



Prevalence and Correlates of Dietary Supplements Use by Adult Outpatients Seeking Healthcare Services in a County Referral Hospital, Kenya

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Abstract:

There is minimal knowledge on the prevalence and correlates of use of most dietary supplements (DS) by the adult outpatients in Kenya, Kericho county despite the global rise of their use by patients. Dietary supplementation in illness is highly arguable since toxic effects of excessive intake and drugs interactions have been identified for some of the supplements when their use is not prescribed and monitored by a healthcare worker. Randomly selected 237 participants responded to a structured questionnaire in this cross-sectional study.

The prevalence of dietary supplements use was 42% with 58% being non-prescribed. The correlates of dietary supplements were gender (male), presence of non-communicable disease and engagement in at least moderate physical activity ($p < 0.05$ and adjusted O.R > 1) at 95% CI. The prevalence of DS use among the outpatients was high compared that of most developed countries. Patient-centered interventions should be enhanced to ensure safety and relevance of use of dietary supplements.

Key words: Dietary supplements, Prevalence, Prescription, Adult, Patient

1. Introduction

Dietary supplement use is on the rise globally and it is considered common in the developed countries (Knapik et al., 2016). An earlier study by Barringer had reported an approximate of 40% of adults in the developed countries who used dietary supplements (Barringer, Kirk, Santaniello, Foley, & Michielutte, 2003). An approximated 40% of the Danish too, used dietary supplement and a similar utilization rate has also been shown in Scandinavian countries (Knudsen et al., 2002).

It is reported that the use of the dietary supplements is more rampant among the adults and even the elderly especially those suffering from chronic illnesses (Aryeetey & Tamakloe, 2015). Dietary supplements can provide a combination or individual components of minerals, vitamins, fatty acids, amino acids, herbs, botanicals and other nutritive substances (Park, Johnson, & Joan, 2014). It has been established that these supplements contribute a significant proportion of the total minerals and vitamin intake



(Rock, 2007) as well as prevention of chronic communicable and non-communicable diseases (Rautiainen, Manson, & Lichtenstein, 2016).

Indeed, most dietary supplements users have previously reported that their main significant drive for using these products is to correct a perceived nutritional insufficiency or to improve overall health and wellness (Dickinson, Bonci, Boyon, & Franco, 2012). The use of dietary supplements has been reported to be associated with various aspects. For instance the age and presence of an illness, for instance their usage is frequently reported among the adults and even the elderly especially those suffering from chronic illnesses (Aryeetey & Tamakloe, 2015). Other correlates of dietary supplements use that have been reported include socio-economic factors, lifestyle factors as well as dietary habits of dietary supplements users (Anders & Schroeter, 2017; Dickinson & Mackay, 2014; Mullie, Clarys, Hulens, & Vansant, 2011; Ohta, Tsuchihashi, & Arakawa, 2007).

This study was therefore conducted to assess the prevalence of use as well as the correlates of dietary supplements by the adult outpatients aged 18-65 years seeking healthcare services at Kericho county referral hospital, Kenya.

2. Problem Statement

In the developed countries the prevalence of general dietary supplements use among the outpatients has been studied extensively (Chiba et al., 2014; Fan, Lee, Frazier, Lennie, & Moser, 2014; Johnston, Fritz, & Ward, 2013). The most documented literature on dietary supplements use in low income countries are mainly for those supplements which are routinely recommended and prescribed due to the nutrition and disease challenges faced by these countries. For example corn soy blend is a dietary supplement that has been used for long as part of food aid programs (Ndekha et al., 2009) and Spirulina supplements which have been used extensively in management of various health conditions including HIV (Kumar, Bioinnovations, & Dwivedi, 2017).

This provides hardly any information on the usage of some other supplements used by the patients that may or may not be prescribed routinely by healthcare provider or those which are self-prescriptions. This bit of information which may be very limited in low income countries is crucial in patient care because, when patients use dietary supplements especially without the knowledge of their healthcare providers, it may lead to consumption of excessive amounts of some micronutrients leading to toxicities and also may lead to complex interactions with drugs especially when consumed concomitantly (Fan et al., 2014). It is reported that these interactions and subsequent adverse events are common among patients of advanced ages with 2% of hospitalizations being associated with them (Levy, Attias, Ben-arye, Goldstein, & Schiff, 2017).

