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Original Research Article

A study to estimate utilization pattern of vitamins, minerals and trace elements in clinical practice

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ABSTRACT

Background: Vitamins, minerals and trace elements are essential micronutrients widely prescribed in clinical practice for prevention and treatment of deficiencies and various disease conditions. However, their increasing use is often empirical and not always evidence based, leading to concerns about irrational prescribing, inappropriate dosing and unnecessary combinations.
Methods: Prospective, observational study was conducted in OPD pharmacy of Goa Medical College and two Private pharmacies of North Goa from August 2022 to August 2024. Approval was obtained from Institutional Ethics Committee. The prescriptions were photographed only after getting the patient's consent and then returned to them. Patient details were kept confidential. Prescriptions that had legible writing, prescribed by only allopathic doctors were included in this study.
Results: Among the 765 vitamin and mineral preparations analyzed, 406 (53.1%) were single preparations and 359 (46.9%) were combinations. Brand-name preparations accounted for 51.0% of the total, while 40.0% were not included in either the National List of Essential Medicines (NLEM) 2022 or the WHO Model List of Essential Medicines 2023. Drug interaction analysis identified 638 distinct potential interactions from 202 of the 392 prescriptions. Cost analysis revealed that single mineral formulations contributed the largest share of expenditure (33%), followed by vitamin–mineral combinations (32%).
Conclusions: This study highlights the need for rational multivitamin use, emphasizing evidence-based prescribing, generic names and adherence to the National List of Essential Medicines (NLEM) and WHO Model List. It also improves understanding of prescribing patterns, interactions and costs, supporting safer, cost-effective practices.

Keywords: Minerals, Utilization pattern, Vitamins

INTRODUCTION

The discovery of vitamins marked a significant milestone in our comprehension of health and illness. In 1912, Casimir Funk introduced the term "vitamine." The primary era of discovery spanned from the early 19th century to the mid-20th century. Investigation into vitamins associated with major deficiency syndromes commenced during the dominance of the germ theory of disease. During that era, the prevailing belief was that only four nutritional components were essential: proteins, carbohydrates, fats and minerals. However, clinicians quickly identified scurvy, beriberi, rickets, pellagra and xerophthalmia as distinct vitamin deficiencies rather than illnesses caused by infections or toxins. The use of animal models in experimental physiology proved pivotal in nutritional research, significantly reducing the duration of human suffering from vitamin deficiencies. In the end, it was chemists who played a pivotal role in isolating different vitamins, unraveling their chemical structures and devising techniques for synthesizing them. Since the initial discovery phase, our comprehension of vitamins

has continuously advanced, reflecting ongoing research and insights.[1]

According to the World Health Organization, over 2 billion individuals globally suffer from inadequate intake of essential vitamins and minerals. In the United States, the Dietary Guidelines Advisory Committee to the US Departments of Health and Human Services and Agriculture has identified several key nutrients that are commonly lacking in the general population. These include vitamins A, C, D and E, as well as choline, calcium, magnesium, iron and potassium. Moreover, deficiencies in calcium, potassium, dietary fiber and vitamin D are deemed significant public health issues due to their crucial roles in maintaining health, coupled with the documented low levels of intake.[2]

While fixed-dose combinations (FDCs) span across nearly all therapeutic domains, numerous combinations, including those of vitamins and minerals, appear unconventional. Despite the fundamental principle guiding FDC formulation, the Indian pharmaceutical market has emerged as a global frontrunner in FDCs, boasting an estimated count exceeding 6000. Repeatedly, research studies and editorials have highlighted the lack of scientific justification for numerous FDCs, revealing a pattern of disregarding scientific rationale. Exploiting the lenient licensing framework, many unconventional FDCs are introduced, raising concerns about their appropriateness and safety.[3]

As medication usage becomes increasingly prevalent, the importance of drug-nutrient interactions in everyday clinical practice continues to escalate. These interactions can encompass a single nutrient, multiple nutrients, general food intake or overall nutritional status. Mechanistically, drug-nutrient interactions arise from changes in intestinal transport and metabolism, as well as systemic distribution, metabolism and excretion. Additionally, interactions may result from additive or antagonistic effects. Providing optimal patient care entails the identification, assessment and management of these interactions. A systematic approach to categorizing interactions and assessing their clinical significance can greatly aid in this endeavour.[4]

The economic ramifications of indiscriminate multivitamin and mineral (MVM) supplement usage are underscored by the projected growth of the global market, expected to exceed USD 81 billion by 2025. This growth is particularly pronounced in the vitamin-B product segment, forecasted to soar at a rate of 6.6 percent between 2019 and 2025. This trend is especially concerning in countries like India, where approximately 70 percent of healthcare expenses are paid out-of-pocket by patients, with medications accounting for over half of this expenditure. In such contexts, curtailing the indiscriminate use of MVM preparations is imperative to alleviate financial burdens on healthcare systems and facilitate more effective allocation of resources.[5]

Taking all aspects into consideration, this study aims to analyze the usage patterns, fixed-dose combinations, costs and potential drug interactions associated with single vitamins or minerals, multivitamins/minerals and combinations of vitamins and minerals in clinical practice.

