Research Article
J. Adv. Nutri. Sci. Technol. 6(1-2): 46-54, 2026 **DOI:10.15228/ANST.2026.v06.i01-2.p07**

Assessment of Prescribing Patterns, Potential Drug-Drug Interactions and Nutraceutical Use in Pediatric Patients: A Cross-Sectional Study

Ayesha Abrar[1], Ali Akhtar[1], Saira Saeed[1], Subhan Nawaz[1], Maryam Asif[1], Waqas Akram[1]
Faculty of Pharmaceutical Sciences, University of Central Punjab, Khayaban--Jinnah Road, Lahore 54000, Pakistan
*Corresponding Author Email: waqas.akram@ucp.edu.pk

Abstract
Infants and pediatric patients are at high risk of adverse drug events due to irrational prescribing, polypharmacy, and medication errors. Poor nutritional status further affects growth, immunity, and treatment outcomes. The increasing use of drugs and nutraceuticals in pediatrics raises serious concerns regarding polypharmacy, drug interactions, and nutritional health. Therefore, prescription pattern studies are needed to promote rational medication use and improve the nutritional status and overall health of pediatric patients. The study aimed to assess drug and nutraceutical prescribing practices, identify potential drug-drug interactions, and determine their determinants among pediatric outpatients. A prospective observational study was conducted at a private outpatient clinic over 6 months. The study population comprised 213 pediatric patients aged 0 to 12 years. Data collection included reviewing treatment records and drug therapy. Data were collected and analyzed, and potential drug interactions were checked using the Medscape drug interaction checker. Analysis of prescriptions revealed an average of 5.37 medications per encounter. Notably, 99.1% of drugs were prescribed by brand name. Antipyretics or analgesics were prescribed most frequently (17.7%), followed by antibiotics (12.1%). A total of 78.5% of drugs were from the essential drug list. Upper respiratory tract infections were the most common diagnosis. Polypharmacy prevalence was 69.5%, with most patients receiving five or more drugs. Potential drug-drug interactions were present in 29.5% of prescriptions, with cetirizine and azithromycin being the most common drug pair involved in moderate interactions. Multivariate logistic regression identified polypharmacy as a strong predictor for drug interactions, while age and gender were not significant. Among 213 patients, 59 received nutraceuticals (31 males [52.5%], 28 females [47.5%]), with Vitamin D3 being the most prescribed nutraceutical, and no prescriptions for proteins. This study revealed a high prevalence of polypharmacy and potential drug-drug interactions among pediatric outpatients, highlighting the need for rational prescribing and careful medication monitoring. Collaborative efforts between pharmacists and pediatricians, along with regular prescription audits, are essential for promoting safe use of medications and nutraceuticals and improving the overall health and nutritional status of pediatric patients.

Keywords: WHO prescribes indicators, polypharmacy, nutraceuticals, drug-drug interactions, prescribing patterns

Highlights
- 69.5% of pediatric outpatients received five or more drugs, averaging 5.37 medications per encounter, with polypharmacy identified as the strongest predictor of potential drug-drug interactions.
- Antipyretics/ analgesics (17.7%) and antibiotics (12.1%) were the most frequently prescribed drug categories, and 29.5% of prescriptions carried potential drug-drug interactions.
- 31% of patients received nutraceuticals alongside conventional drugs, with vitamin D3 being the most commonly prescribed.

1. Introduction
The health status of children is important because a large proportion of the population in most developing nations consists of children (Botzenhardt et al., 2016). One of the major problems in the pediatric population is malnutrition. Some identifiable dietary deficiency diseases include dwarfism, anemia, rickets, and vitamin- and mineral-deficiency blindness. (Paul, 1974). They tend to develop acute watery diarrhea, viral fever, and recurrent respiratory and gastrointestinal tract diseases, which account for the largest proportion of pediatric visits (Sabbu et al., 2021). The rational and safe use of medication is very important in children to ensure that treatment is safe and effective (Anwar et al., 2025; Patil et al., 2019). Treatment guidelines play a very important role in the safe administration of medicines, as irrational medication use is quite common among pediatric patients (Hollon et al., 2002).

Due to frequent comorbidities, pediatric patients are often subjected to polypharmacy, which is defined as the concurrent prescription of five or more medications per encounter (Ewig et al., 2022), which increases their susceptibility to drug-drug interactions, toxic effects, and medication-related errors (Mengato et al., 2025). To address complex comorbidities, the use of polypharmacy is increasing, which has led to a higher incidence of potential drug-drug interactions and adverse drug reactions. Consequently, these pharmacological complications pose a significant threat to pediatric health (Patel et al., 2025).

For safe and effective medication therapy, the prescriptions should be audited regularly to identify the different forms of non-rational prescribing, including polypharmacy, irrational use of antimicrobials and injectables, among others. (Oshikoya & Ojo, 2007). Irrational use of antimicrobials has been cited as the biggest problem in most pediatric prescription studies; it may cause antimicrobial resistance, treatment failure, or increased healthcare expenses (Fadare et al., 2015). The primary causes are: polypharmacy, self-medication by the patient, the inappropriate use of antimicrobials, and the overuse of parenteral and oral medicines as opposed to the usual clinical practice. To prevent these effects, the World Health Organization (WHO), in collaboration with the International Network for the Rational Use of Drugs (INRUD), developed a list of core drug-use indicators. The WHO has identified three fundamental components that enhance the rational use of drugs worldwide: prescribing indicators, patient care indicators, and healthcare facility-specific indicators. The WHO prescribing indicators are useful for determining the extent of polypharmacy in prescriptions (Bhatt et al., 2022).

