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# Perspective of biopharmaceutics knowledge and practice of pharmacy personnel toward the effect of medication route and medical procedure on nullifying fasting



Muna Oqal<sup>a,\*</sup>, Bushra Hijazi<sup>b</sup>, Enaam Al Momany<sup>c</sup>, Abdelrahim Alqudah<sup>c</sup>, Basima A. Almomani<sup>b</sup>, Amjad Z. Alrosan<sup>c</sup>, Areen Alshweiat<sup>a</sup>, Rasha Istaiteyeh<sup>d</sup>, Roaa Alnajjar<sup>a</sup>, Yazeed Bani Younes<sup>a</sup>, Ro'ya Al-karra'ein<sup>a</sup>

<sup>a</sup> Department of Pharmaceutics and Pharmaceutical Technology, Faculty of pharmaceutical sciences, The Hashemite University, P.O box 330127, Zarqa 13133, Jordan

<sup>b</sup> Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, Jordan

<sup>c</sup> Department of Clinical Pharmacy and Pharmacy Practice, Faculty of pharmaceutical sciences, The Hashemite University, P.O box 330127, Zarqa 13133, Jordan

<sup>d</sup> Department of Economics, Faculty of Economics and Administrative Sciences, The Hashemite University, P.O box 330127, Zarqa 13133, Jordan

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## ABSTRACT

**Background:** In Ramadan, most of the dosing schedules for the patients are changed, and to ensure patient compliance to medications and to healthy life among patients, appropriate guidelines and educations are needed. This can be achieved by pharmacy personnel in all clinical settings who are recognized as biopharmaceutical experts and integral educators of medications.

**Aims:** This study aimed to identify the perspective knowledge of pharmacy personnel about effect of medication route and medical procedure on nullifying fasting in Ramadan and to determine the predictors of this knowledge.

**Methods:** A cross-sectional study was conducted in Jordan during March–April 2022. An internet-based self-administrated questionnaire on knowledge, and views was distributed using social media groups to the pharmacy personnel among different geographical areas in Jordan. A descriptive and univariate analysis were performed. Binary logistic regression was conducted to determine the predictors of knowledge including all variables with  $p < 0.20$  on univariate analysis.

**Results:** A total of 1003 responses to the study questionnaire were collected and included in the analysis. The most common source that pharmacy personnel used to get information on medication intake and medical procedures during fasting in Ramadan was Fatwa (57.8%) followed by Islamic materials “books and brochures” (47.1%). The majority of respondents were knowledgeable about the effect of administration route of medication and medical procedures on nullifying fasting in Ramadan (greater than 70%). The univariate analysis showed that more than half of respondents (56.1%) were considered knowledgeable, and the binary logistic regression analysis identified that both professional degree type and confidence of respondents to modify the patient’s medication schedule as predictors for knowledge (OR = 1.791, 95% CI = 1.035–3.098,  $p = 0.037$ ), (OR = 1.375, 95% CI = 1.04–1.817,  $p = 0.025$ ), respectively.

**Conclusions:** Most of pharmacy personnel in Jordan are knowledgeable in biopharmaceutics principles and practice toward effect of medication route and medical procedure on nullifying fasting, and the

\* Corresponding author at: The Hashemite University, Zarqa, Jordan.

E-mail addresses: [Munak@hu.edu.jo](mailto:Munak@hu.edu.jo) (M. Oqal), [enaam@hu.edu.jo](mailto:enaam@hu.edu.jo) (E. Al Momany), [abdelrahim@hu.edu.jo](mailto:abdelrahim@hu.edu.jo) (A. Alqudah), [baalmomani1@just.edu.jo](mailto:baalmomani1@just.edu.jo) (B.A. Almomani), [amjadz@hu.edu.jo](mailto:amjadz@hu.edu.jo) (A.Z. Alrosan), [areen.alshweiat@hu.edu.jo](mailto:areen.alshweiat@hu.edu.jo) (A. Alshweiat), [ristaiteyeh@hu.edu.jo](mailto:ristaiteyeh@hu.edu.jo) (R. Istaiteyeh), [roaanajjar1298@gmail.com](mailto:roaanajjar1298@gmail.com) (R. Alnajjar), [Yazeedakram99.dz@gmail.com](mailto:Yazeedakram99.dz@gmail.com) (Y. Bani Younes), [Royaalkaraeen9@gmail.com](mailto:Royaalkaraeen9@gmail.com) (R. Al-karra'ein).

