Research Article
Published: 01 Oct, 2019

Journal of Nutrition and Food Science Forecast

Prevalence of Dietary Supplements use and Dietary Practices among Teachers in Public Secondary Schools in Kikuyu, Kiambu County, Kenya: A Cross Sectional Analytic Study

Gikwa JN, Kimiywe J and Njogu E*

Department of Food, Nutrition and Dietetics, Kenyatta University, Kenya

Abstract

Objective: The article describes prevalence of dietary supplements use and dietary practices among teachers in public secondary schools in Kikuyu, Kiambu County, Kenya.

Methodology: This was a cross-sectional analytical study which exhaustively sampled 178 secondary school teachers stationed in 17 public secondary schools in Kikuyu Sub County. A researcher-administered questionnaire was used to source for data from the participants. The questionnaire gathered information on use of dietary supplements and dietary practices. A 24 hour dietary recall questionnaire elicited quantitative data on dietary intakes of specific micro nutrients that is Vitamin A, B6, C, D, E, calcium, iron and zinc through all meals and snacks consumed in a day. The 16 food-group Household Dietary Diversity Score (HDDS) questionnaire obtained qualitative data on DDS from the 24-hour recall period [1]. Statistical Package for Social Sciences (SPSS) version 22 was used to analyze data. Statistical significance set at $p< 0.05$. Descriptive statistics used to summarize data. Chi-square test used to test the relationship between categorical variables while odds ratio was used to test associations.

Results: The prevalence of dietary supplements use among the teachers was 28.7% (n=51). The participants had a high dietary diversity (≥6 food groups) at 84.8%, while 13.5% had moderate dietary diversity with (4-5 food groups). The mean intakes of vitamin A (2300±4432), Vitamin B6 (1.43±0.69), iron (28.39±24.7) and zinc (14.40±5.30) were adequate to meet daily requirements for most of the participants but the mean intakes of vitamin D (6.906±4.59), E (10.12±5.697), vitamin C (42.30±27.09) and calcium (703.04±420.87) were inadequate. The study established significant relationship between dietary practices (dietary diversity, nutrient intake) and dietary supplements use.

Conclusion: The current study has revealed a prevalence of 28.7% of supplements use among teachers, but with insufficient uptake of vitamin C, vitamin E, vitamin D and calcium from dietary intake. With the current increase in the cases CVD and cancers in Kenya, it is important for the general population to be aware of importance of vitamin C and vitamin E as antioxidants so as to reduce the prevalence of these lifestyle diseases. The role of healthcare professionals can also not be ignored in advising their clients on importance of eating diversified diets for provision of basic specific nutrients needed by the body.

Keywords: Prevalence and dietary supplements use; nutrient intake; dietary diversity; teachers

Abbreviations

CVD: Cardio Vascular Diseases; DDS: Dietary Diversity Score; DS: Dietary Supplement; HDDS: Household Dietary Diversity Score; HUFA: Highly Unsaturated Fatty Acid; NACOSTI: National Commission for Science, Technology and Innovation; RNIs: Recommended Nutrient Intakes; SPSS: Statistical Package for Social Sciences; SSA: Sub Saharan Africa; UL: Upper Level of Tolerable Intakes.

Introduction

Dietary supplements appear to have attracted much consumer interest with their use increasing dramatically over the past 20 years in both the developed and developing world [2-4]. There is

OPEN ACCESS

**Correspondence:*
Jane Njambi Gikwa, Department of Food, Nutrition and Dietetics, Kenyatta University, Nairobi, Kenya.
Tel: 254736229333
E-mail: njambigikwa@gmail.com

Received Date: 06 Sep 2019
Accepted Date: 26 Sep 2019
Published Date: 01 Oct 2019

Citation: Gikwa JN, Kimiywe J, Njogu E. Prevalence of Dietary Supplements use and Dietary Practices among Teachers in Public Secondary Schools in Kikuyu, Kiambu County, Kenya: A Cross Sectional Analytic Study. J Nutri Food Sci Forecast. 2019; 2(3): 1013.