In addition, Nutraceuticals, or nutritional supplements, lie at the interface of nutrition and pharmacotherapy and have increasingly become apparent in pediatric outpatient care over the past decade. Common outpatient presentations that have attracted interest in nutraceuticals as an adjunct to diet and conventional therapy include micronutrient deficiencies, recurrent infections, functional gastrointestinal ailments, and growth-related issues (Rani, 2025).

Pediatric drug therapy and nutrition are closely intertwined and mutually influential. Nutritional status can significantly affect a child's ability to metabolize medicines – for example, the baseline nutritional status of children can alter or disrupt drug clearance pathways and cause unexpected side effects in children (Ngcobo, 2025). However, long-term medical treatments may deplete important micronutrients or prevent the body from absorbing key nutrients from food. Prescribing patterns can be analyzed only if one is aware of the effects of multiple drug and supplement prescriptions on overall nutritional status; as in pediatric physiology, growth is rapid, and metabolic changes are complex.(Attia, 2024; Sabbu et al., 2021)). Nonetheless, prescribing trends and their alignment with clinical need are poorly documented, particularly in pediatric outpatient clinics and hospitals (Rani, 2025).

Pakistan has limited evidence on the prescribing patterns of drugs, nutraceuticals, and polypharmacy leading to potential drug-drug interactions in pediatrics; hence, there is a need to carry out frequent prescription audits, which will help in making sure that the drugs and nutritional supplements are utilized properly among the pediatric population. Therefore, this study was conducted to assess prescribing patterns for drugs and nutraceuticals, identify potential drug interactions, and determine the prevalence of polypharmacy among pediatric patients.

2. Materials and Methods

2.1. Study Design

A prospective observational study was conducted to evaluate prescribing patterns of drugs and nutraceuticals in the pediatric population, assess the incidence of polypharmacy, and identify potential drug-drug interactions. This study was conducted from October 2025 to March 2026. The study was conducted in a pediatric outpatient clinic in Gujranwala, Pakistan.

2.2 Inclusion criteria

The study population consists of pediatric patients aged 0 to 12 years who receive at least one prescribed drug or nutraceutical. Pediatric patients with complete, legible prescriptions were included.

2.3 Exclusion criteria

Critically ill patients requiring emergency medical care and those aged above 12 years were excluded from the study.

2.4. Sampling Technique

A convenience sample of 213 participants was recruited and included all eligible patients during the study period.

2.5. Data Collection Form and Statistical Analysis

Data were collected using a structured data collection form adapted from (Kulkarni et al., 2020; Sabbu et al., 2021) and (Patel et al., 2025). Relevant demographic details, such as age, gender, weight, symptoms, and clinical diagnosis, were obtained from patient records and prescriptions. The prescribing patterns were analyzed by evaluating the mean number of drugs per prescription, therapeutic categories of the prescribed medications, commonly prescribed drug classes, dosage forms, routes of administration, duration of therapy, and whether medications were prescribed by generic or brand names. The rationality of prescribing was also analyzed using WHO indicators. While evaluating drug prescribing patterns, polypharmacy was also assessed in pediatric patients using descriptive analysis. According to the literature, a prescription having five or more medicines was considered polypharmacy. For checking the potential drug-drug interactions, a computer-based online software was used (Medscape drug interaction checker). According to this software, all interactions are categorized by severity as minor, monitor closely, severe, or contraindicated. Fisher's test was applied to check the association of potential drug-drug interaction severity with gender. Polypharmacy and determinants of potential drug-drug interactions were also assessed by applying multivariate logistic regression. The prescribing patterns of

nutraceuticals were assessed by documenting the types of nutraceuticals prescribed, including vitamins, minerals, and proteins. The proportion of prescriptions containing nutraceuticals and the patterns of their use across different age groups were also evaluated using descriptive statistics, including frequencies, means, and percentages. The Statistical Package for the Social Sciences (SPSS) software, version 27, was used to process the data.

Administrative clearance was obtained from the pediatrician in charge of the clinic before the study commenced. The study objectives, methodology, and data collection procedures were explained, and approval was granted to access pediatric prescriptions and relevant information. Patient confidentiality and anonymity were strictly maintained. Consent was also obtained from patients' guardians..

3. Results and Discussion

Analysis of 213 prescriptions revealed that 16 (7.5%) prescriptions were for neonates. The gender distribution consisted of 106 male (49.8%) patients and 107 female (50.2%) patients. The distribution of age and gender is reported in Table 1.