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identified predictors for this knowledge, can provide an opportunity to improve safe and effective use of medications and medical procedures during the holy month of Ramadan.

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## 1. Introduction

In Ramadan, Muslims fast from dawn to sunset. During this period, they are refrained from both eating and drinking and consequently they have only two main meals throughout the day (Azizi 2002, Zairi et al., 2021). Thus, it becomes inconvenient for patients to follow the regular schedule of medication intake; especially that is taken on an empty stomach or given frequently during the day. In a clinical review of medication intake during Ramadan, a large misuse of medications was found that subsequently led to increasing the rate of treatment failure (Aadil et al., 2004, AlAbdan et al., 2022). Two studies have shown that the majority of patients in Ramadan change their dosing schedule (Leiper et al., 2003, Ali et al., 2007, Amin and Abdelmageed 2020, Mahanani et al., 2021). It was reported also in previous studies, which was conducted on Muslim diabetic patients, that education and appropriate guidelines are needed for medication adjustment in Ramadan (Zainudin et al., 2018, Zainudin and Hussain 2018). The majority of studies on the effect of fasting on blood pressure in hypertensive patients have revealed a slight variations in blood pressure associated with changes of sleep, activity, and eating pattern (Abdelaziz et al., 2019, Al-Jafar et al., 2021, Zairi et al., 2021). Therefore, to ensure compliance during Ramadan; there is a need to manage these medications and to modify the dose schedule to once or twice daily, as required (Amin and Chewning 2016, Almansour et al., 2017).

In fact, pharmacy personnel has a great opportunity in Ramadan to boost healthy life style among patients through advising them about smoking cessation and healthy dietary habits (Mohamed Ibrahim 2015). Patients with acute illnesses may need to be informed that their fasting needs to be broken and compensated later (Alshehri et al., 2021). Before Ramadan, pharmacists should counsel patients who intend to fast regarding modifications' doses and frequencies, in addition to changes in dietary intake, physical activity, and sleeping pattern (Grindrod and Alsabbagh 2017). Furthermore, diabetic patients need to be educated about the importance of self-monitoring of blood glucose level several times daily, especially if there (is a potential risk of hypoglycemia) are symptoms of hypoglycemia (Zainudin et al., 2018, Tourkmani et al., 2021). Notably, as the majority of patients who have the intent to fast seek consultation voluntarily before Ramadan; it is important to draw their attention for the follow up visits before starting fasting (Hassanein et al., 2019, Alshehri et al., 2021). It is familiar that the compatibility of fasting with the various medication administration routes, medical procedure and their choice during Ramadan usually remain a matter for the physician's own judgment (Aadil et al., 2004, Abolaban and Al-Moujahed 2017). However, pharmacists may encounter fasting Muslim patients who are seeking for counseling and advising to know whether a specific procedure or route of medication administration during Ramadan would invalidate their fast. Accordingly, pharmacists have an essential role in counselling patients who are fasting Ramadan for medication managements and advising on effect of medication route and medical procedure on patients' Fasting. By understanding the possible compliance and adherence issues, pharmacists can support patients during fasting in Ramadan (Abolaban and Al-Moujahed 2017).

Importantly, pharmacists have biopharmaceutics knowledge (Oqal et al., 2022, Shawahna et al., 2022) which supposed to qualify

their role in enhancing medication treatment outcomes and promoting wellness, through ensuring dispensing and preparing medications in the correct doses and frequency, and counseling patients for safe and appropriate use of medications (Mansur 2016). In fact, health care professionals rely on and trust pharmacists in selecting and administering medications that promote the quality of life for patients, based on their specialized expertise in medication (Shawahna et al., 2022).

Overall, few studies have been conducted in Jordan on assessing the role of pharmacy personnel in managing prescription regimens throughout the fasting month of Ramadan. However, up to our knowledge no previous studies have been performed before to assess the perspective biopharmaceutics knowledge and practice toward the effect of medication route and medical procedures on nullifying fasting during Ramadan.