ISSN 2643-8186

increasing appreciation of the role of poor dietary practices as a predisposing factor in chronic health conditions and the implications it has on public expenditure on health [5,6]. Adequate evidence exists that establish the causative link between nutritional deficiencies and poor health particularly in chronic disease conditions and this engendered new impetus in the efforts to ensure adequate nutrient intakes particularly among those that seek to fill the gaps between dietary supply and RNIs [7]. In this regard, dietary supplements are now gaining recognition among both healthcare fraternity and the general population as a means of promoting good health as well as being a prophylactic strategy in disease control [8].

Universally, the sales of dietary supplements are estimated to be $50 billion, with an annual forecast growth of up to 4% with Singapore, Hong Kong and Norway leading in their usage and spending in household consumption and use [9]. In South Africa, the dietary supplements market is estimated to be worth R7 billion, with main categories being fish oils, vitamins, minerals, herbs, fiber and probiotics [10]. In Kenya, the last few years have witnessed a tremendous growth in the dietary supplements' market [11]. Large multinational companies have engaged or contracted various local marketing and distribution agents who in turn have set up 'health shops' at strategic locations in major urban centers as well as using multilevel marketing to augment sales.

For promotion of good health, it is important to ensure adequate intake of essential nutrients by having a variety of foods and increasing the number of food groups consumed [12]. Dietary intake is correlated with a series of positive health outcomes of public health concerns. A diet that meets recommendations for both food group sand nutrients, [13] and which is associated with disease prevention and promotion of optimal health, is considered a high-quality diet [14]. Further, nutrient dense diets have been linked to lower risk of obesity in children and other chronic diseases [15-17].

Access to good quality diet that is adequate in terms of nutrients is essential for human health, productivity and employment output [18]. A non-diversified, low quality diet can impact negatively on an individual's health and wellbeing since it may not meet his/her micronutrient requirements [19-21]. Dietary supplements can help bridge the gap between dietary intakes and the Recommended Nutrient Intakes (RNIs) for various micronutrients in situations where the latter may not be easily attainable through normal diet [22]. The use of dietary supplements, however, should not make up for poor food choices and inadequate diets. A well-chosen diet will promote an adequate intake of all nutrients.

An uptake of 43.5% among Kenyan gym users [23] and 15.5% among Kenya league rugby players, [24] has been reported but it is uncertain whether the use of dietary supplements has increased due to self-medication, aggressive marketing by producers, expensive health care or simply owing to inadequate diets. Although many studies have described the prevalence, trends and the dynamics in the use of dietary supplements in various populations, [25-28] they are mostly restricted to profiled groups or to medically challenged subjects who often use dietary supplements alongside drug prescriptions. There is limited information on the factors and outcomes surrounding their use in the general population. In Kenya, there exist minimal empirical evidence regarding dietary supplements usage among the general adult population and its linkage to dietary practices. This study, therefore intends to fill in a gap in the literature on prevalence of supplements use and dietary practices among teachers as a representation of a general adult population.

Methods

A cross sectional analytical study design was adopted for this study. Both qualitative and quantitative methods were used in data collection, analysis and presentation. This methodology was chosen as it allows the analysis of use of dietary supplements and whether dietary practices are related to dietary supplement use among secondary school teachers from data collected at one point in time.

Study area

The study was undertaken in17 public secondary schools in Kikuyu Sub-County of Kiambu County. The area was chosen due to its proximity to city center where many of the major distributors of the dietary supplement are located and are sold. It is also among the wealthiest counties in Kenya.

Study population

The study targeted teachers in public secondary schools as they typically represent the Kenyan working class in the lower middle income bracket which constitutes the majority the working population in Kenya. They are also considered as key decision makers in the local community hence they can influence opinion about use of certain products in the local context. A computer generated table of random numbers was used to select the participants.