METHODS

Study design and setting

This was a prospective, observational study conducted at the outpatient department (OPD) pharmacy of Goa Medical College and two private pharmacies in North Goa.

Study duration

The study period was from August 2022 to August 2024.

Ethical considerations

The study was approved by the Institutional Ethics Committee. Permission was obtained from the hospital pharmacy in charge and the owners of the private pharmacies. Prescriptions were photographed after obtaining informed consent from patients and confidentiality was maintained. Consent from prescribing physicians could not be obtained due to logistical constraints; however, all identifiable details were masked to ensure anonymity.

Participants

A total of 1,000 prescriptions were randomly selected to minimize selection bias. Prescriptions with legible handwriting and issued by allopathic practitioners were included.

Data collection and variables

Brand names were converted to generic names using standard drug information sources (1 mg, CIMS, MIMS and manufacturer websites). Products containing vitamins and/or minerals were classified into predefined categories, including single agents, FDCs and health supplements. Information on irrational and banned FDCs was obtained from the CDSCO website and published literature.

Assessment of interactions and cost

Potential drug–nutrient interactions were assessed between vitamin/mineral products and concomitantly prescribed drugs, as well as within FDC components, using the Medscape drug interaction checker. Interactions were categorized as mild, severe or requiring close monitoring. Cost analysis included calculation of the total cost of vitamin and mineral products per prescription based on dose, frequency and duration.

Statistical analysis

Data were analyzed using Microsoft Excel and expressed as descriptive statistics (mean and percentages).

RESULTS

Out of the 392 prescriptions analyzed, gender information was documented in 221 prescriptions (56.4%), of which 40% pertained to males and 60% to females (Figure 1). Age information was mentioned in 116 of the 392 prescriptions, accounting for 29.6% of the total prescriptions reviewed (Figure 2).

Among the 765 preparations analyzed, frequency of administration was specified in 708 preparations (92.5%), dose information in 276 preparations (36.1%) and duration of therapy in 611 preparations (79.9%) (Figure 3). Of the 765 preparations, 406 (53.1%) were single-ingredient formulations, while 359 (46.9%) were fixed-dose combinations of vitamins, minerals or health supplements (Figure 4).

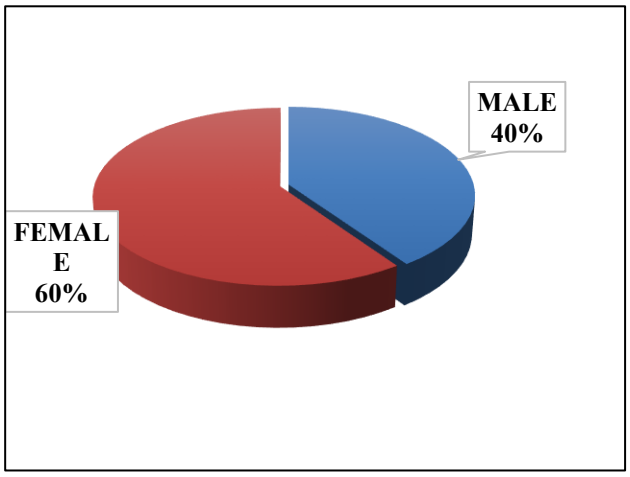

Figure 1: Sex distribution.

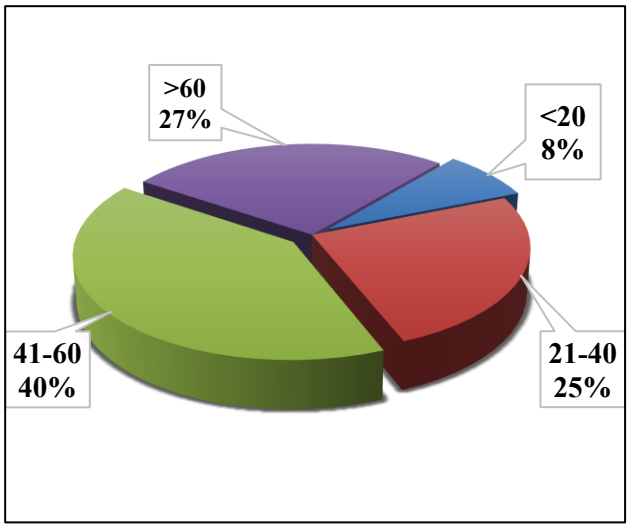

Figure 2: Age distribution.