### 1.1. The aims of this study

The main objective of this study was to assess the biopharmaceutics knowledge of pharmacists or pharmacy technicians toward the effect of medication route of administration and medical procedure on nullifying fasting in Ramadan and to determine the predictors of this knowledge. This will help to settle medications management during Ramadan and standardize the choice of routes and medical procedures. A secondary objective was to explore and assess the pharmacy personnel's role in the followings: providing pharmaceutical care; exploring pharmacists' perspective on the importance of medication regimen adjustment along with the proper counseling required to optimize patients' health during Ramadan.

## 2. Methods

### 2.1. Design and data collection

This is a cross-sectional study using an internet-based self-administrated questionnaire which was created using *Google Forms*. The participants in our study represented pharmacists and pharmacy technicians who are practicing in Jordan and were recruited through social media platforms using snowball sampling technique in which the existing participants provided referrals to recruit samples required. They distribute the study questionnaire to their network of pharmacists and pharmacy technicians. This helped to collect the data in time and in a cost-effective manner. Data collection was performed between the periods March-April 2022. The questionnaire was distributed through several media groups of pharmacists and pharmacy technicians among different geographical areas in Jordan. These social media groups were created as a tool for general communication within the pharmacist's community. Informed consent was obtained from the participants as a pre-request to participate in the study. After explaining the study objectives, procedure, and confidentiality of the study findings as an introduction of the questionnaire, the participants were asked if they would like to participate in the study. If the participant chooses yes to participate, he/she could proceed to questionnaire and if chooses no he/she cannot proceed to questionnaire questions and cannot participate.

## 2.2. Sample size

The sample size was calculated using Raosoft software, and revealed the need for minimum at least 382 pharmacy personnel based on 95% confidence level, 5% confidence interval, and a total number of pharmacists and pharmacy technicians in Jordan of 50,000. However, and to enhance the generalizability of the results and to account for inappropriate responses and errors in questionnaire filling, a minimum sample of 500 pharmacy personnel was intended.

## 2.3. Ethical consideration

The study was approved by Institutional Review Board at The Hashemite University in Jordan (Reference number: (5/7/2021/2022)).

## 2.4. Development of the survey questionnaire

The survey consisted of three sections. The first section consisted of six questions about the sociodemographic data of the participants. The second section consisted of nine questions about pharmacists/ pharmacy technicians' consultation practices for patients during fasting period in Ramadan including frequency of providing consultation, percentages of patients that are provided with consultation, confidence level in the credibility of consultation, type of involvement, the most encountered diseases, what pharmacists/ pharmacy technicians' will do in case they encounter question that they do not know its answer and if there are any provided guidelines from the health authority (ministry of health, association of pharmacists) emphasizing on patients' medication adjustments during the month of Ramadan. The third section measured the pharmacists'/pharmacy technicians' biopharmaceutics knowledge (total number of questions = 34) on administration routes of medication or medical procedures that nullify fasting in Ramadan: (i) topical, local, or inhalational administration routes (n = 9), (ii) enteral (n = 9), (iii) parenteral (n = 3), and medical procedures (n = 13). The questions related to pharmacy personnel consultation practice and knowledge were selected and developed after an extensive review of the literature (Aadil et al., 2004, Mohamed Ibrahim 2015). Adequate answers for the knowledge questions were obtained after extensive reading and searching of the official website of the Fatwa Department of the Hashemite Kingdom of Jordan. Fatwa Department is the official authority for Muslims in Jordan that provide them with Islamic regulations, answering questions from Islamic perspective, and preparing of the required research papers and Islamic studies on important matters and emerging issues and many other duties (2022).

Face validity was performed by a group of experts in the field. The expert panel constituted of two pharmacologists, three specialists in biopharmaceutics and pharmaceuticals, and two certified experts in FATAWA. The Expert panel reviewed the questionnaire for the appropriateness and accuracy of the questions in relation to the research objective, and to identify possible redundancy among the survey questions. A pilot study (n = 5) was performed after modifying the questions based on the expert panel suggestions. Pilot study was conducted to test the comprehension, easy understanding, and clarity, and to ensure the usability of the data-collection method. The survey was then modified based on the comments and recommendations before the actual data collection.

