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## Public knowledge about dosage forms, routes of drug administration and medication proper storage conditions in Riyadh District, Saudi Arabia

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### Abstract

**Objectives** The purpose of this study was to assess public knowledge on the safety, efficacy, proper storage conditions and other physiochemical properties of different dosage forms.

**Methods** This study was based on a cross-sectional design. A structured quantitative survey, which included five sections, was used as an instrument for data collection. The first section addressed the demographic characteristics of the sample, whereas the second section assessed public knowledge on medications. The third section inquired about participants' preferred dosage forms. The fourth section was related to the perceived effects of physiochemical properties of medicines on their safety and efficacy. The fifth section addressed participants' thoughts on appropriate ways for medications usage and storage. A total of 752 participants completed the questionnaire. Data were analysed using SPSS (20.0) software.

**Key findings** Although our study findings pointed out some knowledge gaps based on participants' answers, most of the participants (87%) reported that physicians or pharmacists were the main sources of their medicine-related information. There was a great variation in participants' responses regarding perceived onset of action, proper storage conditions and other properties of different dosage forms.

**Conclusion** The study findings demonstrated the need to educate the public about basic information related to different dosage forms of medications.

**Keywords** dosage form; Kingdom of Saudi Arabia; public knowledge; route of administration; storage

### Introduction

Dosage form can be defined as a formulation that ideally consists of at least one active pharmaceutical ingredient in addition to excipients prepared for purpose of giving the human or animal patients the correct and accurate active pharmaceutical ingredient(s).<sup>[1]</sup> Proper use of different dosage forms leads to success in delivering the active ingredient to patient and, consequently, success in treating or preventing disease. However, success of drug therapy is dependent on patient adherence,<sup>[2]</sup> which in turn is related to patient knowledge about medications and perceived health benefits of such medications.<sup>[3]</sup> Therefore, adherence to medications is highly influenced by the patient knowledge about the medication itself, method of administration, and patient's personal experiences as well as family members' and friends' experiences.<sup>[3,4]</sup> Furthermore, patient adherence is a serious health issue as 50% of patients with chronic diseases are not compliant to their medications.<sup>[5]</sup> In sum, findings from previous research highlight the need to increase patient knowledge about physiochemical properties of different dosage forms.

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In general, patients seek information regarding their treatment from a variety of sources.<sup>[6]</sup> For example, some patients consider friends or family members trustworthy sources of health information whereas others rely on healthcare professionals such as physicians and pharmacists. Additionally, the literature (e.g. books, magazines) and the Internet are becoming more popular sources of health information for some patients. Therefore, healthcare providers are expected to verify the validity of patients' health information and to counsel patients and provide them with the information they need regarding proper use of medications.<sup>[7]</sup> For instance, it is the responsibility of pharmacists to verify the accuracy of prescribed medications, including correct product, strength and dosage form, and to counsel patient on proper use, including the correct route of administration that is detailed in the medication label. The role of pharmacists in this regard is necessary to ensure optimum benefits to patients.<sup>[8,9]</sup>

By law, antibiotics cannot be dispensed without a valid prescription in Saudi Arabia.<sup>[10]</sup> Yet, previous research demonstrated that over a third of surveyed individuals in Saudi Arabia used antibiotics without a prescription,<sup>[11]</sup> perhaps due to inadequate enforcement of this law. Inappropriate self-medication may result in negative outcomes such as increased microbial resistance, wastage of resources, and may cause serious health hazards and adverse reactions.<sup>[12,13]</sup> Therefore, public awareness of the appropriateness of self-medication use, or lack thereof, can influence what medications people use and how they use them. This may result in great variability concerning how medications are used by different people, which may result in patient dissatisfaction or even serious adverse reactions due to use of inappropriate medications, strengths or dosage forms.<sup>[14]</sup> Several studies that investigated the effect of educational interventions on proper medication use concluded that such interventions were effective in increasing medication knowledge and in promoting appropriate use.<sup>[15–17]</sup> For example, in the United States (US), the National Institutes of Health reported that individuals who used over-the-counter medications did not have enough experience to deal with conditions and adverse reactions that could be attributed to the use of these medications.<sup>[18]</sup> Further, false self-diagnosis is another factors that result in delay of cure.<sup>[19]</sup> Several other studies have found that certain avoidable adverse reactions were attributed to medication overdosage<sup>[20]</sup> and that drug–drug interactions can be caused by inappropriate polypharmacy.<sup>[21]</sup> As a result, the World Health Organization (WHO) reported that individuals with no or limited medication knowledge are susceptible for false self-diagnosis, unnecessarily long period of medication use, inappropriate polypharmacy, delay in receiving appropriate medical intervention, higher exposure to drug–drug interactions, more frequent use of inappropriate dosage, improper storage of medications, use of medications beyond their shelf life, having insufficient education about precautions associated with medication use and having higher likelihood for drug abuse.<sup>[22]</sup> All these factors highlight the significance of understanding public knowledge regarding dosage forms, and the need to educate patients with regard to their