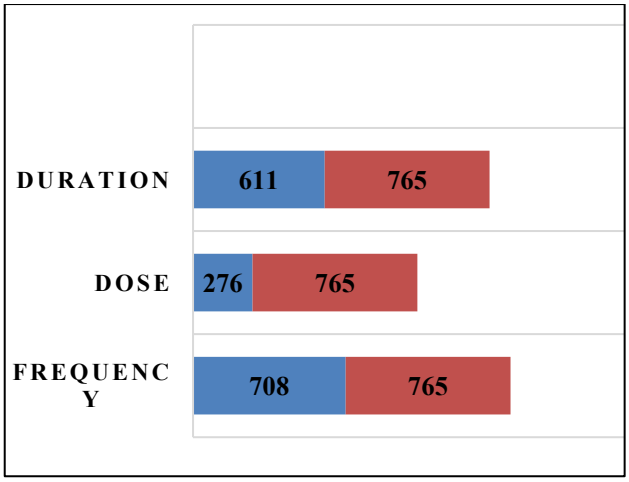

Figure 3: Number of preparations in which Duration, dose, frequency were mentioned.

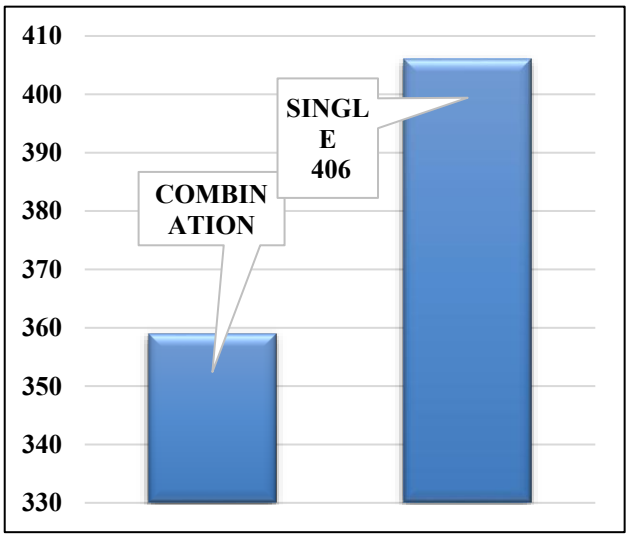

Figure 4: Count of single and combination preparations.

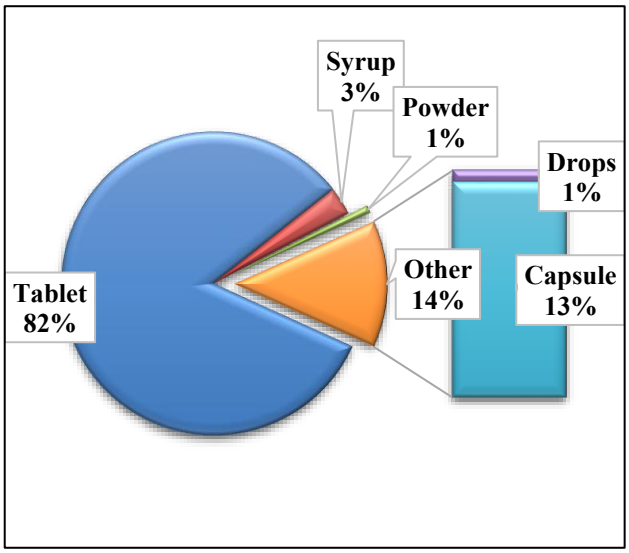

Figure 5: Percentage of different oral forms.

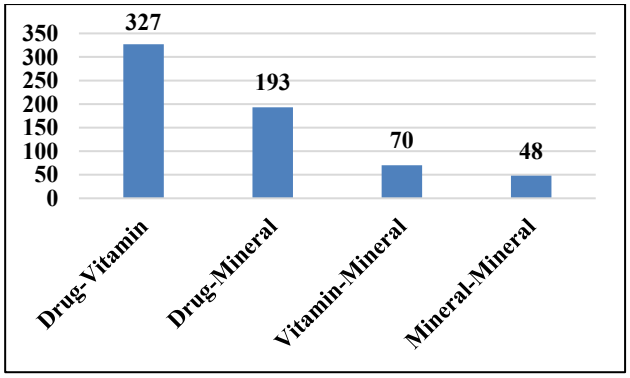

Figure 6: Types of interactions.

