



Original Research Article

Nutritional Screening for Genomic Health of some Healthy Adults

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ABSTRACT

Keywords

Supplements,
Deficiency,
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The incredible variety of dietary supplements available in the market now a days comprises a wide range of brand names, supplement forms (pill, powder), and suggested daily-intake (more or less than the recommended daily intake allowance). The micronutrients required are vitamins and minerals and an optimal intake for each micronutrient maintains the metabolic well-being, while the deficiency and/or excess can alter it with the result that disease or illness may manifest. Rather, many of the micronutrients at optimal levels are needed also for the maintenance of the genome and their excess/less amounts are known to lead to genomic instability. Keeping in mind the array of nutritional/dietary supplements available and the optimal micronutrient requirements for normal physiological functions, it was thought of interest to find out what supplements are preferred by a random group of healthy individuals and whether their constituents fulfill the recommended daily allowance (RDA). Hence for the present study, a survey of 100 healthy individuals (age range 20-80y) was made for their preferences of any nutritional supplements and whether this was on medical prescription. There were 67% regularly taking nutritional supplements from 6-18 months. Among the nutritional supplements, five nutritional supplements namely Nutrilite Daily (Amway), Supradyn (Bayer Health care), Riconia (Ranbaxy) and Well women (Meyer Organics) were the preferred brands. Vitamin/Multivitamin supplementations have an important role for a healthy lifestyle, provided there are no underlying health issues either due to their deficiency or overdose. On comparison of the constituent's viz. Vitamins B₃, E, B₁₂, folate, β carotene, retinol and also magnesium, calcium, selenium and zinc with the minimum recommended dietary intake (RDI) for genomic instability revealed that these were decreased or increased than those of the recommended guidelines. Nutrilite Daily had adequate amount of vitamin B₃ as recommended for genomic damage prevention. The study thus emphasizes that adequate intake of nutritional supplements is required to minimize genetic damage, improve health and prolong healthy lifespan.

Introduction

India is ranked at 136 in terms of human development among 186 countries (Rajadhyaksha, 2013) and 25.70% of the population living in rural and 13.70% in the urban areas while 21.90% of the

Population on the whole lies below the poverty line (GOI, 2013). The per capita availability of various food stuffs is comparable to recommended dietary allowance but the low income and reduced

purchasing power may cause unfavorable distribution of foods to some vulnerable groups (NIN,2010) thereby predisposing them to ill-health as under-and over-malnutrition lead to chronic diet- related disorders as well as increased mortality and reduced physical work output which can undermine the development of the country (Shenkin, 2006). Fortunately, regular health supplement usage can compensate for the deficiency of the micronutrients (McKay,2000) and the demand for dietary supplements has rather increased even in developing countries like India (Devla et al., 2011).

A dietary supplement is a product containing one or more dietary ingredients and includes vitamins, minerals, herbs, other botanicals and amino acids besides other substances (DSHEA, 1994). Multi-vitamin/ Multi-mineral supplements (MV/MS) are the most commonly used dietary supplements (Rock,2007) containing almost cent-per-cent of the daily value requirement for most vitamins and nutritionally-essential minerals (Huang et al., 2007). The supplements come as pills, capsules, tablets or liquid form and are labeled as dietary supplements (Devla et al., 2011).

Micronutrients are required for metabolic processes, cellular efficiency and support optimal nutrition; the dietary micronutrients include 40 essential minerals, vitamins, amino acids and fatty acids (Ames, 2010). The recommended dietary allowances (RDA) of micronutrients are essential for prevention of symptoms of deficiency diseases. Genomic instability may also be maintained by dietary factors as these impact all relevant pathways such as on exposure to dietary carcinogens or are useful in activation/detoxification of

carcinogens, DNA repair and DNA synthesis as well as in apoptosis(Nepomuceno,2013).MV/MS in critical amounts are substrates and/or co-factors useful for DNA maintenance reactions. Hence their sub-optimal levels can cause reduced genomic stability, producing similar effects to inherited genetic disorders or of exposure to carcinogens (Fenech and Ferguson,2001).