Table 1: Age and Gender distribution of pediatric patients

Age of participants	Male	Female	Patients
0-4 weeks	4 (25%)	12 (75%)	16 (7.5%)
1 month – 1 year	29 (49.2%)	30 (50.8%)	59 (27.7%)
1 year – 5 years	55 (53.4%)	48 (46.6%)	103 (48.4%)
5 years – 12 years	18 (51.4%)	17 (48.6%)	35 (16.4%)
Total	106 (49.8%)	107 (50.2%)	213

A major portion of participants had upper respiratory infections (50.70%), followed by lower respiratory tract infections (19.25%) and gastrointestinal problems (16.43%). The distribution of cases by diagnosis is shown in the pie chart (fig. 1).

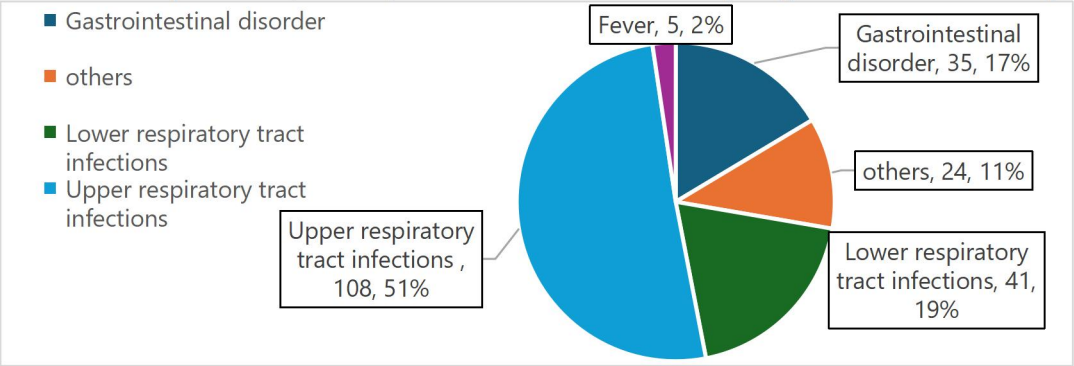

Figure 1: Distribution of clinical diagnoses

Among the 1144 prescribed medicines, the most frequent drug class was antipyretics (17.74%), followed by antibiotics (12.06%) and antihistamines (10.40%). The number of medications per encounter ranged from 1 to 9. The distribution of drug classifications is shown in Table 2.

Table 2: Distribution of therapeutic classes of drugs

Therapeutic class of drugs	No. of drugs, n (%)	Therapeutic class of drugs	No. of drugs, n (%)
Antibiotic	138 (12.1%)	Antifungals	10 (0.9%)
Bronchodilator	93 (8.1%)	Antiprotozoal	21 (1.8%)
Antipyretic/analgesic	203 (17.7%)	Gastrointestinal agents	43(3.8%)
Antihistamine	119 (10.4%)	Cold and flu FDC drugs	48 (4.2%)
Antiemetic	59 (5.2%)	Herbals	68 (5.9%)
Steroid	118 (10.3%)	Probiotics	48 (4.2%)
Antitussive	45 (3.9%)	Leukotriene receptor antagonist	37 (3.2%)
Nasal decongestant	66 (5.8%)	Others	28 (2.4%)

213 prescriptions were analyzed to assess prescribing practices and drug utilization according to the WHO core indicators (Table 3). The average number of drugs per encounter was found to be 5.37. Generic prescribing was notably low at 0.87%. Conversely, antibiotic prescribing was quite high at 63.85%. Injectable medications were prescribed in 19.25% encounters falling within the reference range, while EDL compliance was recorded at 78.50%.

Table 3: World Health Organization core drug prescribing indicators

Sr. no	Indicators	Observed Value	Reference Standard
1	Average number of drugs per prescription	5.37	1.6–1.8
2	Drugs prescribed by generic name (%)	0.87%	100%
3	Encounters with antibiotics (%)	63.85%	20–26.8%
4	Encounters with injectables (%)	19.25%	13.4–24.1%
5	Drugs prescribed from the Essential Drug List (%)	78.50%	100%

Polypharmacy was also found during the analysis of 213 prescriptions.149 patients were prescribed 5 or > 5 drugs, out of which the highest number of patients, 43 (20.2%), received 5 drugs, while 106 were given > 5 drugs (Table 4). The prevalence of polypharmacy was 69.5%.

Table 4: Number of drugs prescribed in prescriptions

Number of drugs prescribed	Prescriptions, n (%)	Number of drugs prescribed	Prescriptions, n (%)
1	8 (3.8%)	6	40 (18.8%)
2	7 (3.3%)	7	39 (18.3%)
3	23 (10.8%)	8	22 (10.3%)
4	26 (12.2%)	9	5 (2.3%)
5	43 (20.2%)		

The potential drug-drug interactions were assessed by using the Medscape drug interaction checker. The data from all the prescriptions were processed through the software to check for potential drug interactions. It was found that out of 213 prescriptions, 150 (70.4%) prescriptions did not have any potential drug-drug interactions. Out of 63 prescriptions that have potential drug-drug interactions, 40 (18.8%) prescriptions had 1 interaction, while only 2 (0.9%) prescriptions had 4 interactions. The distribution of potential drug-drug interactions is presented in Table 5.

Table 5: Number of PDDIs in prescriptions.

