

Original Research Article

Prescribing Pattern of Vitamins and Supplements in a Tertiary Care Hospital in Abbottabad

Muhammad Usman Nazir, Sikander Khan Tanoli, Rumeesa Khan, Sania Saeed,
Adil Muhammad, Qazi Said Rahim

Abstract

Ayub Teaching Hospital Abbottabad

*Corresponding Authors Email:
drabdul.haq15@gmail.com

People have been using vitamins mainly to feel stronger, have more energy and for treating illnesses, thinking that whatever dietary recommendations could not be met by food alone should be supplemented for but the problem is not lack of beneficial effects altogether rather the inappropriate use of multivitamins in dosages and indications not supported by research studies, specifically in the developing countries. The aim of this study is to identify the pattern of prescription of multivitamin drugs in different departments in Ayub Teaching Hospital Abbottabad. And, the association between different chief complaints and the prescription of multivitamins. A descriptive cross-sectional study was performed. A total of 203 cases were considered with 108 females and 95 males from both the OPDs and wards making up 109 and 94 cases, respectively. Of these, 86 patients were prescribed supplements for body aches and 68 were given due to fatigue. The maximum numbers of prescriptions of Vitamins were from Medicine ward i.e. 61, followed by 33 from Gynecology. The vast majority of patients were given multivitamins comprising 134 cases. In conclusion, the benefits of prescribing specific Vitamins in certain conditions are obvious. However, the use of multivitamins is not found to be beneficial in most part, in addition to putting financial burden on the patient and setting up an ethical dilemma for the doctor for prescribing drugs with no scientific evidence.

Keywords: Multivitamins, Supplements, Nutraceuticals, Prescribing pattern

INTRODUCTION

The word vitamin was coined in the year 1912 abbreviated from Vital Amines and it was during this time that in a randomized control trial it was found that scurvy was improving with citrus fruits, which later were proved to be rich sources of Vitamin C (Panel, 2007). Since then, people have been using vitamins mainly to feel stronger, have more energy and for treating illnesses, thinking that whatever dietary recommendations could not be met by food alone should be supplemented for (Daly and Sobal, 1990). However, research to back these claims is lacking mainly because the people who use these supplements are the people who have healthy lifestyle and consume

healthy food making it difficult to associate healthy life with multivitamin use (Rosenberg, 2007).

On the contrary, researchers found out that use of multivitamins is not linked to decrease in the risk of heart diseases, cancer and cognitive decline rather some found Vitamin E and beta carotene harmful, especially at higher dosages. Moreover, Vitamin A with beta carotene was found to be increasing the risk of lung cancer and cardiovascular diseases. Similarly, excess of Vitamin A is associated with birth defects (Almarsdóttir and Traulsen, 2005) and Vitamin D and Calcium with renal stones (Wactawski-Wende et al., 2006). Not to refute the use of

multivitamins and supplements completely, there are recommendations for use of some vitamins in certain conditions e.g. folic acid in pregnant women (Bronstein et al., 2008) as well as those planning to get pregnant, use of vitamin D in exclusively breastfed infants (Pitkin, 2007), vitamin D and calcium in postmenopausal women (Yetley, 2007) and Iron in those with diagnosed iron deficiency (Pitkin, 2007; (Trumbo et al., 2001; Yetley, 2007).

Therefore, the problem is not lack of beneficial effects altogether rather the inappropriate use of multivitamins in dosages and indications not supported by research studies, specifically in the developing countries (Ofori-Asenso et al., 2016). In addition, the World Health Organization (WHO) estimates that half of the medicines are prescribed and sold inappropriately probably due to a weaker health system with inadequate systems to monitor the use of medicine (World Health Organization, 2004). This could also be because of lack of any standard scientific, regulatory or market-place definitions of multivitamins (Ofori-Asenso and Agyeman, 2016).