## 2.5. Data analysis

Statistical Package for Social Sciences (SPSS) version 24.0 (SPSS Inc., Chicago, IL, USA) was used for analysis of the data. Descriptive

statistical analyses were performed to summarize the data for the total sample as counts (percentage).

Univariate analysis was performed using a Chi square ( $\chi^2$ ) (categorical variables), *t*-test analysis and One-way ANOVA (continuous variables) as appropriate. All variables with  $p < 0.20$  on univariate analysis were included in the multivariate analysis to determine predictors of knowledge using binary logistic regression. Statistical significance was set at  $p$  value  $< 0.05$ . Odds ratio (OR) values and their 95% confidence intervals (95% CI) were calculated for the predictors of knowledge. Knowledge was dichotomized as knowledgeable and non-knowledgeable. For this purpose, a score of 1 was given to each correct answer and the sum of all answers to the 34 questions of knowledge for each participant was calculated. Each participant was labelled as categorical variables (knowledgeable/ non-knowledgeable) using a cutoff point for cumulative scores of correct answers. The cutoff point was determined based on the sample median of 19 (mean = 18.34). A participant was categorized as knowledgeable if his/her sum of the scores was  $\geq 19$  (out of 34) and non-knowledgeable if the sum of the scores was  $< 19$  (out of 34).

## 3. Results

### 3.1. Demographics

A total of 1003 responses to the study questionnaire were collected and included in the analysis. Respondents aged between 31 and 40 years represented the highest percentage (46.4%) among all age groups and almost two third of the respondents were female (n = 647, 64.5%). Almost the entire sample belong to Muslim faith (97.9%). The percentage of respondents have a bachelor's degree in pharmacy as the highest degree is 77.7%. Almost the half of the respondents worked as community pharmacists (49.3%) followed by hospital pharmacists (23.8%), medical representatives (10.9%), hospital pharmacy technicians (8.6%), and community pharmacy technicians (4.8%). Half of the respondents (51.1%) served in their professionalism for 1–3 years followed by 4–10 years

**Table 1**  
Demographic data of respondents (n = 1003).

Demographics	Frequency (n)	Percentage (%)
<b>Gender</b>		
Male	356	35.5
Female	647	64.5
<b>Age</b>		
21–30 years	226	22.5
31–40 years	465	46.4
41–50 years	222	22.1
> 50 years	90	9.0
<b>Religion</b>		
Muslim	982	97.9
Non-Muslim	21	2.1
<b>Professional degree type</b>		
Bachelor of Pharmacy	828	82.5
Doctor of Pharmacy	102	10.2
Diploma	73	7.3
<b>Professional specialty</b>		
Community pharmacy technician	48	4.8
Hospital pharmacy technician	86	8.6
Community pharmacist	494	49.3
Hospital pharmacist	239	23.8
Medical representative	109	10.9
Other (academia, hospital pharmacist, pharmacologist...)	27	2.7
<b>Length of service in professional specialty</b>		
< 1 year	114	11.4
1–3 years	513	51.1
4–10 years	313	31.2
> 10 years	63	6.3