No. of pDDI	Prescriptions, n (%)	No. of pDDI	Prescriptions, n (%)
0	150 (70.4%)	3	4 (1.9%)
1	40 (18.8%)	4	2 (0.9%)
2	17 (8.0%)		

* PDDIs: Potential drug-drug interactions

Fisher's exact test was applied to check the association between gender and the severity of potential drug-drug interactions (Table 6). The test explains that there is no statistically significant relationship between these variables.

Table 6: Distribution of PDDIs based on severity of interactions.

Severity of PDDIs	Male (n %)	Female (n %)	Total (n %)	p-value
Minor	14 (27.5%)	4 (9.3%)	18 (19.1%)	
Monitor closely	29 (56.9%)	33 (76.7%)	62 (66.0%)	
Serious – use an alternative	8 (15.7%)	6 (14.0%)	14 (14.9%)	
Total	51	43	94	0.61

*Fisher's exact test

The Potential drug-drug interactions were also classified based on severity. Out of 63 prescriptions with 94 interactions, 18 (19.1%) were minor interactions. 62 (66.0%) were moderate, while 14 (14.9%) were serious interactions. Co-prescription of cetirizine with azithromycin was identified as the most frequent drug pair involved in moderate interactions. 15 prescriptions had the drug pair cetirizine and azithromycin, followed by 13 prescriptions that had the drug pair paracetamol and metronidazole. Additionally, salbutamol and ibuprofen, dimenhydrinate and salbutamol, and azithromycin and ondansetron were present in only 1 prescription. These findings emphasized the importance of exercising caution when prescribing medications to prevent adverse drug reactions. Potential drug interactions and their effects are given in the Table 7.

Table 7: Drug pairs having potential interactions and their effect.

Drug pairs	No. of PDDI	Effect of drug interaction
Cetirizine + Azithromycin	15	The amount or activity of cetirizine is increased by P- glycoprotein (MDR1) efflux transporter, which is increased by azithromycin.
Paracetamol + Metronidazole	13	Paracetamol will have its level or effect increased by Metronidazole through its effect on the hepatic enzyme CYP2E1. Minor
Salbutamol + Azithromycin	11	Both increase the QTc interval.
Salbutamol + Terbutaline	10	Both lower serum Potassium and sedation enhance Adrenergic effects, such as elevated blood pressure and elevated heart rate. Use caution.
Ondansetron + Metronidazole	4	Both increase the QTc interval.
Desloratadine + Chlorpheniramine	3	Both increase sedation. Monitor.
Desloratadine + Diphenhydramine	3	Both increase sedation. Use caution/ monitor.
Diphenhydramine + Ipratropium	3	Both decrease cholinergic effects/transmission.
Hydrocortisone + Montelukast	3	Hydrocortisone will reduce montelukast concentrations by inhibiting CYP3A4 activity in the liver and intestines. Minor.
Ibuprofen + Prednisolone	3	One increases the toxicity of the other by pharmacodynamic synergism.
Carbinoxamine + Chlorpheniramine	2	Both increase sedation. Use caution.

Clarithromycin + Hydrocortisone	2	Clarithromycin will increase the level or effect of hydrocortisone by affecting hepatic and intestinal CYP3A4 metabolism. Avoid or use an alternative.
Clarithromycin + Prednisolone	2	Clarithromycin will increase the level or effect of prednisolone by p-glycoprotein (MDR1) efflux transporter. Use caution.
Desloratadine + Carbinoxamine	2	Both increase sedation. Use caution.
Hydrocortisone + Prednisolone	2	Hydrocortisone will inhibit the metabolism of prednisolone by hepatic and intestinal CYP3A4 enzymes, leading to reduced prednisolone levels and effects. Minor.
Ibuprofen + Dexamethasone	2	Either increases the toxicity of the other by pharmacodynamic synergism. Also increases the risk of GI ulcer. Use caution.
Ibuprofen + Terbutaline	2	Ibuprofen increases serum potassium, and terbutaline decreases it. The effect of the interaction is not clear. Use caution.
Salbutamol + Clarithromycin	2	Both increase the QTc interval. Use caution/ monitor.
Azithromycin + Ondansetron	1	Both increase the QTc interval. Avoid or use an alternative drug.
Desloratadine + Cyproheptadine	1	Both increase sedation. Monitor.
Desloratadine + Dimenhydrinate	1	Both increase sedation. Use caution/ monitor.
Desloratadine + Hyoscine	1	Both increase sedation. Use caution/ monitor.
Dexamethasone + Ibuprofen	1	Either increases the toxicity of the other by pharmacodynamic synergism. Increased risk of GI ulceration. Use caution.
dimenhydrinate + salbutamol	1	Dimenhydrinate increases sedation while salbutamol decreases it. The effect of the interaction is unclear. Use caution.
Ibuprofen + Hydrocortisone	1	Either increases the toxicity of the other by pharmacodynamic synergism. Increased risk of ulceration.
salbutamol + Chlorpheniramine	1	Chlorpheniramine increases, and salbutamol decreases sedation. The effect of the interaction is not clear. Use caution.
Salbutamol + Ibuprofen	1	Ibuprofen increases serum potassium, and salbutamol decreases it. The effect of the interaction is unclear. Use caution.
Terbutaline + Chlorpheniramine	1	Chlorpheniramine increases sedation, and terbutaline decreases sedation. Use caution.