As a solution, appropriate use of medicine must be ensured which means that the patients receive medications appropriate to their clinical needs, in doses that meet their own individual requirements, for an adequate period of time, and at the lowest cost to them and their community (Conference of Experts on the Rational Use, 1985).

Thus, the aim of this study was to identify the pattern of prescription of multivitamin drugs in different departments in Ayub Teaching Hospital Abbottabad and the association between different chief complaints and the prescription of multivitamin

Research Methodology:

Study Design: Descriptive cross-sectional study

Study Duration: one month i.e. from 25th October 2020 to 26th Nov 2020.

Sample Size: A total of 203 prescriptions were included in this study.

Sampling Technique: Non-probability sampling (consecutive sampling)

Sample Population: All the patients visiting medicine, surgery, gynecology, neurosurgery, pediatrics, orthopedics, departments during the study time period

Data Collection Tool

A structured questionnaire was used to collect data from

the prescriptions and discharge cards from different departments.

Data Collection Procedure

A member of the team visited six different wards and out-patient departments namely, General Medicine, General Surgery, Neurosurgery, Pediatrics, Gynecology, Orthopedics. Then, filled up questionnaires from the prescriptions of the patients in the OPDs and from the discharge slip of the admitted patients

Data Analysis

It was done using SPSS 21. Data was analyzed in the form of frequencies, and displayed in the form of tables and crosstabs. The Chi square test was used to test associations for statistical significance.

RESULTS ANALYSIS

Gender and Age

In this study, the number of female patients who were prescribed vitamins/supplements was 108(53%) and the male patients were 96 (46%). The maximum number of patients getting vitamin/supplements was in the age range of 20-40 years and was 59 (39.4%) followed by 64(32%) patients in >40 years old category. Those patients younger than 20 years were only 80(29%). (Tables 1,2)

Variation with Chief Complaints

There were a total of 86 patients presented with body aches who got prescribed the nutritional supplements. The second maximum number of patients getting these drugs had fatigue as their main complaint and they, precisely, were 68. Those patients who presented with shortness of breath were 27 whereas those who had joint pain as the chief complaint were 13. However, only 9 patients who came in with fever got prescribed vitamin/supplement. (Table 3)

Different Wards/Departments

Out of 203 patients in this study 61 were in medical units, 33 in gynecology department, 31 in neurosurgery, 33 in surgery, 29 pediatrics and 15 in orthopedics. (Table 4)

Table 1. Shows gender of the patients.

Gender	Frequency	Percent Valid	Percent Cumulative	Percent
Female	108	53.2	53.2	53.2
Male	95	46.8	46.8	100.0
Total	203	100.0	100.0	

Table 2. Shows age of the patients

Age	Frequency	Percent Valid	Percent Cumulative	Percent
<20	59	29.1	29.1	29.1
>40	64	31.5	31.5	60.6
20-40	80	39.4	39.4	100.0
Total	203	100.0	100.0	

Table 3. Shows Chief Complaints

Chief Complaint	Frequency	Percent Valid	Percent Cumulative	Percent
Body aches	86	42.4	42.4	42.4
Fatigue	68	33.5	33.5	75.9
Fever	9	4.4	4.4	80.3
Joint pain	13	6.4	6.4	86.7
Shortness of breath	27	13.3	13.3	100.0
Total	203	100.0	100.0	

Table 4. Shows different wards

Ward	Frequency	Percent Valid	Percent Cumulative	Percent
Gynecology	33	16.3	16.3	16.3
Medicine	61	30.0	30.0	46.3
Neurosurgery	32	15.8	15.8	62.1
Orthopedics	15	7.4	7.4	69.5
Pediatrics	29	14.3	14.3	83.7
Surgery	33	16.3	16.3	100.0
Total	203	100.0	100.0	

Table 5. Shows Vitamin/Supplement Types

Vitamin/Supplement Type	Frequency	Percent Valid	Percent Cumulative	Percent
Multivitamin	134	66.0	66.0	66.0
Vitamin B 12/Folic acid	51	25.1	25.1	91.1
Vitamin D/ Calcium	18	8.9	8.9	100.0
Total	203	100.0	100.0	