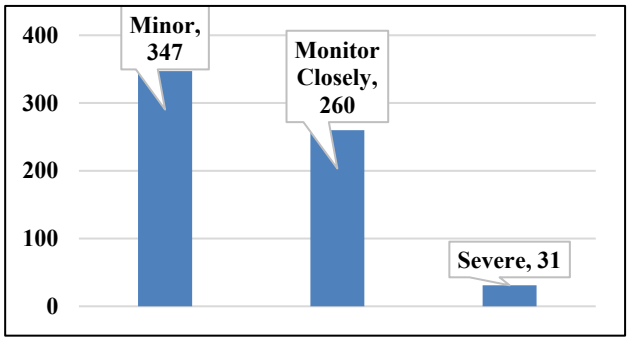

Figure 7: Severity of interactions.

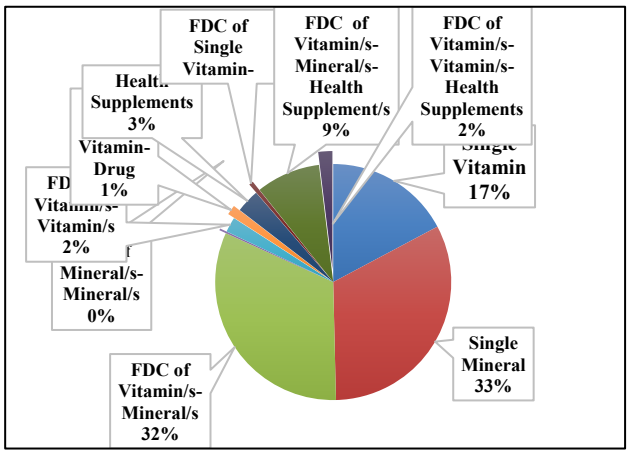

Figure 8: Percentage of cost attributed by different preparations in one month.

Among the vitamin- and mineral-based preparations, single-vitamin formulations and vitamin–mineral fixed-dose combinations were the most frequently prescribed, each constituting 31% of the total. Single-mineral preparations accounted for 22%, while fixed-dose combinations of multiple vitamins comprised 10%. Preparations containing vitamins, minerals and health supplements constituted 2%, while health supplements alone accounted for 1%. Other combination categories, including vitamin–drug and mineral–mineral fixed-dose combinations, individually contributed less than 1% each (Table 1).

Of the total 765 preparations analyzed, 92% were oral dosage forms and 8% were injectable preparations. Among the oral dosage forms, tablets were most common (82%), followed by capsules (13%). Syrups constituted 3%, while powders and drops accounted for 1% each (Figure 5).

Of the total preparations, 389 (50.8%) were prescribed by brand name. Additionally, 305 preparations (39.9%) were not included in either the National List of Essential Medicines (NLEM) 2022 or the World Health Organization Essential Medicines List (WHO EML) 2023. Drug interaction analysis using the Medscape drug interaction checker identified drug–vitamin interactions as the most frequent, followed by drug–mineral interactions. Mineral–mineral interactions were least frequently observed (Figure 6).

Of the total interactions identified, 31 were classified as severe, 260 required close monitoring and 347 were categorized as minor interactions (Figure 7). Cost analysis revealed that single-mineral preparations contributed the highest proportion of total cost (33%), followed by vitamin–mineral combinations (32%) and single-vitamin preparations (17%) (Figure 8).

Assessment of pharmacoeconomic burden showed that 26% of patients incurred costs below ₹100 per prescription, 22% spent ₹101–250, 26% spent ₹251–500, 16% spent ₹501–750, 5% spent ₹751–1000 and 5% spent more than ₹1000. The mean monthly expenditure on nutraceuticals was ₹367.3 per patient, with prescription costs ranging from ₹42 to ₹3992 (Table 2).

Table 1: Number and percentage showing types of preparations.

Count of type	Total	%
Single vitamin	240	31
FDC of vitamin/s-mineral/s	240	31
Single mineral	166	22
FDC of vitamin/s- vitamin/s	76	10
FDC of vitamin/s-mineral/s- health supplement/s	18	2
Health supplements	10	1
FDC of single vitamin-drug	6	1
FDC of vitamin/s-vitamin/s- health supplement/s	5	1
FDC of mineral/s- mineral/s	3	1
FDC of single vitamin- health supplement/s	1	0

Table 2: Pharmacoeconomic analysis based on amount spent for vitamin, mineral and nutritional supplements.