**Table 2**  
Participants Consultation Practices for Patients During Fasting in Ramadan (n = 1003).

	Frequency (n)	Percentage (%)
<b>Frequency of providing consultation to the patients about their medication schedule during fasting in Ramadan</b>		
Never	42	4.2
Once/ month	98	9.8
More than once/ month	209	20.8
More than once/ week	247	24.6
Once/ week	407	40.6
<b>Percentage of patients that pharmacy personnel provide consultation to them about their medication schedule in Ramadan</b>		
0%	50	5.0
20%	197	19.6
50%	366	36.5
≥80%	390	38.9
<b>Pharmacy personnel's confidence in their capability to modify the patient's medication schedule (administration route and/or frequency) to fit fasting hours/period during Ramadan</b>		
Extremely capable	62	6.2
Capable	420	41.9
Somewhat capable	299	29.8
Slightly capable	172	17.1
Not capable	50	5.0
<b>Pharmacy personnel's confidence regarding medication modifications</b>		
Confident	700	69.8
Not confident	333	30.2
<b>Pharmacy personnel involvement in modifying the medication schedule (administration route and/ or frequency) for patients</b>		
I intervene more in acute conditions	69	6.9
I intervene more in chronic conditions	279	27.8
I intervene equally in acute and chronic condition	532	53.0
I do not intervene at all in the adjustment of medication regimen during Ramadan	123	12.3
<b>Are there any provided guidelines from the health authority emphasizing on patients' medication adjustments during Ramadan</b>		
Yes	606	60.4
No	251	25.0
Do not know	146	14.6
<b>What will pharmacy personnel do if you don't know the answer to a patient's medication/medical procedure-related question regarding the fasting plan?</b>		
Refer patients to their Physician	262	26.1
Refer patients to the Fatwa (religious consultation)	740	73.8
Both	1	0.1
<b>Sources of information</b>		
Islamic materials "books and brochures"	472	47.1
Published medical articles or reviews	360	35.9
Media (Newspaper)	325	32.4
Colleagues' opinions and experience	289	28.8
Personal opinion and experience	249	24.8
Browsing Internet	295	29.4
Fatwa from the Fatwa Department, Ministry of Awqaf and Islamic Affairs or other Islamic authorities	580	57.8
<b>Responsibility of the advice regarding medication management or medical procedures during Ramadan fasting</b>		
Physician	488	48.7
Nurse	205	20.4
Pharmacist	554	55.2
Any healthcare provider	326	32.5
Health educator	221	22.0
Sheikh/Imam	394	39.3

(31.2%). The detailed information about the demographics of the respondents is presented in [Table 1](#).

### 3.2. Pharmacy personnel consultation practices for patients during fasting in Ramadan

The respondents' answers to the questions on the consultation practices are shown in [Table 2](#). Less than half of respondents

(40.6%) indicated that they were providing consultation to the patients about their medication schedule once weekly. Approximately 40% of respondents provided consultation to ≥ 80% of their patients about their medication schedule in Ramadan. The respondents felt capable and somewhat capable to modify patients' medication schedule (71.7%). Almost half of the respondents (53%) said they intervene equally in the modification of medication schedule in acute and chronic conditions followed by intervening more in chronic conditions (27.8%). Two third of respondents (60.4%) indicated that there are guidelines provided by the health authority (Ministry of Health, Association of Pharmacists) emphasizing on patients' medication adjustments during the month of Ramadan and 14.6% indicated that they do not know about these guidelines. Fatwa from the Fatwa Department from the Ministry of Awqaf and Islamic Affairs or other Islamic authorities was cited as the most common source to get information on medication intake and medical procedures during fasting in Ramadan (57.8%) followed by Islamic materials "books and brochures" (47.1%). When the respondents were asked what they will do if they do not know the answer related to the fasting plan, the majority answered that they will refer patients to the Fatwa (religion consultation) (73.8%). Fifty-five percent of the respondents think that it is the responsibility of the pharmacist to give the advice on medication management (route of administration, scheduling) and medical procedures during Ramadan, followed by the physician (48.7%) and Sheikh/Imam (39.3%). Hypertension followed by diabetes mellitus, asthma, and dyslipidemia, respectively were the most common diseases that pharmacy personnel had helped patients to adjust their regimens during Ramadan ([Fig. 1](#)).

### 3.3. Biopharmaceutics knowledge of pharmacy personnel respondents regarding the effect of administration route of medication and medical procedures on nullifying fasting in Ramadan

Regarding topical route of administration, the majority were knowledgeable about skin cream/gel/ointment, topical spray, medicated skin patches, eye drops, and vaginal pessaries. For enteral route of medication administration, most of respondents (greater than 70%) were knowledgeable about oral hygiene products, lozenges, medicated chewing gum, oral (tablets, capsules...), and sublingual medications. Almost all participants were knowledgeable (greater than 70%) about parenteral route of medication administration such as IV, IM and SC. Regarding medical procedures, more than 80% were knowledgeable about oxygen inhalation, thermometer and urinary catheterization. Details of participants answers are shown in [Table 3](#).