Type of Vitamin/Supplement

The overwhelming majority of the patients were getting multivitamins, followed by vitamin b12/folic acid making up 66% and 25% of the patients, respectively. However, the least number of patients, i.e.18 (9%), got vitamin d/calcium. (Table 5)

Other Medical Conditions

The known medical illnesses patients had who got vitamin/supplements in this study were anemia, bone fracture, hepatic failure, pregnancy and renal failure. And the number of patients in each of these categories was 110, 26, 8, 22 and 25, respectively. (Table 7)

Table 6. Shows Brand Price

Brand Price	Frequency	Percent Valid	Percent Cumulative	Percent
<100	61	30.0	30.0	30.0
>300	26	12.8	12.8	42.9
100-300	116	57.1	57.1	100.0
Total	203	100.0	100.0	

Table 7. Shows Other Medical Conditions

Other Medical Conditions	Frequency	Percent Valid	Percent Cumulative	Percent
Anemia	110	54.2	54.2	60.1
Bone fracture	26	12.8	12.8	72.9
Hepatic failure	8	3.9	3.9	76.8
Pregnancy	22	10.8	10.8	87.7
Renal failure	25	12.3	12.3	100.0
Total	203	100.0	100.0	

Table 8. Shows OPD/Admitted

Opd/Admitted	Frequency	Percent Valid	Percent Cumulative	Percent
Admitted	94	46.3	46.3	46.3
Opd	109	53.7	53.7	100.0
Total	203	100.0	100.0	

Table 9. Shows Opd/Admitted * Price Cross tabulation

Opd/Admitted * Price Cross tabulation		Price			Total
		<100	>300	100-300	
Opd/Admitted	Admitted	27	13	54	94
	Opd	34	13	62	109
Total		61	26	116	203

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.248 ^a	2	.883
Likelihood Ratio	.248	2	.883
N of Valid Cases	203		

Brand Price

The price of the prescribed drug was categorized in 3 categories i.e. RS <100, RS 100-300 and RS > 300. The number of patients who were given the most expensive brand was 26 and those who got prescribed the cheapest were 61. However, the vast majority of the 116 (57%) patients were given a vitamin/supplement brand which was in the mid price range (Table 6).

Association of Patient Status with Price of the Brand

Out of a total of 203 patients 94 patients were visiting the outpatient departments whereas 109 patients were admitted in different wards. The price of the brand prescribed to OPD patients the most was between 100-300 which was the same for admitted cases. A total of 26 patients were given vitamin/supplement worth more than RS300. This ratio was the same in both categories.

Table 10. Shows Opd/Admitted * Chief Complaint Cross tabulation

Opd/Admitted * Chief Complaint Cross tabulation		Chief Complaint					Total
		Body aches	Fatigue	Fever	Joint pain	Shortness of breath	
Opd/Admitted	Admitted	41	30	4	3	16	94
	Opd	45	38	5	10	11	109
Total		86	68	9	13	27	203

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.852 ^a	4	.303
Likelihood Ratio	5.039	4	.283
N of Valid Cases	203		

Table 11. Shows OPD/ Admitted * Vitamin/Supplement Type Cross Tabulation

Opd/Admitted * Vitamin/Supplement Type Cross tabulation		Vitamin/Supplement Type			Total
		Multivitamin	Vitamin B 12/ Folic acid	Vitamin D/Calcium	
Opd/Admitted	Admitted	55	28	11	94
	Opd	79	23	7	109
Total		134	51	18	203

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.594 ^a	2	.101
Likelihood Ratio	4.600	2	.100
N of Valid Cases	203		

However, the test of significance negates any association between the patient status and the price of the given brand. (Tables.8, 9)

