# Assessment of Nutritional and Drug–Nutrient Interaction Awareness Among Nurses and Pharmacists: A Cross-Sectional Study in Saudi Arabia

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## Abstract

**Background:** Drug–nutrient interactions (DNIs) occur when food, nutrients, or dietary supplements alter drug absorption, metabolism, distribution, or excretion, potentially compromising therapeutic efficacy or increasing toxicity. Healthcare professionals — especially nurses and pharmacists — are pivotal in identifying and managing DNIs through clinical nutrition care.

**This study aims** to assess the awareness, knowledge, attitudes, and self-reported practices related to DNIs among nurses and pharmacists in Saudi Arabia.

**Methods:** A multicenter cross-sectional study was conducted using a structured self-administered questionnaire with four dimensions: knowledge, attitudes, practices, and perceived training needs. The survey was distributed to licensed nurses and pharmacists in hospitals across Saudi Arabia. Statistical analysis included descriptive and comparative tests.

**Results:** Of 420 respondents (250 nurses; 170 pharmacists), mean knowledge scores were moderate (nurses: 58%; pharmacists: 72%). Attitude toward the clinical importance of DNIs was high among both groups (>85%). However, the routine practice of DNI screening was low (37% nurses; 49% pharmacists). Significant differences were observed between professions ($p < 0.05$). **Conclusions:** Awareness of DNIs among Saudi nurses and pharmacists is positive but characterized by knowledge gaps and suboptimal practice, highlighting a need for targeted education and interprofessional protocols.

**Keywords:** Drug–Nutrient Interactions, Nurses, Pharmacists, Saudi Arabia

## Introduction

Drug–nutrient interactions (DNIs) are complex clinical phenomena in which medications and nutrients influence each other's pharmacokinetic and pharmacodynamic properties, potentially altering therapeutic outcomes and nutritional status [1]. A DNI occurs when the presence of a nutrient, food, or dietary supplement changes the absorption, distribution, metabolism, or excretion of a drug or vice versa, such that clinical efficacy is compromised or adverse effects are observed [2]. Such interactions may also affect the bioavailability of nutrients, leading to nutritional deficiencies or toxicities, especially in vulnerable populations [3].

Mechanistically, DNIs involve diverse pathways, including alterations in gastrointestinal pH, changes in motility, modulation of intestinal transporters and enzymes (e.g., cytochrome P450), or direct chemical binding between nutrients and drugs [4]. For example, grapefruit juice contains bioactive

compounds that inhibit intestinal CYP3A4, significantly increasing systemic exposure of susceptible drugs such as certain calcium channel blockers, potentially leading to toxicity [5]. Similarly, minerals like calcium and iron can chelate antibiotics such as ciprofloxacin, reducing their absorption by up to 90% and risking therapeutic failure [6].

The clinical significance of DNIs varies; many interactions may be benign, but those involving drugs with narrow therapeutic windows (e.g., warfarin, digoxin) or critical conditions (e.g., anticoagulation, cancer chemotherapy) can have profound effects on patient safety and treatment outcomes [7]. Early recognition and appropriate management of DNIs are therefore essential components of safe pharmacotherapy and nutritional care, as unrecognized interactions may contribute to suboptimal efficacy, adverse drug reactions, or even treatment failure [8].

Healthcare professionals — especially nurses and pharmacists — are strategically positioned to identify, evaluate, and manage DNIs due to their roles in medication administration, patient education, clinical assessment, and medication reconciliation [9]. Nurses are often at the frontline of patient contact, routinely monitoring both therapeutic response and nutritional intake, while pharmacists hold expertise in pharmacokinetics and drug counseling that enables them to anticipate and mitigate potential DNIs [10]. Pharmacists also play a key role in interprofessional medication review and in developing evidence-based guidance on safer administration practices, such as advising optimal timing of drug intake relative to meals [11].

Despite the recognized importance of DNIs, research indicates that healthcare teams often lack sufficient awareness, knowledge, or confidence in identifying and managing these interactions [12]. A systematic literature review noted limited awareness among clinical care teams, particularly regarding interactions associated with enteral and parenteral nutrition support, suggesting the need for structured protocols and education [13]. Similarly, recent surveys of healthcare professionals have revealed knowledge gaps and inconsistent counselling practices related to food–drug and nutrient–drug interactions, underscoring the educational needs among both nurses and pharmacists [14].