3. Objectives

This study sought to determine the prevalence of dietary supplements use and to describe the correlates of the use of dietary supplements among the adult outpatients aged 18-65 years seeking healthcare services at Kericho county referral hospital.

4. Literature review

4.1 Prevalence of dietary supplements use by adult outpatients

The findings of a study among adult outpatients aged over 20 years recorded prevalence of dietary supplements use of 31.5% (J. S. Lee & Kim, 2009). Additionally, another study in Japan had reported 39.1% prevalence of use of dietary supplements among adult outpatients (Chiba et al., 2014). These two studies were done in developed countries and showed a



lower prevalence of dietary supplements use as compared to the findings of a study done in Nigeria, a low income country which had recorded 66% (Udo & Albert, 2015).

The prevalence of use of dietary supplements by gender has been reported a higher usage of dietary supplements among women than men, prevalence being 40% and 30% respectively (Li, Kaaks, Linseisen, & Rohrmann, 2018). Similarly, (Kesse-guyot et al., 2013) had reported a higher usage of dietary supplements among women above 45 years than men of the same age. The earlier findings for prevalence of dietary supplements use had reported that individuals over 50 years were more likely to use DS than those less than 50 years (Li et al., 2018).

Similarly, urban dwellers have been reported to have used dietary supplements more than the rural dwellers in Korea (J. S. Lee & Kim, 2009). Despite this comparison, other comparable studies in low income countries had not reported much on the residential aspect in dietary supplements use.

Furthermore, studies have shown that highly educated women (Kesse-guyot et al., 2013) and men (Li et al., 2018) were using the supplements rampantly as compared to less educated persons.

Additionally, researchers have as well reported higher usage of dietary supplements among non-smokers as compared to former and current smokers (Mcnaughton, Mishra, Paul, Prynne, & Wadsworth, 2005). Similarly, based on a study conducted among French women, it was reported that the dietary supplements users were the least consumers of alcohol, (Touvier, 2006). Most dietary supplements users have been reported to be leading a very active lifestyle in terms of physical activity. For instance the gym users and athletes (Simiyu, 2009; Wachira, 2011). Pertaining the Body Mass Index (BMI) aspect of lifestyle earlier study had reported less usage of supplements by respondents with abnormal BMI, whereby obese and overweight individuals were less likely to use dietary supplements (Rock, 2007).

The use of dietary supplements by patients with long standing illnesses has been noted as a common trend (Bristol, Sonnad, & Guerra, 2008). A previous study had reported that most adults and the elderly who were already taking prescription medicines for long standing illnesses were 17 times more likely to be using dietary supplements (Aryeetey & Tamakloe, 2015). In fact it had been reported that up to 36% of the dietary supplements adult users were using them to manage and even treat an existing disease (Islam, Hasan, Al-fuad, & Mamun, 2018).

The most commonly used supplement in an earlier study were Calcium (single mineral), vitamin D, (single vitamin), multivitamin and vitamin C were common representing 31.1%, 31.1%, 25.8% and 16.2% respectively among patients attending an outpatient clinic in Canada (Johnston et al., 2013). However, the most commonly used dietary supplement by adult outpatients with heart failure in Canada was reportedly multivitamins, calcium and/or vitamin D, fish oil, vitamin C, and vitamin E at 60%, 29%, 25%, 17% and 15% respectively (Fan et al., 2014). The proportion of dietary supplement users who were using multivitamins in this study were fewer as compared to a study among outpatients who was reported up to 46% of the respondents using the multivitamins (Lee et al., 2015). Herbal supplements had also been reported to be commonly used supplement especially where non-communicable diseases were involved (Dickinson & Mackay, 2014; Franklin, Schneider, & Goto, 2009). A study had earlier reported that the use of herbal substances was rampant especially among multiple dietary supplements users who either consumed the herbs alone or together with mineral or vitamin supplements (Braun & Venter, 2008). Similarly based on a study conducted in Nigeria herbs was a commonly consumed dietary supplement among patients (Udo & Albert, 2015). It is worth noting that the use of herbal substances especially in illness, is a argumentative issue especially in diabetes care since the use of herbal substances has been shown to increase the risk of hypoglycaemia among



the patients on treatment for diabetes (Damnjanovic, Kitic, Stefanovic, & Zlatkovic-guberinic, 2015).