Association of OPD/Admitted Status with Chief Complaints

The p value calculated for this association was 0.30 which makes any difference insignificant statistically. Overall, the number of patients presenting to the OPD with body aches was 45 and those admitted who had the same complaints was 41. Furthermore, the second majority was in the category of fatigued patients both in the out-patient departments as well as admitted patients amounting to 38 and 30, respectively. (Table. 10)

Association of patient status with the type of Vitamin/Supplement:

A total of 134 patients were prescribed multivitamins whereas 58 patients got Vitamin B 12/Folic acid. In detail, 55 admitted patients and 79 OPD patients were in the multivitamin category while 28 admitted patients and 23

OPD cases got Vitamin B 12/Folic acid. However, the tests of association prove this difference to be insignificant with a p value of 0.1. (Table.11)

Association of Gender and the type of Vitamin/Supplement:

A total of 61 female and 73 male patients in this study were found to have been prescribed multivitamins. On the contrary, only 13 male patients were prescribed Vitamin B 12/ Folic acid whereas the number of female patients in the same category was 38. Equal numbers of patients were given Vitamin D/ Calcium i.e. 9 of each gender. This contrast in type of Vitamin and gender was proven significant statistically with a p value of 0.002. (Table.12)

Association of Age and the type of Vitamin/Supplement:

This study found out that there is significant association between the age of the patient and the type of Vitamin given in different departments in Ayub Teaching hospital.

Table 12. Shows Gender * Vitamin/Supplement Type Cross Tabulation

Gender * Vitamin/Supplement Type Cross tabulation		Vitamin/Supplement Type			Total
		Multivitamin	Vitamin B 12/ Folic acid	Vitamin D/Calcium	
Gender	Female	61	38	9	108
	Male	73	13	9	95
Total		134	51	18	203

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.548a	2	.002
Likelihood Ratio	13.043	2	.001
N of Valid Cases	203		

Table 13. Shows Age* Vitamin/Supplement Type Cross Tabulation

Age* Vitamin/Supplement Type Cross tabulation		Vitamin/Supplement Type			Total
		Multivitamin	Vitamin B 12/ Folic acid	Vitamin D/Calcium	
Age	<20	50	9	0	59
	>40	43	9	12	64
	20-40	41	33	6	80
Total		134	51	18	203

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	31.927 ^a	4	.000
Likelihood Ratio	35.017	4	.000
N of Valid Cases	203		

Table 14. Shows Chief Complaint * Vitamin/Supplement Type Cross tabulation

Chief Complaint * Vitamin/Supplement Type Cross tabulation		Vitamin/Supplement Type			Total
		Multivitamin	Vitamin B 12/ Folic acid	Vitamin D/Calcium	
Chief Complaint	Body aches	60	25	1	86
	Fatigue	38	21	9	68
	Fever	8	0	1	9
	Joint pain	6	2	5	13
	Shortness of breath	22	3	2	27
Total		134	51	18	203

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.179 ^a	8	.000
Likelihood Ratio	30.377	8	.000
N of Valid Cases	203		

The calculated p value for this association is 0.000. In figures, 50 patients <20 years old were given multivitamins whereas none got Vitamin D and Calcium. The number of patients prescribed multivitamins in 20-40 years category were 43 whereas those in >40 range were 41. The only surprising fact revealed was in the age category of 20-40. A total of 33 patients in this category were prescribed Vitamin B12/Folic acid which was clearly more than that in other age ranges. (Table.13)

Association between type of the Vitamin and the chief complaint:

Out of all 134 patients, the vast majority of the patients given multivitamins had body aches or fatigue with 60 and 38 patients, respectively. This same category of complaints constituted the most prescriptions of any type of Vitamin. Only 9 patients with fever were given any type of Vitamin whereas this figure is 13 for those with joint

pains. In addition, 22 patients with shortness of breath as their chief complaint were prescribed multivitamins. This association is statistically significant with the p value of 0.000. (Table 14)

