An Assessment of Vitamin Supplements in the Indian Market

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Chugh and Lhamo: Vitamin Supplements in India

We aimed to study the composition and availability of various vitamin preparations in the Indian market, data about which was collected from an annual Drug Compendium. The preparations were assessed for total number, different formulations, constituents and amount of each constituent present in the formulation. A large number of vitamin supplements are available in the Indian market. It includes single-ingredient products and various combinations of vitamins, minerals, and other constituents. Among single products, the maximum number was that of vitamin D3 (n=150). Most of the supplements are available as combinations (76.49%), with vitamin-minerals combinations constituting the maximum number. In a large number of products, amount of the vitamins was not specified. The most common formulation for oral administration was capsules (34.1%). In our research, majority of the supplements contained nutrient amounts higher than the recommended intakes recommended dietary allowance. Unsupervised intake of vitamins can pose a serious health risk in the susceptible population. The composition and amount of each constituent in the dietary supplement should be detailed and properly labelled for each preparation. Availability of a large number of preparations with unknown composition as 'over the counter' agents requires a serious review of the legal provisions in India for drug manufacturing and marketing. There is a need for proper guidelines and regulations for the manufacturing, labelling and marketing of dietary supplements in India. Strict enforcement of such provisions is essential to safeguard the health of the population at large.

Key words: Indian population, micronutrient, multivitamins, supplement, vitamins

Vitamins are widely used as dietary supplements. They are commonly prescribed by physicians as a concomitant medication for mild illness to severe chronic illnesses. It is believed that they help in enhancing immunity, improve wellbeing and aid in faster recovery of the illness[1]. Vitamins are defined as organic substances that must be provided in small quantities from environment, because they either cannot be synthesised *de novo* in human body or their rate of synthesis is inadequate for maintenance of health[1]. They are also selfprescribed by healthy people; for enhancing their health, supplementing nutrition and prevention of minor ailments. It has been reported that the most common type of dietary supplement in the United States is a multivitamin supplement[2]. In a large scale study in Danish population involving over 4000 participants, it was observed that more than half of the study subjects were users of these micronutrient dietary supplements. This usage increased with age and with 'intention to eat healthy'[3]. In a drug utilisation study in secondary care hospitals in Maharashtra, India, it was found that in 16% of the prescriptions, a multivitamin product was prescribed. More so, 2% of the prescriptions contained more than one vitamin supplements[4]. In a large scale national survey in US, it was found that the usage of vitamin mineral supplements increased from 23.2% in 1987 to 33.9% in 2000 across all races, both sexes and ethnic groups. This supplement use was most commonly seen in educated females living a healthy lifestyle[5]. In another large multiethnic cohort, about 50% of the participants without chronic diseases reported using a multivitamin supplement at least once weekly for 1 year[6]. They may be taken more often than once a day and at times, more than one type of multivitamin may be consumed[7]. One of the major reasons for their increasing use is their easy availability as over the counter (OTC) agents. OTC drug products are those drugs that are available to consumers without a prescription. OTC agents generally have a low misuse/abuse potential; their benefits outweigh their risks and can be used for selfdiagnosed conditions[8].

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Increasing health awareness, education and income among general population are important reasons for their widespread use[9].

In view of the relatively high prevalence of supplement use, dietary supplements may contribute considerably to the daily nutrient intake. Large scale prevalence studies are required to evaluate the intakes, estimate its adequacy and relationship with health and disease in any population. However, data is limited in Indian population on usual intakes from these supplements or on intakes from foods plus supplements. An important prerequisite for these studies is the availability of reliable data on the consumption of vitamin/mineral dietary supplements. There should be uniform and adequate information on the supplement product label to ensure that a study participant reports correctly. Thus, we undertook this study to ascertain the availability and composition of various vitamin supplement products available in the Indian market.

This study was conducted to determine the number and composition of the various vitamin supplements available to the consumer. Data for the study was collected from an annual Drug Compendium entitled The Drug Today 2010 (October–December issue). The preparations were assessed for total number, different formulations, constituents and amount of each constituent present in the formulation.