The users of dietary supplements are safer if they obtained their supplements from a healthcare worker who would monitor their use and who would ensure that only those whose needs for the supplements are justified. However, the findings of most studies have noted that there is a significant proportion of dietary supplement users whose supplements were not prescribed by the HCW. For instance, a study in the US had reported less than a quarter of the dietary supplement users having their supplements without recommendation of healthcare worker (Djuv, Nilsen, & Steinsbekk, 2013; Thomas & Dwyer, 2013). Despite this more than half (55%) of the dietary supplement users had been reported to be using supplements which were recommended by healthcare worker in another study (Kesse-guyot et al., 2013).

4.2 Correlates of dietary supplements use by adult outpatients

Gender has been noted as a key correlate of use of dietary supplements by the adult patients. The usage of dietary supplements had earlier been reported to be higher among women than in men within all age categories whereby within all ages with an average of about 48% among men and 53% among the females (Dickinson & Mackay, 2014). Another study had reported a similar trend which also put females at a higher probability of dietary supplements use (Franklin et al., 2009). Even though females have been reported to be using the DS more than male in most studies as explained in the aforementioned studies (Dickinson & Mackay, 2014; Franklin et al., 2009), anyhow, the findings of this study tallied with a study which had reported positive correlation of dietary supplements use with males in Japan (Chiba et al., 2014).

Similarly, socio-economic indicator; the income level has been shown to be a correlate of dietary supplements use with low income earners being unlikely to use dietary supplements. This trend had been reported earlier whereby the people who were earning very little were not probable to use dietary supplements since they would not afford them even though their nutritional needs were wanting (Anders & Schroeter, 2017). However, another study did not show any association of dietary supplements use with any level of income (Mullie et al., 2011)

Having achieved any level of formal education and the knowledge of dietary supplements were also correlated with the use of dietary supplements. This might have comes about with ability to obtain information on dietary supplements. For instance, findings of a study in Nigeria documented a positive association of higher level of education with the use of dietary supplements (Odds Ratio of 3.13 and a p value of 0.002) (Udo & Albert, 2015). Another study had also reported that respondents who had college education were using supplements more than those who did not have college education (Franklin et al., 2009). It has also been noted that people who already know about dietary supplements were more likely to use them as opposed to those who don't know about them

The dietary supplements users have been noted to be engaging in healthy dietary practices characterized by high consumption of fruits among other practices. Higher consumption of the fruits, specifically has been studied and reported to be associated with the use of dietary supplements (Beitz, Mensink, Hintzpeter, Fischer, & Erbersdobler, 2004; Mullie et al., 2011; Reinert, Rohrmann, Becker, & Linseisen, 2007).

It has been reported that some supplements have been used for treatment of existing ailments by most patients (Chiba et al., 2014). Patients, for instance, those diagnosed with some Non-Communicable Diseases (NCDs) have resulted to using Dietary Supplements more than the well population in general (Rautiainen et al., 2016). In fact it has been reported that large proportion of the populations with or which are prone to non-



communicable diseases are actually using various supplements to treat or prevent these diseases (Marleen & Senior, 2019).

5. Methodology

An institutionalized cross-sectional design was used in this study. A questionnaire was administered to 237 respondents aged between 18 and 65 years old through face-face interview by trained enumerators. This questionnaire sought various socio-economic, demographic and lifestyle aspects as well as physical activity, the usage of dietary supplements and the type of supplement used. The respondents' weights in kilograms and heights in meters were measured using Seca ® weighing scales and height boards respectively, and their body mass indices in kilograms per square meters were computed and recorded in the designated sections of the questionnaire. Simple random sampling was used to select the participants whereby even-numbered patient was selected each day of the study and recruited to the study only if they were 18 years, symptomatically stable and had voluntarily consented to participate in the study. Pregnant women were excluded from this study as well as the patients who were explicitly seeking care for HIV and AIDS since these groups were routinely supplemented for various micronutrients.