Cost (INR)	Number of prescriptions	%
≤100	102	26
101-250	88	22
251-500	100	26
500-750	64	16
751-1000	20	5
>1000	18	5

DISCUSSION

In our research, we collected and assessed 1000 prescriptions. Among these, 392 prescriptions were identified to contain either vitamins, minerals, trace elements or health supplements, either individually or in various combinations with each other or with medications. Among the 392 prescriptions analyzed, information regarding sex was provided in only 221 and age was mentioned in 116. Among the prescriptions with recorded sex data, 40% were for males and 60% for females who were prescribed vitamins and minerals. This distribution aligns with findings from studies conducted in India, US and Nepal, indicating consistency in prescription patterns across different regions.[6,14-16] In contrast, a study in India showed a gender distribution of 61.3% males and 38.67% females.[9] Among the 116 prescriptions where age was specified, majority of the patients were from the age group of 41-60 which accounts for 40% followed by individuals older than 60 years (27%). 8% individuals were younger than 20 years and 25% were aged between 21 and 40. These figures align with a study report conducted in India and diverged from data reported in studies from other countries like US.[9,17,18] For instance, a study conducted in Nepal revealed nearly uniform usage across all age groups, ranging around 22-26%.[6] A total of 765 preparations containing vitamins, minerals and trace elements were identified. Among these, information regarding dose was provided for 276 (36%), frequency for 406 (92.5%) and duration for 611 (79.8%) of the preparations. The results diverged from a study conducted in India where the dose was mentioned in 77% of the prescriptions and the duration in 84.3% of the prescriptions.[19]

Of the total 765 preparations, 53% (406) were single preparations, while the remaining 47% (359) were combinations of these substances. Notably, the count of combinations nearly matched the count of single preparations. Among the 359 combinations, FDCs of vitamins and minerals were the most frequently prescribed, accounting for 67%, followed by combinations of different vitamins, which comprised 21% of the total. These findings are consistent with results from studies conducted in India, indicating a similar pattern of prescription preferences.[8,10] Among the combinations of vitamins and minerals, FDCs containing B-complex vitamins and minerals were the most commonly prescribed, accounting for 53.3% of the total. This was followed by FDCs of iron-folic acid, which comprised 19% of the combinations. The results were comparable to previous studies conducted in India, but deviated from another study in India, which showed that vitamin-mineral combinations were prescribed at a rate of 28%.[8,9,11,14] Among single vitamins, Vitamin C was the most commonly prescribed, accounting for 44.5%, followed by Vitamin D at 29%. This aligns with findings from another study conducted in India.[8] The increased usage of Vitamin C began during the COVID-19 pandemic in 2019, largely due to its recognized immune-boosting properties in combating the virus. Vitamin D, known for its role in calcium homeostasis and bone metabolism, also plays a crucial part in enhancing immunity and mitigating the severity of various infectious diseases.[20] Studies have indicated that deficiencies in these immune-boosting vitamins, C and D, may elevate the risk and severity of COVID-19. Supplementation of Vitamin C and Vitamin D has been shown to enhance antiviral activity and mitigate cytokine storms in COVID-19 patients, leading to favorable outcomes.[21,22]

Among minerals, calcium was the most commonly prescribed, accounting for 65.6%, followed by iron at 27.7%. A study conducted in India revealed similar findings, with calcium being the most prescribed in single mineral preparations.[8] A study conducted in Nepal also showed comparable results.[6] Out of 359 prescribed FDCs, 95% were deemed rational, while only 5% were considered irrational. The irrational combinations identified in this study included a FDC of diacerein, glucosamine and methylsulfonylmethane, which lack evidence supporting their combined use and formulations containing both Iron and Zinc. Iron and zinc compete for absorption in the intestines, reducing the bioavailability of each other, which can lead to ineffective treatment of deficiencies. The most commonly used dosage forms were oral forms, constituting 92% of prescriptions, followed by intravenous (IV) at 7% and intramuscular (IM) at 1%. Among oral forms, tablets were the most frequently prescribed (82%), followed by capsules (13%), syrups (3%), powders (1%) and drops (1%). These results differ from studies conducted in Nepal (tablets were 56%, capsules 45%) and Karnataka (tablets (50.64%), capsules (49.36%)).[8,10] Injectable drugs accounted for only 8% of prescriptions, which falls below the WHO standard range of 13.4% to 24.1% for injectable drugs. Based on the analysed data, approximately 51% of the preparations

were prescribed using brand names, while the remaining 49% were prescribed using generic names. This distribution demonstrates a relatively balanced use of brand and generic names in prescriptions. Contrasting this with previous research, there's notable variation in the prevalence of generic name usage across different regions and countries. For instance, studies from Iran (95%) and Jordan (100%) reported higher proportions of prescriptions using generic names, while in states within India such as Maharashtra (16%), Karnataka (7.7% and 2%) and Rajasthan (0.30%), the utilization of generic names varied considerably, with some regions showing very low usage.[23-28] On the contrary, a study conducted in Maharashtra revealed 100% usage of generic names.[14] These differences likely reflect various factors including healthcare policies, cultural preferences and pharmaceutical regulations influencing prescription practices in different regions.