Sampling

The sample size for the number of teachers was calculated by using the formula: $N= Z^2pq /d^2$ yielding 384 teachers. A finite population correction, gave a total of 165 teachers. Ten percent non response was factored to get a sample of 182 teachers. A sampling frame was prepared consisting of the names, with assigned numbers of all the 289 teachers from all the 17 public secondary schools in the Kikuyu Sub County. Simple random sampling was used to select the study participants for the interview through a computer generated table of random numbers [29].

Data collection tools

A researcher-administered questionnaire was used to source for data on use of dietary supplements while a 24 hour dietary recall questionnaire elicited quantitative data on dietary intakes of specific micro nutrients that is Vitamin A, B6, C, D, E, calcium, iron and zinc through all meals and snacks consumed in a day. The 16 food-group Household Dietary Diversity Score (HDDS) questionnaire obtained qualitative data on DDS from the 24-hour recall period [30].

Data analyses

Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 22 allowing for quantitative analysis by use of descriptive statistics such as means, percentages and frequencies. Data on nutrient intake was analyzed using the Nutri-survey software. The intakes of key nutrients of interest among the participants were compared to the Recommended Nutrient Intakes (RNIs) to establish the percentage meeting the RNIs. The DDS of the respondents was computed by awarding a point to each food group eaten over the given period and a total of all points were computed [31]. A scale of fourteen food groups was used. An individual dietary diversity score was measured by totaling the number of foods or food groups taken by a participant 24 hours preceding the recall time. Using the fourteen food groups, dietary diversity terciles were established namely; low diversity tercile (≤ 3 food groups); medium diversity tercile (4 to 5 food groups) and high diversity tercile (≥6

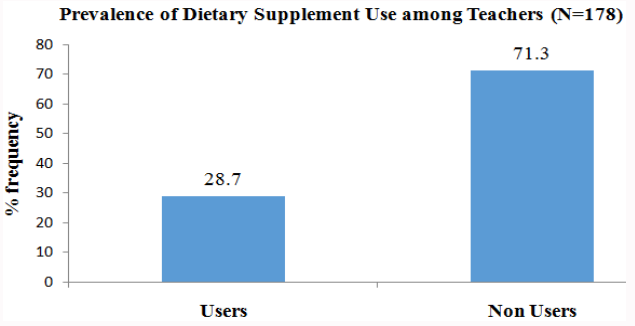

Figure 1: Dietary supplements use among teachers.

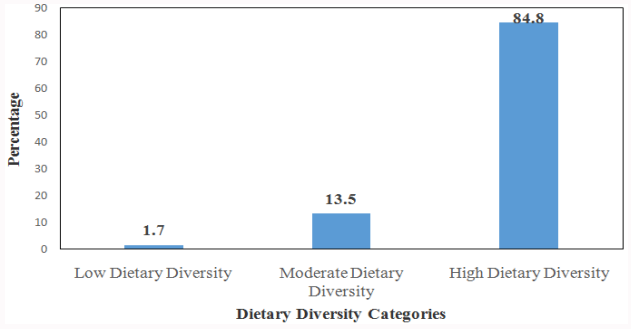

Figure 2: Dietary diversity scores of teachers.

food groups) [32-33]. The participants' DDS was then assessed based on their position on the scale. Chi square was used to establish relationship between dietary practices (dietary diversity and nutrient intake) and DS use. Statistical significance was set at $P<0.05$.

Logistical and Ethical considerations

Approval to carry out research was sought from Graduate School of Kenyatta University. Kenyatta University Ethical Review Committee gave ethical clearance while National Commission for Science, Technology and Innovation (NACOSTI) gave a research permit. The researcher also sought written permission from Sub-County Education Officer and verbal consent from head teachers of the respective school before engaging the teachers in the schools. The questionnaire was administered to the participants upon voluntary informed consent. The researcher ensured that all information obtained was kept in strict confidence. For privacy, the questionnaires did not bear the names of the participants nor other means of identity linked to individual participants.