In view of the changed dietary patterns and affluent lifestyle of the peoples of *Punjab*, it was thought relevant to ascertain whether and which supplements have become integral in the diet-chart of some healthy adults and whether these supplements meet the recommended dietary allowance. If these are not *at par* with the recommendations, which diet-related disorders and type of genetic damage could manifest in the study group.

Materials and Methods

The study was carried out after clearance from the Institutional Ethics Committee and written informed consent from the participants. A cross-sectional random survey in an urban residential area in the city of Amritsar on a door-to-door basis was conducted using a face- to face interview method.

The information obtained was recorded on a proforma on the use and types of dietary supplements as well as on time on dietary supplementation. The RDA values for multivitamins and minerals as recommended by National Institute of Nutrition, Hyderabad (NIN, 2010) were compared with the concentrations of respective vitamins and minerals in these dietary supplements. The observations would reveal which MV/MS are the preferred brands, the comparisons would show which fulfill Indian RDA and

whether the study participants could be susceptible to some ill-health effects on the basis of over-or under-RDA intake as reported in literature.

Results and Discussion

The information on demographic and lifestyle characteristics of the surveyed group (n=100) is presented in Table 1. The participants self-reported as belonging to the upper middle class and comprised 3% having diseases (diabetes, breast cancer and hypertension) with 97.00% healthy adults (average age $45.31 \pm 1.374y$). They were stratified among the population sub-groups of *Jat Sikhs* (25.00%), *Hindus* (26.00 %) and *Khatri Sikhs* (49.00%). Educational levels varied from matriculation (5.00%) through to post-graduation (49.00%). There were 52.00% females and 48.00% males. The group comprised 16.00% students and 21.00% house wives, with business (20.00%) and teaching (25.00%) as other professions. Vegetarian dietary preference was by 61.00% while 67.00% were on MV/MS from 6-18 mo. (average 9.43 ± 0.516 mo) taking these on medical prescription (37.31%) or on self-administration (70.13%). The most common reason for use of MV/MS was older age (43%). There were 62% between 40-60y of age while 21% were in the age-range of 61-80y. Chi-square analysis revealed that there were no gender differences in the surveyed group for population sub-groups, educational levels, health status and use and duration of supplement intake. However, there were some differences *viz.* for age with more males in the older range (61-80y) and more younger females (41-60y); for dietary preferences with non-vegetarian diet was more among males, and occupation-types also varied as there were 42% housewives while more males were students and businessmen.

The information gathered regarding intake of nutritional supplements by 67% of the participants is presented in Table 2. There were 15 different types of supplements. Nutralite Daily (Amway) was preferred by 20% followed by Ranbaxy's Revital (13%) and Pfizer's Becasol (11%). Other supplements taken by 23% included Supradyn (Bayer Health Care), Protein Powder (Amway), Bio C (Amway), Nervigard (Accenture), Calcimax (Meyer Organics) etc. with 33% not taking any MV/MS.

A record of types of micronutrients in the preferred nutritional supplements by 67% has also been made (Table 3) after perusal of available literature on the MV/MS being used and as given on the product-labels. From the composition of the supplements, it was apparent that mostly had 13 vitamins and 15 minerals. Among the five preferred nutritional supplements, Revital only lacked vitamins A and B7 (biotin) but had co-enzyme Q10 and Ginseng which others were lacking. The other four supplements included most vitamins (A, B, C, D, E, K). Among minerals, Riconia again emerged as having most of these (14/15; 93.30%), followed by Supradyn (12/15; 80.00%), Revital (11/15; 73.33%), Nutralite Daily (10/15, 66.66%) with least in Well women having only 66.67% (4/15). Overall, therefore Riconia emerged as having maximum number of nutrients (90.00%), followed by Supradyn (83.33%), Revital (80.00%), Nutralite Daily (76.66%) and Well women (56.67%).