The ethical approval to carry out this study was given by the Kabarak University institutional research and ethics committee and a research permit was subsequently given by the National Commission for science, technology and innovation (NACOSTI). The data was analyzed using statistical package for social sciences (SPSS) version 20. The summaries were presented as percentages in tables and figures. The Pearson's chi-square tests were used to establish the statistical significance of relationship between dietary supplements use with various variables and binary logistics regression was computed to determine the correlates of dietary supplements use. These statistical analyses were done at 95% confidence interval.

6. Results

The findings of this study recorded an overall prevalence of dietary supplements use among the adult outpatients to be 41.8% (Figure 1), with prevalence among the females (55.8%) being almost twice the prevalence among the males (27.4%) (Table 1). The dietary supplements use, generally was the highest among young adults aged below 35 years (65.5%), tertiary highest level of education (51.9%), farmers (51.9%) and among the widowed respondents (55.6%). The consumption was the least among the respondents with no formal education (0.0%), middle aged adults aged between 36 and 55 years (30.3%), males (27.4%), informal salaried employees (10.5%), the married (38.1%) and the urban residents (25.8%). The statistical significance between dietary supplements use and gender, age, type of occupation and the place of residence was evident, $p < 0.05$ at 95% C.I. The statistical significance between dietary supplements use and level of education attained as well as the marital status was however not manifest, $p > 0.05$.

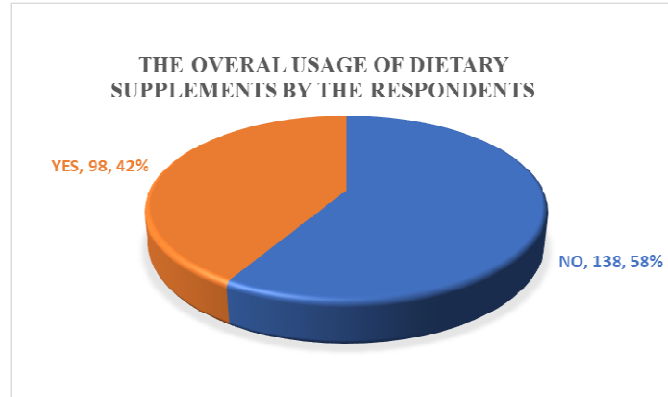


Figure 1. Prevalence of dietary supplement use by the adult outpatients

Table 1. Prevalence of dietary supplements use by selected socio-demographic characteristics (n=99).

Characteristic	% of Total respondents (n=237)	Dietary Supplements users n=99(41.8%)	Chi-square P value
Age in years			
18-35	23.2	65.5	<0.001*
36-55	61.2	30.3	
>55	15.6	50.0	
Gender			
Male	49.4	27.4	<0.001*
Female	50.6	55.8	
Highest level of Educational attained			
No formal education	1.7	0.0	0.143
Primary	40.1	38.9	
Secondary	36.3	40.7	
Tertiary	21.9	51.9	
Occupation of the respondent			
Formal salaried employee	11.8	46.4	0.003*
Informal salaried employee	8.0	10.5	
Unemployed	14.8	22.9	
Business	26.2	48.4	
Farmer	34.2	51.9	
Casual	5.1	33.3	
Place of Residence of the respondents			
Rural	73.8	47.4	0.003*
Urban	26.2	25.8	
Marital status of the respondents			
Married	56.5	38.1	0.228
Single	32.1	43.4	
Widowed/separated	11.4	55.6	

*statistically significant p-value at 95%CI(p< 0.05)



In the following Table 2 higher prevalence of dietary supplements use was noted among the respondents who were exercising (68.9%), non-users of alcohol (47.1%), smokers (44.8%), Obese I(82.8%) and underweight (81.2%). The variables that exhibited statistical significance with the use of dietary supplements were exercise and Body Mass Index (BMI), $p < 0.05$.