To find the predictors of potential drug-drug interactions, a multivariate logistic regression analysis was performed. An increasing number of drugs was significantly associated with drug interactions because $p < 0.001$, while other variables, such as age and gender, showed no statistically significant association with potential drug-drug interactions because $p > 0.05$. The 95% confidence interval for the number of drugs prescribed indicates that with each additional medication, the odds of a potential drug-drug interaction increase by at least 27.9% (Table 8).

Table 8: Regression analysis for predictors of potential drug-drug interactions.

Variables	B	Adjusted odds ratio	95% CI	p-value
Gender of participants	0.443	1.557	0.827-2.930	0.170
Age of participants	0.228	1.256	0.816-1.932	0.301
Number of drugs in prescription	0.445	1.561	1.279-1.904	<0.001*

*- p-value <0.05: highly significant association
*CI: Confidence interval

While examining prescribing patterns for nutraceuticals, the study found that 59 of 213 patients received nutraceuticals as vitamins, minerals, or vitamins + minerals. Protein supplements were not prescribed. Of the 59 patients who received nutraceuticals, 31 were male, and 28 were female (Fig. 2).

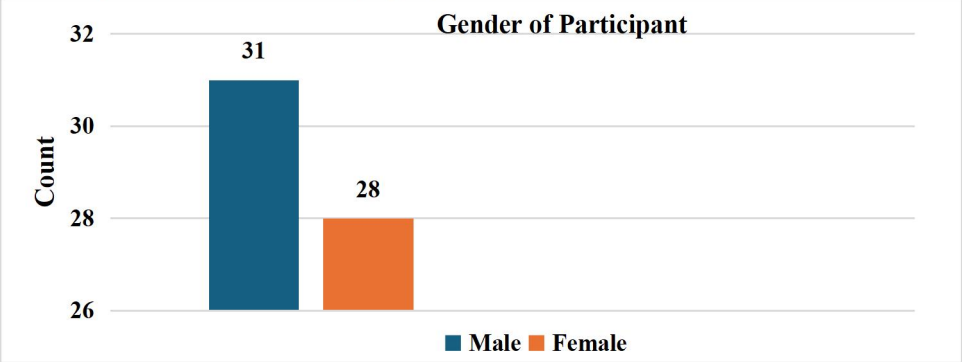

Figure 2: Distribution of Nutraceutical Use According to Gender

The distribution of vitamins, minerals, proteins, and a combination of vitamins and minerals is given in Figure 3. These include folic acid, multivitamins, iron polymaltose, vitamin B complex, vitamin D3, and calcium + vitamin D. Vitamins were given to 49 patients (62%) receiving nutraceuticals (Fig. 3). Minerals were given to 22 patients (28%) receiving nutraceuticals. Vitamin and mineral preparations were prescribed in 8 (10%) patients. Multiple nutraceutical categories were prescribed to some patients, so the total exceeds 59.

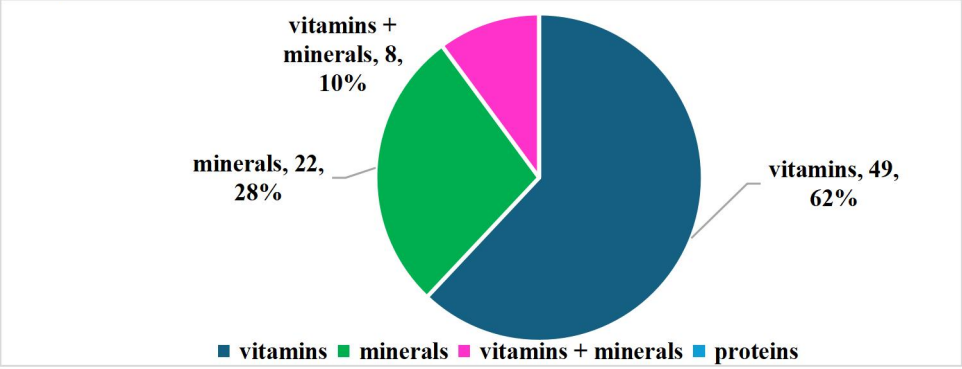

Figure 3: Distribution of vitamins, minerals, vitamins +minerals, and proteins.

The distribution of prescribed nutraceuticals is shown in Figure 4. Vitamin B complex preparations were not prescribed. Calcium and vitamin D are included in 8 prescriptions, while vitamin D3 is mostly prescribed as drops, syrups, and injections. Poly-vitamins were given in 22 prescriptions. While folic acid counts for only 5.