DISCUSSION

Nutraceuticals are either foods or food additives perceived to benefit the health. This concept has gone far and wide. Although, this perception has long been around but the data in support has always been lacking. This has not only affected the general population but medical practitioners have been convinced to use and prescribe these harmless compounds as multivitamins. A study on prescribing patterns of nutraceuticals found out that the maximum prescription in a tertiary care hospital of these drugs are from Internal medicine, followed by orthopedics and surgery (Gosavi et al., 2016). These results support the findings in this study where medical wards were found to be prescribing the multivitamins the most. In contrast, in this study it was the General Surgery and Gynecology department following the medicine wards as most prescribers of Vitamins and supplements. Another study done in India in 2018 reported, Vitamins and Supplements as the second most prescribed drugs using the WHO criteria for drug prescription (Hussain et al., 2018).

This use of these dietary supplements is not all free from benefit; a study reported decreased incidence of ASD in children of mothers who have been taking Vitamin supplements regularly (Levine et al., 2017). Moreover, studies have confirmed added advantage of these drugs in older age groups and in some specific socioeconomic conditions e.g. older age, living in a metropolitan area and higher educational status (Sebastian et al., 2007). There are some recommendations for use of some of the Vitamins and Supplements like the use of Vitamin A, D and K in infants and the use of Vitamin D in lactating and pregnant females as well as Folic acid for expecting mothers and lastly, Vitamin D for elderly (Jayabalan and Low, 2016). In addition, some studies advocate for the use of supplements to fulfill any dietary deficiency as Vitamins largely are benign (Blumberg et al., 2018). In pregnant patients, a study showed lower risk of preeclampsia in patients who had taken Vitamin D (Palacios et al., 2016).

Despite these benefits the evidence to support the use of Vitamins and Supplements for general well being and disease prevention is largely lacking. For example, the previous studies showed no benefit of Vitamin supplementation in patients with poly cystic ovarian syndrome (Zhao et al., 2017). Moreover, no association has been found between the risk of fractures and Calcium and Vitamin D supplementation (Trumbo et al., 2001). In a mixed effect meta-analysis of 50 studies Vitamin supplementation were not

linked to reduction in major cardiovascular events (Myung et al., 2013). Similarly, studies have failed to prove benefit of multivitamin supplementation in diabetic patients except for Vitamin B 12 in those taking metformin because this drug reduces the absorption of Vitamin B 12 (Valdés-Ramos et al., 2015). Even in pregnant patients previous data indicates no benefit of Supplements, specifically of Vitamin C and Vitamin E in terms of total fetal loss, and early or late stillbirth (Balogun et al., 2016). This supplementation of Vitamin A, C, E, B 2, B 6 and B 12 is not even justified because of their significant amount in food (Waśkiewicz et al., 2014). However, some herbs have shown promising results as nutraceuticals in studies e.g. Moringa Oleifera, the leaves of this plant contain essential amino acids thus, has potential as nutritional supplement (Abdull Razis et al., 2014).

On the contrary, some studies demonstrated benefits of the use of Vitamin in specific conditions and dosages. This is especially true of vitamin E, Beta Carotene and Selenium as demonstrated in a Chinese study to effectively decrease the incidence of gastric cancer and cancer related mortality. A similar study on French men showed similar results with the addition of Zinc and was confined to males only i.e. had no benefit in females. Moreover, Zinc/Antioxidants have proven benefits in patients with age related macular degeneration especially in patients with high risk of disease (Huang et al., 2006).

CONCLUSION

In conclusion, the vast majority of the patients were prescribed multivitamins especially to patients who presented with body aches and fatigue as their chief complaints. The most important aspects of the use of these supplements are in females (pregnant and expectant) and children. However, the use of multivitamins for disease prevention and general well being especially in young male patients is not established. Although, this approach is not recommended globally but this can be adopted in countries where inadequacies in diet are still a concern. Nonetheless the price patients have to pay to buy these Vitamin and Supplements is at least a financial burden on them. Lastly, the prescription of a drug not scientifically backed, in the face of delusion of its benefit, is itself an ethical dilemma for the prescribing doctor.