### 3.4. Predictors of pharmacy personnel respondents' knowledge

More than half of respondents (56.1%) were considered knowledgeable and 43.9% were considered non-knowledgeable. The results of univariate analysis (see [Table 4](#)) indicated that respondents' professional degree type, confidence in their capability to modify the patient's medication schedule and professional specialty were associated with knowledge with p values of < 0.20 in the univariate analysis (p = 0.011, 0.166, and 0.174 respectively). So, these variables were investigated as predictors for knowledge and included in the multivariate analysis. The results of multivariate analysis identified that respondents who had a bachelor's degree in pharmacy were more likely to be knowledgeable than those who had diploma (OR = 1.791, 95% CI = 1.035–3.098, p = 0.037). In addition, respondents who reported to be confident about the medication modifications were more likely to be knowledgeable compared to non-confident respondents (OR = 1.375, 95% CI = 1.04–1.817, p = 0.025).

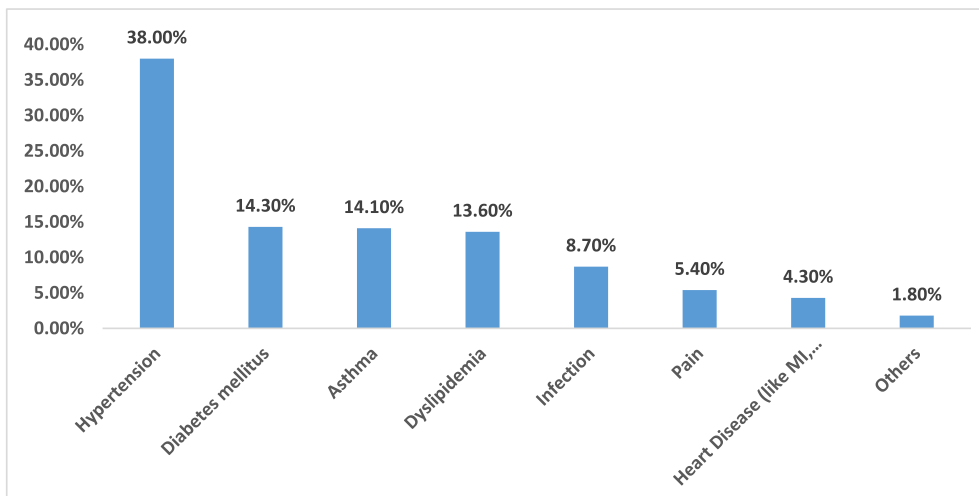


Fig. 1. The percentage of most common diseases that pharmacists/pharmacy technicians had helped patients to adjust their regimens during Ramadan.

Table 3

Knowledge of the participants regarding the effect of administration route of medication and medical procedures on nullifying fasting in Ramadan.

	Adequate answer	Percentage of adequate answers (%)
<b>Topical (or local/inhalational) route of medication</b>		
Topical spray	No	89.5
Skin cream/gel/ ointment	No	89.1
Medicated skin patches	No	88.9
Eye drops	No	83.5
Vaginal pessaries	No	81.8
Inhaler/Nebulizer	Yes	25.5
Nasal insufflations	Yes	23.3
Nasal drops	Yes	20.9
Ear drops	Yes	18.6
<b>Enteral route of medication administration</b>		
Oral hygiene products	No	76.4
Oral (tablets, capsules...)	Yes	75.2
Medicated chewing gum	Yes	74.6
Sublingual medications	No	71.5
Lozenges	Yes	70.8
Gastrostomy tube	Yes	57.5
Nasogastric tube	Yes	43.6
Enema	Yes	27
Suppositories	Yes	26.7
<b>Parenteral route of medication administration</b>		
Intramuscular (IM)	No	76.4
Subcutaneous (S.C)	No	73.9
Intravenous (IV)	No	71.9
<b>Medical procedure</b>		
Thermometer	No	87.2
Urinary catheterization	No	82.6
Oxygen inhalation	No	80.7
Peritoneal dialysis	Yes	70.9
Hemodialysis	Yes	68.1
Blood transfusion	Yes	58.1
Tooth extraction	No	57.7
Blood sample for testing	No	57.6
Anesthesia during surgery	No	50.7
Gastric lavage	Yes	47.7
Blood donation	No	35.5
Vaginal examination	Yes	23.2
Rectal examination	Yes	19.7

Table 4

Multivariate analysis of factors affecting the participants' knowledge.