The information on the constitution and composition of the micronutrients in different nutritional supplements as compared to respective RDA values is

given in Table 4. The recommended daily allowance (NIN,2010) were used for comparison of constituents to find which fit best with respect to RDA for these constituents. As per the recommended RDA values, vitamin B₁ was in excess of RDA in Nutrilite Daily, Revital, Supradyn and Well Women; Vitamins B₂ and B₁₂ were increased in Nutrilite Daily, Supradyn and in well women, Vitamin B₃ was increased in Supradyn and in Well Women; Vitamin B₆ was increased in Well Women and Supradyn but low in Revital and in Riconia. Vitamin C concentration was also increased in Nutrilite Daily and in Riconia; it was optimal in Revital but was decreased concentration in Supradyn; folate levels were elevated in Nutrilite Daily and in Well Women but lesser in Revital, Supradyn and Riconia. Also, magnesium concentration was low in all the nutritional supplements whereas zinc was increased in Nutrilite Daily and in Riconia but was low in Supradyn. However Calcium levels were low in all these supplements. On the other hand, carotene was a missing component in all these supplements while Retinol was almost in excess in Nutrilite Daily, Retinol, Supradyn and Riconia but missing completely in Well women. Nutrilite Daily meets only RDA of Vitamin B₃ and Vitamin B₆ but has lesser calcium and magnesium levels with exceeding vitamins A(Retinol), B₁, B₂, B₁₂, C, folate and zinc levels. Retinol has optimal RDA vitamins B₂, B₁₂ and C and zinc levels, with increased retinol and vitamin B₁ and decreased levels of vitamins B₃, B₆, dietary folate, Calcium and Magnesium. Supradyn has only calcium levels optimal for females but excess of vitamin A (retinol), B₁, B₂, B₃, B₆, B₁₂ and deficient levels of Vitamin C, dietary folate,

Magnesium and Zinc. Riconia meets only vitamin B₂ and B₁₂ RDA levels while all others are in lesser levels except for vitamin C and Zinc which are in excess. In Well women, only vitamin C and zinc levels are in optimal RDA, others being excess except for calcium and magnesium levels being low. Therefore, Revital meets only 36.36%(4/11) of the RDA for 11 MV/MS, followed by all other supplements each meeting only 18.18% with least by Supradyn (9.09%). Hence though Riconia with 93.30% has maximum MV/MS, yet it meets only 18.18% RDA for the selected MV/MS while Revital meets 36.36% RDA though it has 73.33% of MV/MS. Nutrilite Daily also meets 36.36% RDA though having 66.67% MV/MS.

As the deficiency as well as excessive intake can have deleterious effects (Table 5), there is a need to sensitize and educate those using self-administered supplements in relation to type and dosage of MV/MS supplementation. Those who are taking excessive or deficient MV/MS are at-risk for dire outcomes.

Micronutrient analyses in blood serum samples of the participants can further assist in knowing whether there is optimal concentration as per RDA of various micronutrients in blood sera. In those situations if dietary or MV/MS supplementation-intake is in excess for vit A, it can cause blurring of vision, loss of appetite, weight gain, nausea, vertigo and pain in bones (Ross *et al.*, 2010); all the supplements namely Daily Nutrilite, Revital, Supradyn, Riconia and Well women have much higher levels of vitamin A (retinol) and their excessive intake can cause these problems. All these supplements (except Riconia which has lower than RDA levels and makes persons

prone to BeriBeri) have higher than RDA levels of vitamin B1 and those taking these supplements regularly may be susceptible to weakness, headaches, arrhythmias and low blood pressure (*Health supplements nutritional guide.com*).

Allergic reactions and respiratory distress from excess vitamin B2 (as in Daly Nutrilite, Supradyn, Well women) can occur. Excess intakes of vitamins B5 and B6 (as in Supradyn, Well women) can lead to vision problems, abdominal pain, vomiting (vitamin B5) or dyspnea, muscle incoordination and anemia (Revital, Riconia) or other deficiencies (Jellin and Gregory, 2011). Folic acid (vitamin B9) deficiency can cause anemia (as in Revital, Riconia, Supradyn) with excessive intake (Daily Nutrilite, Well women) causing central nervous system damage while deficiency in vitamin C can cause Scurvy (Supradyn) and over intake can lead to cramps in stomach, diarrhea and nausea (Hathcock, 2004).

