21.357$, $p < .001$. It explained 22.6% of the variance in knowledge scores. Educational exposure score, Likert Total ($B = 0.329$, $Beta = 0.401$, $t = 7.720$, $p < .001$) was the strongest and most significant independent predictor of knowledge scores. The GPA range ($B = 0.401$, $t = 3.051$, $p = 0.002$) was a significant independent predictor of knowledge, which suggests that higher academic achievement is independently associated with higher knowledge scores. Academic year ($B = 0.145$, $t = 2.791$, $p = 0.006$) also was a significant predictor in the model. No significant association between gender and knowledge score was found ($B = - 0.003$, $t = - 0.052$, $p = 0.959$). As seen in the bivariate analysis, knowledge

scores were largely predicted by variables related to educational experience, academic progress, and year of study, with gender not providing independent prediction.

Table 9
Multiple Linear Regression Analysis Predicting Knowledge Score (N = 297)

Variable	B	Std. Error	Beta	t	p-value	95% CI
(Constant)	1.135	0.329	—	3.450	0.001	0.487–1.783
Gender	−0.003	0.158	−0.001	−0.052	0.959	−0.314–0.308
Academic Year	0.145	0.052	0.144	2.791	0.006	0.043–0.247
GPA Range	0.401	0.132	0.119	3.051	0.002	0.142–0.660
Educational Exposure (Likert Total)	0.329	0.043	0.401	7.720	< 0.001	0.244–0.414

Discussion

The findings of this study demonstrated suboptimal knowledge among medical students regarding the safe use of medications during pregnancy, with a mean knowledge score of 5.86 out of 14 (41.82%). This reflects an overall moderate-to-low level of understanding, indicating room for improvement in this important area of pharmacotherapy. Considering that medical students progress through different stages of training, variations in knowledge are expected between preclinical and clinical years, where exposure to pharmacology and patient care gradually increases. When stratified by academic level, differences in knowledge were observed between preclinical students (first and second years) and clinical students (third, fourth, and fifth years, including interns). Clinical-year students generally demonstrated better understanding of medication safety principles compared to preclinical students, likely due to increased exposure to pharmacology, clinical rotations, and patient-based learning. However, despite this progression, overall performance still indicates that knowledge is not at an optimal level across all academic stages, suggesting that both preclinical and clinical curricula may require strengthening in maternal pharmacotherapy. These findings are consistent with previous studies that reported significant gaps in knowledge regarding teratogenicity and medication safety during pregnancy. [Banu G et al] study found that although 51% of medical practitioners demonstrated good knowledge, 19% still had poor knowledge, and only 24% felt confident prescribing medications during pregnancy (7). [Kumari P et al] study reported that only 34.69% of undergraduate medical students were aware of the US-FDA fetal risk categories, while less than one quarter could correctly identify teratogenic drugs (8). Similarly, only 21% of students understood the importance of counseling women before pregnancy (9), and 33.58% could correctly identify all FDA pregnancy risk categories (10). These findings highlight the need for stronger educational focus on maternal pharmacotherapy during undergraduate medical training.

A closer examination of specific knowledge domains in the present study reveals that deficiencies were mainly concentrated in clinically applied pharmacotherapy rather than basic teratogenic principles. Although recognition of the first trimester as the most critical period for congenital malformations was high (85.9%), similar awareness regarding teratogenicity has been reported among undergraduate medical students in India (9). However, this understanding did not consistently translate into clinical decision-making. Significant gaps were observed in FDA pregnancy risk classification, particularly Category C (35.4%) and Category D (15.5%), reflecting difficulty in interpreting intermediate-risk categories. In addition, only 46.8% correctly identified insulin as the preferred antidiabetic agent and 40.4% selected heparin as the safest anticoagulant, indicating limitations in the application of pharmacological knowledge to common clinical scenarios during pregnancy. Awareness of NSAID contraindication in the third trimester also remained limited (30.6%). Similar deficiencies in medication safety knowledge and risk assessment during pregnancy have been reported among healthcare professionals in Saudi Arabia and other developing settings (5, 18). Although more than half correctly identified ACE inhibitors (51.9%) and valproic acid (59.9%) as teratogenic, overall performance suggests stronger recognition of high-risk medications than broader clinical pharmacotherapy principles during pregnancy.