Table 2. Prevalence of Dietary Supplements use by selected lifestyle characteristics of the outpatients dietary supplements users (n=99)

Characteristic	Proportion(%) of DS users (n=99)	Chi-square P value
Exercise		
Engaging in at least moderate Physical activity	68.9***	<0.001**
engaging in light physical activity	32.4	
Alcohol use		
Using alcohol	44.8	0.824
Not using alcohol	47.1	
Smoking		
Smoking	44.8	0.732
Not smoking	41.5	
BMI(Kg/m²)*		
<18.5(Underweight)	81.2***	<0.001**
18.5-24.9(Normal)	34	
25.0-29.9(Overweight)	24.2	
30-34.9(Obese I)	82.8***	
35-39.9(Obese II)	33.3	

* Categorization of BMI according to WHO 2007 ** statistically significant p-value at 95%CI ** Majority DS user

The findings of this study, as shown in Figure 2, showed that only 42.2% of the dietary supplements users were taking dietary supplements which were prescribed by a health care worker while the rest who were more than half were taking dietary supplements which were not prescribed by healthcare provider. The key prescribers, apart from the healthcare providers were self, sales agents linked to network marketing companies and friends who contributed 16.7%, 15.6% and 25.6% respectively of all the prescriptions.



Figure 2. Prescribers of dietary supplements

From the table 4.3, presenting the output for the logistics regression analysis for the correlates of dietary supplements use, gender, attainment of formal education, knowledge about dietary supplements and presence of a non-communicable disease (NCD) were significant factors which would independently be positively associated with the use of dietary supplements by the dietary supplements users as evidenced by their significant p-values of less than 0.05 and OR greater than 1. Additionally, attainment of formal education and having a monthly income of between Ksh 5,000 and Ksh 10,000 also showed statistically significant association with the use of dietary supplements though it was not positive since their odds ratios were less than 1. However, age of fruit consumption and exercise by the dietary supplements users did not show a correlation with the use of dietary supplements among the respondents.

Table 4.3 Adjusted Odds ratios for the association between the use of dietary supplements and the characteristics of the adult outpatient dietary supplement users

Variable	Adjusted Odds Ratio**(C.I) Adjusted Odds Ratio	p-value
Age in years		
18-35	0.408 (0.14-1.18)	0.098
Above 35		
Gender		
Male ^a	9.150(2.36-35.46)	0.001*
Female		
Education level		
With formal education	0.264(0.08-0.89)	0.032*
With no formal education		
Monthly Income (K.sh)		
(5000-10000)	0.008 (0.001-0.103)	0.000*
<5000/>10000		
Knowledge of Dietary Supplements (DS) ^a		



Know what DS are	4.528 (1.342-15.278)	0.015*
Don't know what DS are		
Smoking		
Smoking cigar	0.104(0.01-1.47)	0.094
Not smoking cigar		
Alcohol use		
Consuming alcohol	7.042(0.69-71.6)	0.099
Not consuming alcohol		
Fruit consumption		
Consumed fruits regularly	1.043(0.343-3.196)	0.940
Not consumed fruits regularly		
Illness		
Presence of NCD ^a	4.754(0.58-0.97)	0.029*
Absence of NCD		
Physical Activity(P.A)		
At least moderate P.A	4.631(0.85-25.30).	0.077
Light P.A		

*significant *p*-value at 95% C.I ** Adjusted for all variables presented ^a positive correlate of dietary supplement use

8. Recommendations and Areas for Further Studies

There is need for targeted patient centered interventions to ensure relevant and safe use of dietary supplements during illness. Similar County-specific and even institutionalized specific studies to include private hospitals whose services are sought after by a sizable number of populations need to be carried out. Finally, there is a need for larger and even prospective studies to establish cause-effect relationship between the use of dietary supplements and disease development.

Conclusion

In conclusion, the prevalence of dietary supplements use among the outpatients in this study was high compared to prevalence in high income countries and the correlates are gender, presence of NCDs and engaging in at least moderate physical activities.

References

- Anders, S., & Schroeter, C. (2017). The impact of nutritional supplement intake on diet behavior and obesity outcomes, 1–17.
- Aryeetey, R., & Tamakloe, S. M. (2015). Use of Dietary and Herbal Supplements among Elderly Ghanaians in the Keta Municipality, (October).
- Barringer, T. A., Kirk, J. K., Santaniello, A. C., Foley, K. L., & Michielutte, R. (2003). Effect of a Multivitamin and Mineral Supplement on Infection and Quality of Life, 365–372.
- Beitz, R., Mensink, G. B. M., Hintzpeter, B., Fischer, B., & Erbersdobler, H. F. (2004). Do users of dietary supplements differ from nonusers in their food consumption ?, 98, 335–336.