A deficiency in Magnesium can cause tremors, muscle spasm, loss of appetite and nausea (Elin, 1988). All the preferred supplements lacked optimal RDA levels of magnesium. Zinc levels lesser than RDA can cause dermatitis (as in Supradyn) while over-intake can cause nausea, gastrointestinal disorders and central nervous system deficits (Nriagu, 2007) as observed in the constituents of Nutrilite Daily and Riconia. Osteoporosis is a common problem in calcium deficiency (Nordin and Morris, 1989). The supplements Nutrilite Daily, Revital, Riconia and Well Women have lesser RDA for calcium level, all have lesser magnesium levels, Revital, Riconia and Supradyn have deficiency of B9, Revital and Riconia have lesser B6 and B6 with B1 being less in Riconia which also has lesser vitamin C and zinc levels. All the

supplements have excessive levels of vitamin A (retinol) and vitamin B1. Nutrilite Daily, Supradyn and Well Women have also excess of vitamins B2 and B12. Nutrilite Daily and Well women have excess vitamin B9, D and Riconia has excess vitamin C and zinc levels with Supradyn and Well Women having excess of vitamins B5 and B6.

If the deficiencies are not met by dietary nutrients or if these nutritional supplements are in excess, the risk for diseases from deficiency or excessive intake is immense and therefore requires health-surveillance and appropriate medical guidance and prescription as well as keeping in mind the RDA levels.

Genetic health can also be compromised in case the micronutrients are lesser than optimal values because micronutrients are required for maintenance of genome stability (Cheng, 2009; Fenech, 2010). Trace elements (magnesium, selenium, zinc) and vitamins (B2, B3, B5, B7, B9, E) and pro-vitamin A (β -Carotene) can alter genome stability (Ames and Wakimoto, 2002; Fenech, 2010). If there is higher intake of vitamins B2, B5, B7 and lower levels of calcium, vitamin B9, vitamin E, vitamin A (retinol) and pro-vitamin A (β -Carotene) there is increased genomic instability (Fenech et al., 2005).

The minimum Recommended Dietary Intake (RDI) levels for genome stability include 20mg of vitamin B₃, 7.9mg of Vitamin E, 2 μ g of vitamin B₁₂, 206 μ g of folate, 4161 μ g of β carotene, 296 μ g of retinol and 927mg of calcium (Wijesundera et al., 2012). However, Revital and Riconia each have less concentration of vitamins B₃, E, B₁₂, folate and β carotene than those required for genomic stability whereas Nutrilite Daily has adequate amount of vitamin B₃.

Table.1 Demographic and Lifestyle information of Study Participants

Characteristics	Categories	Total N/%	No: of Males (n=48)	No: of Females (n=52)	Chi Square value (p value)
Age (y)	20-40	17	04	13	5.106 (0.077)
	41-60	62	32	30	
	61-80	21	12	09	
Diet	Vegetarian	61	23	38	7.927 (0.005)
	Non-vegetarian	39	25	14	
Population Sub-group	<i>Jat Sikh</i>	25	10	15	3.230 (0.198)
	<i>Hindu</i>	26	10	16	
	<i>Khatri Sikh</i>	49	28	21	
Education	Matriculation	05	03	02	3.319 (0.345)
	Higher Secondary School	12	07	05	
	Graduation	34	19	15	
	Post-graduation and above	49	19	30	
Occupation	Teachers	43	20	23	33.30 (0.000)
	House wives	21	-	21	
	Students	16	14	02	
	Business persons	20	14	06	
Health status	Diseased	03	-	03	1.217 (0.27)
	Healthy	27	48	49	
Supplements Intake	Yes	67	32	35	0.021 (0.88)
	No	33	16	17	
Duration of Supplement Intake(y)	<1	42	17	25	1.676 (0.195)
	≥1	25	15	10	

*p values in bold are significant (p<0.01); N/%- same value because sample size =100