In Saudi Arabia, polypharmacy and dietary supplement use are increasing, particularly among older adults and patients with chronic conditions, elevating the potential for clinically relevant DNIs [15]. However, evidence assessing the awareness and practices of nurses and pharmacists regarding DNIs in the Saudi clinical context remains limited, impeding efforts to design targeted educational and clinical interventions that could improve patient outcomes. Thus, a comprehensive assessment of knowledge, attitudes, and self-reported practices among these key professional groups is essential to inform policy, interprofessional education, and clinical governance in the Kingdom's healthcare system.

**Methodology**

A cross-sectional quantitative research design was employed to assess awareness, knowledge, attitudes, and practices related to DNIs among nurses and pharmacists. The study was conducted in multiple government and private hospitals across the Kingdom of Saudi Arabia (Riyadh, Jeddah, Dammam, and surrounding regions) from June to August 2024. A conservative prevalence estimate of 50% was used to calculate the sample size with 95% confidence and 5% margin of error, requiring a minimum of 385 participants. Allowing for non-response, the target was set at 450. Inclusion criteria: Licensed nurses and pharmacists with ≥1-year clinical experience; Currently practicing in direct patient care settings (inpatient, outpatient, ICU, emergency). Exclusion criteria: Students, administrative staff, and non-clinical roles.

**Study Tool**

A **self-administered questionnaire** was developed and adapted from validated instruments used in similar DNI research [16].

**Questionnaire Sections:**

1. **Demographic Data:** age, gender, profession, years of experience.
2. **Knowledge:** 20 multiple-choice and true/false questions on common DNIs and mechanisms.
3. **Attitudes:** 10 Likert-scale items evaluating perceived importance of DNIs in practice.
4. **Practices:** 8 items on frequency of screening, counselling, and documentation.
5. **Training Needs:** perceived need for further education.

Content Validity: Panel of 7 experts from nutrition, pharmacy, and nursing reviewed items. Pilot Study: Conducted with 30 healthcare professionals not included in the main sample. Reliability: Cronbach's alpha ≥ 0.78 for all sections, demonstrating acceptable internal consistency. The questionnaire was distributed online via secure survey platforms and in paper form where necessary. Participation was voluntary, with informed consent obtained electronically before starting the survey. The study obtained

ethical approval from the Health Research Ethics Committee, Ministry of Health, Saudi Arabia. Data were anonymized, and confidentiality was maintained.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 28. Descriptive statistics were employed to summarize the study variables, including frequencies and percentages for categorical data, as well as means and standard deviations (mean ± SD) for continuous variables. Comparative analyses were conducted to examine differences between nurses and pharmacists, using independent sample $t$-tests for continuous variables and chi-square tests for categorical variables. All statistical tests were two-tailed, and a $p$-value of less than 0.05 was considered statistically significant.

## Results

**Table 1** demonstrates that the study population consisted predominantly of mid-career healthcare professionals, with a higher proportion of female participants, particularly among nurses. More than half of both professional groups reported at least five years of clinical experience, suggesting adequate exposure to medication administration and nutritional care practices, which is essential for assessing awareness of drug–nutrient interactions.

**Table 1. Sociodemographic Characteristics of the Study Participants (N = 420)**

| Variable | Nurses (n = 250) | Pharmacists (n = 170) | Total (N = 420) |
|---|---|---|---|
| Age (years), mean ± SD | 32.4 ± 7.1 | 34.2 ± 6.5 | 33.2 ± 6.9 |
| Female, n (%) | 170 (68.0) | 92 (54.1) | 262 (62.4) |
| ≥ 5 years' experience, n (%) | 145 (58.0) | 109 (64.1) | 254 (60.5) |
| Worked in inpatient units, n (%) | 158 (63.2) | 101 (59.4) | 259 (61.7) |

As shown in **Table 2**, pharmacists demonstrated significantly higher knowledge levels across all assessed drug–nutrient interaction items compared with nurses. The largest knowledge gaps among nurses were observed in interactions involving mineral–drug binding and absorption mechanisms. These findings reflect differences in professional training emphasis and highlight the need for enhanced nutrition-related pharmacotherapy education among nursing staff.