medication dosage forms, routes of drug administration and other related issues.

On the other hand, there is a significant environmental risk caused by improper disposal of medications, and an elevated risk of occasional childhood poisonings caused by prolonged storage of expired and unused medications in households.<sup>[23]</sup> For example, flushing medication down the toilet was found to contaminate water supplies, rivers and lakes,<sup>[24]</sup> which may cause health problems to the public later on. The US Food and Drug Administration (FDA) recommends certain method for disposal of medications, for instance by mixing medications with cat litter or coffee grounds and then dispose it in trash cans after concealing patient name and medication information on the label.<sup>[25]</sup> Accidental poisoning deaths that are attributed to controlled medication overdose comprised 20 per cent of total injury deaths in the United States in 2009. This statistic reflects the seriousness of improper drug storage and disposal.<sup>[25]</sup> On the other hand, the healthcare system in Kingdom of Saudi Arabia (KSA) has improved tremendously during recent years.<sup>[26]</sup> This improvement comes as a result of more governmental funding and investment in healthcare infrastructure, including hospitals, primary health centres and other healthcare facilities.<sup>[27,28]</sup> Riyadh, the capital of KSA, is one of the territories that has such medical interests and developments.<sup>[29]</sup>

Reviewing the literature, we found only few publications with respect to public knowledge about medications, dosage forms, routes of drug administration and drug storage in Middle East and especially in KSA. Even though immense effort has been made to increase patient knowledge and improve adherence to prescribed medicines, patients show poor adherence to their treatment plans worldwide,<sup>[30–32]</sup> including KSA.<sup>[20,33–36]</sup> Adherence of the public in KSA, as part of worldwide audience, to prescribed medicines will be examined as a reference point for similar populations in the Middle East and worldwide. Additionally, interventions aimed at increasing awareness of proper medication use in KSA can be considered an experimental intervention that policymakers examine for future, more effective interventions.

In a study based in KSA, which included 900 participant most of which were highly educated, participants had several misconceptions regarding a few medications that were investigated in the study.<sup>[37]</sup> Because of the lack of studies investigating public knowledge about proper use of medicines, this study aimed to investigate public knowledge about dosage forms, routes of administration and proper storage conditions in Riyadh district, KSA.

This study was based on a pre-validated cross-sectional survey, which was prepared based on extensive literature review process. Simple random sampling design was utilized.<sup>[32]</sup> The questionnaire was administered in a manner that limited both response and non-response bias. The survey included a structured questionnaire that was reviewed by several faculty members at the College of Pharmacy, Prince Sattam Bin Abdul-Aziz University. The questionnaire was translated to Arabic language by expert researchers who are fluent in Arabic and English languages.

### Material and methods

The survey was composed of five parts. The first part addressed the demographic characteristics of the sample including gender, age, marital status and educational level. The second part consisted of a few general information questions that addressed use of medications. The third part inquired about preferred dosage forms. The fourth part investigated participants' thoughts regarding the effects of medicines physiochemical characteristics on its safety and efficacy. Finally, the fifth part addressed participants' thoughts on proper ways for medications use and storage conditions.

Participants were recruited from a public venue in Riyadh district through face-to-face interviews in 2017. Data were collected over a 3-month period. Persons who work in the medical field like MDs and pharmacists were excluded. We analysed the data using Statistical Package for the Social Sciences SPSS (version 20.0) software.

Descriptive analyses were conducted to present the demographic characteristics of the sample. Additionally, point-biserial correlation was investigated between highest level of education and a number of measured factors. These factors included perceived trustworthiness of pharmacists and route of drug administration that is believed to be associated with the fastest onset of action.