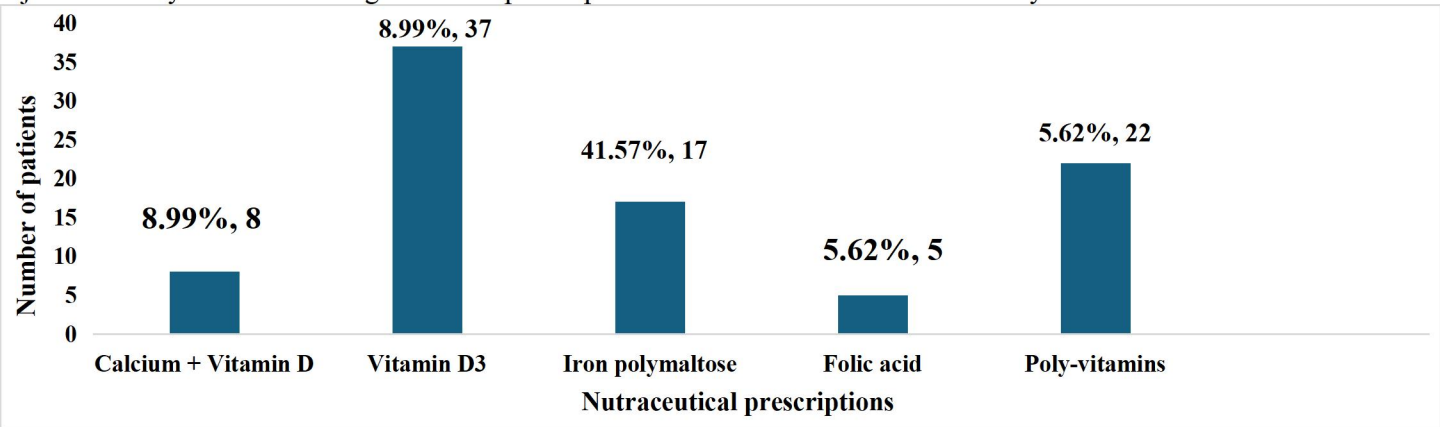

Figure 4: Distribution of various nutraceuticals in pediatric patients.

In the present study, the following parameters were assessed: prescribing patterns, polypharmacy, potential drug-drug interactions, and nutraceutical use among pediatric outpatients. There were nearly equal numbers of male and female patients, with 49.8% male and 50.2% female. The same conclusion was drawn by (Palikhe, 2004), who found no significant difference in the numbers of boys and girls at the outpatient departments. Most of the patients in the present study were aged 1-5 years. Similar results were found by (Sharma & Agrawal, 2016), who noted that the highest percentage of outpatient children's visits occurred in children under 5 years of age. Younger children are more likely to develop infections, particularly because their immune systems are less developed; they may be exposed to more infections in the environment, be malnourished, and have poor hygiene habits.

Upper respiratory tract infections (50.7%) were the most common diagnosis in the current study, followed by lower respiratory tract infections and gastrointestinal disorders. This is similar to the findings of (Sharma & Agrawal, 2016), which reported that upper respiratory tract infections were the most common cause of pediatric outpatient visits in children aged 0-12. The findings were in line with those of (Choudhury & Bezbaruah, 2013). The high rate of respiratory infections in the present study might be linked to various environmental factors, including polluted air (smog), seasonal viral infections, lower nutritional status, and greater exposure of children to infectious agents. Gastrointestinal disorders were also frequently observed, likely due to poor sanitation and hygiene practices.

Of the prescribed medicines, the most frequently prescribed therapeutic class was antipyretics/analgesics, followed by antibiotics and antihistamines. Similarly, Sankhla & Gaur (2017) found that, among all drugs prescribed to pediatric outpatients, the most frequently used were antibiotics and antipyretics. This study may reflect the high prevalence of febrile illness and respiratory infections among children, given the frequent use of antipyretics. Allergic and respiratory disorders were common, leading to the use of bronchodilators and antihistamines.

Some irrational prescribing practices were observed in the current study while evaluating WHO prescribing indicators. The average number of drugs dispensed per prescription was 5.37, which is significantly higher than the WHO range of (1.6-1.8) drugs per prescription/visit. In Ethiopia, (Desalegn, 2013) found an average of 1.9 drugs per encounter, and (Bilal et al., 2016) noted an average of 2.2 drugs per prescription. The significantly higher mean in the study might be explained by polypharmacy, empirical prescribing, symptomatic treatment, and the high frequency of use of supportive drugs such as antihistamines, vitamins, cough preparations, and gastrointestinal agents. Over-prescribing is likely to lead to treatment costs, non-adherence to treatment, and the potential for adverse drug effects and drug interactions.

The level of generic prescribing was very low in this study (0.87%) compared with the WHO-recommended standard. Likewise, generic prescribing rates are comparable across South Asian countries, where the majority of prescriptions are written for brand names. Otherwise, (Desalegn, 2013) found that 98.7% of prescriptions were generics in Ethiopia. Physician preferences, pharmaceutical promotional activities, and concerns about the bioequivalence of generic products may be responsible for the low rates of generic prescribing. Brand prescribing also increases the economic burden on caregivers.

Antibiotics were used in 63.85% of encounters, exceeding the WHO-recommended range of 20–26.8%. Additionally, it is in line with the results that were reported by (Bhattarai et al., 2026). Similar findings were reported by (Palikhe, 2004), who found that antibiotics were widely prescribed. High antibiotic use in this study could be attributed to the following: empirical treatment for respiratory tract infections, lack of culture sensitivity testing, and parents' expectation of quick recovery. Overusing antibiotics can contribute to the global problem of antimicrobial resistance.