The observed deviation from the WHO standard protocol, which advocates for 100% usage of generic drugs in prescriptions, is indeed significant and indicates a departure from ideal prescribing practices. Several factors may contribute to this discrepancy. Firstly, there may be a lack of understanding or awareness among prescribers regarding the WHO's prescribing guidelines, leading to suboptimal prescription practices. Additionally, pharmaceutical companies' aggressive marketing campaigns promoting branded medications may influence prescribing behaviour. Concerns regarding the quality and efficacy of generic medications, as well as shortages of generic drugs in hospitals, could also contribute to the lower utilization of generic names in prescriptions.[28]

It's possible that prescribers are more accustomed to using brand names than generic names, which may further perpetuate the trend of prescribing branded medications. However, it's important to recognize the numerous advantages associated with generic prescribing, including cost-effectiveness and a reduced risk of dispensing errors.[29] Efforts to promote awareness of the benefits of generic medications, improve access to high-quality generic drugs and enhance prescriber education on WHO prescribing guidelines may help align prescription practices more closely with international standards and optimize patient care. Among all 765 preparations analyzed, 60% were prescribed from either the NLEM 2022 or the World Health Organization (WHO) Essential List of Medicines 2023. This finding diverges from previous studies conducted in other states such as Maharashtra, Karnataka and Rajasthan, where the proportion of prescriptions from these essential medicine lists varied considerably. In Maharashtra, (68.4%) a higher percentage of prescriptions were aligned with essential medicine lists compared to the current study. Similarly, in Karnataka, (44% and 48.4%) while there was a substantial proportion of prescriptions following essential medicine lists, the percentage was lower compared to the current findings.[25-27] In Rajasthan, (32.23%) the usage of essential medicines in prescriptions was notably lower compared to other states.[28] These differences may reflect variations in healthcare policies, availability of essential medicines and adherence to prescribing guidelines across different regions. Prescribing medications listed in essential medicines lists offers a straightforward approach to selecting treatments and reducing costs. It promotes evidence-based decision-making and cost-effective healthcare. Encouraging prescribers to use these lists in their practice through monitoring compliance and providing education can foster the adoption of essential medications. By doing so, healthcare systems can streamline prescribing practices, improve access to necessary treatments and enhance overall patient care while optimizing resource utilization.[29]

In terms of drug interactions, data from the Medscape drug interaction checker revealed 638 distinct interactions from 202 out of 392 prescriptions containing vitamins or minerals. Among these, 31 were deemed serious, 260 required close monitoring and 347 were considered minor. The most common interactions were between drugs and vitamins (327), followed by drugs and minerals (193), vitamins and minerals (70) and minerals with each other (48). On average, there were 3.1 interactions per prescription among those with interactions and 1.6 among all prescriptions containing vitamins/minerals.

The most common serious interactions identified were Atorvastatin and niacin (drug-vitamin). Both increase the toxicity of the other due to pharmacodynamic synergism.

Calcium carbonate and dapsone (drug-mineral): Calcium carbonate decreases the level or effect of dapsone by increasing gastric pH.

Sodium bicarbonate and ofloxacin (drug-mineral): Sodium bicarbonate decreases the levels of ofloxacin by inhibiting gastrointestinal absorption.

The most common interactions requiring close monitoring include.

Vitamin D and calcium carbonate (vitamin-mineral): While generally beneficial, this combination can result in hypercalcemia in some patients.

Pantoprazole and ferrous salts (drug-mineral): Pantoprazole can decrease the levels or effect of ferrous salts by increasing gastric pH.

Calcium carbonate and metoprolol (drug-mineral): Calcium carbonate can decrease the levels of metoprolol by inhibiting gastrointestinal absorption.

Pyridoxine and levodopa (drug-vitamin): Pyridoxine can decrease the levels of levodopa by increasing its metabolism.

These interactions highlight the importance of careful management and monitoring when prescribing vitamins, minerals and health supplements, particularly when they are used alongside other medications. Based on the collected data, the average number of preparations per prescription was found to be 1.91. The highest recorded number of preparations in a single prescription was 6 multivitamin/mineral/health supplement preparations, accounting for 1% of the total. The majority of prescriptions contained only one preparation, comprising 43% of the total, followed by prescriptions with two preparations, which accounted for 36%. These findings are almost consistent with studies conducted in Karnataka, which reported an average of 1.57 preparations per prescription and in Nepal, which reported an average of 1.52 preparations per prescription.[9,30] The cost analysis of various preparations revealed that single mineral preparations accounted for the largest portion at 33%, followed by vitamin-mineral combinations at 32% and single vitamin preparations at 17%.