### Results

Out of 752 respondents who participated in the study, 412 participants (54.79%) were men. The sample was majorly

composed of young adults (18–25 years old). Other demographic data are summarized in Figure 1.

The main source of information about medications, according to the respondents, was physicians, followed by pharmacists. In addition, participants who reported reading medication leaflet all the time were only 222 (29.52%) participants.

Other questions in part 2 included (1) Which of the following routes of administration results in a faster action, (2) Do generic medications have the same efficacy and properties as branded medications, and (3) Do you think that same dosage forms of the same drugs can possibly be available in the market from different manufacturers. Figure 2 summarizes participants' responses regarding these general information questions. Only 146 participants (19.41%) reported their preference to use locally manufactured medications, whereas 349 participants (46.41%) reported that they were indifferent between using medications from local manufacturer as opposed to foreign manufacturer. Almost half of the participants agreed with the statement 'Generic medications have the same efficacy and the same properties as brand medications'.

Only 432 participants (56.69%) believed that parental administration of medications is associated with the fastest onset of action.

Figure 3 presents information about the preferred dosage forms and contains two questions. These questions are (1) What is your preferred dosage form, and (2) Why do you prefer this dosage form? Three hundred thirty-eight participants (44.95%) reported that their most preferred dosage

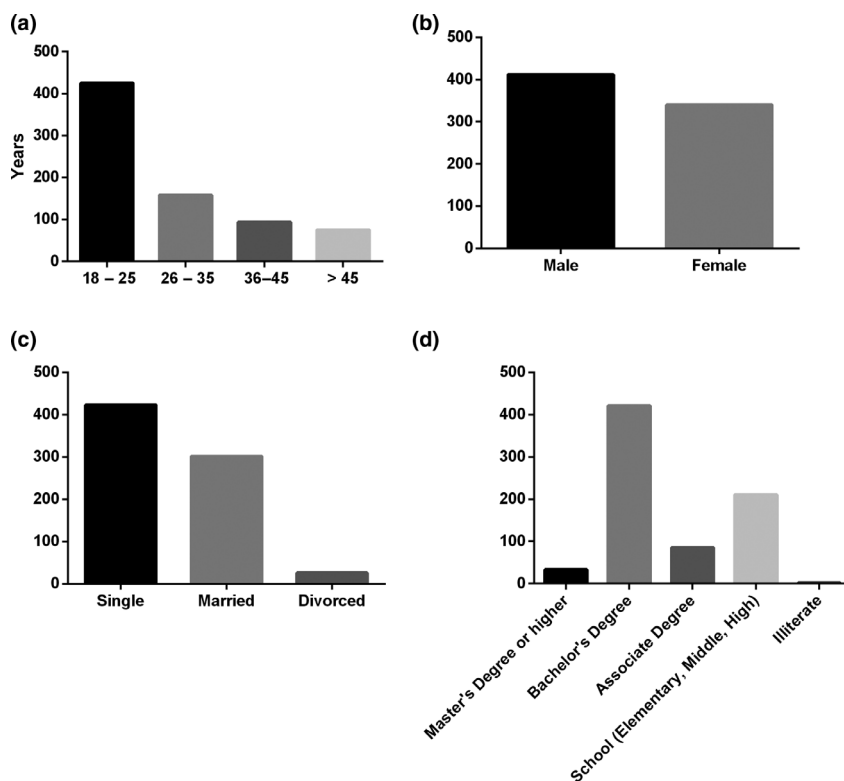
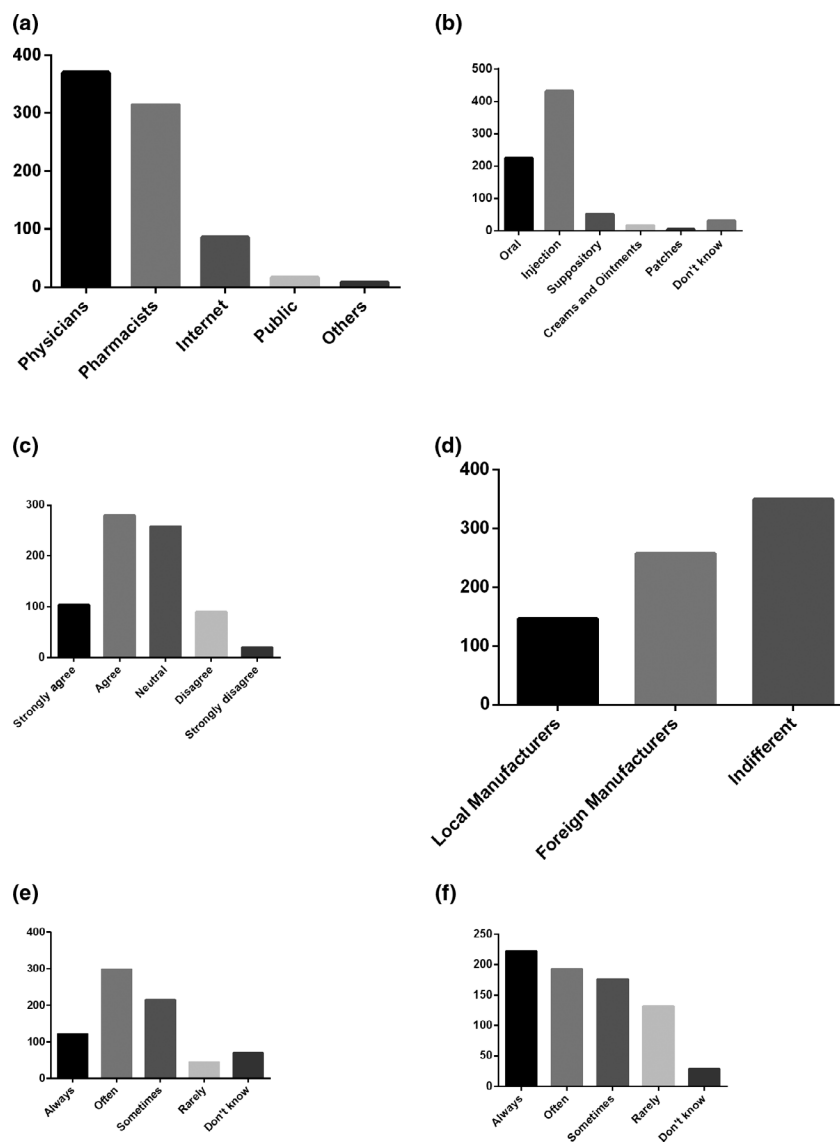