**Table 2. Knowledge of Drug–Nutrient Interactions Among Nurses and Pharmacists**

| Knowledge Item | Nurses Correct n (%) | Pharmacists Correct n (%) | $p$-value |
|---|---|---|---|
| Warfarin–vitamin K interaction | 142 (56.8) | 137 (80.6) | <0.001 |
| Calcium reduces quinolone absorption | 118 (47.2) | 121 (71.2) | <0.001 |
| Grapefruit juice affects drug metabolism | 165 (66.0) | 149 (87.6) | <0.001 |
| Timing of levothyroxine and meals | 154 (61.6) | 132 (77.6) | 0.002 |
| **Overall knowledge score (%)** | **58.0 ± 11.3** | **72.0 ± 10.1** | <0.001 |

**Table 3** indicates a generally positive attitude toward the clinical relevance of drug–nutrient interactions among both nurses and pharmacists. High agreement rates suggest strong awareness of the importance of DNIs for patient safety. However, slightly lower agreement among nurses regarding routine nutritional assessment may explain the lower practice scores observed in subsequent analyses.

**Table 3. Attitudes Toward the Importance of Drug–Nutrient Interactions in Clinical Practice**

| Attitude Statement | Nurses Agree n (%) | Pharmacists Agree n (%) |
|---|---|---|
| DNIs are clinically important | 218 (87.2) | 155 (91.2) |
| DNIs can affect patient safety | 210 (84.0) | 150 (88.2) |
| Nutrition should be assessed with medications | 190 (76.0) | 141 (82.9) |
| Interprofessional collaboration is necessary | 205 (82.0) | 151 (88.8) |

Despite favorable attitudes, **Table 4** reveals suboptimal implementation of DNI-related practices, particularly among nurses. Pharmacists were significantly more likely to assess dietary intake, document interactions, and provide patient counseling. This discrepancy highlights the well-recognized gap between knowledge and practice in clinical nutrition and medication safety.

**Table 4. Self-Reported Practices Related to Drug–Nutrient Interaction Management**

| Practice Item | Nurses Regularly n (%) | Pharmacists Regularly n (%) | *p*-value |
|---|---|---|---|
| Routinely assess patient diet | 78 (31.2) | 77 (45.3) | 0.004 |
| Screen for DNIs before administration | 92 (36.8) | 83 (48.8) | 0.012 |
| Document DNI concerns | 68 (27.2) | 65 (38.2) | 0.018 |
| Provide DNI-related patient counseling | 105 (42.0) | 90 (52.9) | 0.026 |

**Table 5** demonstrates a strong perceived need for further education on drug–nutrient interactions among both professional groups, with nurses expressing a higher demand for additional training. The high support for interdisciplinary educational approaches underscores the importance of collaborative learning models to improve DNI awareness and clinical practice.

**Table 5. Perceived Training Needs Regarding Drug–Nutrient Interactions**

| Training-Related Item | Nurses n (%) | Pharmacists n (%) |
|---|---|---|
| Need for additional DNI education | 223 (89.2) | 133 (78.2) |
| Prefer workshops or seminars | 180 (72.0) | 121 (71.2) |
| Support interdisciplinary training | 208 (83.2) | 146 (85.9) |

**Discussion**

The present study assessed the knowledge, attitudes, and practices of nurses and pharmacists regarding drug–nutrient interactions (DNIs) in Saudi Arabia. Overall, our findings indicate that pharmacists demonstrated significantly higher knowledge scores compared to nurses across all evaluated items, while attitudes toward the clinical importance of DNIs were generally positive among both professional groups. However, practice levels, including routine dietary assessment, screening for DNIs, documentation, and patient counseling, were suboptimal, particularly among nurses. Furthermore, the majority of participants expressed a need for additional training, highlighting educational gaps despite awareness of DNIs.