- Braun, M., & Venter, I. (2008). Use of dietary supplements , and awareness and knowledge of the recommended fruit and vegetable intakes and consumption of health food store customers in the Cape Town city bowl. *South African Journal of Clinical Nutrition*, 21(4), 323–330.
- Bristol, M. N., Sonnad, S. S., & Guerra, C. (2008). Uninformed Complementary and Alternative Supplement Use : A Risky Behavior for, 100–109.
- Chiba, T., Sato, Y., Nakanishi, T., Yokotani, K., Suzuki, S., & Umegaki, K. (2014). Inappropriate Usage of Dietary Supplements in Patients by Miscommunication with Physicians in Japan, 5392–5404. <https://doi.org/10.3390/nu6125392>
- Damjanovic, I., Kitic, D., Stefanovic, N., & Zlatkovic-guberinic, S. (2015). Herbal self-medication use in patients with diabetes mellitus type 2, 964–971. <https://doi.org/10.3906/sag-1410-60>
- Dickinson, A., Bonci, L., Boyon, N., & Franco, J. C. (2012). Dietitians use and recommend dietary supplements: report of a survey. *Nutrition Journal*, 11(14), 1–7.
- Dickinson, A., & Mackay, D. (2014). Health habits and other characteristics of dietary supplement users : a review, 1–8.
- Djuv, A., Nilsen, O. G., & Steinsbekk, A. (2013). The co-use of conventional drugs and herbs among patients in Norwegian general practice : a cross-sectional study.
- Fan, X., Lee, K. S., Frazier, S. K., Lennie, T. A., & Moser, D. K. (2014). The use of , and perceptions about , dietary supplements among patients with heart failure. <https://doi.org/10.1177/1474515113494790>
- Franklin, R., Schneider, J., & Goto, K. (2009). Factors Associated with the Use of Dietary Supplements among African-American Adults, 7(1), 67–75.
- Islam, M., Hasan, T., Al-fuad, S., & Mamun, A. Al. (2018). Dietary Supplements Use and Associated Determinants Among Adult Dietary Supplements Use and Associated Determinants Among Adult Population in Southern Bangladesh, (September).
- Johnston, B. D., Fritz, P. C., & Ward, W. E. (2013). Use of Dietary Supplements in Patients Seeking Treatment at a Periodontal Clinic, 1110–1121. <https://doi.org/10.3390/nu5041110>
- Kesse-guyot, E., Pouchieu, C., Andreeva, V. A., Pe, S., Lassale, C., Hercberg, S., & Touvier, M. (2013). Sociodemographic, lifestyle and dietary correlates of dietary supplement use in a large sample of French adults: results from the NutriNet-Sante cohort study. *British Journal of Nutrition*, 110, 1480–1491. <https://doi.org/10.1017/S0007114513000615>
- Knapik, J. J., Steelman, R. A., Hoedebecke, S. S., Austin, K. G., Farina, E. K., & Lieberman, H. R. (2016). Prevalence of Dietary Supplement Use by Athletes : Systematic Review and Meta-Analysis. *Sports Medicine*, 46(1), 103–123. <https://doi.org/10.1007/s40279-015-0387-7>
- Knudsen, V. K., Ovesen, L., Rasmussen, L. B., Bu, I., Knudsen, N., Jørgensen, T., ... Perrild, H. (2002). Use of dietary supplements in Denmark is associated with health