Figure 1 Demographic data: (a) age of respondents, (b) sex, (c) marital status and (d) educational level.



**Figure 2** General information about medications: (a) the main source of information about medications, (b) Which of the following Routes of Administration results in a faster action, (c) generic medications have the same efficacy and the same properties as Brand, (d) I prefer using products from, (e) for most drugs, same drug and dosage form are available in the market from different manufacturers, and (f) Do you read medicine leaflet which contains specific information about medical conditions, doses, side effects, warning, etc.

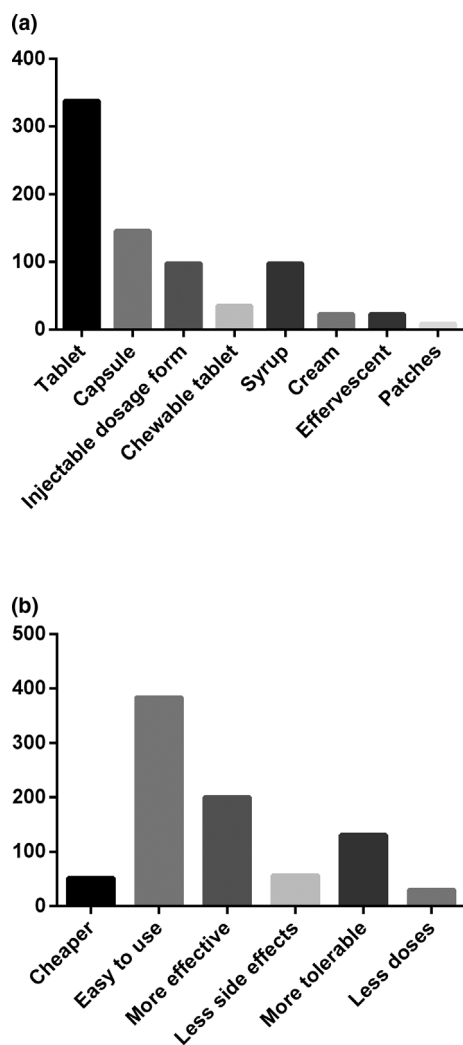
form is tablet, whereas 146 participants (19.41 %) chose capsule as their most preferred dosage form. Ease of use was the most common reason behind participants' preferences, as it was selected by 384 participants (51.06 %).