These findings suggest that the problem extends beyond simple recognition of teratogenic drugs and reflects broader deficiencies in clinically applied pharmacotherapy during pregnancy. In this context, educational exposure becomes an important factor influencing students' knowledge and confidence regarding safe medication use during pregnancy. In the present study, more than half of the participants reported receiving formal teaching on this topic, with 52.9% agreeing or strongly agreeing that they were taught about safe medications during pregnancy during basic science courses, while 55.6% reported that examinations included related questions. However, despite this exposure, students' objective knowledge remained low, and their self-perceived preparedness was limited, indicating that current teaching methods may not be sufficient to ensure effective clinical application. However, despite this exposure, students' self-perceived preparedness remained low. Only 29.3% of participants felt that their current knowledge was adequate for their level of study, while 69.0% reported needing additional training. This gap suggests that although the topic is included in the curriculum, the depth, clinical application, or reinforcement of teaching may be insufficient. Therefore, educational exposure should not only involve theoretical lectures but also case-based learning, clinical scenarios, and practical examples of medication decision-making during pregnancy. This finding is consistent with a national study among pharmacy students in Jordan, where 60.6% of students reported that they did not receive enough undergraduate instruction about medication use in pregnancy. That study also found that only 2.5% had good knowledge, and 52.6% were not confident in recommending medications for pregnant women, supporting the idea that insufficient curricular exposure can lead to poor knowledge and low confidence (19).

Despite more than half of participants reporting formal teaching and examination coverage of medication safety in pregnancy, only 29.3% felt adequately prepared, and 69.0% requested further training. This suggests that current curricular exposure may be insufficient in depth or clinical integration. Similar findings have been reported in other studies, highlighting that inadequate undergraduate teaching is associated with low confidence and poor knowledge in prescribing during pregnancy.

Academic year was significantly associated with knowledge scores regarding medication safety during pregnancy and lactation. A total of 297 students participated, with Year 3 students representing the largest group (39.7%), followed by Year 4 students (24.2%). Year 1 students had the lowest early stage mean score (4.38), while Year 4 students achieved the highest mean score (7.36), followed by Year 5 students (6.58). Interestingly, interns demonstrated the lowest mean score overall (3.75), which is concerning because internship represents the final stage before independent clinical practice. The Kruskal-Walli's test showed a statistically significant difference between academic groups ($H(5) = 41.562$, $p < 0.001$), indicating that progression through medical school influences knowledge acquisition. The relatively higher performance among Year 4 students may reflect optimal exposure to pharmacology and clinical medicine during that stage of training, whereas the lower performance among interns may be related to reduced academic revision, shift toward service-based clinical duties, or small sample size. Similar findings have been observed in studies among Peruvian dental students, where knowledge levels varied significantly by academic year, and students in earlier clinical years demonstrated poorer understanding compared with final-year students. This suggests that timing, reinforcement, and curriculum structure all influence knowledge retention and application.

When comparing with [Flores M. et al] study that conducted among Peruvian dental students, 25.96% showed poor knowledge, while 55.13% showed fair knowledge and 18.91% showed good knowledge about pharmaco-logical management of pregnant women. The highest frequencies of poor, fair and good levels of knowledge were found among students in the 4th year (32.4%), 3rd year (62.4%) and 5th year (34.5%) of the professional career, respectively. Dental students who were in their 3rd and 4th year of study were significantly ($p < 0.001$) three times more likely to have poor knowledge (OR = 3.17, CI: 1.68–5.97 and OR = 3.88, CI: 2.07–7.31; respectively), compared to those in their 5th year of study. So being in the 3rd and 4th years of academic training was a risk factor for having poor knowledge about dental management in pregnant women, compared to those who were in the 5th year. While in term of GPA and gender our study demonstrated that gender was not significantly associated with knowledge score regarding safe medication use during pregnancy ($p = 0.819$), which is consistent with findings among Peruvian dental students where gender was also not considered an influential factor affecting knowledge performance (20).