- and former smoking. *Public Health Nutrition*, 5(3), 463–468. <https://doi.org/10.1079/PHN2001276>
- Kumar, P., Bioinnovations, I., & Dwivedi, M. (2017). Multiple Potential Roles of spirulina in Human Health : A critical Review, (January 2016).
- Lee, J. S., & Kim, J. (2009). Research and Professional Briefs Factors Affecting the Use of Dietary Supplements by Korean Adults : Data from the Korean. *YJADA*, 109(9), 1599–1605. <https://doi.org/10.1016/j.jada.2009.06.374>
- Lee, V., Goyal, A., Hsu, C. C., Jacobson, J. S., Rodriguez, R. D., & Siegel, A. B. (2015). Dietary Supplement Use Among Patients With Hepatocellular Carcinoma. <https://doi.org/10.1177/1534735414550038>
- Levy, I., Attias, S., Ben-arye, E., Goldstein, L., & Schiff, E. (2017). Adverse events associated with interactions with dietary and herbal supplements among inpatients. <https://doi.org/10.1111/bcp.13158>
- Li, K., Kaaks, R., Linseisen, J., & Rohrmann, S. (2018). Consistency of vitamin and / or mineral supplement use and demographic , lifestyle and health-status predictors : findings from the European Prospective Investigation into Cancer and Nutrition (EPIC) -Heidelberg cohort, (May), 1058–1064. <https://doi.org/10.1017/S0007114510001728>
- Marleen, & Senior, L. (2019). The balance between food and dietary supplements in the general population, 78(1), 97–109. <https://doi.org/10.1017/S0029665118002525>.The
- Mcnaughton, S. A., Mishra, G. D., Paul, A. A., Prynne, C. J., & Wadsworth, M. E. J. (2005). Supplement Use Is Associated with Health Status and Health-Related Behaviors in the 1946 British Birth Cohort 1 – 3. *The Journal of Nutrition*, 135(7), 1782–1789.
- Mullie, P., Clarys, P., Hulens, M., & Vansant, G. (2011). Socioeconomic, health, and dietary determinants of multivitamin supplements use in Belgium. *International Journal of Public Health*, 56(3), 289–294. <https://doi.org/10.1007/s00038-010-0210-z>
- Ndekha, M. J., Van Oosterhout, J. J. G., Zijlstra, E. E., Manary, M., Saloojee, H., & Manary, M. J. (2009). Supplementary feeding with either ready-to-use fortified spread or corn-soy blend in wasted adults starting antiretroviral therapy in Malawi: Randomised, investigator blinded, controlled trial. *BMJ (Online)*, 338(7706), 1309–1311. <https://doi.org/10.1136/bmj.b1867>
- Ohta, Y., Tsuchihashi, T., & Arakawa, K. (2007). Prevalence and Lifestyle Characteristics of Hypertensive Patients with Metabolic Syndrome Followed at an Outpatient Clinic in Fukuoka , Japan, 30(11), 1077–1082.
- Park, S., Johnson, M. A., & Joan, F. (2014). Vitamin and Mineral Supplements: Barriers and Challenges for Older Adults. *Journal of Nutrition for the Elderly*, 27(2008), 3/4. <https://doi.org/10.1080/01639360802265855>



- Rautiainen, S., Manson, J. E., & Lichtenstein, A. H. (2016). Dietary supplements and disease prevention — a global overview. *Nature Publishing Group*, 12(7), 407–420. <https://doi.org/10.1038/nrendo.2016.54>
- Reinert, A., Rohrmann, S., Becker, N., & Linseisen, J. (2007). Lifestyle and diet in people using dietary supplements. *European Journal of Nutrition*, 46(3), 165–173. <https://doi.org/10.1007/s00394-007-0650-2>
- Rock, C. L. (2007). Multivitamin-multimineral supplements: who uses them? 1–3. *Am J Clin Nutr*, 85, 277–279.
- Simiyu, N. W. W. (2009). The extent of dietary supplements use by male rugby players in Kenya, 1306–1311.
- Thomas, P. R., & Dwyer, J. T. (2013). Why US Adults Use Dietary Supplements, 173(5), 355–361. <https://doi.org/10.1001/jamainternmed.2013.2299>
- Touvier, M. (2006). Dietary and cancer-related behaviors of vitamin / mineral dietary supplement users in a large cohort of French women, 205–214. <https://doi.org/10.1007/s00394-006-0587-x>
- Udo, I. A., & Albert, U. K. (2015). Prevalence , Clinical and Socio-Demographic Profiles of Dietary Supplements Users in a Tertiary Hospital in Uyo , 4(4), 92–97. <https://doi.org/10.11648/j.cmr.20150404.11>
- Wachira, S. W. (2011). Knowledge and usage of dietary supplements and dietary patterns of gym users in Nairobi, (August).