Almost half of participants (47.47%) thought that taste of medication affects its safety. The perceived effects of medicine physicochemical characteristics on its safety and efficacy are summarized in Figure 4.

About two-thirds of the participants (66.76 %) indicated that their most preferred place to store topical dosage forms like creams and ointments was refrigerator. Information about perceived proper ways for medications usage and storage is shown in Figure 5, which contains eight questions: (1) Do you think all tablets can be crushed in mouth,

(2) Do you think all tablets can be split if we need to take half of the dose, (3) Which of the following liquid dosage forms has to be shaken well before use, (4) How long can a bottle of suspension be used for after reconstitution, (5) What is the most preferred place to store topical dosage forms like creams and ointments, (6) How long can ophthalmic preparations be used for after opening, (7) Does leaving medications in your vehicle lead to drug deterioration, and (8) Can you store medications in the kitchen or in the bathroom.

Point-biserial correlation analyses demonstrated that level of education was significantly associated with perceived trustworthiness of pharmacists ( $r_{pb}(315) = 0.158$ ,  $P = 0.005$ ), the belief that fasted onset of medication action



**Figure 3** Information about most preferred dosage forms: (a) the preferred dosage form is, and (b) in your opinion, why you preferred this dosage form.

is accompanied with oral ( $r_{pb} (315) = -0.162, P = 0.004$ ) and parenteral ( $r_{pb} (315) = 0.159, P = 0.005$ ) routes of administration.

## Discussion

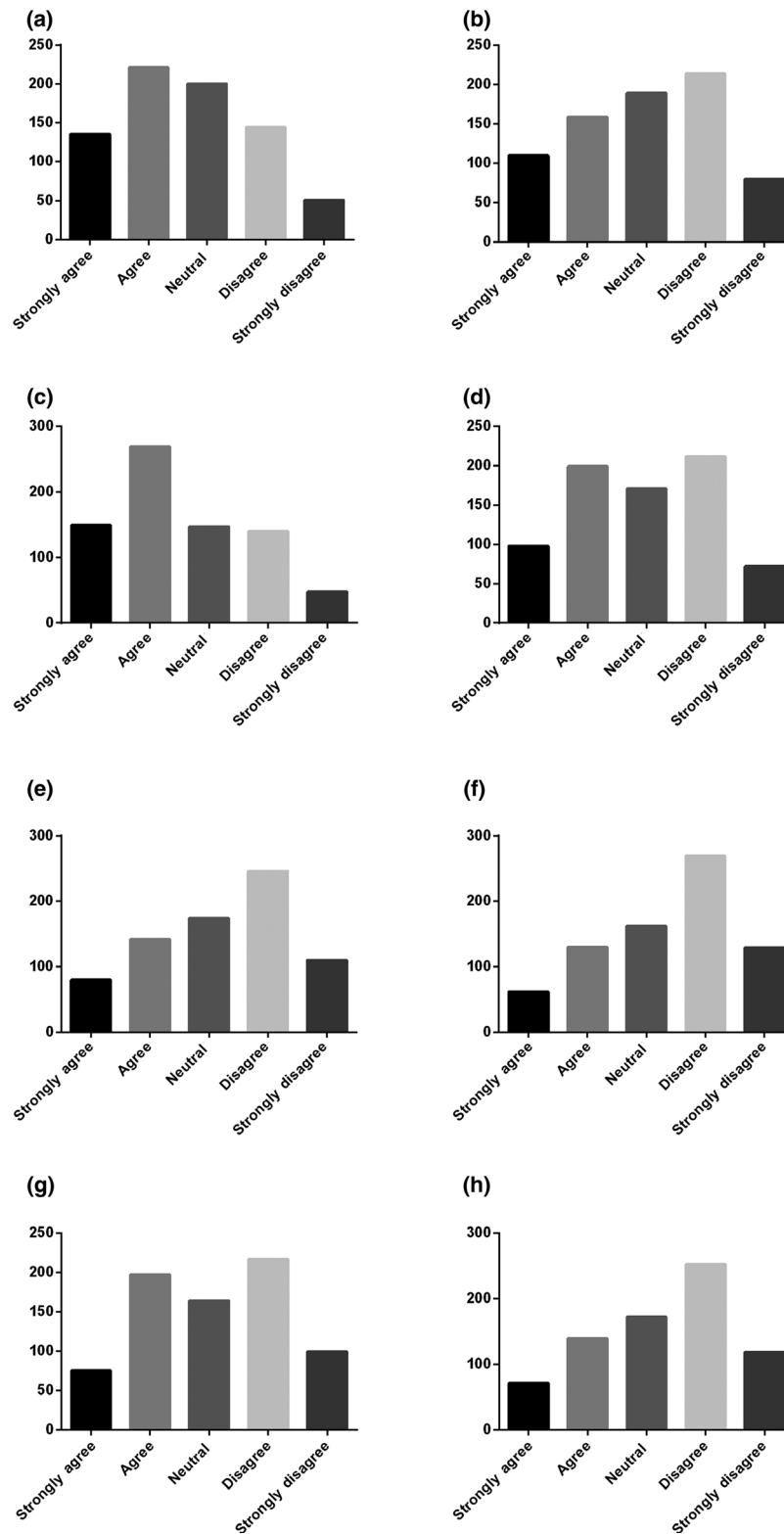
Most of the participants reported that physicians or pharmacists were the preferred sources of their medicine-related information. Many participants in this study (56%) reported having bachelor's degree, which reflects relatively high level of education in the sample, compared to the general population of KSA. Point-biserial correlation analyses demonstrated that level of education was significantly associated with perceived trustworthiness of pharmacists ( $r_{pb} (315) = 0.158, P = 0.005$ ); that is, higher education – as compared to lower education – was associated with more perceived trustworthiness of pharmacists. These results were consistent with the results of a previous study based in