Prescription of Injectable medicines was issued in 19.25% of encounters, which is within the WHO-recommended acceptable range (13.4-24.1%). Also, similar results were noted by (Bilal et al., 2016), who reported 22% of encounters involved prescribing injectables. Moderate use of injections in this study suggested that injections may be used with caution and that the oral route of administration was preferred for pediatric outpatients. Preventing unnecessary injections reduces treatment costs, pain, and the risk of infection transmission.

The level of essential drug list compliance in this study was 78.5%, which is less than the WHO-recommended standard of 100%. In contrast, the EDL compliance was reported to be 96.6% by (Desalegn, 2013). The absence of essential medicine lists for branded medicines, fixed-dose combinations, and nutraceuticals could explain the low adherence in the current study. The relatively high compliance, however, indicates some amount of adherence to standard treatment guidelines.

The prevalence of polypharmacy was 69.5%, with the majority of patients taking five or more medications. (Rashed et al., 2012) Also noted that there were concerns about polypharmacy among children, as the use of multiple medications is associated with an increased risk of adverse drug reactions and drug-drug interactions in children. The high prevalence in this study might be explained by multiple drug usage, including antibiotics, antipyretics, antihistamines, bronchodilators, steroids, and others at the same time.

In 29.5%of prescriptions, potential drug-drug interactions were present, and the majority of interactions were of moderate severity. The same conclusions were drawn by (Medina-Barajas et al., 2020), who found that the incidence of pDDIs was 42% in the hospitalized pediatric patients and that the risk of interactions increased with the increased number of drug utilization. A high prevalence of pDDIs in the current study could be attributed to co-prescribing of medicines. Logistic regression analysis also showed that the increasing number of medications significantly elevated the risk of pDDIs.

Regarding nutraceutical use, vitamins and minerals were prescribed to 59 patients. However, protein supplements were not prescribed to any of the patients. The most commonly prescribed nutraceuticals were vitamin D3 and polyvitamins. Similar results were reported by (Zaman et al., 2017), who found that 60% of vitamins were prescribed. The higher prevalence of Vitamin D3 in the present study may be due to the physician’s awareness of the role of Vitamin D in bone growth, immunity, and nutrition. A lack of protein supplementation could reflect under-recognition of protein-energy malnutrition or a decision to focus on dietary advice rather than on protein supplements.

Strengths and Limitations:

The primary strength of this study is its focus on pediatric prescribing patterns, using real clinical data to provide a comprehensive analysis of potential drug-drug interactions (PDDIs) and polypharmacy in routine practice. The cross-sectional design effectively highlights prevalence, supporting safer prescribing for children. However, several limitations must be noted, including the use of a single-center study with a small convenience sample, which may limit generalizability. Furthermore, the reliance on a theoretical interaction checker and the lack of follow-up outcomes suggest that further research is needed to validate these findings in clinical settings over time.

Conclusion

This study has highlighted the importance of rational prescribing in the pediatric outpatient department in Pakistan. Systemic issues in pediatric pharmacotherapy were raised, with many children being prescribed multiple drugs, which is

contrary to WHO guidelines for prescribing. Sub-optimal prescribing in relation to generic prescribing and systemic issues in pediatric pharmacotherapy were highlighted, particularly that several children were prescribed more than one drug, which the WHO did not recommend. Polypharmacy was found to be the only important factor associated with a potential risk of drug-drug interactions. Co-prescribing of nutraceuticals, especially Vitamin D3, was common among 31% of patients, necessitating consideration of drug-nutraceutical interactions and their resulting nutritional effects in treatment. The results highlight the need to consider nutrition as a component of medical history taking for prescribing, as malnutrition and micronutrient deficiencies may modify drug pharmacokinetics and treatment outcomes. Cooperation between the pharmacy and pediatrics is crucial for rational drug use, to reduce the occurrence of adverse drug reactions, and to enhance the overall health of the child. Further studies are needed to determine the clinical implications of identified interactions and the effect of nutrition on the effectiveness and safety of medications in children.

Acknowledgment

The authors would like to thank all participants and supervisors who contributed to the completion of this study.

Conflict of Interest

The authors declare no conflicts of interest.

Funding Resource

This study was not externally funded

References

Anwar, M. F., Daud, N. A. A., & Hussain, R. (2025). From prescribing indicators to rational drug use: a medication safety perspective. *Journal of Pharmaceutical Policy and Practice*, *18*(1), 2544656.

Attia, K. A. (2024). Physiological, anatomical and physicochemical characteristics of children affecting food-drug interaction-review. *Pak J Biol Sci PJBS*, *27*(1), 1-7.

Bhatt, S., Patel, A., Prajapati, K., Joshi, R., Patel, M., & Patel, C. (2022). Assessment of prescription patterns at pediatric outpatient clinics. *KB Institute of Pharmaceutical Education and Research, Kadi Sarva Vishwavidyalaya, Gh-6, Gandhinagar, Gujarat-382023, India*, *11*(10), 730-746.

Bhattarai, S., Dhungana, J., & Rayamajhi, A. (2026). P-421. Outpatient antibiotic prescribing for acute respiratory infections: An observational study in two pediatric hospitals of Nepal. Open Forum Infectious Diseases.