Variable	OR	(95%CI)	P value
<b>Professional degree type</b>			
Bachelor of Pharmacy	1.791	1.035–3.098	0.037
Doctor of Pharmacy	1.261	0.654–2.430	
Diploma	Ref		
<b>Professional specialty</b>			
Community pharmacy technician	0.684	0.257–1.821	0.448
Hospital pharmacy technician	0.757	0.312–1.836	0.538
Community pharmacist	1.042	0.471–2.303	0.919
Hospital pharmacist	0.940	0.418–2.0113	0.981
Medical representative	1.182	0.500–2.795	0.704
Other (academia, hospital pharmacist, pharmacologist...)	Ref		
<b>Confidence regarding medication modifications</b>			
Confident	1.375	1.040–1.817	0.025
Not confident	Ref		

#### 4. Discussion

There are little researches in general and particularly in Jordan which addresses the role of pharmacy personnel in optimizing medication regimens during the fasting month of Ramadan. Our findings have enlightened potential areas for improving patient's medical management during Islamic fasting (Abolaban and Al-Moujahed 2017, Hamodat et al., 2020). Moreover, the results highlight the importance of providing adequate support and education to patients on their medication schedule and to any necessary requirements for pharmacotherapy adjustments, to ensure safe and effective use of medications during Islamic fasting (Mahmood et al., 2022). Community pharmacies are widely distributed across Jordan with a total count of around 3,500 in 2020

(Basheti et al., 2020), and our findings indicate that most respondents work in community and hospital pharmacies, which match with the findings from a previous study in Jordan (Kheir et al., 2008). The main length in professional service (1–3 years) that respondents have does not match well with the respondents' age group (31–40 years) of the highest percentage. This may indicate that fresh pharmacy graduates may not enter the market soon after graduation because the supply of new pharmacists likely exceeds the domestic demand in Jordan (Nazer and Tuffaha 2017).

#### 4.1. Pharmacy personnel's knowledge and consultation practices during Ramadan

The findings of the current study reported that respondents who had a bachelor's degree in pharmacy were more likely to be knowledgeable than those who had diploma. This could be explained by the fact that the curriculum of Pharmacy bachelor degree has many courses in biopharmaceutics and pharmacokinetics that qualify pharmacists to recognize the importance of absorption, distribution, metabolism, and elimination (ADME) (Shawahna et al., 2022). Ironically, the type of professional specialty does not predict the knowledge of the respondents, as some pharmacists work as technicians possibly because of the imbalance between pharmacists supply and demand and its consequences on the shortage in job vacancies (Zurn et al., 2004). The results also revealed that pharmacy personnel feel capable and confident to provide advice to a high percentage of their patients on their medication regimens during Ramadan in acute and chronic diseases as reported in previous studies (Lin et al., 2012, Ahmed et al., 2020). In addition, more than two thirds of respondents indicated that they are confident in providing medication modification to their patients/customers. This may indicate that pharmacists in Jordan feel responsible and self-confidence to provide medication management advice to patients during Ramadan as they are considered the drug expert (Frankel and Austin 2013, Mohamed Ibrahim 2015, Nazer and Tuffaha 2017, Showande and Laniyan 2022). Notably, Jordan health authorities provided guidelines and recommendations which emphasizing on the importance of patients' medication adjustments during the month of Ramadan; which led to increase the pharmacy personnel knowledge and reliance in this regard (Stankov et al., 2012, Ibrahim et al., 2020). Thus, this explains that confidence of respondents is a predictor of being knowledgeable (Cichoń et al., 2021). Furthermore, as Islam is the state religion in Jordan with 97.2% Muslims, Fatwah is the most common source of information that pharmacy personnel refer to and get information from on medication and medical procedures during fasting in Ramadan (Amin and Abdelmageed 2020, Ahmed et al., 2022).