In our analysis, the available vitamin preparations were grouped on the basis of details of the constituents of the product. Group I: Amount of vitamins specified in the preparation; group II: Amount of vitamins not specified in the preparation. Further on, three categories were made; namely; single vitamin preparations, vitamins in combination and products labelled as 'multivitamins'. The vitamins could be in combination (a) with vitamins only; (b) with minerals only; (c) vitamin/vitamin-mineral combinations with other substances (antioxidants, lactobacillus, choline, lysine, thyroxine, lycopene, lactobacillus spores). Similarly, products labelled as 'multivitamins' were further grouped as 'multivitamins' only, 'multivitamins' with antioxidants/minerals/ both and 'multivitamins' with other substances. A 'multivitamin' preparation with minerals/ antioxidants and other substances was placed in the third subcategory. In our study, 'multivitamin' was not synonymous with a preparation containing more than one vitamin.

Recommended dietary allowance (RDA) is defined as the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97-98%) healthy individuals in a particular life stage and gender group[10]. The RDA varies according to age, sex, body weight, physiological state and activity. In our analysis, the amount of vitamin in each preparation was compared with RDA of reference Indian male with moderate activity.

A total of 936 vitamin formulations are available in the Indian market. The nutrient profiles of the multivitamin products vary widely. There is a huge discrepancy in the nomenclature of vitamin/mineral supplements. There is a lack of uniformity in naming/ labelling, as products contain 'multivitamins' (without specifying the composition), one or more minerals, antioxidants and various other nutritional supplements.

Among single preparations (*N*=220, group I, *n*=180; group II, *n*=40) (Table 1), the maximum number is that of vitamin D3 (*n*=150; 16.02%) followed by folic acid (*n*=45; 4.80%). Most of the preparations are available as combinations (*N*=716, 76.49%, group I; *n*=540; group II, *n*=176). Vitamin-minerals combinations constitute the maximum number in group I (*n*=272, 29.05%). Vitamins combinations were seen in 142 formulations (group I, *n*=127; group II, *n*=16). 'Multivitamins' was a constituent of 88 formulations in group II (*n*=78 in combinations) (Table 1).

The most common formulation for oral administration is in the form of capsules (*n*=319, 34.1%) followed by tablets (*n*=297, 31.7%). There is only one formulation of paediatric tablet that contains vitamins

TABLE 1: THE VARIOUS VITAMIN PREPARATIONS IN GROUP I AND GROUP II

Various vitamins	Group I	Group II
Single vitamins	180	40
Combinations		
Vitamins only	127	16
Vitamins+minerals	272	-
Vitamins+others	141	72
'Multivitamins' only	-	10
'Multivitamins'+AO+minerals	-	47
'Multivitamins'+others	-	31

AO=Antioxidants

in combination with other substances. Among the liquid dosage forms, liquids/syrups constitute a majority (n=176, 18.8%). Only 6.62% of formulations are available as injectable (n=62) (Table 2). Few products are also available in various miscellaneous formulations (powders/sachet, granules, elixir, ointment, massage oil).

In the single vitamin category, the minimum priced preparation was that of vitamin C (Rs. 0.579 for a single tablet). One of the brands of vitamin D was the most expensive in this category (Rs. 8.50 for single tablet). In the vitamin combinations category, a formulation of vitamins with zinc was least priced at Rs. 0.68 for a single capsule. The costliest preparation was a combination of multivitamin with multiminerals and antioxidants (Rs. 9.00 for a single capsule).

Vitamins are essential for vital functions of the body, in addition to improving health and wellbeing. They should be used rationally in the right amount according to age, physiological state or pathological condition to obtain maximum benefit. Our research examines the various vitamin supplements available to the consumer in India. Many studies report an increase in the use of such dietary supplements by the population at large[2,3,6]. However, current detailed data on the prevalence of supplement use, characteristics of users and their relation to health and nutrition are lacking in Indian population. One of the important prerequisites would be the uniformity of data collected on vitamin supplement use. This prompted us to assess the various supplements and, their composition in the Indian market. The products available include a variety of vitamin mineral mixtures, and vitamin mixtures with nonvitamin, nonmineral supplements. We found that a large number of products have misleading names/labels; not specifying the constituents, or amount or the maximum amount that can be consumed.