Bilal, A. I., Osman, E. D., & Mulugeta, A. (2016). Assessment of medicines use pattern using World Health Organization's prescribing, patient care and health facility indicators in selected health facilities in eastern Ethiopia. *BMC health services research*, *16*(1), 144.

Botzenhardt, S., Rashed, A. N., Wong, I. C., Tomlin, S., & Neubert, A. (2016). Analgesic drug prescription patterns on five international paediatric wards. *Pediatric Drugs*, *18*(6), 465-473.

Choudhury, D., & Bezbaruah, B. (2013). Antibiotic prescriptions pattern in paediatric in-patient department gauhati medical college and hospital, Guwahati. *Journal of Applied Pharmaceutical Science*, *3*(8), 144-148.

Desalegn, A. A. (2013). Assessment of drug use pattern using WHO prescribing indicators at Hawassa University teaching and referral hospital, south Ethiopia: a cross-sectional study. *BMC health services research*, *13*(1), 170.

Ewig, C. L., Wong, K. S., Chan, P. H., Leung, T. F., & Cheung, Y. T. (2022). Chronic medication use and factors associated with polypharmacy among outpatient pediatric patients. *The Journal of Pediatric Pharmacology and Therapeutics*, *27*(6), 537-544.

Fadare, J., Olatunya, O., Oluwayemi, O., & Ogundare, O. (2015). Drug prescribing pattern for under-fives in a paediatric clinic in South-Western Nigeria. *Ethiopian journal of health sciences*, *25*(1), 73.

Hollon, D., Miller, I. J., & Robinson, E. (2002). Criteria for evaluating treatment guidelines. *American psychologist*, *57*(12), 1052-1059.

Kulkarni, M., Ambekar, P., & Athawale, S. (2020). Prescribing pattern of nutraceuticals in pediatric outpatient department at tertiary care teaching hospital. *International Journal of Basic & Clinical Pharmacology*, *9*(7), 1060.

Medina-Barajas, F., Vázquez-Méndez, E., Pérez-Guerrero, E. E., Sánchez-López, V. A., Hernández-Cañaveral, I. I., & Huerta-Olvera, S. G. (2020). Pilot study: Evaluation of potential drug–drug interactions in hospitalized pediatric patients. *Pediatrics & Neonatology*, *61*(3), 279-289.

Mengato, D., Zanin, A., Baratiri, F., Pivato, L., Camuffo, L., Benini, F., & Venturini, F. (2025). Polypharmacy in pediatric palliative care: exploring discrepancies between physicians and pharmacists. *Children*, *12*(2), 124.

Ngcobo, N. N. (2025). Malnutrition and Its Effect on Drug Pharmacokinetics: A Clinical Perspective: NN Ngcobo. *Clinical Pharmacokinetics*, *64*(9), 1283-1293.

Oshikoya, K., & Ojo, O. (2007). Medication errors in paediatric outpatient prescriptions of a teaching hospital in Nigeria. *Nigerian quarterly journal of hospital medicine*, *17*(2), 74-78.

Palikhe, N. (2004). Prescribing pattern of antibiotics in paediatric hospital of Kathmandu valley. *Kathmandu University medical journal (KUMJ)*, *2*(1), 6-12.

Patel, M., Dave, D., Shukla, A., Patel, A., & Shah, A. (2025). Polypharmacy and drug interactions in pediatric prescribing. *Hosp Pharmacol Int Multidiscip J*, *12*, 1620-1627.

Patil, N., Salimath, P., Karimungi, A., Gandage, M., & Clayton, I. (2019). A Study on Drug use Pattern among Paediatric In-Patients at a Tertiary Care Hospital at Gulbarga. *Indian Journal of Pharmacy Practice*, *12*(1), 35. k

Paul, F. (1974). Nutritional disorders encountered in children in the Department of Paediatrics, Singapore. *Singapore Med. J*, *15*, 231-240.

Rani, S. (2025). Prescribing pattern of Nutraceuticals in pediatric outpatient department at tertiary care teaching hospital.

Rashed, A. N., Wong, I. C., Cranswick, N., Tomlin, S., Rascher, W., & Neubert, A. (2012). Risk factors associated with adverse drug reactions in hospitalised children: international multicentre study. *European journal of clinical pharmacology*, *68*(5), 801-810.

Sabbu, R., Devathi, S., & Hiremath, D. (2021). Study of drug prescribing pattern in pediatric outpatient department at a tertiary care teaching hospital. *J Drug Deliv Ther*, *11*(5), 23-26.

Sankhla, S., & Gaur, S. (2017). A retrospective study of drug utilization pattern in the outpatient department of pediatrics in a tertiary care teaching hospital. *International Journal of Basic & Clinical Pharmacology, 6*(2), 397–401.

Sharma, S., & Agrawal, G. (2016). A study on drug prescribing pattern in upper respiratory tract infections among children aged 1-12 years. *International Journal of Basic & Clinical Pharmacology*, *5*(2), 406-410.

Zaman, T., Adetunji, H., & Salih, E. (2017). Nutraceuticals: A slow transition from preventive to curative healthcare and the perceptions among physicians and patients A study of South Delhi in India. *Int J Pharm Sci Res*, *8*(7), 3113-3117.

Received: April 30th, 2026 **Accepted: June 1st , 2026**