Table.2 Dietary Supplement Intake by Healthy adults

Name of Supplement (Firm)	Individuals (%)	Daily intake/serving amount
Nutriline Daily (Amway)	20.00	1/5618mg
Revital(Ranbaxy)	13.00	1/100g
Becasol(Pfizer limited)	11.00	1/360mg
Protein powder(Nutriline;Amway)	3.00	1/10g
Supradyn(Bayer Health care)	3.00	1/220mg
Wellwomen(Meyer Organics)	2.00	1/320mg
Supraactive (PiramalHealthcare)	2.00	1/220mg
Palmovit Gold (Palma Lifesciences)	2.00	1/200mg
Calcimax(Meyer Organics)	2.00	1/500mg
Nervigard(Accenture)	2.00	1/1614mg
Bio C (Amway)	2.00	1/250mg
Shilajit Gold(Dabur)	2.00	1/470mg
Rubired(Macleods)	1.00	1/100mg
Riconia Silver (Ranbaxy)	1.00	1/500mg
Pregmala(PalmaLifesciences)	1.00	1/250mg
Total	On supplements	67.00
	Those not taking any supplements	33.00

Table.3 Micronutrients in the Five Preferred Nutritional Supplements

Micronutrients		Nutritional Supplements (per unit/capsule)					†RDA			
		Nutrilit eDaily	Revital	Supradyn	Riconi a	Well wome n	Males	Females	Infants	Children
Vit. A (µg/d)	Retinol	-	-	-	-	-	600	600-950	350	400-600
	Carotene	5000.00	2000.00	2666.00	2500.00	-	4800	4800-7600	2800	3200—4800
		↑	✓	✓	✓					
Vit.B ₁ (Thiamine) (mg/d)		2.30	10.00	4.20	1.00	10.00	1.2-1.7	+0.2-1.4	0.2-0.3	0.5-1.5
		↑	↑	↑	↓	↑				
Vit.B ₂ (Riboflavin) (mg/d)		2.60	1.50	4.80	1.50	5.00	1.4-2.1	+0.3-1.7	0.3-04	0.6-1.8
		↑	✓	↑	✓	↑				
Vit B ₃ (Niacin) (mg/d)		20.00	10.00	54.00	2.00	36.00	16-21	+2-16	650-710 ^a	8-16
		✓	↓	↑	↑	↑				
Vit B ₆ (Pyridoxin) (mg/d)		02.00	01.00	6.00	1.00	20.00	2.0	2.0-2.5	0.1-0.4	0.9-2.0
		↑	↓	↑	↓	↑				
Vitamin C (Ascorbic acid) (mg/d)		90.00	40.00	18.00	500.00	60.00	40.00	40-80	25.00	40
		↑	✓	↓	↑	✓				
Dietary folate (µg/d)		400.00	0.12	0.60	0.15	400.00	200	200-300	25	80-200
		↑	↓	↓	↓	↑				
Vitamin B ₁₂ (Cobalamin) (µg/d)		09.00	1.00	3.00	1.00	20.00	1	1-1.5	0.2	0.2-1.0
		↑	✓	↑	✓	↑				
Calcium(mg/d)		200.00	75.00	120.00	162.00	6.00	600	120	120	120
		↓	↓	✓	↓	↓				
Magnesium (mg/d)		100.00	58.00	45.00	100.00	2.50	340	310	30-45	50-235
		↓	↓	↓	↓	↓				
Zinc (mg/d)		15.00	10.00	8.00	15.00	12.00	12	10-12	-	5-12
		↑	✓	↓	↑	✓				