Results

Prevalence of dietary supplements use among teachers: The prevalence of dietary supplements use among the teachers was 28.7% (n=51) (Figure 1), with those taking the supplements reporting having taken them for a period of between one month to twelve years.

Types of dietary supplements taken and frequency of use: The main types of supplements taken included Omega 3 and 6 which were used by 60.8% of the DS users, followed by calcium supplements (56.9%). 64.7% of the participants reported taking the supplements on daily basis (Table 1).

Reasons for taking dietary supplements: The reasons the dietary supplement users gave for taking supplements were varied. The majority (59.6%), of the participants said they took the supplements on prescription. 29.8% and 25.5%, said they took them to prevent diseases or deficiencies and promote good health respectively, while 2.1% used them to prevent aging or for cosmetic purposes (Table 2).

Dietary practices of the teachers

Individual dietary diversity score based on 24 hour recall: From the possible fourteen food groups, the mean DDS was 7.42±1.21 with scores ranging from 3-11 food groups. In this study, 84.8% of the participants had a high dietary diversity (≥6 food groups), while 13.5% had moderate dietary diversity with (4-5 food groups). Only 1.7% of the participants were found to have low dietary diversity (≤ 3 food groups) (Figure 2).

Nutrient intake of selected nutrients among teachers: Nutrient intake from 24 hours dietary recall was analyzed using Nutri-survey.

Table 1: Type of supplement and frequency of use of dietary supplements.

Type of Supplement	N=51	
	n	%
Omega 3 and 6	31	60.8
Calcium supplements	29	56.9
Multivitamins	10	19.6
Iron tablets	8	15.7
Spirulina	4	7.8
Frequency of Intake	**n**	**%**
Daily	33	64.7
Weekly	10	19.6
Monthly	5	5.6
Rarely	3	9.8

Table 2: Participants reasons for taking dietary supplements.

Reasons for taking supplements	n	%
On prescription	28	59.6
Prevent diseases or Deficiencies	14	29.8
Promote health	12	2505
Beauty or to prevent aging	1	2.1

*Multiple responses allowed

Selected micronutrients included vitamins A, C, B6, D, E, iron, calcium, and zinc. These are micronutrients commonly deficient in many populations in SSA and which play key role in maintenance of good health [34-35]. The total amounts of nutrient intake from all meals and snacks consumed in a day were established. This was compared with the Recommended Nutrient Intakes (RNIs) (Table 3). The study showed that the mean intakes of vitamin A (2300±4432), Vitamin B6 (1.43±0.69), iron (28.39±24.7) and zinc (14.40±5.30) were adequate to meet daily requirements for most of the participants but the mean intakes of vitamin D (6.906±4.59), E (10.12±5.697), vitamin C (42.30±27.09) and calcium (703.04±420.87) were inadequate (Table 3).

Relationship between dietary diversity and the use of dietary supplements: Cross tabulations was done to establish whether there was any relationship between supplement use and meeting the minimum dietary diversity. A chi square test established a significant association between dietary diversity score and dietary supplement use (χ^2=6.217, df=2, p=0.045) (Table 4).

Further, dietary diversity and supplement use was associated using binary and multinomial logistic regression as reflected in Table 5. Those using the supplements were 3.15 times likely to meet the

Table 3: Nutrient intake of selected nutrients among the participants.

Nutrient	Mean intake (SD)	Reference value Men(women)	% of those meeting RNIs
Vitamin A (µg)	2300 ± 4432.08	600(500)	65.2
Vitamin B6(mg)	1.43 ± 0.69	1.3(1.3)	75.3
Vitamin C (mg)	42.30 ± 27.09	45(45)	40.4
Vitamin D (ug)	6.906 ± 4.59	10 (10)	42.1
Vitamin E (eq)	10.12 ±5.697	12(12)	19.7
Calcium (mg)	703.04 ± 420.87	1000(1000)	43.8
Iron (mg)	28.39 ± 24.7	27.4(58.8)[a]	61.8
Zinc (mg)	14.40 ± 5.30	14(9.8)[a]	58.4

FAO/WHO 2001; WHO/FAO 2004 [a]Based on a low bioavailability level of 5%

Table 4: Relationship between dietary diversity and dietary supplements use.