KSA,<sup>[37]</sup> which provided different findings for KSA population as compared with research studies conducted in the Western world. For example, a study that relied on data collected from the United States demonstrated that the Internet is a more preferred source of health information than healthcare professionals.<sup>[38]</sup> This can be explained by the ease of access to information via the Internet in the United States<sup>[39]</sup> as opposed to visiting healthcare professionals. In the Middle East, however, and due to high accessibility to physician and pharmacist as compared with Western world, people may prefer to seek information from these healthcare professionals rather than from the Internet. Because pharmacists are considered medication experts, they can be deemed the best source of medication-related information by the public. Therefore, it is not surprising that pharmacists remain the main source of specialized information regarding medication worldwide.<sup>[40–43]</sup>

Another result that was found correlated with high education level was perceived fastest route of administration, as 56% of participants thought that parenteral administration was associated with the fastest onset of action. Approximately 29%, however, believed that taking medications orally was associated with the fastest onset of action. Point-biserial correlation analyses demonstrated that level of education was significantly associated with the belief that fasted onset of medication action is accompanied with oral ( $r_{pb} (315) = -0.162, P = 0.004$ ) and parenteral ( $r_{pb} (315) = 0.159, P = 0.005$ ) routes of administration; that is, higher education – as compared to lower education – was associated with a lesser belief that oral route of administration results in faster onset of action. Additionally, higher education – as compared to lower education – was associated with a greater belief that parenteral route of administration results in faster onset of action.