In addition, the study outcomes indicate that most diseases that pharmacy personnel had advised patients on regarding their pharmacotherapy regimens during Ramadan are chronic diseases and this comes in line with the fact that most common diseases encountered in Jordan are chronic illnesses and the most common of which are hypertension, diabetes mellitus, and respiratory (Nazer and Tuffaha 2017).

#### 4.2. Medication use and route of administration during Ramadan

The medication regimens might be altered in Ramadan in terms of route of administration as some routes nullify fasting while others do not (Jaber et al., 2014). The results reported that most respondents were knowledgeable about topical, enteral, and parenteral route of drug administration. In fact, pharmacists can provide many aspects of support to patients during fasting in Ramadan including adjustments made to medication frequency, dosing, dosage form and routes, and medication itself based on

their unique biopharmaceutics knowledge (Amin and Chewning 2015, Mohamed Ibrahim 2015, Amin and Chewning 2016, Showande and Laniyan 2022). Distinguished Muslim jurists and religion experts, medical practitioners, pharmacologists, biopharmaceutics expert and specialists - agreed unanimously on routes of administration that do not nullify fasting to settle differences in point of view and standardize the choice of routes (Al Rifai et al., 2022, Showande and Laniyan 2022).

The findings of this study indicated that more than 50% of the respondents think that it is the responsibility of the pharmacist to give the advice on medication management (route of administration, scheduling) and medical procedures during Ramadan. This could be explained by knowing that most patients seek medical advice from pharmacists in pharmacies before visiting a physician due to the high accessibility of pharmacists, availability of pharmacies, and pharmacists being the drug expert with free charge of consultation (Mohamed Ibrahim 2015, Nazer and Tuffaha 2017). Hence, pharmacists have a great responsibility and opportunity to modify the patient's pharmacotherapy regimen to suite the fasting schedule (Amin and Chewning 2016, Ahmed et al., 2021).

Regarding medical procedures, more than 80% of pharmacy personnel were knowledgeable about oxygen inhalation, thermometer and urinary catheterization. In fact, most of pharmacy personnel can provide many aspects of support to patients during fasting in Ramadan including adjustments based on their unique biopharmaceutics knowledge (Al-Qahtani et al., 2022) and our findings support their willing to take on a more significant role in educating patients about the effect medical procedure on nullifying fasting in Ramadan (Abolaban and Al-Moujahed 2017, Amin and Abdelmageed 2020).

There are few limitations for the current study findings: first, the potential of recall bias that could affect participants' responses. Second, the gap between "knowledgeable" and "non-knowledgeable" classification has the potential to lose a simple difference in the response. However, this was performed to simplify the analysis and previous studies categorize the knowledge by dividing the participants into two groups.

## 5. Conclusion

This study has identified predictors for biopharmaceutics knowledge and practice of pharmacy personnel about the effect of medication route and medical procedure on nullifying fasting. Additionally, it provided an opportunity to encourage safe and effective use of medications and medical procedures during the holy month of Ramadan to avoid treatment failure. In conclusion, Jordanian pharmacists have a huge obligation and opportunity to adjust the patient's medication plan to fit the fasting schedule. Most of pharmacy personnel are knowledgeable in biopharmaceutics principles and pharmacotherapy regimen adjustments and might be willing to take on a more significant role in educating patients about the effect of different routes of drug administration and medical procedure on nullifying fasting in Ramadan.

## 6. Recommendation

Future researches in Jordan are encouraged to be large and comprehensive to assess and allow in-depth analysis of all the views and knowledge of patients about drug regimen adjustments during fasting in Ramadan. This has the potential to bridge knowledge gaps from pharmacists and patients altogether. The quality of pre-Ramadan structured education on dose adjustment of medication and change patients' prescription by pharmacists should also be evaluated to ensure effective, safe management and positive outcome to their health. Integrating more biopharmaceutics and

pharmacokinetics training courses to pharmacy personnel could improve understanding and implementing this knowledge in optimizing pharmaceutical practice to patients. Further studies are still needed to determine the optimal teaching/learning methods that can improve knowledge and skill acquisitions of pharmacists in the area of PK.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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