N=178						
DDS level	Dietary supplement use				Chi square	P value
	Yes	%	No	%	χ^2	
Low DD	0	0	3	2.4	6.217	0.045*
Moderate DD	0	17.6	15	11.8		
High DD	42	82.4	109	84.4		

*significance (p=0.05)

Table 5: Association between dietary diversity and supplements use.

	95% CI			
Dietary diversity	Odds Ratio	Upper	Lower	*P*-Value
Minimum Acceptable Dietary diversity				
Unmet	*	-	-	-
Met	3.15	4.657	1.548	<0.001
Dietary diversity category				
Low diversity	*	-	-	-
Moderate diversity	1.50	2.637	0.610	0.447
High diversity	2.05	4.474	0.986	0.048

Reference category: Not using supplement
*Base category

minimum acceptable dietary diversity (OR: 3.15; C.I: 1.548; -4.657; *P* value <0.001). Furthermore, those using DS were also noted to be 2.05 more times likely to have a high dietary diversity (OR: 2.05; C.I; 0.986; -4.474; *P* value = 0.048) (Table 5).

Relationship between participant's nutrient intake and dietary supplements use: Cross tabulation was done to establish the percentage of both supplement users and non-users who met the RNI of the selected micro nutrients. Majority of both users and non-users met the RNIs for vitamin A (users: 86.3%, non-users 56.7%), Vitamin B6 (users 86.3% and non-users at 70.9%), iron (users 71%, non-users 58.3%) and zinc (users: 72.5% non-users: 52.8%). On the other hand, only supplement users, respectively had majority fulfilling their RNIs for vitamin C (82.4%) vitamin D (68.6%) and calcium (80.4) while both users and non-users could not meet their RNIs for vitamin E (25% and 17% respectively).When the Chi square test was conducted, there was significant association between vitamin A, vitamin C, calcium and iron intake and supplement use (p value<0.05). There were no significant associations between supplement use and all the other selected nutrients (Table 6).

Discussion

The use of dietary supplements established by the current study

Table 6: Relationship between nutrient intake and dietary supplements use.

	RNI Men/ (women)	Users (n=51)		Non-users (n=127)		Total	Chi-Sq. χ^2	*p*-value
		N	%	n	%			
VITAMIN A (µG)								
MET RNI	600(500)	44	86.3	72	56.7	65.2	5.27	0.047*
UNMET RNI		7	86.3	55	43.3	34.8	-	-
VITAMIN C (MG)								
MET RNI	45(45)	42	82.4	30	23.6	40.4	5.86	0.037*
UNMET RNI		9	17.6	97	76.4	59.6	-	-
VITAMIN B6 (MG)								
MET RNI	1.3(1.3)	44	86.3	90	70.9	75.3	5.86	0.037*
UNMET RNI		7	13.7	37	29.1	24.7	-	-
VITAMIN D (µG)								
MET RNI	10(10)	35	68.6	40	31.5	42.1	1.23	0.558
UNMET RNI		16	31.4	87	68.5	57.9	-	-
VITAMIN E (EQ)								
MET RNI	12(12)	13	25	22	17	19.7	1.54	0.218
UNMET RNI		38	75	105	83	80.3	-	-
CALCIUM (MG)								
MET RNI	1000(1000)	41	80.4	37	29.1	43.8	6.04	0.015*
UNMET RNI		10	19.6	110	70.8	56.2	-	-
IRON (MG)								
MET RNI	28(58)	36	71	74	58.3	61.8	2.77	0.038*
UNMET RNI		15	29	53	41.7	38.2	-	-
ZINC (MG)								
MET RNI	14(9.8)	37	72.5	67	52.8	58.4	2.12	0.182
UNMET RNI		14	27.5	60	47.2	41.6	-	-

*significance (p=0.05)

(28.7%) among participants falls below that reported in other studies there the prevalence of usage was 47.7% and 43% respectively [36-37]. The higher prevalence could be attributed to better socio economic environment that prevail in developed countries which imply both better access to information on dietary supplements and purchasing power [38]. Currently, there are no studies on use of dietary supplements in Kenya on a general population.