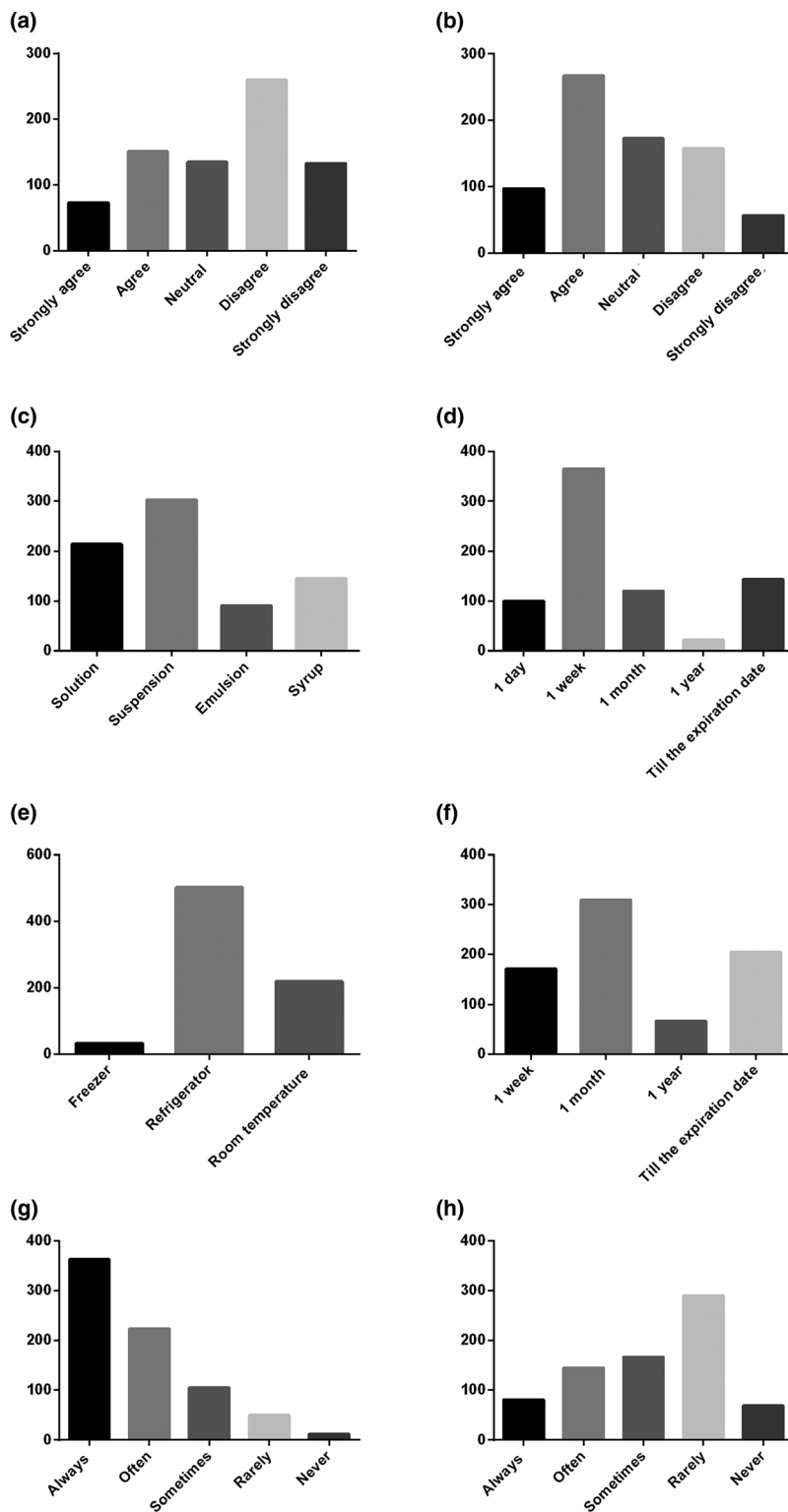
Nevertheless, oral dosage form was the most convenient dosage form for several patients. Tablet form was the number one most preferred dosage form in the list, which was consistent with previous research.<sup>[44]</sup> Another explanation for this finding is perhaps related to our young adult sample. Previous research reported that paediatrics and geriatrics are less likely to use tablet form due to difficulty swallow this dosage form.<sup>[44]</sup> Thus, having tablet dosage form as the most preferred dosage form in our sample may be explained by (1) excluding minors from the study and (2) recruiting limited number of older adults. In our study, approximately 77% of participants were in age range of 18–35 years of old, which are expected to not have any problems with swallowing oral solid dosage forms such as tablets (about 45% of participants in this study prefer its use) and capsules (about 19% of participants in this study prefer its use). These results are consistent with the finding of other studies.<sup>[45]</sup>

Participants' responses to the question that addressed whether it is acceptable to divide tablets were noteworthy. Approximately 35% of participants agreed that it is acceptable to divide tablets regardless to their pharmaceutical properties. Similarly, patients had limited knowledge about what dosage forms need to be shaken before administration. To clarify, 28% of participants reported that there was a need to shake solutions before use. In fact, the public should be educated that a tablet must not be split unless it



**Figure 4** Information about the effects of medicine characteristics on its safety and efficacy: (a) taste of medication affects its safety, (b) taste of medication affects its efficacy, (c) tablet size affects its safety, (d) tablet size affects its efficacy, (e) colour of medication affects its safety, (f) colour of medication affects its efficacy, (g) shape of medication dosage form affects its safety, and (h) shape of medication dosage form affects its efficacy.