Table.4 Micronutrients in nutritional supplements in comparison to RDAs

Micronutrients	Nutritional supplements				
	Daily	Revital	Supradyn	Riconia	Well women
VITAMINS					
Vit A	✓		✓	✓	✓
Vit B ₁	✓	✓	✓	✓	✓
Vit B ₂	✓	✓	✓	✓	✓
Vit B ₃	✓	✓	✓	✓	✓
Vit B ₅ (Niacin)	✓	✓	✓	✓	✓
Vit B ₆	✓	✓	✓	✓	✓
Vit B ₇ (Biotin)	✓	-	✓	✓	✓
Vit B ₉ (Folic acid)	✓	✓	✓	✓	✓
Vit B ₁₂	✓	✓	✓	✓	✓
Vit C	✓	✓	✓	✓	✓
Vit D	✓	✓	✓	✓	✓
Vit E	✓	✓	✓	✓	✓
Vit K	✓	✓	✓	✓	✓
Co-enzyme Q10 (CoQ10)	-	✓	-	-	-
Ginseng	-	✓	-	-	-
MINERALS					
Boron	-	-	✓	✓	-
Calcium	✓	✓	✓	✓	✓
Chromium	✓	✓	✓	✓	-
Copper	✓	✓	✓	✓	-
Iodine	✓	✓	✓	✓	-
Iron	✓	✓	✓	✓	-
Magnesium	✓	✓	✓	✓	✓
Manganese	✓	✓	✓	✓	-
Molybdenum	-	✓	✓	✓	-
Nickel	-	-	-	✓	-
Phosphorous	✓	✓	✓	-	✓
Selenium	✓	✓	✓	✓	-
Tin	-	-	-	✓	-
Vanadium	-	-	-	✓	-
Zinc	✓	✓	✓	✓	✓

Table.5 Vitamin-Intake-Deficiencies and Excesses

Vitamins/Micronutrients	Chemical name	Metabolic Function/Role	Deficiency Diseases	Over-intake Effects
*Vitamins				
A	Retinol	Visual cycle, membrane integrity	Demyelination, keratomalacia, Nyctalopia	Xerophthalmia, phrynoderma, Blurred vision, Bone pain, decreased appetite, weight gain, nausea and vertigo
B1	Thiamine	coenzyme in many decarboxylation reactions.	Beriberi	Weakness and headache, irregular heartbeats and low blood pressure.
B2	Riboflavin	FAD as a cofactor in respiration	Glossitis, corneal vascularization	Allergic reactions, breathing problem.
B3	Niacin	formation of Conenzyme A	Adrenal cortical insufficiency	Diarrhea
B5	Pantothenic acid	Constituent in pyrimidine nucleotide coenzymes, NAD and NADP.	Pellagra	Blurring of vision, frightening, stomach pain, vomiting.
B6	Pyridoxine	Growth factor to a number of bacteria and carrier in active transport of amino acids across cell membranes.	Convulsions and anemia	Dyspnea, loss of muscle coordination and even paralysis.
B7	Biotin	As a prosthetic group for many enzymes which bring about carboxylation and synthesis of fatty acids .	dermatitis, loss of hair & edema.	No toxic effects.
B+9	Folic acid	Enzymatic synthesis of purines, pyrimidines and amino acids.	megaloblastic anemia	Damage to Central nervous system ,paralysis, numbness.
B12	Cobalamin	Nucleic acid metabolism	pernicious anemia	Blood clots, itching, diarrhea, allergic reactions.
C	Ascorbic acid	Reducing agent, biosynthesis of adrenal steroid hormones	Scurvy	Stomach cramps, nausea, diarrhea.
D	D2- Ergocalciferol D3- cholecalciferol	Calcification of bones and teeth	Rickets (in Children) Osteomalacia (in adults)	Anorexia, dehydration, fatigue, muscle weakness(university of Maryland Medical centre)
E	A, β and γ tocopherol	Act as antioxidants, control O ₂ consumption, Participating nucleic acid metabolism	Sterility in rats, Muscular dystrophy, in rabbits and guinea pigs.	Fatigue, muscle weakness, diarrhea, nausea, disturbed vision (Alexander 2013)
K	K1- phylloquinone K2- Farnoquinone	Biosynthesis of prothrombin; Oxidative phosphorylation , Electron Transport system	Hemorrhage(in infants), Steatorrhea(in adults)	Damage cell membranes.
**Macronutrients/Micronutrients				
Magnesium		ATP synthesis and utilization, carbohydrate, lipid, protein, RNA, and DNA synthesis	Tremor, muscle spasms, loss of appetite, nausea	stomach problems and diarrhoea