Considering the cost of MVM (multivitamin and mineral) per prescription, it was observed that 26% of patients spent less than 100 INR, 22% spent between 101-250 INR, 26% spent between 251-500 INR, 16% spent between 501-750 INR, 5% spent between 751-1000 INR and 5% spent over 1000 INR during the treatment period. So, the average pharmacoeconomic burden for a patient was determined to be 367.3 INR per month for nutraceuticals. whereas the maximum cost per prescription was 3992 INR and the minimum cost was found to be 42 INR. The findings were consistent with a study conducted in Nepal, which reported costs of 575.78 NR or approximately 360 INR as the average pharmacoeconomic burden per month for nutraceuticals.[30] However, they slightly varied from other studies conducted in Nepal, where figures of 746 NR (equivalent to 467.16 INR) and 1017.884 NR (approximately 637 INR) were observed.[6,31] Another study in Karnataka showed an average pharmacoeconomic burden of 440.55 INR per month for nutraceuticals.[9]

Limitation

The study was conducted in a single tertiary care hospital and two private pharmacies in North Goa, which may limit the generalizability of the findings to other healthcare settings.

CONCLUSION

This study provides a comprehensive evaluation of the utilization of multivitamin preparations, particularly FDCs, in prescription practice. The findings highlight the need for more rational prescribing of vitamin and mineral supplements, with greater emphasis on the use of generic names and adherence to medicines listed in the NLEM and the WHO Model List of essential medicines to ensure affordability and accessibility. The study also brings attention to potential drug–nutrient interactions associated with concurrent use of multivitamins and other medications, indicating the importance of careful prescribing and monitoring. Furthermore, the pharmacoeconomic assessment demonstrates that irrational or unnecessary use of multivitamin preparations can impose an avoidable financial burden on patients. By systematically examining prescribing patterns, potential interactions and associated costs, this study advances understanding of multivitamin utilization and highlights the importance of promoting evidence-based and cost-effective prescribing practices to improve patient safety and optimize healthcare resources.

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Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Semba RD. The discovery of the vitamins. Int J Vitam Nutr Res. 2012;82(5):310–5.
2. Blumberg JB, Bailey RL, Sesso HD, Ulrich CM. The evolving role of multivitamin/multimineral supplement use among adults in the age of personalized nutrition. Nutrients. 2018;10(2):248.
3. Gupta YK, Ramachandran SS. Fixed dose drug combinations: Issues and challenges in India. Indian J Pharmacol. 2016;48(4):347–9.
4. Boullata JI, Hudson LM. Drug–nutrient interactions: a broad view with implications for practice. J Acad Nutr Diet. 2012;112(4):506–17.
5. Rana P, Roy V. Prescribing vitamin B complex: Need for reassessment. Indian J Med Res. 2021;154(6):781.
6. Adhikari P, Yadav AK. Prescription pattern of nutraceuticals in patients visiting a tertiary care hospital, kathmandu, nepal. Inn J Med Sci. 2024;11:7–10.
7. Patel ZJ, Prajapati A, Thaker V, Patel S. Prescribing pattern of vitamins in dermatologic disorders at tertiary care teaching hospital in western India. Pharmacol Clin Pharm Res. 2023;4;8(2):80–92.
8. Shah A, Pillai A. A study of prescribing pattern of micronutrients in dermatology outpatient department at tertiary care teaching hospital. Int J Bas Clin Pharmacol. 2022;11(5):401–3.
9. Mohammed AH, Kellarai A, Mateti UV, Rawal KB, Raju BN, Shetty S, et al. Prescription pattern and cost analysis of nutraceuticals among type 2 diabetes mellitus patients: a cross-sectional study. JCDR. 2022;12:587-9.
10. Anila AB, Ancy PS, Sreelekshmi BS, Mahesh NM, Vishwanath BA. A study on prescription pattern of multivitamins in type-2 diabetes mellitus in tertiary care hospital. J Drug Delivery Therap. 2020;10(3):91–7.