The main types of supplements taken by the DS users were Omega 3 and 6, calcium supplements, multivitamins, iron tablets, with most of the participants reporting daily supplement intake. This corroborates with other findings that reported calcium, multi vitamins, fish oils and iron as being the commonly used dietary supplements [37,39,40,]. The Highly Unsaturated Fatty Acid (HUFA) supplements are particularly becoming popular due to their reported enhancement of cardiovascular health, a growing health threat assuming public importance in Kenya [10] while calcium supplements are popular with the older people trying to prevent/manage musculoskeletal conditions such as osteoporosis and osteoarthritis [41].

There are many reasons as to why people take supplements. In this study the main reasons cited included, medical reasons (supplements taken on prescription), to prevent diseases or deficiencies and to promote health. This findings are consistent with those of other studies, [40,42] that reported the main reasons cited for the use of DS were maintenance of good health, bone health, and filling nutrient gaps. This findings underscores the lengths individuals are willing to

go in order to maintain good health.

Most of the participants in this study had a high dietary diversity with a mean DDS of 7.42±1.4. This is despite the study being conducted during a relatively dry season. The findings of this study correspond with that of a study where eating behavior and dietary diversity among adults in an Urban and Rural districts, had a mean DDS of 7.72±1.44 SD [43]. The high dietary diversity reported in this study could be attributed to fair incomes levels of the participants who were serving government employment with a monthly salary. This had positive implications on their purchasing power enabling them access to wide variety and options for food.

The mean intake of vitamin A, vitamin B6, iron and zinc in this study was relatively high (above the RNIs) with over 60% of the participants being able to fulfill their daily requirements. This could be attributed to high dietary diversity as well as moderate consumption of animal foods. Animal foods particularly meat products are good sources of highly bio available iron, zinc and vitamin A. These findings agree with another study which found that some participants took more than the UL (Upper Level of Tolerable Intake) for some nutrients from food alone [39]. This shows that with good dietary diversity, one can be able to attain most of his daily nutrient requirements. The current study has revealed insufficient uptake of vitamin C, vitamin E, vitamin D and calcium which can be improved through diversified diets. With the current increase in the cases CVD and cancers in Kenya, it is important for the general population to be aware of importance of vitamin C and vitamin E as antioxidants so as to reduce the prevalence of these lifestyle diseases. The role of healthcare professionals can also not be ignored in advising their clients on importance of eating diversified diets for provision of basic nutrients needed by the body.

The study further established significant association between dietary diversity and dietary supplements use with users of dietary supplements having a higher DDS than non-users. This corresponds with other findings that found out that DS use was co-related to better dietary patterns [39, 44]. Non-users of dietary supplements were found to have higher prevalence of the consuming high fat, low fiber diets, low fruit diets. This could be due to the concomitant high levels of health and nutrition consciousness among users of dietary supplements implying that DS users would normally be keener on their all-round nutrition and make greater efforts to eat correct.

The study further revealed significant differences in dietary supplements use and the dietary adequacy of the participants. There were significant differences in intakes and the fulfillment of RNIs of vitamin A, vitamin C, calcium and iron between DS users and non-users. These results corroborate those of other studies which have similarly shown that those taking DS were more likely than non-users to consume better diets and also try to improve their total nutrient intake [45,40,39]. This could also be credited to the fact that dietary supplements use is also associated with higher overall health consciousness among subjects, which translates into better practices including dietary choices and patterns.