Calcium	Maintains rigidity and strength of the skeleton, involved in metabolic processes, including blood clotting, cell adhesion, muscle contraction, hormone and neurotransmitter release, glycogen metabolism, and cell proliferation and differentiation	reduced peak bone density and thus increase the risk of osteoporosis	stomach problems for sensitive individuals
Selenium	Protects tissues against oxidative stress, the maintenance of the body's defence systems against infection, and the modulation of growth and development	Keshan disease (cardiomyopathy), cardiac insufficiency and arrhythmias, congestive heart failure and heart enlargement	Neuromuscular defects; liver and muscle damage

*Jain et al.,2008; **<http://www.lenntech.com/recommended-daily-intake.htm> ,accessed on April 18,2014

Table.6 Comparison of Nutritional Supplement constituents vis-à-vis Genomic Stability

Micronutrient	* RDI		*Minimum RDI Levels for Genome Stability	Nutritional Supplements				
	Male	Female		Nutrilite Daily	Revital	Supradyn	Riconia	Well women
Vitamin B3 (Niacin) (mg)	16	14	20.00	20.00	↓2	↑2.7	↓10	↑1.8
Vitamin E (mg)	10	7	7.90	↑6	↓1.58	↑1.26	↓1.05	↑3.79
Vitamin B 12(µg)	24 00	2.4	2.00	↑4.5	↓2	↑1.5	↓2	↑10
Folate (µg)	400	400	206.0	↑1.94	↓1716.6	↓343.33	↓1373.33	↑1.94
β Carotene(µg)	-	-	4161.0	↑1.20	↓2.08	↓1.56	↓1.66	-
Retinol (µg)	900	700	296.0					
Magnesium (mg)	400-420	310-320	-	-	-	-	-	-
Calcium (mg)	1000-1300	1000-1300	927.0 mg	↓4.63	↓12.36	↓7.72	↓5.72	↓154.5
Selenium (µg)	70	60	-	-	-	-	-	-
Zinc (mg)	14	8	-	-	-	-	-	-

RDA-Recommended Dietary Allowance; *Wijesundera et al.(2012)

The Nutrilite Daily, Well women and Supradyn brands of supplements have increased vitamins E, B₁₂ and while Vitamin B₃ is increased in Supradyn and in Well Women, folate levels in Nutrilite Daily and in Well Women and β-carotene is increased in Nutrilite Daily. The vitamin B₃ is optimal as there is inadequate concentration of vitamin B₃ as required for genomic stability. Furthermore, all the nutritional brands have decreased calcium levels than levels (927.0 mg) required for prevention of genomic damage prevention.

It is well documented that regular intake of MV/MS improves the health status of patients particularly among those with low income, the young and elderly and even obese individuals (NIN, 2010). Human diet requires approximately forty micronutrients (Ames, 2010). Deficiency of vitamins B₁₂, folic acid, B₆, niacin, C or E or iron or zinc, appears to mimic radiation in damaging DNA by causing single- and double-strand DNA breaks, oxidative lesions, or both (McCann and Ames, 2009). The percentage of the U.S. population that has a low intake (<50% of the RDA) for each of these eight micronutrients ranges from 2% to 20+%; rather half of the population may be deficient in at least one of these micronutrients (McCann and Ames, 2009). Ames and McCann (2009) reported that the folate deficiency breaks chromosomes due to massive incorporation of uracil in human DNA (4 million/cell) with subsequent single-strand breaks in DNA formed during base excision repair: two nearby single strand breaks on opposite strands cause the chromosome to fall apart. The deficiency of several micronutrients (iron, magnesium, zinc and vitamins B₆, C, folic

acid and biotin) have been reported to cause increased DNA damage in primary human cells in culture or in rodents (Ames, 2001). Studies have also documented DNA damage in humans caused by deficiency of iron, zinc, folate and B₁₂ or choline and in rodents or human cell cultures for mostly severe deficiencies in selenium, copper, calcium, niacin and choline (Ames, 2006; Ames 2010; Fenech et al., 2005). The depletion of zinc, which is a cofactor for several DNA repair pathways, has been reported to increase single-strand DNA breaks which returned to normal upon zinc repletion (Song et al., 2009).