In contrast, GPA was identified as a significant predictor of knowledge score in the current study. Students within the highest GPA category (4.50–5.00) achieved the highest mean knowledge score (6.20 ± 2.71), and the association between GPA and knowledge score was statistically significant ($H(4) = 12.432$, $p = 0.014$). Furthermore, GPA remained a significant independent predictor in the regression analysis ($B = 0.401$, $p = 0.002$). These findings are supported by the Iranian study conducted among dental students in Yazd, which also demonstrated significantly higher knowledge scores among students with higher GPA ranges (16.1–17.3) compared with lower GPA categories ($p = 0.001$) (21). The Iranian study additionally reported higher knowledge scores among female students ($p = 0.040$), although gender was not a significant factor in our study. Collectively, these findings suggest that academic achievement may play a greater role in correct clinical decision-making than demographic factors such as gender.

These findings suggest that current curricular exposure may not be sufficient to ensure clinically applicable knowledge regarding medication safety in pregnancy. Although more than half of participants reported prior teaching or assessment on this topic, only 29.3% perceived their knowledge as adequate and 69.0% requested additional training. The low score among interns should be interpreted cautiously because of the small subgroup, yet it is concerning because internship precedes independent prescribing. This pattern is consistent with a recent scoping review showing that active strategies — e-learning, case-based, experiential and interprofessional learning — can improve pharmacological knowledge or prescribing skills, although higher-level outcome evidence remains limited [16]. Similarly, [Tobaiqy M. et al] reported that students struggled to apply pharmacology and preferred practical, case-based approaches (22).

Several limitations should be considered when interpreting this study. First, cross-sectional design limits the ability to establish causal relationships between education and knowledge levels. Second, as the study was conducted at a single institution, the findings may not be generalizable to other medical schools. The short data collection period (14 days) may also have affected participation rates. In addition, participant distribution across academic years was uneven, with most responses from third- and fourth-year students, while other groups were underrepresented, which may have affected representativeness. Furthermore, the use of a self-administered questionnaire may have introduced response bias, including guessing and socially desirable answers. The questionnaire also assessed theoretical knowledge rather than actual clinical practice. Despite these limitations, the study provides valuable insight into knowledge gaps regarding medication safety during pregnancy and emphasizes the need for targeted educational interventions.

Conclusion

This study found that medical students at King Saud University have suboptimal knowledge regarding medication safety during pregnancy, with an overall mean score of 5.86 out of 14 (41.82%). Although knowledge improved in clinical years, important gaps remained, particularly in applying pharmacological principles to clinical scenarios and interpreting drug safety classifications.

Despite some curricular exposure, students reported low confidence and a high need for further training, suggesting that current teaching methods are insufficient for developing clinical competence. GPA was positively associated with knowledge, while gender showed no significant effect.

Overall, the findings highlight the need to strengthen undergraduate education in maternal pharmacotherapy through more clinically oriented and case-based teaching. Future research should assess the impact of targeted educational interventions on long-term knowledge and prescribing skills.

Declarations

Ethics approval

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of King Saud University Medical City (Approval No: R26-IRB-183).

consent to participate

Participation was voluntary, and informed consent was obtained from all participants before enrollment in the study. All procedures were conducted in accordance with the ethical standards of the institutional and national research committee and with the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

1-Ayidh Hussain Alqantash: Responsible for writing the literature review and the discussion section. He also led the research team and wrote the entire manuscript.

2-Saad M Alshehri: Contributed to writing the literature review and the discussion section.

3-Abdulrahman Al-Malki: Contributed to writing the literature review and the discussion section.

4-Saleh Al-Janah: Responsible for writing the methodology section of the research and discussion.

5-Abdulrahman Al-Ahideb: Involved in collecting relevant studies and participated in data collection and questionnaire distribution and writing discussion.

6-Mohammed Al-Sulaimani: Involved in collecting relevant studies and participated in data collection and questionnaire distribution and write discussion.

7-Mohammed Al-Otaibi: Involved in collecting relevant studies and participated in data collection and questionnaire distribution and write discussion.

8- Malak Al-Hakeem – Supervisor: Supervised the research process, reviewed the manuscript, and provided critical feedback and revisions.

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Clinical trial number

Not applicable.

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