REFERENCES

- Abdull Razis AF, Ibrahim MD, Kntayya SB (2014). Health benefits of Moringa oleifera. *Asian Pac J Cancer Prev.*;15(20):8571-6. doi: 10.7314/apjcp.2014.15.20.8571. PMID: 25374169.
- Almarsdóttir AB, Traulsen JM (2005). Rational use of medicines--an important issue in pharmaceutical policy.
- Balogun OO, da Silva Lopes K, Ota E, Takemoto Y, Rumbold A,

- Takegata M, Mori R (2016). Vitamin supplementation for preventing miscarriage. *Cochrane Database Syst Rev*. May 6;2016(5):CD004073. doi: 10.1002/14651858.CD004073.pu b4. PMID: 27150280; PMCID: PMC7104220.
- Blumberg JB, Cena H, Barr SI, Biesalski HK, Dagach RU, Delaney B, Frei B, Moreno González MI, Hwalla N, Lategan-Potgieter R, McNulty H, van der Pols JC, Winichagoon P, Li D (2018). The Use of Multivitamin/Multimineral Supplements: A Modified Delphi Consensus Panel Report. *Clin Ther*. 2018 Apr;40(4):640-657. doi: 10.1016/j.clinthera. 02.014. Epub 2018 Mar 21. PMID: 29573851.
- Bronstein AC, Spyker DA, Cantilena LR, Jr., Green JL, Rumack BH, Giffin SL (2008). Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 26th Annual Report. *Clinical toxicology (Philadelphia, Pa)*. 2009;47(10):911-1084.
- Conference of Experts on the Rational Use of D, World Health Organization (1985). Action Programme on Essential D, Vaccines. The Rational use of drugs : review of major issues. Geneva: World Health Organization.
- Daly MP, Sobal J (1990). Vitamin/mineral supplement use by geriatric outpatients in the United Kingdom. *Journal of nutrition for the elderly*. 10(1):55-64.
- Gosavi S, Subramanian M, Reddy R, Shet BL (2016). A Study of Prescription Pattern of Neutraceuticals, Knowledge of the Patients and Cost in a Tertiary Care Hospital. *J Clin Diagn Res*. Apr;10(4):FC01-4. doi: 10.7860/JCDR/2016/ 18424. 7620. Epub 2016 Apr 1. PMID: 27190824; PMCID: PMC4 866122.
- Huang HY, Caballero B, Chang S, Alberg A, Semba R, Schneyer C, Wilson RF, Cheng TY, Prokopowicz G, Barnes GJ (2006). 2nd, Vassy J, Bass EB. Multivitamin/mineral supplements and prevention of chronic disease. *Evid Rep Technol Assess (Full Rep)*. May;(139):1-117. PMID: 17764205; PMCID: PMC4781083
- Hussain S, Yadav SS, Sawlani KK, Khattri S (2018). Assessment of drug prescribing pattern using world health organization indicators in a tertiary care teaching hospital. *Indian J Public Health*. Apr-Jun;62(2):156-158. doi: 10.4103 /ijph.IJPH_429_16. PMID: 29923544.
- Jayabalan B, Low LL (2016). Vitamin B supplementation for diabetic peripheral neuropathy. *Singapore Med J*. Feb;57(2):55-9. doi: 10.11622/smedj.2016027. PMID: 2689 2473; PMCID: PMC4759374.
- Levine SZ, Kodesh A, Viktorin A, Smith L, Uher R, Reichenberg A, Sandin S (2017). Association of Maternal Use of Folic Acid and Multivitamin Supplements in the Periods Before and During Pregnancy With the Risk of Autism Spectrum Disorder in Offspring. *JAMA Psychiatry*. 2018 Feb 1;75(2):176-184. doi: 10.1001/jamapsychiatry. 4050. PMID: 29299606; PMCID: PMC5838577