Conclusion

Almost a third of the participants (28.7%) took dietary supplements with most of the supplements users taking omega 3 and 6 and calcium tablet for maintaining bone density and general health. Dietary supplements usage was significantly associated with dietary diversity with users of dietary supplements tending to have a higher dietary diversity score than non-users. A significant association was also established between dietary supplement use and the intakes of certain nutrients including vitamin A, C and the minerals; iron and calcium. Those taking supplements were found to be more likely to fulfill their RNIs for these nutrients than non-users. Dietary supplements contribution to nutrient intake was not assessed. More studies should be done on other healthy population sub-groups to build the weight of evidence of DS and the contribution of dietary supplements in achieving dietary adequacy.

References

1. FAO. Guidelines for measuring household and individual dietary diversity. 2010.
2. Marik PE, Flemmer M. Do dietary supplements have beneficial health effects industrialized nations: what is the evidence? JPEN J Parenter Enternal Nutr. 2012; 36: 159-168.
3. Kantor ED, Rehm CD, Du M, White E, Giovannucci EL. Trends in Dietary Supplement Use Among US Adults From 1999-2012. JAMA. 2016; 316: 1464-1474.
4. Manson JE, Brannon PM, Rosen CJ, Taylor CL. Vitamin D Deficiency - Is There Really a Pandemic? N Engl J Med. 2016; 375: 1817-1820.
5. Walter WC, Koplan JP, Nugent R, Dusenbury C, Puska P, Gaziano TA. Prevention of Chronic Disease by Means of Diet and Lifestyle Changes. 2006; 44.
6. Harrison GG. Public Health Interventions to Combat Micronutrient Deficiencies. Public Health Reviews. 2010; 32: 256-266.
7. Dickinson A, MacKay D, Wong A. Consumer attitudes about the role of multivitamins and other dietary supplements: report of a survey. Nutrition Journal. 2015; 14.
8. McGinnis JM, Ernst ND. Preventive Nutrition: A historic perspective and future economic outlook. 2001.
9. Euro monitor. Vitamins and dietary supplements in Malaysia. 2014.
10. Euro monitor . Vitamin and dietary supplements in South Africa. 2017.
11. Euro monitor. Vitamin and dietary supplements in Kenya. 2013.
12. Ministry of Health. National Guidelines for Healthy Diets and Physical Activity 2017. Nairobi: Government of Kenya. 2017.
13. Melina V, Craig W, Levin S. Position of the Academy of Nutrition and Dietetics: Vegetarian Diets. J Acad Nutr Diet. 2016; 116: 1970-1980.
14. Kranz S, Hartman T, Siega-Riz AM, Herring AH. A diet quality index for American preschoolers based on current dietary intake recommendations and an indicator of energy balance. J Am Diet Assoc. 2006; 106: 1594-1604.
15. Kranz S, Findeis JL, Shrestha SS. Use of the Revised Children's Diet Quality Index to assess preschooler's diet quality, its sociodemographic predictors, and its association with body weight status. J Pediatr (Rio J). 2008; 84: 26-34.
16. Tulchinsky TH. Micronutrient Deficiency Conditions: Global Health Issues. Public Health Reviews. 2010; 32: 243-255.
17. Springer SC, Silverstein J, Copeland K, Moore KR, Prazar GE, Raymer T, *et al.* The management of type 2 diabetes in children and adolescents. Pediatrics. 2004; 56: 255-264.
18. WHO/MOH. Kenya Stepwise Survey for Non Communicable Diseases risk Factors 2015 Report: Nationally Representative Survey on Non Communicable Diseases. 2015.
19. FANTA. Dietary Diversity as a Measure of the Micronutrient Adequacy of Women's Diets in Resource-Poor Areas: Summary of Results from Five Sites. 2011; 97.
20. Habte T, Krawinkel M. Dietary Diversity Score: A Measure of Nutritional

Adequacy or an Indicator of Healthy Diet? J Nut Health Sci. 2016; 3.

21. Nithya DJ, Bhavani RV. Dietary Diversity and its Relationship with Nutritional Status among Adolescents and Adults in Rural India. J Biosoc Sci. 2017; 50; 397-413.