In any population, it is essential to examine the total nutrient intake and the percentage that comes from supplements. This holds the key in establishing a relationship between nutrition and disease. Both inadequate and excess intakes of nutrients impact vital body functions and are associated with increased morbidity and mortality. To ascertain the adequacy of intake, knowledge of RDA/average requirement (AR)/ adequacy intake (AI) and upper intake levels (UIL) of nutrients is essential. In our research, majority of the supplements contained nutrient amounts higher than recommended intakes RDA, but many contained lower amounts or nutrients or other compounds that do not have recommended intakes. In a national survey in US, it was observed that the labels of most preparations listed nutrients below the UIL. Amounts of niacin, magnesium, zinc, iron, folate, vitamin B6, vitamin C and vitamin A were at or above the UIL[2]. In another study involving a multiethnic cohort in US, 10-15% of the participants had higher intakes of vitamin A, iron and zinc[6]. In our study, the amount of folate in the preparations was 5 mg; compared to RDA which is only 200 μg. In pregnancy, 5 mg/day of folate supplementation is advised to prevent neurological abnormalities in the foetus[11]. This could possibly explain the reason for higher amount of folate in the preparations. A large scale study involving over 38,000 participants demonstrated an increase in the risk of total mortality with the use of dietary vitamin and mineral supplements (vitamin B6, folic acid, iron, magnesium, zinc and copper) when compared with corresponding nonuse[11]. Availability of supplements (containing high nutrient content) and usage of multiple supplements could predispose to high risk of toxicity.

TABLE 2: THE VARIOUS DOSAGE FORMS OF THE VITAMIN PREPARATIONS IN GROUPS I AND II

Various vitamins	Solid		Liquid		Injectable		Others	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
Single vitamins	T-127, C-28	T-7, C-14	D-1	-	15	6	PS-6, G-1, O-1	PS-6, G-1, O-1
Combinations								
Vitamins only	T-22, C-23	T-1, C-3	D-11, LS-30	D-1, LS-10	30	1	E-1, S-1, CP-1	-
Vitamins+minerals	T-85, C-135	-	D-14, LS-32	-	2	-	PS-2, G-2	-
Vitamins+others	T-27, C-50	T-8, C-28	D-8, LS-50	D-2, LS-32	1	-	PS-2, E-1, PT-1, MO-1	PS-6, G-1
'Multivitamins' only	-	T-1, C-1	-	D-6, LS-2	-	-	-	-
'Multivitamins'+AO+minerals	-	T-8, C-24	-	D-3, LS-12	-	-	-	-
'Multivitamins'+others	-	T-1, C-13	-	D-8, LS-8	-	-	-	PS-1

AO=Antioxidants, T=Tablets, C=Capsules, D=Drops, LS=Liquid/syrups, I=Injections, PS=Powders/sachet, G=Granules, E=Elixir, S=Solution, CP=Combination pack, O=Ointment, MO=Massage oil, PT=Paediatric tablet

In a large number of products (n=216, 23.07%), amount of the constituent vitamins was not specified. This is an area of grave concern. A vitamin preparation may not be suitable for different age groups (children/adults/elderly) and physiological states. Ingestion of supplements with unknown composition/amount ('multivitamins') can pose a serious risk in susceptible population. High doses of vitamin A can result in hypervitaminosis manifesting as nausea, vomiting, itching, dermatitis, increased intracranial tension, hydrocephalus and even liver derangement in patients with impaired renal function. Serious hypercalcemia may occur in acute ingestion of large doses of vitamin D resulting in cardiac arrhythmias and renal failure[1]. A patient is prone to adverse reactions/therapeutic failure of concomitant drugs if vitamins/unknown combinations are used without supervision. It is known that pyridoxine (vitamin B6) can decrease the efficacy of levodopa by increasing its peripheral metabolism; thus decreased effect in patients of parkinsonism. Also, prolonged therapy with anticonvulsants (phenytoin, phenobarbitone) induces folate catabolism by interfering with DNA synthesis and possibly by depressing intestinal folate absorption and storage[12]. Their long term use can also result in rickets/osteomalacia by decreasing the half-life of vitamin D, depleting the hepatic stores and reducing the responsiveness of target tissues to calcitriol[13]. Additionally, dose of a vitamin varies according to the indication for use. In conditions such as isoniazid-induced peripheral neuropathy, dose of pyridoxine (vitamin B6) varies in prophylaxis (10 mg) and treatment (100 mg)[14]. However, such dosing is not possible when the amount of vitamin in the product is not labelled.