However lesser known is that more than optimal intake of many of the minerals (like iron, zinc, copper, selenium), and of some of the vitamins (such as vitamin A and β-carotene) is toxic (Christian, 2003). Common complaints from excessive intake of vitamin A include blurred vision, bone pain, decreased appetite and vertigo (Furman, 1973). Vitamin B in excess can cause diarrhoea, low blood pressure and even paralysis (Pritchard, 2011). Vitamin C over-intake can lead to stomach cramps and nausea (WHO, 1999) and of vitamin D causes anorexia, weight loss, polyuria, and heart arrhythmias (NIH, 2011) with increased vitamin E nausea, vomiting, severe fatigue, muscle weakness, high blood pressure, easy bruising and bleeding, double vision and slow wound healing can result (Biala, 2013). Vitamin K in excess can cause the breakdown of red blood cells and liver damage and alter blood clotting times (Bellows and Moore, 2012). Similarly for many minerals, hemochromatosis has been reported from more than optimal intake of iron (Adams, 2005); gastrointestinal and neurological symptoms, respiratory distress syndrome,

myocardial infarction, hair loss, muscle tenderness, tremors, lightheadedness, facial flushing, kidney failure, cardiac failure from selenium over-intake (Institute of Medicine,2000) and copper over-intake may cause neuronal damage (Brewer, 2012).

Intervention studies for those on micronutrient supplements have also been suggested for assessing genetic damage (Ames, 2004).In nutrigenomics, effect of dietary factors on the stability of DNA synthesis and gene expression has been studied. The nutrients have been reported to affect the genome and its expression through the synthesis of nucleotides, prevention and repair of DNA damage, or through epigenetic mechanisms (Nepomuceno, 2013).As inappropriate nutrient levels can induce mutations and alter expression of genes required for genome maintenance. Vitamin B complex has increased the risk of colon cancer, heart disease and neurological dysfunction while caloric restriction can upregulate DNA repair capacity(Ames and McCann,2009).Among vitamins, deficiencies in Vitamin A,B6,niacin,folic acid, C and E were reported to cause chromosome damage in cultured human cells (Smith et al.,1990; Courtemanche et al.,2004; Atamna et al.,2007).These vitamin deficiencies in addition to deficiencies in calcium, selenium, copper, zinc, iron, magnesium induce genomic instability (Ho and Ames,2002;Walter et al.,2002;Killilea and Ames,2008) and have also association in cancer-causation(Giovannucci et al.,1993).Rather excessive intake of vitamins (folate, K) may stimulate existing cancer cells and minerals in excess (iron, selenium)can also be detrimental(Ames et al.,2002;Walter et al.,2002; Waters et al.,2005; Ulrich and Potter,2007;Ma et al.,2008; Wu et

al.,2009; Ebbing et al.,2009). The RDA may not be appropriate for DNA protection since excessive intake or deficiency of micronutrients can cause genetic damage which has implications in causing morbidity in terms of malignancy, neurodegenerative diseases and precocious ageing (Fenech, 2010).

The objectives of the present study have provided information on sources of particular micro-nutrients in a healthy group who are regularly using speciality products. The data can be used for designing dietary patterns and for formulating nutritional supplements. Adequacy i.e. neither deficiency nor excess of micronutrients is required for genome maintenance, for increasing optimal health strategies, for disease prevention since DNA damage at the gene sequence, epigenome and chromosome level is the fundamental cause of both, developmental and degenerative diseases (Fenech et al., 2005). As diet is one of the major determinants of chronic disease and mortality (Mathers et al., 2010), therefore implementation of effective interventions in the domains of modified diet in terms of nutritional supplements is required especially for safeguarding genomic health (Fenech et al.,2005).

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