**Figure 5** Information about perceived proper ways for medications usage and storage: (a) all tablets can be crushed in the mouth, (b) all tablet can be divided if we need to take half of the dose, (c) Which of the following liquid dosage forms must be shaken well before use, (d) the bottle of suspension after reconstitution can be used for, (e) it is preferred to keep the topical dosage forms like creams and ointments in the, (f) ophthalmic preparations can be used after opening for, (g) leaving the medications in your vehicle leads to drug deterioration, and (h) you can store medications in the kitchen or in the bathroom.

is bisected. Likewise, solutions are not required to be shaken before use.

On the other hand, responses related to storage conditions demonstrated a lack of accurate information among the studied sample. About 66% of participants reported that the preferred storage condition for topical dosage form was the refrigerator whereas 29% of participants in this study thought that room temperature was the correct answer. In addition, when answering the question 'you can store the medications in the kitchen or in the bathroom', only about 9% of participants answered 'never' whereas the remaining answered 'always', 'often', 'sometimes' or 'rarely'. In fact, keeping medications in the kitchen or in the bathroom is a common mistake because such places might be highly humid and, therefore, unsuitable for storing medications.

Despite the important findings of this study, there are some drawbacks. One of these drawbacks was the limited generalizability of our findings, particularly regarding education level and age range of participants. In other words, the study sample was not representative to the whole community in Saudi Arabia. Approximately 77% of participants were between 18 and 35, whereas only 10% of the sample were older than 45 years. Generally, older individuals tend to need more medications compared with younger individuals. Thus, our findings may not be generalizable to older individuals. Another drawback was related to not measuring whether participants had children, which might be an important factor affecting participants responses to some of the questionnaire items. Another drawback was the sampling design, which may have resulted in selection bias.

## Conclusions

This study demonstrated a need for developing more awareness campaigns that aim to increase the public knowledge about different dosage forms, appropriate ways of using medications, and recommended methods to store medications. We believe that patients should take a more active role in their treatment and that they should participate in preparing treatment plans for their diseases. In other words, we think that physicians can involve patients by taking their opinions when selecting appropriate treatments. For example, considering that participants reported high preference for tablets and capsules dosage forms, prescribers are strongly encouraged to take these findings into consideration when they prescribe medicines to patients. We believe that involving patients in the decision-making process will increase patients' adherence and, therefore, improve the therapeutic outcomes.

Our findings demonstrated that there was a moderate level of public knowledge regarding dosage forms that are associated with the fastest onset of action, the appropriateness of splitting the tablet to get a lower dose of the drug and the optimum storage place of various dosage forms. Such findings should be taken into consideration when devising future awareness interventions. On the other hand, several factors, such as education level, were found associated with the medication knowledge level among participants. We believe that this study will be very beneficial in

developing public-oriented educational interventions aimed at educating the public regarding dosage forms, routes of drugs administration and drug storage.

## Declarations

### Conflict of interests

The Author(s) declare(s) that they have no conflicts of interest to disclose.

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### Author contributions

Mohammad Hailat, Omar Attarabeen and Fadi M. Alkhaateb wrote and edited the main manuscript text and figures. Ramadan I. Al-Shdefat, Nehad Ahmed, Suhaib M. Mufflih, Ezeddin Salem Gassar and Osaid Al Meanazel wrote, designed and collected all the surveys. All authors reviewed the manuscript.

### Ethical approval

(a) The name of the Institutional Review Board or Ethics Committee that approved the study and all protocols: *Head of the Research Ethics Committee (REC) of Faculty of Pharmacy, Jadara University*. (b) The date of this approval: *11 November 2018*. (c) The number of the certification or document that verified approval of the study: *one*.

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