More than half of the products, contain one or more minerals in combination (60.1%, n=563). Of these, zinc constitutes the maximum number (n=308, 32.9%). There is increasing evidence on the essentiality of zinc in growth and development, immune function and regulation of human health. It is involved in cellular growth and differentiation, process of apoptosis and plays a structural role in biomembranes and proteins. Beneficial effect of zinc supplements have been demonstrated in rapid growth both prenatally and postnatally, enhancing growth velocity in young children and preventing and/or ameliorating acute diarrhoea[15]. There are increased chances of toxicity, if magnesium containing antacids are taken concomitantly with mineral/unknown vitamin combinations. Iron is a constituent of 43 multivitamin preparations. Iron plays an essential role in the various metabolic functions and redox reactions. Deficient intake impacts psychomotor development and cognitive performance with adverse outcomes in pregnancy. However, accidental poisoning with medicinal iron is common in young children. Large doses in adults can cause liver cirrhosis and type 2 diabetes mellitus[16]. Long term intake of supplements containing high/unknown doses of iron needs caution to prevent iron overload. Large scale study indicates that supplemental iron may even be associated with increased total mortality risk[17]. It is essential that iron containing preparations do not combine calcium; as it inhibits the absorption of both iron salts and heme iron in a dose dependent manner[18]. Multimineral combinations require right formulations to ensure that minerals like calcium do not interfere with the absorption/action of others (zinc, iron, magnesium, phosphorus).

As these supplements are widely used, it is necessary to safeguard the health of our human resource by ensuring right products are available to them. However, we found that banned fixed dose combination of vitamins B1, B6 and B12 were available in the Indian market. This combination product is available even as a single formulation and in combination with other vitamins[19]. This calls in for strict action on the part of legal and regulatory authorities to recall all such products in the market and prevent their further manufacture, sale and use. Strict enforcement of the existing rules is essential to prevent any untoward harm to the population at large. In addition, the cost of these products also shows a huge discrepancy. Many of these combinations are overtly priced. There is a need for strict regulatory control to monitor the retail price of these supplements.

Our research highlights the various vitamin supplement products available in India. It includes single-ingredient products and various combinations of vitamins, minerals and other constituents. Increasing use of vitamin preparations as a 'daily health pill' is alarming. Greater awareness of the consumers is required to prevent misuse and excessive intake of these dietary supplements. It is important to monitor the availability and use/intake of multivitamins in patients/healthy population.

These agents, though relatively safe can result in drug interactions/adverse reactions/toxicity if taken without supervision. 'Blanket prescription' of these supplements in all patients for prolonged use should be stopped. The prescribing physicians should be aware of the potential interactions and prescribe them on an individual basis. Supplements (containing high nutrient content) and usage of multiple supplements predispose to high risk of toxicity. Physicians need to evaluate the patient's consumption when assessing overall nutrient and medication use.

More than the consumer and the physician, the regulatory bodies need to take notice of the easy availability and misuse of dietary supplements. The dietary guidelines for Indian population need to address the important issue of high usage of dietary supplements. A standard cut-off defining the upper level of intake or average requirement needs to be defined and labelled on each product. Multivitamin products should be better formulated/labelled to reduce the risk of inadequacy or excessive intakes. Any special instructions/precautions/warning, if any should be mentioned on the label. Additionally, the amount of vitamin in each product should be comparable to the units of UIL to reliably estimate the intake. Caution is advised when assuming default values for the composition of multivitamin intakes, as it may result in inaccurate estimate of intake. Misleading information on the label may result in excess consumption causing human morbidity and mortality in extreme cases. Stringent regulations are required to keep a check on the marketing of these preparations. Availability of banned products as OTC agents needs urgent attention and action. Adequate legal actions are required for pharmaceutical companies/drug firms not adhering to the regulatory provisions. Availability of such a large number of vitamin supplements with unknown composition requires a serious review of the legal provisions in India for drug manufacturing and marketing.

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Accepted 8 October 2012
Revised 2 October 2012
Received 3 January 2012
Indian J. Pharm. Sci., 2012, 74 (5): 469-473