22. Shao A, Drewnowski A, Willcox DC, Krämer L, Lausted C, Eggersdorfer M, *et al.* Optimal nutrition and the ever-changing dietary landscape: a conference report. European Journal of Nutrition. 2017; 56: 1-21.

23. Wachira SW. Knowledge and Usage of dietary supplements and dietary patterns of gym users in Nairobi. 2011.

24. Kimiywe E, Simiyu, NW. The extent of dietary supplements use by male rugby players in Kenya, Journal of applied Biosciences. 2009; 22: 1306-1311.

25. Archer EL, Boyle DK. Herb and supplement use among the retail population of an independent, urban herb store. J Holist Nurs. 2008; 26: 38-40.

26. Pouchieu C, Lévy R, Faure C, Andreeva VA, Galan P, Hercberg S, *et al.* Socioeconomic, Lifestyle and Dietary Factors Associated with Dietary Supplement Use during Pregnancy. 2013.

27. Kantor ED, Rehm CD, Du M, White E, Giovannucci EL. Trends in Dietary Supplement Use Among US Adults From 1999-2012. 2016; 316: 1464-1474.

28. Alfawaz H, Khan N, Alfaifi A, Shahrani FM, Al Tameem HM, Al Otaibi SF, *et al.* Prevalence of dietary supplement use and associated factors among female college students in Saudi Arabia. BMC Womens Health. 2017; 17: 116.

29. Mugenda OM, Mugenda AG. Research Methods: Quantitative and Qualitative Approaches 2nd Edition Nairobi ACTS press. 2013.

30. FAO. Guidelines for measuring household and individual dietary diversity. 2010.

31. Food and Agriculture Organization of the United Nations-FAO. Guidelines for measuring household and individual dietary diversity. 2008.

32. Food and Agriculture Organization of the United Nations-FAO. Guidelines for measuring household and individual dietary diversity. 2007.

33. Food and Agriculture Organization (FAO). Fats and fatty acids in human nutrition Report of an expert consultation. FAO Food Nutr. 2010; 91: 1-166.

34. Miller D, Welch R. Food system strategies for preventing micronutrient malnutrition. Food Policy. 2013; 42: 115-128.

35. WHO. Preventing and controlling micronutrient deficiencies in populations affected by an emergency. 2007.

36. Kennedy ET, Luo H, Houser R. Dietary Supplement Use Pattern of U.S. Adult Population in the 2007-2008 National Health and Nutrition Examination Survey (NHANES), Ecol Food Nutr. 2013; 52: 76-84.

37. O'Brien SK, Malacova E, Sherriff JL, Black LJ. The Prevalence and Predictors of Dietary Supplement Use in the Australian Population. Nutrients. 2017; 9: 1154.

38. FAO. Mediterranean food consumption patterns. Diet, environment, society, economy and health. 2015.

39. Foote J, Murphy SP, Wilkens LR, Hankin JH, Henderson BE, Kolonel LN. Factors Associated with Dietary Supplement Use among Healthy Adults of five ethnicities: Am J Epidemiol. 2003; 157: 888-897.

40. Dickinson A, MacKay D. Health habits and other characteristics of dietary supplement users: a review. Nutrition Journal. 2014; 13.

41. Genga EK. Clinical and socio-demographic profile of patients on treatment for osteoporosis in Nairobi, Kenya. East African Orthopaedic Journal. 2015; 9.

42. The CRN Consumer Survey on Dietary Supplements. 2018.

43. Mkemwa HT. Eating behaviors and dietary diversity among adults in Morogoro urban, Rural and Mvomero districts. 2015.

44. Bailey RL, Fulgoni VL, Keast DR, Dwyer JT. Dietary supplement use is associated with higher intakes of minerals from food sources. Am J Clin Nutr. 2011; 94: 1376-1381.

45. Blumberg JB, Frei B, Fulgoni VL, Weaverand CM, Zeisel SH. Contribution of Dietary Supplements to Nutritional Adequacy in Race/Ethnic Population Subgroups in the United States. Nutrients. 2017; 9: 1295.