- Myung SK, Ju W, Cho B, Oh SW, Park SM, Koo BK, Park BJ (2013). Korean Meta-Analysis Study Group. Efficacy of vitamin and antioxidant supplements in prevention of cardiovascular disease: systematic review and meta-analysis of randomised controlled trials. *BMJ*. Jan 18;346:f10. doi: 10.1136/bmj.f10. PMID: 23335472; PMCID: PMC3548618
- Ofori-Asenso R, Brhlikova P, Pollock AM (2016). Prescribing indicators at primary health care centers within the WHO African region: a systematic analysis (1995-2015). *BMC public health*.;16:724.
- Palacios C, De-Regil LM, Lombardo LK, Peña-Rosas JP (2016). Vitamin D supplementation during pregnancy: Updated meta-analysis on maternal outcomes. *J Steroid Biochem Mol Biol*. 2016 Nov;164:148-155. doi: 10.1016/j.jsbmb. 02.008. Epub 2016 Feb 11. PMID: 26877200; PMCID: PMC5357731.
- Panel NS-o-tS (2007). National Institutes of Health State-of-the-Science Conference Statement: Multivitamin/Mineral Supplements and Chronic Disease Prevention. *The Ame. J. Clin. Nutr*. 85(1):257S-64S.
- Pharmacy world & science : PWS. 27(2):76-80.
- Pitkin RM (2007). Folate and neural tube defects. *The American Journal of Clinical Nutrition*. 85(1):285S-8S.
- Rosenberg IH (2007). Challenges and opportunities in the translation of the science of vitamins. *Ame. J. Clin. Nutr*. 85(1):325S-7S.
- Sebastian RS, Cleveland LE, Goldman JD, Moshfegh AJ (2007). Older adults who use vitamin/mineral supplements differ from nonusers in nutrient intake adequacy and dietary attitudes. *J Am Diet Assoc*. 2007 Aug;107(8):1322-32. doi: 10.1016/j.jada.. 05.010. PMID: 17659898.
- Trumbo P, Yates AA, Schlicker S, Poos M (2001). Dietary reference intakes: vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. *Journal of the Academy of Nutrition and Dietetics*. Mar 1;101(3):294.
- Valdés-Ramos R, Guadarrama-López AL, Martínez-Carrillo BE, Benítez-Arciniega AD (2015). Vitamins and type 2 diabetes mellitus. *Endocr Metab Immune Disord Drug Targets*. 15(1):54-63. doi: 10.2174/187153031466614111103217. PMID: 25388747; PMCID: PMC4435229
- Wactawski-Wende J, Kotchen JM, Anderson GL, Assaf AR, Brunner RL, O'Sullivan MJ, et al (2006). Calcium plus Vitamin D Supplementation and the Risk of Colorectal Cancer. *New England Journal of Medicine*. 354(7):684-96.
- Waśkiewicz A, Sygnowska E, Broda G, Chwojnowska Z (2014). The use of vitamin supplements among adults in Warsaw: is there any nutritional benefit? *Rocz Panstw Zakl Hig*.;65(2):119-26. PMID: 25272578
- World Health Organization (2004). The World Medicines Situation. World Health Organization; Geneva, Switzerland.
- Ofori-Asenso R, Agyeman AA (2016). Irrational Use of Medicines-A Summary of Key Concepts. *Pharmacy (Basel, Switzerland)*.;4(4).
- Yetley EA (2007). Multivitamin and multimineral dietary supplements: definitions, characterization, bioavailability, and drug interactions. *Am J Clin Nutr*. 85(1):269s-76s.
- Zhao JG, Zeng XT, Wang J, Liu L (2017). Association Between Calcium or Vitamin D Supplementation and Fracture Incidence in Community-Dwelling Older Adults: A Systematic Review and Meta-analysis. *JAMA*. 2017 Dec 26;318(24):2466-2482. doi: 10.1001/jama.19344. PMID: 29279934; PMCID: PMC5820727.