11. Babu A, Nair AS, Kurian AM, Abraham AK, Varghese RS. A study on multivitamin utilisation pattern and pharmacoeconomics in a medical teaching care hospital. 2019.
12. Arshad A, Ali M, Manzoor S, Khan SA, Rashid M, Salam MU. Emerging trends to prescribe multivitamins. J Virol Curr Res. 2017;2(3):555588.
13. Islam MdA, Al-karasneh AF, Rizvi M, Nisa ZU, Albakheet AM, Alshagawi MA, et al. Prevalence, reasons and determinants of dietary supplements use among undergraduate female students of health and non-health colleges in a Saudi public university. PLoS One. 2021;16(3):247295.
14. Kulkarni M, Ambekar P, Athawale S. Prescribing pattern of nutraceuticals in pediatric outpatient department at tertiary care teaching hospital. Int J Basic Clin Pharmacol. 2020;9(7):1060–3.
15. Qato DM, Alexander GC, Guadamuz JS, Lindau ST. Prevalence of dietary supplement use in US children and adolescents, 2003-2014. JAMA Pediatrics. 2018;172(8):780-2.
16. Office of dietary supplements. Multivitamin/mineral supplements. Available at: https://ods.od.nih.gov/factsheets/MVMS-HealthProfessional. Accessed on 21 August 2025.
17. Mishra S, Stierman B, Gahche JJ, Potischman N. Dietary supplement use among adults: United States, 2017–2018.
18. Stierman B. Dietary supplement use in children and adolescents aged≤ 19 years—United States, 2017–2018. MMWR. Morbidity and mortality weekly report. 2020;69.
19. Joshi R, Medhi B, Prakash A, Chandy S, Ranjalkar J, Bright H, et al. Assessment of prescribing pattern of drugs and completeness of prescriptions as per the world health organization prescribing indicators in various Indian tertiary care centers: a multicentric study by rational use of medicines centers-Indian council of medical research network under national virtual centre clinical pharmacology activity. Indian J Pharmacol. 2022;54(5):321–8.
20. Ahmed S, Hossain M, Chakrabortty D, Arafat KI, Hosen MJ, Khan MMR. Impacts of vitamin C and D supplement on COVID-19 treatment: possible patho-mechanisms and evidence from different countries. Egyptian J Bronchol. 2023;20;17(1):13.
21. Mokdad AH, Bisignano C, Hsu JM, Bryazka D, Cao S, Bhattacharjee NV, et al. Burden of disease scenarios by state in the USA, 2022–50: a forecasting analysis for the Global Burden of Disease Study 2021. Lancet. 2024;404(10469):2341-70.
22. Lotfi F, Akbarzadeh-Khiavi M, Lotfi Z, Rahbarnia L, Safary A, Zarredar H, et al. Micronutrient therapy and effective immune response: a promising approach for management of COVID-19. Infection. 2021;49(6):1133–47.
23. Ahmadi F, Zarei E. Prescribing patterns of rural family physicians: a study in Kermanshah Province, Iran. BMC Public Health. 2017;17(1):1–7.
24. Aldabagh A, Farha RA, Karout S, Itani R, Hammour KA, Alefishat E. Evaluation of drug use pattern in pediatric outpatient clinics in a tertiary teaching hospital using who drug-prescribing indicators. JMDH. 2022;15:1143–51.
25. Shruti C, Deepak B, Amol U. Prescription pattern at outpatient department in a tertiary care hospital at central Maharashtra, India. IP International J Comp Advan Pharmacol. 2019;4(2):56–8.
26. Abhilash S, Rao RR, Yadunath PS. Assessment of prescribing pattern among orthopedic in-patients using WHO prescribing indicators. Asian J Pharma Clin Res. 2018;11(12):505-9.
27. Rahul S, Sravya DV lakshmi, Doddayya H. Study of drug prescribing pattern in pediatric outpatient department at a tertiary care teaching hospital. J Drug Deliv Therap. 2021;11(5):23–6.
28. Ambwani S, Misra AK, Midha NK, Kumar B, Singh V. A prospective, cross-sectional study on prescribing pattern of drugs and the incidence of potentially inappropriate medications in geriatrics population at a tertiary care teaching hospital in Western India. Asia Pacific J Med Toxicol. 2020;9(4):136–41.
29. Razdan D, Yadav S, Gudibanda KR, Dudhraj V, Anand S, Kaur S, et al. Assessing prescribing practices in Indian health facilities: a comprehensive review. Int J Comm Med Public Health. 2023;10(12):5095–101.
30. Shrestha R, Shrestha S, Shrestha S. Evaluation of nutritional supplements prescribed, its associated cost and patients knowledge, attitude and practice towards nutraceuticals: A hospital based cross-sectional study in Kavrepalanchok, Nepal. Plos One. 2021;16(6):252538.
31. Rijal S, Mandal PK. A study of nutraceutical prescription pattern among patients in an out-patient setting at Birat medical college teaching Hospital. Magna Scient Adva Res Rev. 2024;10(1):330–40.

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