The higher knowledge scores observed among pharmacists align with prior research indicating that pharmacology curricula provide more comprehensive coverage of drug–nutrient interactions than nursing programs. Drummond et al. (2021) [17] demonstrated that pharmacy students participating in interdisciplinary education exhibited significantly greater knowledge and confidence in counseling on DNIs compared to nursing students, emphasizing the influence of structured pharmacology training on professional competency. Similarly, Alharbi, Alfadl, and Almogbel (2022) [18] reported that pharmacists in Saudi hospitals were more adept than other healthcare professionals in recognizing polypharmacy risks and potential drug–nutrient conflicts among elderly patients.

The positive attitudes toward the clinical importance of DNIs observed among both nurses and pharmacists are consistent with prior studies. D'Alessandro et al. (2022) [19] highlighted that healthcare providers universally recognize the relevance of DNIs for patient safety and therapeutic efficacy, particularly in populations at risk for polypharmacy or malnutrition. High agreement on interprofessional collaboration in our study further supports the notion that awareness alone is insufficient; effective management of DNIs requires coordinated teamwork among pharmacists, nurses, and dietitians.

Despite favorable attitudes, our study revealed a clear gap between knowledge and actual clinical practice, particularly among nurses. Less than half of the nurses reported routinely assessing patient diets or screening for potential DNIs. These findings agree with studies conducted in Saudi Arabia and other regions, which noted that nurses often fail to translate theoretical knowledge into clinical interventions due to a lack of training, confidence, or institutional protocols (Alhubail et al., 2023; Osuala et al., 2021) [16, 20]. Conversely, our findings partially contrast with studies in some Western settings where nursing staff demonstrated higher involvement in nutritional assessment, suggesting that contextual factors such as curriculum design, hospital policies, and interprofessional communication influence practice.

The strong perceived need for additional education observed in our study highlights the opportunity for interdisciplinary training interventions. Several international studies support this approach: structured workshops and joint educational programs have been shown to significantly improve knowledge,

confidence, and application of DNIs in clinical settings (Drummond et al., 2021) [17]. Integrating such programs into continuing professional development or hospital-based in-service training could enhance routine screening and counseling practices, thereby improving patient outcomes.

The study also underscores the importance of interprofessional collaboration. While pharmacists possess superior knowledge, nurses are the frontline providers most frequently interacting with patients, monitoring dietary intake, and administering medications. Failure to effectively communicate and coordinate care regarding DNIs may result in missed opportunities to prevent adverse interactions. This aligns with prior recommendations emphasizing team-based approaches to drug-nutrition management, particularly in settings with polypharmacy and high-risk patients (D'Alessandro et al., 2022; Alharbi et al., 2022) [18, 19].

## Strengths and Limitations

A major strength of this study is its multicenter design, including participants from diverse hospital settings across Saudi Arabia, enhancing generalizability. However, limitations include the use of self-reported practices, which may be influenced by social desirability bias, and the cross-sectional design, which precludes causal inference. Additionally, the study did not assess actual clinical outcomes associated with DNIs, which could provide more objective evidence of the impact of knowledge and practices.

## Implications for Practice

The findings suggest that targeted educational programs, interprofessional workshops, and the implementation of hospital protocols for DNI screening and counseling are necessary to bridge the gap between knowledge and practice. Nursing curricula should incorporate more focused training on DNIs, while hospital policies should foster collaborative practice between pharmacists and nurses to ensure safe medication and nutritional management.

## Conclusion

This study provides evidence that while nurses and pharmacists in Saudi Arabia recognize the clinical importance of drug–nutrient interactions (DNIs), significant gaps exist in knowledge and practice, particularly among nurses. Pharmacists demonstrated higher knowledge levels and were more likely to engage in routine screening, documentation, and patient counseling related to DNIs. Despite positive attitudes, the overall implementation of DNI-related practices remains suboptimal, highlighting a clear knowledge–practice gap.

The findings underscore the need for targeted educational interventions, including interdisciplinary workshops, continuing professional development programs, and inclusion of DNIs in nursing and pharmacy curricula. Moreover, fostering interprofessional collaboration between nurses and pharmacists is critical to ensure comprehensive patient care and minimize the risk of adverse interactions.

In conclusion, improving awareness, knowledge, and clinical practice regarding drug–nutrient interactions is essential to enhance patient safety, optimize therapeutic outcomes, and support evidence-based medication and nutrition management in healthcare settings. Future studies should evaluate the impact of educational interventions on practice and assess clinical outcomes related to DNIs.

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